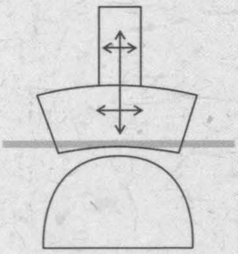
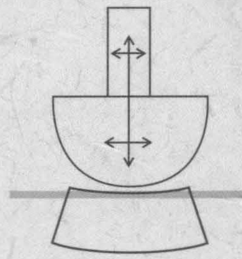
Manual Mobilization of the Joints

The Kaltenborn Method of Joint Examination and Treatment



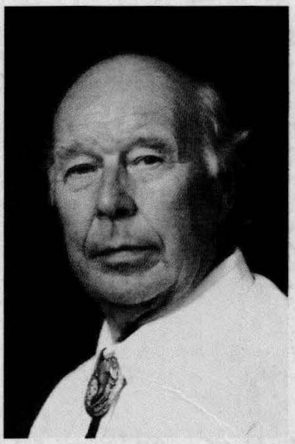


Volume II

The Spine

by Freddy M. Kaltenborn
in collaboration with
Olaf Evjenth,
Traudi Baldauf Kaltenborn,
Dennis Morgan, and Eileen Vollowitz

4th Edition 2003
Norli
Oslo, Norway



Freddy M. Kaltenborn *was the first practitioner and instructor of manual medicine to integrate the theory and practice of orthopedic medicine with the practice of osteopathy. Kaltenborn worked for over 50 years to develop his world-reknown system for the manual treatment of joint conditions. He drew his inspiration from many disciplines, integrated them into a cohesive system, and then expanded and refined them to create the joint examination and treatment approach presented in this book: The Kaltenborn method.*

Kaltenborn teaches what he has found best in osteopathy, chiropraxy and orthopedic medicine without a trace of fringe indoctrination. Only when these different methods are all practised by one person will it become possible to determine if one is more quickly successful than another, and which type of disorder responds best to one particular set of techniques. The only physiotherapy teacher who has achieved this eclectic status is Kaltenborn in Oslo. His approach offers an example that deserves to be followed in physiotherapy schools throughout the world. *James Cyriax, M.D., 1958*

For over 40 years, Kaltenborn's classic handbooks on *Manual Mobilization of the Joints* have introduced thousands of clinicians worldwide to the practical foundations of joint mobilization. In these books, Kaltenborn describes each test and mobilization in simple and precise language reinforced by numerous clear photographs.

This book presents basic manual, passive spinal joint evaluation and mobilization techniques, with its hallmark marriage of functional anatomy to clinical practice.

New in this edition:

- Clear, easy-to-find indications and objectives for each test and mobilization technique.
- Techniques illustrate how simple alterations in grip, body positioning, grade of movement and duration can transform a technique from a test into an effective treatment.
- Expanded theoretical discussions on grades of movement and their application in testing and treatment.
- Basic traction manipulations which are safe even in the hands of beginning students, utilizing low-force "quick mobilizations."

ISBN 82-7054-069-2

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Acknowledgments

For me, teaching manual therapy has been far more challenging (and far more frustrating) than patient treatment ever was. When I treat patients, it is easy to believe that the principles behind my methods are both clear and simple. It is not until I try to teach my methods to others, both in action and in words, that I fully realize the complexities and subtleties involved in evaluating and treating patients with manual techniques. But teach I must. And so, with the help of many colleagues and students, I continue to search for the best ways to provide the requisite knowledge and skills to become an effective orthopedic manual therapist.

My books would not exist were it not for the ongoing efforts of my OMT colleagues and collaborators, Olaf Evjenth, Traudi Baldauf Kaltenborn, Dennis Morgan and Eileen Vollowitz. Over several decades, they have worked with me to document my approach in pictures and in words, and have provided much needed organization, cohesion, and direction to my work.

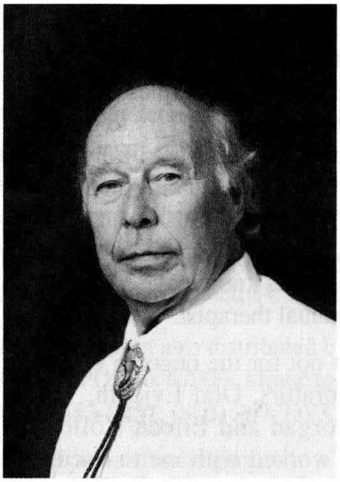
I especially enjoyed working with Eileen Vollowitz on this edition. It is not often I have the pleasure of working with someone with "the head and the hands" for manual therapy, who can also write with such clarity and ease. Her special combination of skills allows me to express my perspective and present my concepts in ways I would not have thought possible.

I am grateful to my colleagues from all over the world from whom I have received many valuable suggestions. With each edition and translation of one of my books, they challenge me to further clarify and revise both theory and techniques. For this edition, I am indebted to Olaf Evjenth, Bjørn Støre, and Jochen Schomacher, whose discussions and suggestions led me to more precisely describe both the principles and application of my manual mobilization techniques.

Last but not least, I extend special gratitude to my wife, Traudi Baldauf Kaltenborn, for her love and support over the last 30 years. She has been my partner in practice, in teaching, in writing, and in life. I could never have accomplished so much without her.

Freddy M. Kaltenborn
June 2003

■ About the author



Kaltenborn's career began as a physical educator and athletic trainer in Germany in 1945 and as a physical therapist in Norway in 1949. He apprenticed with Dr. James Mennell and Dr. James Cyriax in London, England, from 1952 to 1954 to learn more about orthopedic medicine, and received his certification to teach the Cyriax approach in 1955. Thereafter he studied at the British School of Osteopathy. Upon return to his native Norway, Kaltenborn worked to incorporate these concepts into his own system.

In 1958 Kaltenborn was certified in chiropractic by the Forschungs- und Arbeitsgemeinschaft für Chiropraktik (FAC) in Germany and taught chiropractic to the medical doctors within FAC between 1958 and 1962. By 1962 the FAC had incorporated the Kaltenborn Method into their approach and changed the name of their professional practice from "Chiropraktik" to "Chirotherapy." Kaltenborn continued to instruct FAC practitioners until 1982.

In 1962 Kaltenborn studied at the London College of Osteopathy in London, England and subsequently was approved as an osteopathic instructor by Dr. Alan Stoddard in 1971. Kaltenborn was certified in orthopedic manipulative therapy by the International Seminar of Orthopaedic Manipulative Therapy (ISOMT) in 1973. Between 1977 and 1984 he served as a professor at the Michigan State University, College of Osteopathic Medicine, USA.

Kaltenborn practiced physical therapy in his native Norway for thirty-two years, from 1950 to 1982. During that time he instructed countless physical therapists, medical doctors, and many osteopaths and chiropractors in manual treatment methods. He introduced manual therapy to Norwegian physical therapists and was instrumental in developing manual therapy education and certification standards there. Together with Norwegian medical doctors, Kaltenborn also brought the benefits of manual therapy to the attention of the Norwegian national health care system, which by 1957 had recognized the effectiveness of manual therapy by reimbursing skilled manual therapy services at twice the rate of other physical therapy treatments.

Throughout his professional career, Professor Kaltenborn campaigned tirelessly for the creation of international educational standards and certification in manual therapy. He was a founding member of the International Federation of Orthopaedic Manipulative Therapists (IFOMT), now a subgroup of the World Confederation of Physical Therapists (WCPT). Professor Kaltenborn contributed to the creation of IFOMT's first manual therapy education and certification standards, the first such standards to be recognized by an international professional organization.

■ About this book

This book presents basic manual, passive spinal joint evaluation and mobilization with an emphasis on the application of biomechanical principles. It is a companion volume to *Manual Mobilization of the Joints, Volume I, The Extremities*. Both textbooks are intended for beginning students.

Together, these books present the basic theory and skills necessary for the safe and effective application of manual mobilization in the diagnosis and treatment of joint movement restrictions. We made great effort to present the biomechanical principles upon which our techniques in their most simple and clear form. These concepts form an important foundation for all therapists and physicians, no matter what their area of practice.

Note that other areas of OMT practice, while not covered in these books, are also important elements of the OMT Kaltenborn-Evjenth system, including soft tissue mobilization techniques, stabilization techniques, and more advanced joint mobilization procedures (see *OMT Overview*, page 12).

New in this 4th edition

Progression of a manual technique from a test maneuver to an effective mobilization treatment often involves simple alterations in grip, body positioning, grade of movement, or duration. Manual tests and mobilizations are now presented in the same chapter as progressions of the same technique rather than as different procedures, which better mirrors the realities of patient treatment.

Joint mobilization techniques outside the joint resting position can be extremely effective, but also require greater practitioner skill for their safe application than do techniques applied in the joint resting position. In this edition you will find more discussion and description of these more advanced techniques.

Clear objectives for each evaluation technique will guide you toward more effective treatment planning. Expanded technique descriptions indicate whether test maneuvers are more effective as screening tests, specific mobility tests, or as symptom localization tests, and include more of Kaltenborn's conceptual thinking in the interpretation of clinical findings.

Grades of translatoric movement have guided the Kaltenborn treatment approach since 1952. In this edition he more precisely describes the grades-of-movement concept, both in terms of joint range and the resistance to movement the practitioner palpates. He also notes the most effective grade of movement for the application of each technique.

Basic manipulations which can be effective for both diagnosis and treatment are presented for the first time in this book series. Kaltenborn included only those manipulation techniques which could be safe and effective in the hands of beginning students, such as low-force traction "quick mobilizations" in the actual resting position.

Screening tests identify conditions that contraindicate specific mobilization techniques and should be conducted before the therapist treats any particular spinal region. For example, rotatory techniques are contraindicated for the cervical spine in the presence of positive vertebral artery screening tests and are contraindicated in the lumbar spine with certain stages of disc pathology. Such screening tests must be performed or monitored before each treatment session because for some conditions the physical diagnosis and stage of pathology can fluctuate. These tests are essential to ensure safety even when practicing on asymptomatic fellow students in a classroom setting.

■ Measuring progress

Changes in a patient's condition are assessed by monitoring changes in one or more dominant symptoms and comparing these changes with routine screening tests and the patient's dominant signs. Symptoms in the spine may include pain, changes in sensation, a feeling of greater strength or ease of motion, or reduced fatigue. Physical signs of spinal origin may include altered joint play, range of movement, reflexes, or changes in muscle performance.

A relevant sign is one that is reproducible and related to the patient's chief complaints. That is, the sign improves as the patient's symptoms improve, and the sign worsens as the patient's symptoms worsen. For example, when a patient reports increased numbness and tingling in the foot, the straight-leg raise test shows more limited movement.

Periodic reassessment of the patient's chief complaints and dominant physical signs during a treatment session guides treatment progression. If reassessment reveals normalization of function (e.g., mobility) along with decreased symptoms, then treatment may continue as before or progress in intensity. When reassessment during a treatment session indicates that function is not normalizing or that symptoms are not decreasing, be alert to the need for further evaluation to determine a more appropriate technique, positioning, direction of force, or treatment intensity.

Evolution of the book title

This book series was first called *Manual Therapy for the Joints*. In later editions the title changed to *Mobilization*, and finally, to *Manual Mobilization*. These title changes became necessary as the practice of manual therapy expanded and matured.

The term "Manual Therapy" originally described only those passive techniques which were used to mobilize pathological hypomobility in the anatomical joint. As the scope of manual therapy practice expanded, the term "Manual Therapy" became associated with the treatment of the physiological joint and included related techniques, such as stabilization for hypermobility, rehabilitation, and research. In addition, the use of the term varied widely from country to country.

The scope of manual therapy practice became too comprehensive to present in *one* book, so I changed the title to "Mobilization", which at the time was still just a passive procedure.

Over time, the term "Mobilization" encompassed active procedures as well. This prompted me to again change the title of the book series, this time to "Manual Mobilization." Manual Mobilization procedures currently include techniques for pain relief, relaxation, and stretching, in addition to some basic thrust techniques (i.e., "quick mobilization", or "manipulation").

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■ Notes

Kaltenborn-Evjenth Concept

Orthopedic Manual Therapy

Orthopedic medicine specializes in the diagnosis and treatment of musculoskeletal conditions.[1] The physical therapy specialty Orthopedic Manipulative Therapy (OMT) is an important part of orthopedic medicine. Much of OMT is devoted to the evaluation and treatment of joint and related soft tissue disorders and one of the primary treatment methods is mobilization. When examination reveals joint dysfunction, especially decreased range of motion (i.e., hypomobility), the joint mobilization techniques described in this book are often effective.

The OMT Kaltenborn-Evjenth Concept is the result of many years of collaboration between physical therapists and physicians, first in the Nordic countries from 1954 to 1970, and then worldwide. The system began in 1954 with joint testing and treatment only and was known as "Manual Therapy ad modum Kaltenborn." It later became known as the Norwegian System or the Nordic System. In the late 1960's, Olaf Evjenth and I began our decades long collaboration to develop the system as we know it today, the OMT Kaltenborn-Evjenth Concept.

The Orthopedic Manual Therapy (OMT) Kaltenborn-Evjenth Concept is a physical therapy treatment approach based on information and experience from sports medicine, traditional physical therapy, osteopathy, orthopedic medicine, and the further innovations of the many therapists who have practiced manual therapy techniques. The methods presented in this book focus primarily on manual joint testing and treatment, an important part of the OMT Kaltenborn-Evjenth Concept.

History

Orthopedic manual therapy is not a twentieth century invention. It has roots in ancient medical traditions cited by Hippocrates (460-377 B.C.) in his *Corpus Hippocrateum* and sources in the years to follow.

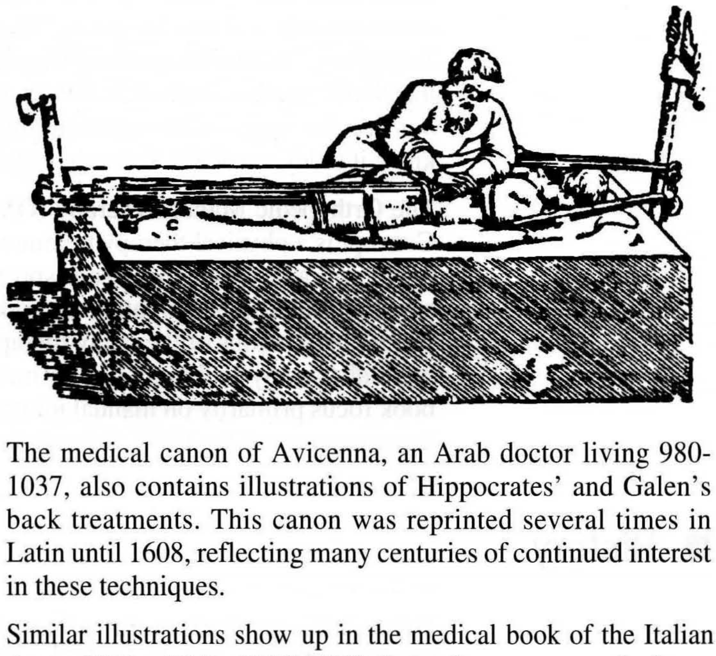
1 In recent years, orthopedic medicine has become known as "manual medicine" or "musculoskeletal medicine."

■ Early Roots

Manipulation Past and Present by Eiler H. Schiøtz and James Cyriax contains a detailed history of manual therapy. The chapter on "Ancient Medicine" includes pictures recording various types of spinal mobilization and traction, treatments attributed to Hippocrates. These ancient drawings show a combination of traction and ventral pressure of the lumbar spine. In some, a person stands on a patient's back, performing a kind of "pedi-pulation" of the sort still practiced today, for example, in Japanese baths.

The physician Galen (Claudius Galenos, 131-202 A.D.) may be the source of our concept. His is the first recorded method of manual therapy: the practitioner's use of their hands for spinal treatment. Galen wrote commentaries on Hippocrates' work, including that on joints. Galen's own manipulations were inspired by Hippocrates.

Figure I.1: Traction combined with manual mobilization as shown in a woodcut from Galen's collection



The medical canon of Avicenna, an Arab doctor living 980-1037, also contains illustrations of Hippocrates' and Galen's back treatments. This canon was reprinted several times in Latin until 1608, reflecting many centuries of continued interest in these techniques.

Similar illustrations show up in the medical book of the Italian doctor Vidius Vidio (1500-1569). Later these same methods are illustrated with the inclusion of a traction table in the works of the French Ambroise Paré (1550) and the German Scultetus (1700).

For the next two hundred years there was little mention in medical literature regarding traction combined with manipulation. However, the method was used in folk medicine all over the world.

Figure I.2: "Weighing salt" practiced in folk medicine as late as this picture from East Prussia, about 1920

Manipulative techniques were reintroduced to traditional medicine in the nineteenth century by the American physician Andrew Taylor Still (1828-1917). In 1874 he founded the School of Osteopathy in Kirksville, U.S.A. Some of Still's students brought the approach to Europe, where they founded the British School of Osteopathy in 1917 and later established the London College of Osteopathy.

■ Development of the OMT Kaltenborn-Evjenth Concept

The story of the OMT Kaltenborn-Evjenth approach to manual therapy began in the 1940's when I became frustrated in my attempts to treat patients with spinal disorders. First as a physical educator treating disabled soldiers in 1945 and later as a physical therapist in 1949, I found that the massage combined with mobilization and manipulation (especially for the extremities) I had learned from physical education, along with the active and passive movements I had learned from conventional physical therapy training, was limited in its effectiveness. Many of the spinal patients I was unable to help reported finding relief from chiropractic treatment.

In Norway at that time doctors of physical medicine would only support the introduction of a new physical therapy approach if it came from within the traditional practice of medicine. Therefore, I turned to the work of Dr. James Mennell, a physician of physical medicine, and Dr. James Cyriax, a physician of orthopedic medicine, both at St. Thomas Hospital in London. These physicians were unusual in their commitment to bringing their experience in manual medicine to the training of physical therapists. Mennell began teaching his techniques to physical therapists as early as 1906 and wrote his first textbook for physical therapists in 1917, *Physical Treatment by Movement and Massage* (published by Churchill, London). He later published *The Science and Art of Joint Manipulation, Volume I: The Extremities* (1949) and *Volume II: The Spine* (1952). Dr. Cyriax's 1947 *Textbook of Orthopaedic Medicine, Volume I: Diagnosis* and *Volume II: Treatment* remain basic texts on evaluating and treating soft tissue disorders for OMT Kaltenborn-Evjenth Concept training today.

In the early 1950's I went to London with my colleague R. Stensnes, to observe the joint mobilization techniques of Dr. Mennell and to study with Dr. Cyriax. Upon my return to Norway, I demonstrated my newly acquired skill at the Medical Association for Physical Medicine, which then agreed to sponsor my first course on Cyriax's approach. The course was taught to eight physical therapists in 1954 and was cosponsored by the Physical Therapy Association of Oslo. This signalled the beginnings of a significant change in the Norwegian medical establishment's view of manual therapy. Well into the 1950's, many Norwegian physicians still considered manual therapy outside of the practice of medicine and therefore did not support its practice by physical therapists or by medical doctors. Norwegian physician Eiler Schiøtz documented manual therapy's historical place in medicine in his monograph, the *History of Manipulation* (1958), and so helped support the eventual inclusion of manual therapy within the scope of traditional medical practice in Norway.

In 1955, Dr. Cyriax visited Norway to approve courses in his approach and to instruct and examine the first physical therapists to complete those studies. These graduates formed the Norwegian Manipulation Group, an ongoing study group that practiced and further developed what was becoming a specialized OMT approach for physical therapists.

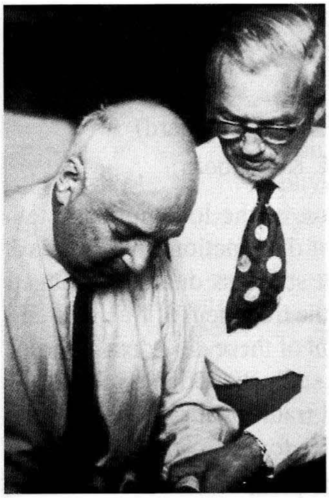


Figure I.3
Cyriax (left) and Stoddard collaborate on treatment methods. Oslo, 1965

Up to this point, only regional, nonspecific approaches to evaluating and treating spinal patients were used by Mennell, Cyriax, and the Norwegian Manipulation Group. But Alan Stoddard, M.D. and D.O., was performing more specific techniques within the practice of osteopathy to treat the spine. Stoddard describes these techniques in his textbooks, *Manual of Osteopathic Technique* (1959) and *Manual of Osteopathic Practice* (1969), which made osteopathic techniques more accessible to physical therapists and medical doctors.

In the late 1950's and early 1960's, I studied at both schools where Stoddard was an instructor: The British School of Osteopathy and The London College of Osteopathy. With Stoddard, I brought selected osteopathic techniques to the Norwegian Manipulation Group.

Cyriax and Stoddard worked with me for many years to determine which evaluative and treatment tools from physical therapy, sports medicine, orthopedic medicine, and osteopathy would most benefit physical therapy practice and should be a part of manual therapy training for physical therapists.

■ MT ad modum Kaltenborn

1958 -

I began to develop my own theories and techniques and to incorporate these into our evolving OMT system. My integrated approach became known as "Manual Therapy (MT) ad modum Kaltenborn" or "The Kaltenborn Method."[2]

Among my contributions were an emphasis on translatoric joint play movements in relation to a treatment plane for evaluating and mobilizing joints, the use of grades of movement, the convex-concave rule, three-dimensional pre-positioning for joint movement, protecting adjacent nontreated joints during procedures, self-treatment, and ergonomic principles applied to protect the therapist. (See *Special Features*, page 9.)

2 In 1958, Norwegian PTs referred to my approach as "Manual Therapy ad modum Kaltenborn." During the 1960's practitioners in other European countries adopted the term as well, as did Nordic medical doctors in 1965.

During this period of time, my method included:

- » Orthopedic Medicine (from J. H. Cyriax and J. B. Mennell)
- » Osteopathy (from A. T. Still and A. Stoddard)
- » My original techniques (F. M. Kaltenborn)

I emphasized functional evaluation of the locomotor system and the biomechanical treatment of dysfunction. In those days patients often presented with joint stiffness due to prolonged immobilization in plaster casts for the treatment of fractures and dislocations. (Modern-day treatment of these disorders incorporates joint movement to prevent such secondary joint problems.) My methods supplemented traditional physical therapy approaches with treatment techniques for:

- » Symptom relief, especially for pain.
- » Relaxation of muscle spasm.
- » Stretching of shortened joint and muscle connective tissues.

Starting in 1960, I presented my MT courses to physical therapists from the Nordic countries. From 1962 physicians attended as well. At this time, Dr. Schiøtz and other Scandinavian physicians created the Nordic Physicians Manual Medicine Association (NFMM). The association also developed groups to teach my MT system and named educational coordinators for Denmark, Norway, Finland and Sweden, for which I served as Nordic Educational Director for Physicians and Physical Therapists. As practicing physicians, the NFMM members reported their clinical results on integrating this manual treatment approach into their practices, and thus contributed to the fine-tuning of the system.

■ OMT Kaltenborn-Evjenth Concept

1973 - present

Olaf Evjenth, a skilled Norwegian practitioner with a background in physical education, athletic training and physical therapy, joined me in 1958. He expanded my approach with specialized techniques for muscle stretching and coordination training. In particular, he believed in more intensive training for patients and developed programs that, in addition to monitoring pain and range of movement, assessed performance. Evjenth also modified specific exercises for patient use at home with automobilization, autostabilization, and autostretching.

Evjenth and I, together with members of the Norwegian Manual Therapy Group, began to develop and use additional self-treatment techniques, equipment for home treatment, and ergonomic innovations including mobilization wedges, fixation belts, and grips to make treatments more effective and less physically stressful for the therapist (always a concern in our system).

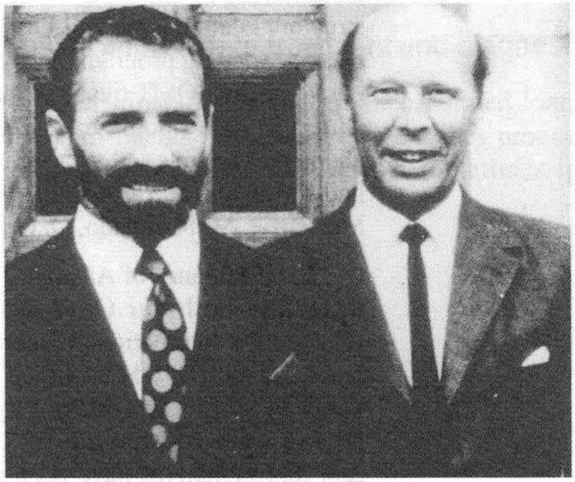


Figure I.4: Evjenth (left) and Kaltenborn in Canada in 1968, introducing our OMT concept in North America

Multiple treatment techniques, often performed within the same treatment session, are basic to our system. This approach to treatment was improved further as Evjenth and I began to sequence techniques for the most effective results.

We presented the "OMT Kaltenborn-Evjenth Concept" worldwide in 1973, when Evjenth and I joined Cyriax, Hinsen, and Stoddard to found the International Seminar of Orthopaedic Manipulative Therapy. At that time we included:

» MT ad modum Kaltenborn
» Contributions from Olaf Evjenth
» Contributions from other practitioners

In 1990, Evjenth introduced symptom alleviation testing as a method for localizing lesions and improved symptom provocation testing. This aided in making evaluations more specific. He also improved techniques for protecting adjacent nontreated joints during manual mobilization procedures.

My philosophy has always been to integrate useful tools from other approaches. Over the years, the OMT Kaltenborn-Evjenth

Concept benefited from the contributions of many physical therapists and physicians, both in the Nordic countries and worldwide. A few have been especially important to our approach and should be mentioned here: Herman Kabat, M.D. and physical therapists Margaret Knott and Dorothy Voss developed the proprioceptive neuromuscular facilitation (PNF) principles behind our active relaxation and muscle reeducation techniques; Oddvar Holten P.T. developed medical training therapy (MTT) and Dennis Morgan D.C., P.T., and OMT instructors Olaf Evjenth and Lasse Thue, developed specialized exercise training programs and equipment which we now incorporate into our OMT treatment programs; Geoffrey Maitland of Australia, with whom I have had many stimulating discussions about our concepts and approach. Many other practitioners also had an influence on my thinking, including S.V. Paris, R. McKenzie, M. Rocabado, O. Grimsby, B. Mulligan and others.

In 1974, Maitland (of Australia) and I, together with therapists trained in both our OMT system and Maitland systems, founded the International Federation of Orthopaedic Manipulative Therapy (IFOMT), which later became a subgroup of the World Confederation of Physical Therapists. Through IFOMT's international forums, OMT Kaltenborn-Evjenth Concept representatives have been a major influence on physical therapy. Our system's continuing evolution has been aided by this opportunity for its practitioners and founders to interact with representatives of other OMT approaches worldwide.

OMT Kaltenborn-Evjenth Concept standards formed the basis for IFOMT educational and certification standards adopted in 1974 and 1975, which must be met by all participating members. Many other countries in which the OMT Kaltenborn-Evjenth Concept is taught are beginning to develop similar educational and certification standards. To date, our system is taught in the Nordic countries, in Australia, Austria, Belgium, France, Germany, Greece, Italy, Japan, Korea, Netherlands, Poland, Spain, Switzerland, Taiwan, the United Arab Emirates, and in North and South America.

Today, our system has expanded to encompass evaluation, treatment and research for a complete neuro-musculoskeletal approach to manual physical therapy. Education incorporates clinically supervised residencies and written and practical examinations. At the highest levels of training, practitioners are also required to conduct independent research in the field of manual therapy.

■ Special features

As the OMT Kaltenborn-Evjenth Concept more extensively influences the practice of physical therapy, so our system continues to evolve. But certain special features can be identified as basic and unique in their application to our system. In many cases we were the first to introduce these concepts to physical therapy practice, which are now widely accepted and practiced.

Biomechanical approach to treatment and diagnosis

Traditional manipulative technique incorporated long-lever rotational movements. The compressive forces produced by these long-lever rotational movements sometimes injured joints.

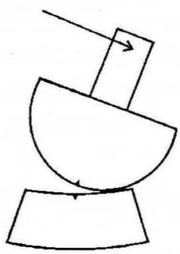


Figure I.5
Prior to 1952, practitioners used long-lever rotation techniques (passive continuation of active movement)

In the early 1900's, James Mennell, M.D. introduced shorter lever rotational manipulations which reduced the possibility of joint damage. In 1952 Norwegian manual therapists adopted these short-lever manipulative techniques.

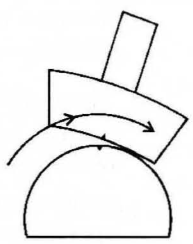


Figure I.6
In 1952, we began to use short-lever rotation techniques

In 1954, I introduced the concept of translatoric bone movements, in the form of linear translatoric traction and gliding *in relation to a treatment plane*, to further reduce joint compression forces. Over the next 30 years I worked to incorporate translatoric joint movements into a comprehensive joint evaluation and treatment approach that reduced the need for short-lever rotation mobilizations. By 1979, Evjenth and I had refined our techniques to eliminate rotatory forces in extremity joint treatment, and by 1991, had accomplished the same for spinal manipulations.

In the OMT Kaltenborn-Evjenth Concept, biomechanical principles form the core of the analysis and treatment of musculoskeletal conditions.

» Translatoric treatment in relation to the Kaltenborn Treatment Plane allows for safe and effective joint mobilization.

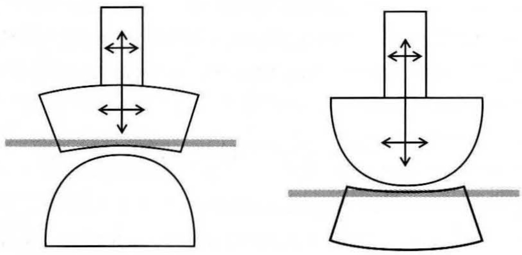


Figure I.7
In 1954, I incorporated the concept of translatoric bone movement in relation to the treatment plane

» The therapist evaluates the translatoric joint play movements of traction and gliding by feeling the amount of slack in the movement and sensing the end-feel. The therapist uses grades of movement to rate the amount of joint play movement they palpate.

» Three-dimensional joint positioning, carefully applied before tests and mobilizations, refines and directs movement in the (actual) resting position, at the point of restriction, and in other joint positions for greater specificity and effect.

» The Kaltenborn Convex-Concave Rule allows indirect determination of the direction of decreased joint gliding to insure normal joint mechanics during treatment.

» The therapist evaluates and treats all combinations of movements, coupled and non-coupled.

» The therapist uses specific evaluation and specific treatment, including special tests to localize symptomatic structures, and to treat hypermobility in addition to hypomobility.

Combination of techniques

The use of multiple treatment techniques, often in one treatment session, has always been part of our system. For example, techniques to improve joint mobility are often preceded by pain-relief and soft-tissue-mobilization techniques such as functional massage and muscle stretching. Self-treatment is an important part of our system and may include instruction in automobilization, autostretching, autotraction, strengthening, stabilization, or coordination exercises. Advice on body mechanics and ergonomics is important to maintain improvements gained in therapy and to prevent recurrences.

Trial treatment and clinical reasoning

An experienced practitioner views treatment procedures also as evaluation procedures, interpreting the patient's response to each treatment in the context of their initial diagnostic hypotheses. I formalized this concept within my system in 1952, with the term "trial treatment," where the manual therapist confirms the initial physical diagnosis with a low-risk trial treatment as an additional evaluation procedure.

Ergonomic principles for the therapist

The OMT Kaltenborn-Evjenth Concept emphasizes good *therapist* body mechanics. An example of this was my development in the 1950's of the first pneumatic high-low adjustable treatment table designed for manual physical therapy practice. Our practitioners have since developed a number of treatment techniques and tools for efficiency and safety, including mobilization and fixation belts, wedges, and articulating tables.

■ Overview

OMT Kaltenborn-Evjenth Concept for Physical Therapists

The Kaltenborn Method for joint testing and mobilization presented in this book is part of the larger scope of OMT Kaltenborn-Evjenth Concept practice.

I. Physical Diagnosis (biomechanical and functional assessment)

A. Screening exam: An abbreviated exam to quickly identify the region where a problem is located and focus the detailed examination

B. Detailed exam:

1. ***History***: Narrow diagnostic possibilities; develop early hypotheses to be confirmed by further exam; determine whether or not symptoms are musculoskeletal and treatable with OMT. *(Includes present episode, past medical history, related personal history, family history, review of systems)*
2. ***Inspection***: Further focus the exam. *(Includes posture, shape, skin, assistive devices)*
3. ***Tests of function***
   - a. **Active and passive movements:** Identify location, type, and severity of dysfunction. *(Includes standard-anatomical-uniaxial movements and combined-functional-multiaxial movements)*
   - b. **Translatoric joint play movements:** Further differentiate articular from nonarticular lesions; identify directions of joint restrictions. *(Includes traction, compression, gliding)*
   - c. **Resisted movements:** Test neuromuscular integrity and status of associated joints, nerves and vascular supply.
   - d. **Passive soft tissue movements:** Differentiate joint from soft tissue dysfunction and the type of soft tissue involvement. *(Includes physiological movements, accessory movements)*
   - e. **Additional tests** *(Includes coordination, speed, endurance, functional capacity assessment ...)*
4. ***Palpation*** *(Includes tissue characteristics, structures)*
5. ***Neurologic and vascular examination***

C. Medical diagnostic studies *(Includes diagnostic imaging, lab tests, electro-diagnostic tests, punctures)*

D. Diagnosis and trial treatment

II. Treatment

A. To relieve symptoms (most often pain)

1. ***Immobilization***
   - *General: bed rest*
   - *Specific: corsets, splinting, casting, taping*
2. ***Thermo-Hydro-Electro (T-H-E) therapy***
3. ***Pain relief joint mobilization*** *(Grade I-II Slack Zone in the actual resting position)*
   - *Intermittent manual traction*
   - *Vibrations, oscillations*
4. ***Special procedures*** *(Includes acupuncture, acupressure, soft tissue mobilization ...)*

B. To increase mobility

1. ***Soft tissue mobilization***

   a. **Passive soft tissue mobilization**
      - *Classical, functional, and friction massage*

   b. **Active-facilitated soft tissue mobilization**
      - *Contract-relax, reciprocal inhibition, muscle stretching*

2. ***Joint mobilization***

   a. **Relaxation joint mobilization** (Grade I - II)
      - *Three-dimensional, pre-positioned mobilizations*

   b. **Stretch joint mobilization** (Grade III)
      - *Manual mobilization in the joint (actual) resting position*
      - *Manual mobilization at the point of restriction*

   c. **Manipulation**
      - *High velocity, short amplitude, linear thrust movement*

3. ***Neural tissue mobilization***
   To increase mobility of dura mater, nerve roots, and peripheral nerves
4. ***Specialized exercise***
   To increase or maintain soft tissue length and mobility and joint mobility

C. To limit movement

1. ***Supportive devices***
2. ***Specialized exercise***
3. ***Treatments to increase movement in adjacent joints***

D. To inform, instruct, and train

Exercises and education to improve function, compensate for injuries, and prevent reinjury. Instruction in relevant ergonomics and self-care techniques, e.g., medical training therapy, automobilization, autostabilization, autostretching, back school, activities of daily living, etc.

III. Research

Clinical trials to determine the efficacy of both single and combined treatment methods. An evidence-based approach to every aspect of evaluation and treatment is an essential precursor to OMT research.

Notes

PRINCIPLES

1 Spinal movement

The orthopedic manual therapist evaluates and treats orthopedic disorders of the spine with both general and specific movements. The more precisely a movement is produced, the more specifically the therapist can identify and treat a movement dysfunction.

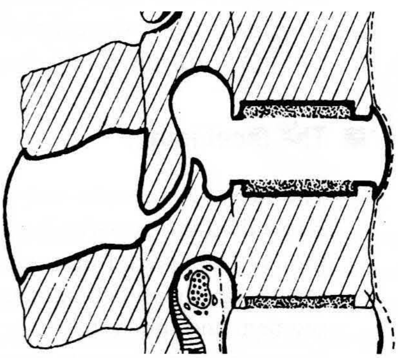
General movement in the spine involves movement of a set of vertebrae, a vertebral region, or of the entire spine. All general movements are under voluntary control (i.e., active movements) and can also be produced passively.

Specific movement in the spine is isolated movement of one intervertebral (or mobile) segment. For this reason, specific movement in the spine is also known as **segmental movement**. Isolated movement of an individual **mobile segment** is not under voluntary control and can only be produced passively.

The mobile segment

The **mobile segment** (*segmentum mobile intervertebralis*) is a three-joint complex composed of the intervertebral disc joint and two facet joints, as well as the muscles, ligaments, and neurovascular structures surrounding, between, and connecting adjacent vertebrae.

Figure 1.1
Schematic representation of a mobile segment (after Junghans 1959)



■ The intervertebral disc joint

The intervertebral disc joint (*synchondrosis intervertebralis*) is the synchondrotic articulation between two adjacent vertebral bodies. The disc consists of a nucleus pulposus and an annulus fibrosus. The nucleus has a tendency to expand, which is stopped by the annulus which envelops the nucleus. Both act together.

The main functions of the disc are:

» Static – to transmit loads from one vertebra to the next and to distribute loads evenly to the end-plate.

» Movement – to maintain sufficient distance between two vertebrae to allow movement between them.

» Stabilization – to connect two vertebrae and to restrict excessive intervertebral movement.

The capacity of the disc to dampen loads is not as significant as once thought. Soft load impulses are partially dampened by the disc; hard load impulses more by the bone. However, the primary shock absorbing mechanism in the spine is the result of spinal bending movements in the sagittal and frontal planes.

In a healthy disc with an intact annulus, the anterior aspect of the nucleus will compress slightly with spinal flexion. With spinal extension the posterior aspect of the nucleus will compress slightly.

If the annulus is torn, the nucleus responds to movement by migrating through the path of least resistance in the direction of the annular tear and may bulge or herniate through the annulus. This type of disc injury, which is most common on the posterior aspect of the disc where the annulus is weakest, plays an important part in the etiology and pathogenesis of most spinal syndromes.

■ The facet joint

The facet (zygapophyseal) joints (*articularis interarcualia*), also called the synovial intervertebral joints, are true synovial joints. The spacial orientation of a facet's articular surface influences the direction of movement available in each mobile segment and limits the range of certain spinal movements (see *Noncoupled movements*, page 27). In the cervical and thoracic regions, and also in the lower lumbar region, the facets also provide some load-bearing support. It is crucial for the manual therapist to know the orientation of each facet joint surface in order to safely and effectively direct passive spinal movement. The characteristic orientation of the facets in various spinal regions is detailed in the *Technique* section of this book.

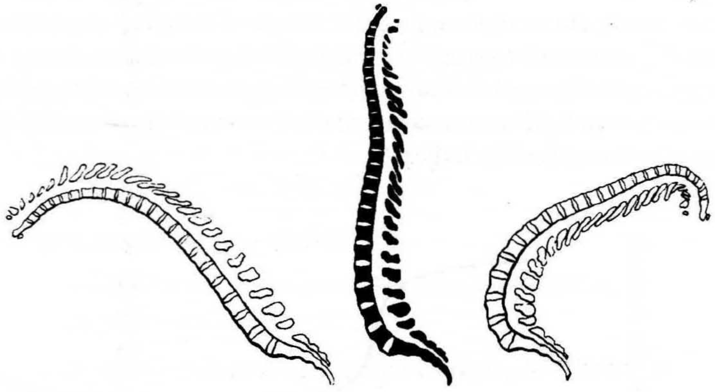
Spinal range of movement

The amount of motion possible for a mobile segment is limited either by the facets or by the intervertebral disc joint, depending on the movement direction. The higher the disc is in relationship to its own diameter, the greater the mobility of the intervertebral (mobile) segment.

Spinal flexibility is influenced by a person's age, the health of tissues surrounding the spine, physical conditioning, and hereditary factors, in addition to the functional anatomy of the spine. With flexion of the entire spine (below C2), the typical spine presents as a curve with flattened ends; the thoracic kyphosis is increased, and the cervical and lumbar lordoses are flattened. In maximal extension, the spine is like a rod with dorsally curved endings.

Spinal curvature will vary depending on the shape of an individual's discs and vertebral bodies.

Figure 1.2
Human spine in maximal flexion, in neutral, and in maximal extension



The intervertebral segments within each spinal region have characteristic ranges and patterns of movement. Because it is not clinically practical to calculate the exact number of degrees of movement in each spinal segment, clinicians compare range of movement in different spinal segments to determine if the movements are characteristic for a particular spinal region. The graphs below illustrate some characteristic patterns of range of movement that can be palpated in various spinal regions.

Figure 1.3 shows a curve representing the range of spinal movement in the sagittal plane. Note that the amount of flexion and extension is almost equal in all segments of the typical spine except in the L5-S1 segment, where there is significantly more extension than flexion range.

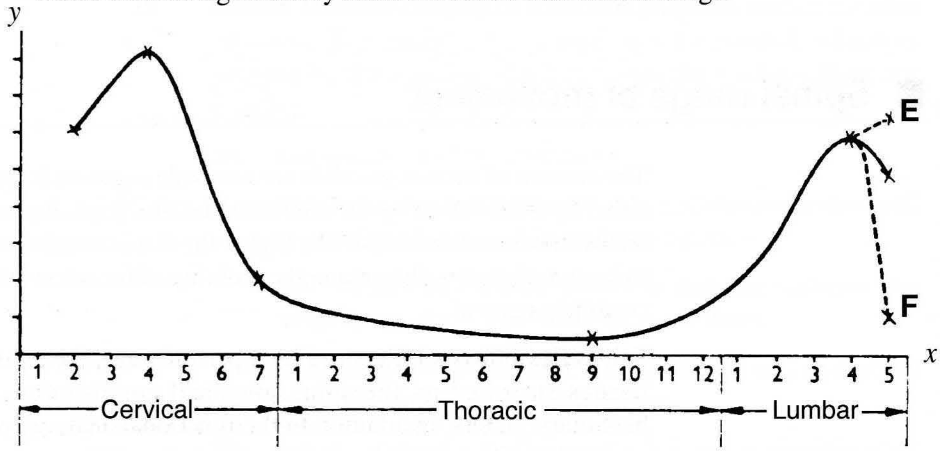


Figure 1.3
Spinal segmental range of movement in flexion and extension. The "y" coordinate represents segmental range of movement. The x coordinate identifies each mobile segment. C2 indicates the mobile segment of C2-C3. Since the amount of extension and flexion is nearly equal in most spinal segments, a single line on the graph represents both flexion and extension range, except at the L5-S1 segment. Here the line often splits and indicates greater range into extension (marked by "E") and much less range into flexion (marked by "F"). (Kaltenborn, 1960)

A curve representing the range of coupled movement (see *Coupled movement*, page 26) in sidebending and rotation during flexion is shown in Figure 1.4. Pure sidebending or rotation movements are relatively small. However, when studied as coupled movement the movement is considerably larger.

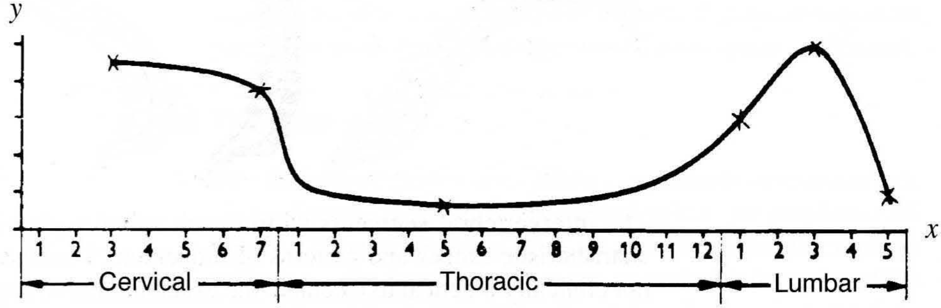


Figure 1.4
Spinal segmental range of movement with simultaneous flexion, sidebending, and rotation coupled to the same side. (Kaltenborn, 1960)

Joint positioning for evaluation and treatment

Three-dimensional joint positioning

Successful segmental evaluation and manual mobilization of the spine requires the practitioner to skillfully position the mobile segment specifically in one, two, or three planes to encourage or limit a movement.

For practical purposes, we classify three-dimensional joint positions into three categories:

» **Resting position** – where periarticular structures are most lax, allowing for the greatest range of joint play.

» **Actual resting position** – where a dysfunctional joint presents with the greatest ease, greatest range of traction joint play, least muscle reactivity and least tissue tension.

» **Nonresting positions** – where subtle joint dysfunctions become apparent and are best treated; where specific soft tissues can be targeted for evaluation, movement, or stretching.

Resting position

The resting position (loose-packed position) is the position (usually three-dimensional) where periarticular structures are most lax, allowing for the greatest range of joint play.[1] With many joint conditions, this position is also the patient's position of comfort (symptom-relieving posture) affording the most relaxation and least muscle tension. The resting position may vary considerably among individuals.

The resting position is useful for:

» evaluating joint play through its range of motion, including end-feel.

» confirming diagnostic hypotheses with a low risk trial treatment.

» treating symptoms with Grade I-II traction-mobilization within the slack.

» treating hypomobility with Grade II relaxation-mobilization or Grade III stretch-mobilization.

» exploring optimal treatment dosage.

1 MacConaill referred to the "resting position" as the "loose packed position."

To find the resting position:

1) Position the joint in the approximate resting position according to established norms. For example, resting position for the neck is usually a slight lordosis.

2) In this approximate resting position, apply several gentle Grade II traction joint play tests to the first stop, feeling for the ease and degree of movement.

3) Re-position into slightly more or less *flexion or extension* and apply the traction tests again until you locate the position with the greatest ease and degree of movement. Maintain this position as you proceed to the next step.

4) Repeat the traction tests with subtle re-positionings into more or less *sidebending* and apply the traction tests again until you locate the position with greatest ease and degree of movement. Maintain this flexion/extension and sidebending position as you proceed to the next step.

5) Repeat the traction tests with subtle re-positionings into more or less *rotation* until you find the position with the greatest ease and range of movement in <u>all three dimensions</u>. This is the resting position.

Experienced practitioners may speed their exploration and identification of the resting position with simultaneous joint re-positioning in multiple planes.

Actual resting position

In some cases, the patient's symptoms or joint pathology restrict movement significantly and prevent joint positioning in the resting position. In such cases you will search for the *actual resting position* in the same way you searched for the resting position, looking for the joint position of greatest ease, greatest range of traction joint play, least muscle reactivity and least tissue tension in the area of the dysfunction. The actual resting position must also be where the patient reports least discomfort. Keep in mind that the actual resting position will display somewhat less ease and range than the resting position.

In the case of antalgic postures in the spine, the patient's presenting posture may or may not be close to their actual resting position. There is a tendency for patients to strive to orient themselves for upright function even though they may be more symptomatic there.

Nonresting positions

Many subtle joint dysfunctions only become apparent when the joint is examined outside the resting position, and can only be treated in such positions. Nonresting positions are also used to specifically position soft tissues for movement or stretch.

Since nonresting positions allow less joint play, more skill is required to perform techniques safely in these positions. Novice practitioners applying spinal stretch mobilizations in nonresting positions are more likely to overstretch tissues and cause injury. Spinal stretch mobilization treatment in positions other than the resting position are considered "advanced" in our system and should be introduced to practitioners only after they demonstrate competence with resting position mobilizations.

■ Joint locking

Spinal mobilization techniques are most effective and safe when movement is focused ("localized") within the spinal segments to be treated while adjacent segments remain stable ("locked" in a close-packed position) and restrained from following the movement.[2] The term "locking" does not mean becoming locked, as a door locks with a key, but rather means being held back against movement forces in a particular direction. Spinal locking maneuvers are usually used either cranial or caudal to the treated segment. In some instances, locking is used both cranial and caudal to the treated segment. In this case, the segment to be treated will always be in its (actual) resting position.

The manual therapist locks a spinal segment by placing it in a movement pattern that constrains its movement.[3] *Noncoupled movement patterns* provide the most effective spinal locking (stabilization). If a neighboring joint segment is hypermobile or symptomatic with movement into the mobilizing direction (e.g., facet syndromes) it may be necessary to *manually* stabilize these segments opposite to the intended mobilization force.

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2 MacConaill referred to the "locked position" as the "close-packed position."

3 For an in-depth discussion of spinal joint locking, see *Muscle Stretching in Manual Therapy, Volume II*, by Evjenth and Hamberg.

Bone and joint movement

Bone movements produce associated joint movements. The relationship between a bone movement (osteokinematics) and its associated joint movements (arthrokinematics) forms the basis for many orthopedic manual therapy (OMT) evaluation and treatment techniques.

Two types of bone movements are important in our OMT system:

Rotations: ***curved (angular) movement around an axis***

Translations: ***linear (straight-lined) movement parallel to an axis in one plane[4]***

Rotations of bone produce the joint movement of roll-gliding. Translations of bone result in the linear joint play movements of traction, compression, and gliding.

Bone movements	***Corresponding joint movements***
Rotatoric (curved) movement	**Roll-gliding**
- Standard (anatomical, uniaxial)	
- Combined (functional, multiaxial)	
Translatoric (linear) movement	**Translatoric joint play**
- Longitudinal bone separation	- Traction
- Longitudinal bone approximation	- Compression
- Transverse (parallel) bone movement	- Gliding

Rotations of a vertebral bone

All active movements occur around an axis and therefore, from a mechanical viewpoint, are considered rotations. All bone rotations can be produced passively as well. There are two types of bone rotations:

1) Standard, uniaxial bone movements – (MacConaill's "pure, cardinal swing")

2) Combined, multiaxial bone movements – (MacConaill's “impure arcuate swing")

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4 From a mechanical perspective, translations can be curved or linear. Only linear translations are relevant to OMT practice. In this text, the term "translation" refers to *linear* translations in relation to The Kaltenborn Treatment Plane.

Standard bone movements

Standard bone movements are bone rotations occurring around one axis (uniaxial) and in one plane. Standard movement is called "anatomical" movement when the movement axis and the movement plane are in anatomical (or cardinal) planes.

Anatomical bone movements beginning at the zero position are useful for describing and measuring test movements. They provide a standardized method for communicating examination findings that can be reproduced by other health care professionals. Anatomical movements of the vertebral bones in the three cardinal planes are described below.

Anatomical bone movements of a vertebra in the cardinal planes (vertebral rotations)

Sagittal plane movements around a frontal axis

» **Flexion** (forward or ventral flexion): The spinous process moves cranially.

» **Extension** (backward or dorsal flexion): The spinous process moves caudally.

Frontal plane movements around a sagittal axis

» **Sidebending** (lateral flexion)—With sidebending to the right, the right transverse process moves caudally and the left transverse process moves cranially. The opposite takes place with sidebending to the left.

Transverse plane movements around a vertical (longitudinal) axis

» **Rotation**: Right rotation is rotation in the clockwise direction viewed from the cranial direction; the spinous process moves to the left. The opposite takes place with rotation to the left.

Combined bone movements

Bone movement that occurs simultaneously around more than one axis (multiaxial) and in more than one plane is called combined, or functional, movement. For example, the simultaneous flexion (frontal axis, sagittal plane) with sidebending (sagittal axis, frontal plane) and rotation (vertical axis, transverse plane) is a combined movement. These movements do not occur purely in cardinal planes and around defined axes, but rather in oblique or diagonal directions. Combined movements represent most of the movements we carry out during daily activities. Manual therapists often examine combined movements in order to reproduce a patient's chief complaint and to analyze mechanisms of injury.

We classify spinal combined movements as coupled or noncoupled according to the degree and nature of movement ease possible when flexion or extension, rotation, and sidebending are combined in various ways. *Coupled movements* have the greatest ease (greatest range, least resistance to movement, softest end-feel). *Noncoupled movements* have less ease (less range, more resistance to movement, and a harder end-feel).

Various combined movement patterns are used in OMT to specifically enhance or limit movement. For example, using coupled movements for combined spinal joint and soft tissue techniques allows for greater tissue excursion. Using non-coupled movements for three-dimensional joint positioning and locking techniques will restrain movement in adjacent vertebral segments.

The skill to *feel* coupled and noncoupled movements in each individual patient separates the skilled manual therapist from the novice. With skill, the practitioner can adapt examination and treatment techniques when anomalous combined movements present clinically, and can use combined movement patterns to more specifically locate a lesion and to more effectively treat it.

The skill to feel how each combination of movement couples in each individual patient separates the skilled manual therapist from the novice.

Coupled movements

Movement combinations that result in the most ease of movement (the greatest range of movement, least resistance and softest end-feel) are classified as coupled movements. From a neurophysiological perspective, coupled movement is easier to perform and is more automatic (non-voluntary) in behavior. Depending on whether the spine is in flexion or extension, sidebending must be associated with a particular rotation to produce maximum movement ease.

The range of a coupled movement is greatest when all components of the movement pattern occur simultaneously. If one component of movement occurs before the other movement components, the available range of movement in the remaining component directions is reduced.

Noncoupled movements

Combined movements are classified as noncoupled movements when they produce less movement ease (more restricted range of movement and a harder end-feel) than coupled movements and the relationship between rotation and sidebending is reversed. Manual treatment in a noncoupled movement direction must be performed with care in the spine, as these movements can suddenly hit a hard stop (for example, due to facet joint opposition) and any attempt to produce movement beyond that point could result in injury.[5]

Combined movement patterns in the spine

The combined movement patterns described here are those that most commonly occur. Keep in mind that variations in the geometrical relationships of vertebrae (e.g., spacial orientation of the facets), the restrictions of the vertebral ligaments, and the spinal curvature can result in atypical combined movements in individuals with anomalies in spinal structure due to genetic, developmental, or pathological causes (e.g., idiopathic scoliosis).

- **Upper cervical spine (above C2):** Coupling between sidebending and rotation usually occurs to opposite sides, regardless whether those vertebrae are in flexion or extension. Sidebending and rotation to the same side will usually produce a noncoupled movement.
- **Cervical spine (below C2):** Coupling between sidebending and rotation usually occurs to the same side, regardless whether those vertebrae are in flexion or extension. Sidebending and rotation to opposite sides will usually produce a noncoupled movement.

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5 Terminology has changed as our concepts have evolved. Before 1992, coupled movement was called "physiological" movement and noncoupled movement was called "nonphysiological" movement. This older terminology was changed because "nonphysiological" movement was sometimes misinterpreted to mean abnormal movement, when in fact it simply named another pattern of normal combined movements with different range and end-feel characteristics.

In the thoracic and lumbar spine (from about T4 to L5), the positions of flexion and extension alter the coupled relationship between sidebending and rotation.

- **Thoracic spine in the resting position and in flexion (kyphosis)**: Coupling between sidebending and rotation usually occurs to the same side. Sidebending and rotation to opposite sides will usually produce a noncoupled movement.

  Thoracic spine in marked extension (flattened or lordosis): Coupling between sidebending and rotation usually occurs to opposite sides. Sidebending and rotation to the same side will usually produce a non-coupled movement.

- **Lumbar spine in the resting position and in extension (lordosis):** Sidebending usually couples with rotation to opposite sides. Sidebending and rotation to the same side will usually produce a non-coupled movement.

  Lumbar spine in marked flexion (kyphosis): Sidebending usually couples with rotation to the same side. Sidebending and rotation to opposite sides will usually produce a non-coupled movement.

■ Joint roll-gliding associated with bone rotations

Joint roll-gliding

In a healthy joint, functional movement (bone rotation) produces joint roll-gliding. Roll-gliding is a combination of rolling and gliding movement which takes place between two joint surfaces (in the spine, between two adjacent vertebrae in a mobile segment). Relatively more gliding is present when joint surfaces are more congruent (flat or curved), and more rolling occurs when joint surfaces are less congruent.[6]

Rolling occurs when new equidistant points on one joint surface come into contact with new equidistant points on another joint surface. Rolling is possible between two incongruent curved surfaces (i.e., surfaces of unequal radii of curvature). As illustrated, a convex surface can roll on a concave surface (Figure 1.5a) or vice versa (Figure 1.5b).

6 Joint "gliding" is referred to as joint "sliding" by some authors.

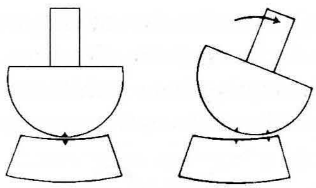


Figure 1.5a
Rolling convex surface

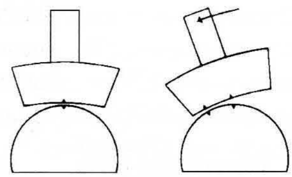


Figure 1.5b
Rolling concave surface

The **direction of the rolling component** of joint roll-gliding is always in the direction of the bone movement.

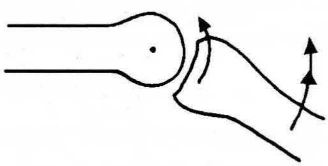
Gliding occurs when the same point on one joint surface comes into contact with new points on another joint surface. Pure gliding is the only movement possible between flat or congruent curved surfaces. Since there are no completely curved congruent or entirely flat joint surfaces, pure gliding does not occur in the human body.

In facet joints with a normally small range of movement, the facet surfaces primarily glide with a negligible rolling component. If there is greater range of movement available, a facet joint can both roll and glide.

The direction of the gliding component of joint roll-gliding associated with a particular bone rotation movement depends on whether a concave or convex articular surface is moving.

If a **concave** surface moves, joint gliding and bone movements are in the **same** direction. The moving bone and its concave joint surface are both on the same side of the axis of movement.

Figure 1.6
Concave surface: gliding (single arrow) in the same direction as bone movement (double arrow)



If a **convex** joint surface is moving, joint gliding and distal bone movement are in **opposite** directions. In this case, the distal aspect of the moving bone and its convex articular surface are on opposite sides of the movement axis.

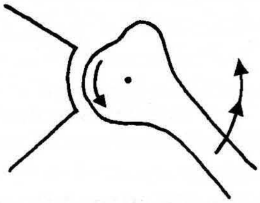


Figure 1.7
Convex surface: gliding (single arrow) in the opposite direction of the bone movement (double arrow)

With movement restrictions (hypomobility) normal joint roll-gliding is often disturbed. Usually the restricted movement is associated with an impaired gliding component which may allow joint rolling to occur without its associated gliding. Highly congruent joints, whether flat or curved, are relatively more affected by impaired gliding. A common goal in our approach to OMT is to restore the gliding component of roll-gliding to normalize movement mechanics.

Abnormal roll-gliding

Joint rolling movements in the absence of gliding can produce a damaging concentration of forces in a joint. On the same side towards which the bone is moving, joint surfaces tend to compress and pinch intraarticular structures, which can cause injury. At the same time, on the side opposite the bone movement, tissues can be overstretched. The following examples illustrate how damaging compression forces may occur when treating hypomobile joints with long-lever rotatoric techniques (Figure 1.8a), or with short-lever techniques applied parallel to a convex articular surface (Figure 1.8b).

A

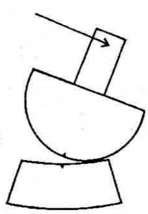


Figure 1.8a
Joint compression can result from forced passive bone rotations stretching through a long lever.

B

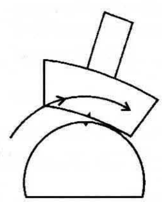


Figure 1.8b
Joint compression can result from forced passive bone rotations stretching through a short lever, or from improperly applied techniques intended to avoid compression.

In the presence of restricted joint movement, it is important to avoid rotational joint treatment techniques. If you use a rotational technique for other purposes (for example, oscillations or muscle stretching) be sure that the simultaneous joint gliding component occurs in an appropriate degree and direction. If you observe restricted or disturbed joint gliding during a rotational technique, stop the movement immediately and apply the appropriate treatment to restore joint gliding.

■ Translation of a vertebral bone

Bone translation is a linear movement of a bone along a defined axis in its respective plane. During translation of a bone, all parts of the bone move in a straight line, equal distances, in the same direction, and at the same speed. Bone translation can be performed only in very small increments.

Depending on the direction of the movement, bone translation can be described as parallel movement along a particular axis in relation to the treatment plane.

Vertebral bone translation

Longitudinal Axis Bone Translation

» **Separation** of adjacent vertebrae, pulling them away from each other

» **Approximation** of adjacent vertebrae, pushing them toward each other

Sagittal Axis Bone Translation

» **Ventral-Dorsal Gliding:** parallel movement of vertebrae in relation to each other in a ventral or dorsal direction

Frontal Axis Bone Translation

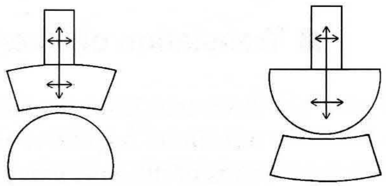
» **Lateral Gliding**: parallel movement of vertebrae in relation to each other to the right or left

In contrast to bone rotation, translation of the bone (with the exception of intervertebral approximation) is never under voluntary control, but occurs as a consequence of external (e.g., passive movement) forces on the body.

■ Joint play associated with bone translation

Bone translations produce isolated traction, compression, or gliding joint play movements in relation to the treatment plane. These translatoric joint play movements are essential to the easy, painless performance of active movement (see Chapter 2: *Translatoric joint play*).

Figure 1.9
Translatoric joint play



The arrows represent the passive joint play movements used for testing and treatment of joints.

2 Translatoric joint play

In every joint there are positions in which looseness or slack in the capsule and ligaments allows small, precise movements of joint play to occur as a consequence of internal and external (e.g., passive) movement forces on the body. These joint play movements are an accessory movement not under voluntary control, and are essential to the easy, painless performance of active movement.

The purpose of joint mobilization is to restore normal, painless joint function. In restricted joints, this involves the restoration of joint play to normalize the roll-gliding that is essential to active movement.

In the OMT Kaltenborn-Evjenth Concept we use translatoric (linear) joint play movements *in relation to the treatment plane* in both evaluation and treatment. We apply translatoric traction, compression and gliding joint play movements to evaluate joint function. We apply translatoric gliding and traction mobilizations to restore joint play.

Figure 2.1
Directions of translatoric joint play

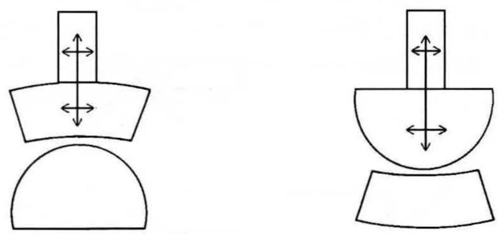


Figure 2.1a
The concave joint surface moves in relation to the stationary convex surface.

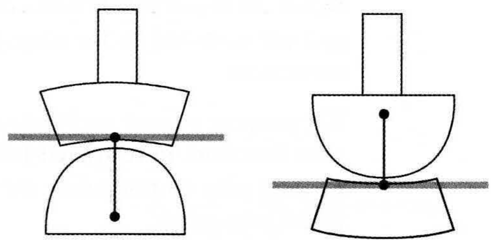
Figure 2.1b
The convex joint surface moves in relation to the stationary concave surface.

We use the term "joint play" only for translatoric (linear) movements. We do not use the term "joint play" for curved gliding movements.

The Kaltenborn Treatment Plane

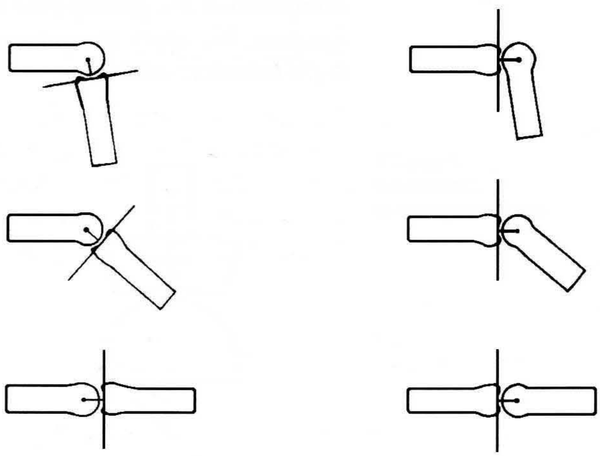
The Kaltenborn Treatment Plane passes through the joint and lies at a right angle to a line running from the axis of rotation in the convex bony partner, to the deepest aspect of the articulating concave surface. For practical purposes, you can quickly estimate where the treatment plane lies by imagining that it lies on the concave articular surface.

Figure 2.2
The Kaltenborn Treatment Plane lies on the concave articular surface.



The Kaltenborn Treatment Plane remains with the concave joint surface whether the moving joint partner is concave or convex.

Figure 2.3
Treatment plane



A

*The treatment plane moves with the **concave** joint partner.*

B

*The treatment plane remains essentially stationary when the **convex** joint partner moves.*

Always test joint play or mobilize a joint by moving the bone parallel to, or at a right angle to, the Kaltenborn Treatment Plane.[1]

1 I first described the treatment plane concept in 1954 as the "joint plane" and later as the "tangential plane." The term "treatment plane" was coined by Dennis Morgan DC, PT in the 1970s while collaborating with me on my writing.

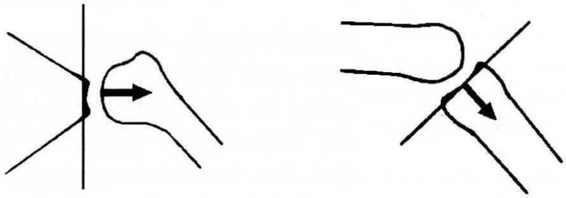
■ Translatoric joint play movements

The translatoric joint play movements used in the OMT Kaltenborn-Evjenth Concept are traction, compression, and gliding. We define traction, compression, and gliding joint play movements in relation to the Kaltenborn Treatment Plane.

Traction

Traction (separation) is a linear translatoric joint play movement *at a right angle to and away from* the treatment plane.

Figure 2.4
Traction

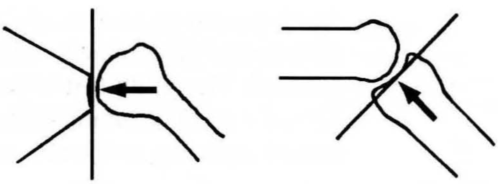


Bone movement at a right angle to and away from the treatment plane results in traction (separation) of joint surfaces.

Compression

Compression (approximation) is a linear translatoric movement *at a right angle to and toward* the treatment plane. Compression presses the joint surfaces together. Joint compression can be useful as an evaluation technique to differentiate between articular and extra-articular lesions.

Figure 2.5
Compression

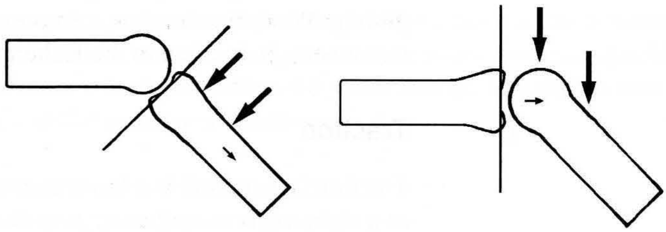


Bone movement at a right angle to and towards the treatment plane results in compression of joint surfaces.

Gliding

Translatoric gliding is a joint play movement *parallel* to the treatment plane. Translatoric gliding is possible over a short distance in all joints because curved joint surfaces are not perfectly congruent. Grade I traction is always performed simultaneously with a translatoric gliding movement. In the figures below, the direction of gliding is indicated by two large arrows and Grade I traction by the small arrow.

Figure 2.6
Translatoric gliding



Translatoric bone movement parallel to the treatment plane resulting in translatoric gliding in the joint

Instead of using the expression "translatoric gliding," we sometimes omit the word "translatoric" or replace it with a word indicating the direction of the gliding movement. For example, we say "dorsal glide" instead of "translatoric dorsal gliding." This describes translatoric gliding of a joint in a dorsal direction as a result of passive, linear displacement of a bone.

■ Determining the direction of restricted gliding

There are two methods of determining the direction of restricted joint gliding: l) the glide test, and 2) the Kaltenborn Convex-Concave Rule.

■ Glide test (the direct method)

Apply passive translatoric gliding movements in all possible directions and determine in which directions joint gliding is restricted. The glide test is the preferred method because it gives the most accurate information about the degree and nature of a gliding restriction, including its end-feel.

■ Kaltenborn Convex-Concave Rule (the indirect method)

First determine which bone rotations are decreased and whether the moving joint partner is convex or concave. Then deduce the direction of decreased joint gliding by applying the Convex-Concave Rule. Remember, if bone rotation is limited by shortened tissues outside the joint, this may skew your findings.

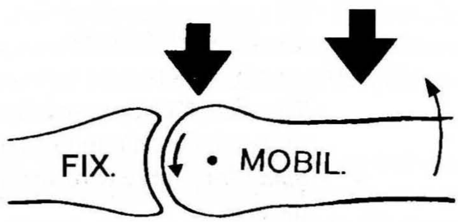
CONVEX → OPPOSITE   CONCAVE → SAME

The Kaltenborn Convex-Concave Rule is based on the relationship between normal bone rotations and the gliding component of the corresponding joint movements (roll-gliding). This approach is useful for joints with very small ranges of movement (e.g., amphiarthroses and significant hypomobility), when severe pain limits movement, or for novice practitioners not yet experienced enough to feel gliding movement with direct testing.

The most effective glide-mobilization treatments are those that stretch shortened joint structures in the direction of the most restricted gliding. The therapist moves a bone with a *convex* joint surface *opposite* to the direction of restricted movement in the distal aspect of the bone, and a *concave* joint surface in the *same* direction as the direction of the restricted bone movement.

In both examples which follow, mobilization is in the direction of the decreased gliding component. The left joint partner is fixated (FIX) and the right partner mobilized (MOBIL). The direction of stretch, a Grade III glide mobilization, is identical to the direction of the restricted gliding component of roll-gliding.

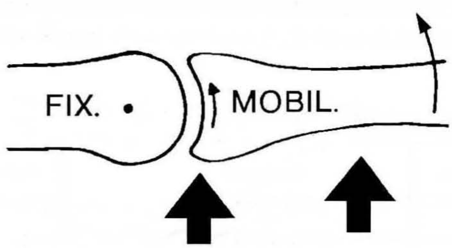
Figure 2.7a



CONVEX RULE → OPPOSITE

The right (moving) joint partner's surface is convex.
When bone movement is restricted in an upward direction (curved arrow), the treatment direction is downward (two bold arrows).

Figure 2.7b



CONCAVE RULE → SAME

The right (moving) joint partner's surface is concave.
When bone movement is restricted in an upward direction (curved arrow), the treatment direction is also upwards (two bold arrows).

In the spine the occiput in relation to the atlas as well as the sacrum in relation to the innominates move according to the convex rule (Figure 2.8a). The vertebrae from C2 to L5 move in relation to its caudal partner according to the concave rule (Figure 2.8b).

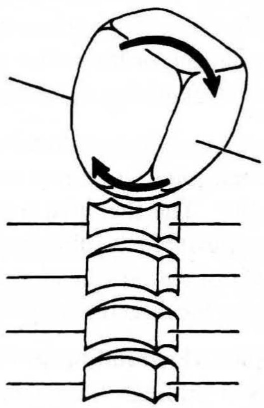


Figure 2.8a
CONVEX RULE —> OPPOSITE
The occiput moves according to the convex rule in relationship to the atlas.

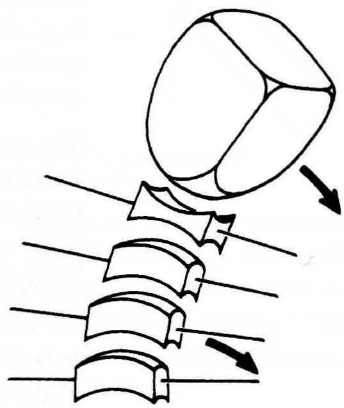


Figure 2.8b
CONCAVE RULE—> SAME
Cervical vertebrae below C2 move according to the concave rule.

The atlas (C1) does not follow the Concave-Convex Rule because of its relationship to the dens. See Chapter 13: *Upper Cervical Spine* for a review of the special movement characteristics of the atlas.

Grades of translatoric movement

Normal grades of translatoric movement

I-III scale

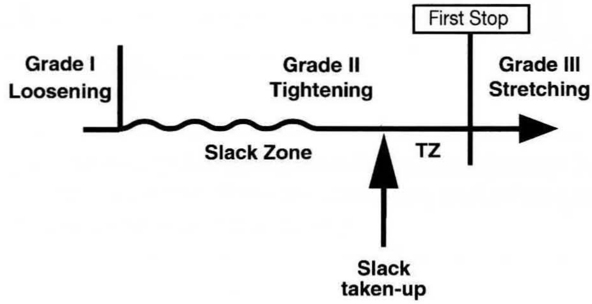
The ability to correctly perform translatoric movements depends on the practitioner's skill in feeling when there is slack in the joint and when the tissues that cross the joint become tightened. Joint play movements are greatest, and therefore easiest to produce and palpate, in the joint's *resting position*, where the joint capsule and ligaments are most lax.

A **Grade I "loosening"** movement is an extremely small traction force which produces no appreciable increase in joint separation. Grade I traction nullifies the normal compressive forces acting on the joint and reduces friction between the joint surfaces during gliding movements.

A **Grade II "tightening"** movement first takes up the slack in the tissues surrounding the joint and then tightens the tissues. In the *Slack Zone* (SZ) at the beginning of the Grade II range there is very little resistance to passive movement. Further Grade II movement into the *Transition Zone* (TZ) tightens the tissues and the practitioner senses more resistance to passive movement. Approaching the end of the Grade II range the practitioner feels a *marked resistance*, called the *First Stop*.

A **Grade III "stretching"** movement is applied after the slack has been taken up and all tissues become taut (beyond the *Transition Zone).* At this point, a Grade III stretching force applied over a sufficient period of time can safely stretch tissues crossing the joint. Resistance to movement increases rapidly within the Grade III range. You will find some variation in the degree of Grade III resistance among individuals and in various joints (see the dotted lines in Figures 2.9b and 2.10b).

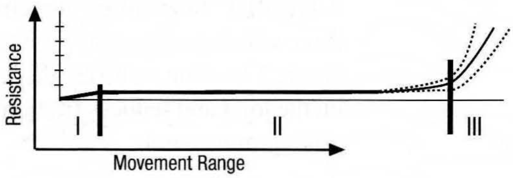
Figure 2.9a
Normal grades of movement



Palpating resistance to normal movement

In the Grade I and IISZ range the therapist senses little or no resistance. In the Grade IITZ range the therapist senses gradually increasing resistance. At the First Stop, the therapist senses marked resistance as the slack is taken up and all tissues become taut. Stretching occurs beyond this point. While in the diagrams below the slack in the Grade II translatoric movement range appears quite large, in reality it may be only millimeters long. Some practitioners apply similar grades of movement to rotatoric movements (e.g., elbow flexion), in which case the Grade II movement range could be quite large.

Figure 2.9b Relationship between resistance and grades of movement.



The location of the first stop can be difficult to feel. There won't be an absence of resistance suddenly followed by an abrupt stop; rather, there is a *Transition Zone*. This zone of increasing resistance may build slowly or quickly. You will feel some increasing resistance immediately before the marked resistance of the First Stop.

Mobilization for pain relief takes place in the Slack Zone and stops at the beginning of the Transition Zone, well before the marked resistance of the first stop. This is *especially important in cases of hypermobility*, since to move further could injure an undiagnosed hypermobile joint which is temporarily hypomobile ("locked") in a positional fault.

■ Pathological grades of translatoric movement

In the presence of joint pathology, the quality of end-feel is altered and grades of movement may be altered as well. For example, in the presence of a *marked hypomobility* the slack is taken up sooner than normal and greater force may be necessary to nullify intra-articular compression forces. In *hypermobility* the slack is taken up later than normal and less force may be necessary to achieve Grade I traction.

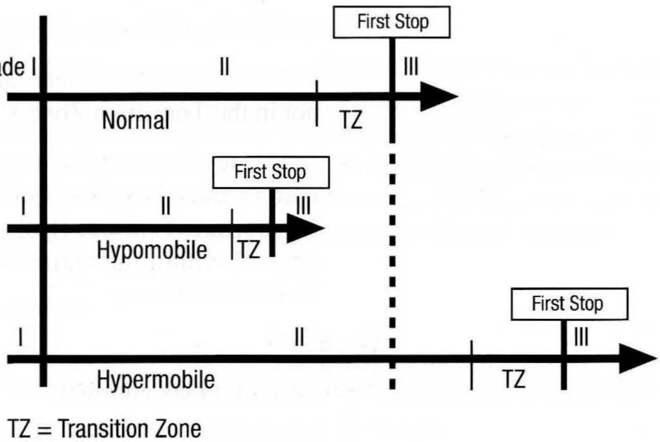


Figure 2.10a Pathological grades of movement

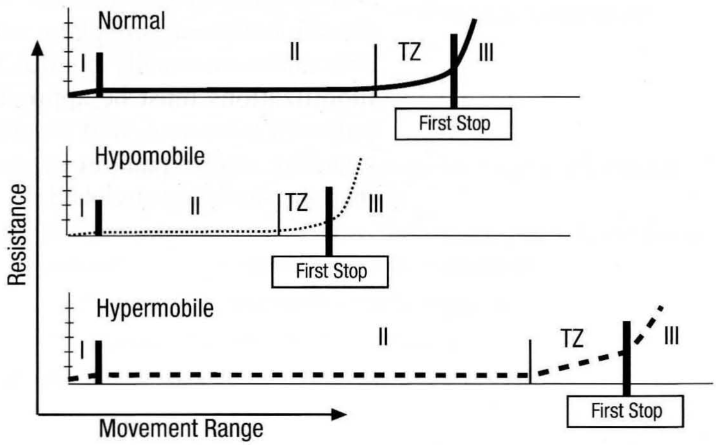


Figure 2.10b Relationship of resistance to pathological grades of movement

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Remember: When mobilizing for pain relief, you must recognize the beginning of the Transition Zone and stop there, well before you feel the marked resistance of the First Stop.

■ Using translatoric grades of movement

Grade I

» Relieve pain with vibratory and oscillatory movements.

» Grade I traction is used simultaneously with glide tests and glide mobilizations to reduce compression force and pain, and to reduce friction between joint surfaces to facilitate glide mobilizations.

Grade II

» Test joint play traction and glide movements.

» Relieve pain. (Treatment takes place in the Slack Zone, not in the Transition Zone.)

» Increase or maintain movement, for example when pain or muscle spasm limits movement in the absence of shortened tissue. (Relaxation mobilization can be applied within the entire Grade II range, including the Transition Zone.)

Grade III

» Test joint play end-feel.

» Increase mobility and joint play by stretching shortened tissues.

Note: Grade III mobilizations can produce a localized sensation of tissue stretching, which can be uncomfortable and occasionally painful for the patient. Stretch mobilizations must be applied with care, within the patient's tolerance, and should not produce muscle guarding, severe pain, or symptoms at locations other than the site being stretched.

3 Tests of function

A test of function enables you to *see*, *hear*, and *feel* the patient's complaints. The constellation of symptoms and signs that emerges from tests of function differentiate the nature of the structures involved in the dysfunction, for example, whether these are muscles or joints and allows you to apply treatment specifically to those structures.

Tests of function are an essential element of the OMT evaluation (see *Chapter 4: OMT evaluation)*. Function tests provide a tool for the manual therapist to confirm diagnostic hypotheses and measure progress. By monitoring the patient's response to these tests during treatment, the practitioner can make in-treatment clinical decisions to modify and improvise further treatment.

Tests of function

A. **Active and passive rotatoric (angular) movements:** Identify location, type (i.e., hypo- or hyper-mobility, and severity of dysfunction.
   - *Standard (anatomical, uniaxial) movements*
   - *Combined (functional, multiaxial) movements*

B. **Translatoric joint play movements:** Further differentiate articular from nonarticular lesions; identify directions of joint restrictions.
   - *Traction*
   - *Compression*
   - *Gliding*

C. **Resisted movements:** Test neuromuscular integrity and status of associated joints and vascular supply.

D. **Passive soft tissue movements:** Differentiate joint from soft tissue dysfunction and the type of soft tissue involvement.
   - *Physiological movements (muscle length...)*
   - *Accessory movements (muscle play...)*

E. **Additional tests**

Principles of function testing

Be specific when asking the patient about symptoms during examination. Ask the patient to describe the character and distribution of their symptoms or if already existing symptoms change with each test procedure. Especially note if a particular movement provokes the primary complaint for which the patient seeks treatment.

Assessing quantity of movement

With larger passive movements (e.g., with general spinal movements), test range of movement slowly through an entire range to the first significant stop. With smaller passive movements in joints with little range of movement such as the spinal segments, test range of movement first with more rapid oscillatory movements that do not require stabilization of neighboring joints. If these oscillatory tests reveal restrictions or symptomatic areas, follow up with more careful evaluation of the movement range using slower movements and stabilization of the adjacent joints.

Measuring rotatoric movement with a device

The amount of active or passive joint movement can be measured with an instrument such as a goniometer, ruler, or other device (e.g., distance of fingertips to floor as a measurement of standard rotatoric spine and hip movement). Standard bone movements are measured from the zero position and take place around defined axes. The results of this test may reveal *hypomobility,* defined as movement less than established norms, or *hypermobility*, defined as movement greater than established norms. Note also that a joint can be hypomobile in one direction and hypermobile in another. Goniometric measurements may also reveal significant muscle shortening.

Hypomobility or hypermobility are only pathological findings if they are associated with symptoms (for example, positive symptom provocation or alleviation tests) and if the associated end-feel is pathological. Hypomobility or hypermobility with a normal end-feel is usually due to a congenital structural anomaly or a normal anatomic variation and is unlikely to be symptomatic or to benefit from mobilization treatment.

Hypomobility or hypermobility are only pathological findings if they are associated with symptoms and a pathological end-feel.

Manual grading of rotatoric movement (0-to-6 scale)[1]

In joints with little range of motion such as the carpal joints or single spinal segments, it may be impossible or impractical to measure range of motion with a goniometer. Range of motion may then be classified manually using the following scale:

Hypomobility	0 = No movement (ankylosis)
	1 = Considerable decreased movement
	2 = Slight decreased movement
Normal	3 = Normal
Hypermobility	4 = Slight increased movement
	5 = Considerable increased movement
	6 = Complete instability

A joint can be both hypomobile in one direction and hypermobile in another.

Assessing quality of movement

The ability to *see* and *feel* movement quality is of special significance, as slight alterations from normal may often be the only clue to a correct diagnosis.

Assess movements with minimal forces so as not to obscure slight deviations from normal. Repeat each passive movement at different speeds to reveal various types of restrictions. For example, slower passive movements are more likely to reveal joint restrictions, while more rapid movements can trigger abnormal muscle reactivity.

Passive movement quality is best assessed throughout an entire range of movement to the first significant stop. Important findings are easily overlooked if passive movement is tested only at the limit of active movement with passive overpressure, since the first significant finding in a passive movement may be detected before the first stop.

1 The 0-to-6 scale for manual grading of rotatoric movement was originally based on Stoddard's 1-to-4 scale and was later revised and expanded by Paris. Paris's expanded concept was first presented at the 1977 IFOMT meeting (Vail, CO) as part of the Kaltenborn-Evjenth sessions.

Quality of movement to the first stop

Test movement quality by first observing the active movement, then feel the same movement passively until you meet the first significant resistance. Apply minimal force and perform the movement slowly several times throughout the entire range of motion.

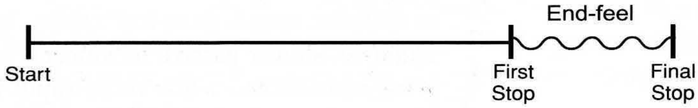
Note quality of movement from the very beginning of the range of movement up to the first stop. Passive movements should be free, smooth, and independent of the speed with which they are carried out. Deviations from normal can often be detected as soon as you contact the patient or very early in the range of movement. Be alert to slight abnormalities from the very instant you contact the patient.

End-feel: Quality of movement after the first stop

End-feel is the sensation imparted to the practitioner at the limit of the available range of movement. End-feel is tested with a slight additional stretch after the first significant stop of a passive movement (quality test). Note that end-feel must be evaluated as part of a *passive* movement test – not simply with overpressure applied after an *active* movement (quantity test).

End-feel can be evaluated during standard and combined passive rotatoric movements (overpressure end-feel) or during translatoric joint play movements (joint play end-feel). It is important for a manual therapist to be able to differentiate normal (physiological) from pathological end-feels.

Figure 3.1
End-feel



Evaluate end-feel slowly and carefully after a passive movement from the zero position (or actual resting position) through the entire range of movement past the first stop (a slight additional stretch) to the final stop. Subtle end-feel findings are easily overlooked if you test end-feel too quickly, or if you test an insufficient range of movement.

Normal physiological end-feel

Each joint movement has a characteristic end-feel, depending on the anatomy of the joint and the direction of movement tested. End-feel also varies with each individual, depending on age, body type and build. After the first significant resistance to passive movement is met (first stop), carefully apply a small additional stretch to determine whether the end-feel is soft, firm, or hard.

» **Soft:** A soft end-feel is characteristic of soft tissue approximation (e.g., knee flexion). There are no normal soft end-feels in the spine.

» **Firm:** A firm end-feel is characteristic of capsular or ligamentous stretching (e.g., medial or lateral rotation of the humerus and femur, general spinal flexion, spinal coupled movements). A normal capsular end-feel is less firm (firm "-") and a normal ligamentous end-feel is more firm (firm "+").

» **Hard**: A hard end-feel occurs when bone or cartilage meet (e.g., elbow extension and flexion, most spinal noncoupled movements).

All three types of normal joint end-feels have an *elastic* quality to varying degrees. When overpressure is released, the joint rebounds back to the first stop or further into the slack (Grade II range). Normal end-feels are pain free.

Remember: Normal end-feels are pain free.

Pathological end-feel

A pathological end-feel is of another quality than is characteristic for the joint being tested. For example, scar tissue imparts a firmer, less elastic end-feel. (A pathological end-feel is judged to be less elastic if the movement does not rebound back to its first stop when testing pressure is released.); muscle spasm produces a more elastic and less soft end-feel; shortened connective tissue (i.e., fascia, capsules, ligaments) gives a firmer, less elastic end-feel; intra-articular swelling produces a soft resistance just before or instead of the movement's usual end-feel. With ligamentous laxity, you will find a final stop later in the movement range and with a softer end-feel than normal.

The presence of abnormal movement quantity (i.e., hypo- or hyper-mobility) with a normal end-feel is not necessarily an indication of pathology. Pathological movement presents both with symptoms *and* an abnormal end-feel.

The patient may guard against end-feel testing or ask that the movement be discontinued before you reach their "true" end-feel. This is called an **empty end-feel**. The empty end-feel is a response to severe pain or muscle spasm secondary to conditions such as fractures or acute inflammatory processes, or can be psychogenic in origin.

It is possible for the same joint to present with a normal end-feel in one movement direction and a pathological end-feel in another direction. Indications and contraindications for treatment based on end-feel findings only apply to the impaired movement direction. For example, a hard, inelastic end-feel only contraindicates Grade III stretch mobilization in the direction that is restricted.

Pathological end-feel findings can be subtle and may be apparent only to the most skilled practitioner. A symptomatic joint may appear to have normal range of movement to the novice, while the experienced practitioner will discover an abnormal end-feel. A novice practitioner usually needs an immediate and careful comparison with a normal joint to recognize the pathological character of an end-feel. By the same token, a novice practitioner may inappropriately judge that a joint with less than expected range of movement requires treatment, while the skilled practitioner would assess a normal end-feel with no associated muscle reactivity, and would judge the joint as normal.

■ Elements of function testing

■ Active and passive rotatoric movements

Active movements require patient cooperation, upper and lower motor neuron integrity, and normal muscle and joint function. Active movements quickly provide a general indication of the location and type of dysfunction as well as its severity. Since active movements stress both joints and soft tissue, any positive findings can only be interpreted in light of additional tests of function, particularly passive movement testing.

Passive movement. The ability to see and feel passive movement is of special significance in OMT because slight alterations from normal are often the only clue to a diagnosis. Another objective of passive movement testing is to assess whether a range of movement is hypomobile or hypermobile.

There are two general categories of active and passive rotatoric joint movements which are used for different purposes in an OMT evaluation:

» **Standard (anatomical) movements,** e.g., flexion, extension, sidebending, and rotation, occur in the cardinal planes and around defined axes. They are used for measurement and to reveal asymmetries and disturbances in movement quality (for example, a painful arc). Since these movements are standard and generally recognized, they facilitate communication between therapists and physicians.

» **Combined (functional) movements,** e.g., coupled and non-coupled spinal movements, occur around multiple axes and in multiple planes and allow you to specifically stress various tissues and structures. These movements are useful in understanding and analyzing the exact mechanism of injury and reproducing the patient's chief complaint. It is not unusual to perform combined movements in order to reveal subtle lesions that could be overlooked with standard movement testing alone.

Changes in the quantity and quality of rotatoric movement can be due to lesions within the joint or the surrounding soft tissue and may manifest themselves in the form of a painful arc, capsular pattern, or muscle shortening. Specific rotatoric bone movement is also used to test neural tension and mobility. For example, see *Mobility of neural tissue*, page 75.

Painful arc

Pain occurring anywhere in the range of active and/or passive movement which is preceded and followed by no pain is called a painful arc, according to Cyriax. A painful arc implies that a pain-sensitive tissue is being squeezed between hard structures. Deviations from the normal path of movement may be an attempt by the patient to avoid such pain. It is important to note such deviations in order to not overlook a painful arc.

Capsular pattern

If the entire capsule is shortened, we find what Cyriax calls a capsular pattern. The capsular pattern manifests itself as a characteristic pattern of decreased movements at a joint. When expressing the capsular pattern, a series of three or four movements are listed in sequence: the first movement listed is proportionally most decreased, the second movement listed is next decreased, and so on.

A capsular pattern is usually present when the entire capsule is affected (e.g., inflammatory arthritic conditions). However, limitation of movement due to capsular shortening does not necessarily follow a typical pattern. For example, only one part of a capsule may be shortened due to trauma, surgery, inactivity, or some other localized lesion of the capsule. In these cases, limitation of movement will be evident only with movements that stretch the affected part of the capsule.

Testing rotatoric movements

Active spinal joint movements are repeated several times while you observe from the back, the front, and the sides. The spinal region to be examined should be at your eye level.

Observe whether a movement is smooth and if there is angularity or asymmetry, or change in the patient's symptoms or abnormal sensations, such as a painful arc. Spinal range of movement should change gradually from one segment to the next. Any abrupt and significant increase or decrease of movement in adjacent segments signals a dysfunction or anomaly.

With flexion and extension, the normal spinal curvatures in the sagittal plane should decrease and increase smoothly and in an appropriate amount. With sidebending a smooth arch should form. With spinal hypermobility a sharp bend is visible, whereas with spinal hypomobility a straight or flattened region is observed (often above or below a hypermobility).

Active movement testing can be performed more specifically to help localize a lesion within a spinal region. For example, with painful active flexion of the cervical spine, the movement may be repeated with the upper cervical spine in extension. If this movement neither produces nor increases pain, the source of pain is probably in the upper cervical region.

When possible, continue the movement achieved actively with gentle passive overpressure, moving the joint to the last stop while the patient relaxes (quantity test). Note that this is not an adequate evaluation of end-feel (quality test), but a way to determine whether a joint lesion is limiting the active movement. Range of movement with passive overpressure is normally greater than the corresponding active movement. If passive overpressure produces little or no increase in the active movement range, the movement is probably limited by a joint structure.

Passive range of movement with overpressure is normally greater than the corresponding active movement.

Passive rotations of the spine are performed both as general movements and as specific movements. With general movements the examiner can localize the symptom provoking direction and area of dysfunction to within three or four segments of the lesion. More specific localization of the lesion requires segmental testing (including joint play and provocation/alleviation tests) which can guide the examiner to the precise segment involved.

There are continuing debates about the reliability of specific passive movement testing in the spine, but some studies indicate that physical (biomechanical) diagnoses based on the manual assessment of hypomobility demonstrate an acceptable uniformity of findings among skilled evaluators. (See *Appendix: Reliability of segmental mobility testing*.)

Localization tests

Localization tests can pinpoint the location of a lesion, indicate the symptomatic movement direction, and sometimes also measure the degree of restriction. Localization tests are especially useful in instances where joints have normal range of movement but are nevertheless symptomatic.

Localization tests use specific passive and active movements to provoke or alleviate the patient's symptoms. **Symptom provocation tests** include joint compression and movement in a symptom-provoking direction. **Alleviation tests** include joint traction and movement in a symptom-alleviating direction.

The more specifically a passive test movement is performed, the more specifically a lesion can be localized. For example, the "springing test" (movement of a vertebra in a ventral direction) pinpoints a lesion to within the two spinal segments above and below the vertebra moved. Moving a vertebral spinous process laterally with fixation of the neighboring caudal vertebra produces an even more specific movement. In this case, there is also movement in the neighboring cranial vertebra. However, since it will rotate relatively in the opposite direction, it is easy to determine whether this movement contributes to symptom provocation or alleviation.

Symptoms are much easier to provoke or to alleviate with the affected joint as close as possible to the verge of symptom onset or increase. For example, a patient reports lumbar pain with extension. Using the provocation test, the patient performs lumbar extension in prone by pushing with the arms, or you lift the headpiece of the table until pain appears or increases. Then slowly ease away from this position just until the patient's pain begins to disappear or lessen. Your movement may be so slight as to be almost imperceptible. With the patient in this position, at the verge of pain, carefully move successive single vertebrae in a ventral-cranial direction to reproduce or aggravate the pain in the affected segment. With a lesion in the L3-4 segment, for example, movement of L4 in the ventral-cranial direction provokes the pain, since this movement produces flexion in the L4-5 segment and relative extension in the L3-4 segment. The same movement of L3, however, produces flexion in the L3-4 segment which is not painful. The alleviation test uses the same principle. Pain can be eliminated or eased with the patient in a pain-provoking position. In this example (pain in extension), ventral-cranial movement of L3 produces flexion in the L3-4 segment and in the segments caudal, and thereby reduces the degree of pain-provoking extension.

In another example, the patient reports pain with right rotation, while left rotation is pain free. Using the provocation test, the patient rotates to the right to the verge of pain. Then, you rotate each vertebra further to the right and when you move the affected segment, pain is provoked. It is best to perform this test starting from a caudal segment and progressing cranially, since with right rotation a relative left rotation occurs at the neighboring cranial segment and all caudal segments will rotate to the right.

Using the alleviation test, the patient is positioned just beyond the point of the pain-provoking right rotation. You induce a specific left rotation force, starting from a caudal segment and progressing cranially. The neighboring cranial segment moves relatively to the right, which keeps it in a pain-provoking position until tested. Once the test moves the cranial vertebra within the symptomatic segment (in this case, L3) to the left, the degree of pain-provoking right rotation is reduced and the pain eliminated or eased.

Differentiating articular and extra-articular dysfunction

We adapt the Cyriax model as a theoretical basis for distinguishing contractile (muscle) lesions from noncontractile (e.g., joint) lesions by comparing responses to various tests of active and passive movement. Cyriax divides musculoskeletal structures into contractile and noncontractile elements for diagnostic purposes. The contractile elements consist of the muscle with its tendons and attachments. Noncontractile elements include all other structures such as bones, joint capsules, ligaments, bursae, fasciae, dura mater, and nerves.

Noncontractile Dysfunction

» Active and passive movements produce or increase symptoms and are abnormal in the same direction and at the same point in the range.

Example: Active and passive right rotation of the cervical spine is painful and/or restricted at the same degree of range.

» Passive joint play movements produce or increase symptoms and are abnormal.

» Resisted movements are symptom free.

Contractile Dysfunction

» Active and passive movements produce or increase symptoms and are abnormal in opposite directions.

Example: Active right rotation of the cervical spine is painful and restricted as the affected muscle contracts; passive right rotation is pain free and shows a greater range of movement; passive left rotation is painful as the affected muscle is stretched.

» Passive joint play movements are normal and symptom free.

» Resisted movements produce or increase symptoms.

Cyriax's differentiation process produces clear findings in many musculoskeletal lesions of the extremities, but interpretation of findings can be less clear in the spine, for a number of reasons: 1) Some subtle contractile tissue lesions remain painless during active spinal movements; 2) Resisted tests in the spine may be unreliable because spinal muscle contraction can produce symptomatic joint compression in underlying dysfunctional joints. Therefore, joint dysfunction must be confirmed with joint testing first. For example, traction-alleviation and compression-provocation tests may reveal joint dysfunction; 3) Active movement in the spine cannot be localized to a single mobile segment.

If you determine that a joint structure is involved, focus the OMT evaluation on more specifically identifying the nature and location of the joint dysfunction so that you can select a more specific, and thus more effective, treatment approach.

Differentiating muscle shortening from muscle spasm

A skilled practitioner can usually tell the difference between muscle connective tissue shortening and muscle spasm based on end-feel testing. A shortened, tight muscle imparts a firmer, less elastic end-feel, while muscle spasm produces a more elastic and less soft end-feel, sometimes accompanied by increased muscle reactivity.

Novice practitioners may make the same differentiation based on the patient's response to a specific muscle relaxation maneuver. For example, in the case where a patient's hamstrings limit a straight-leg-raise movement, the practitioner positions the limb at the limit of available motion, and then performs a "hold-relax" muscle relaxation maneuver on the hamstrings. In the relaxation period immediately following the muscle contraction, a muscle in spasm will relax sufficiently to allow some elongation of the muscle and the straight-leg-raise range will increase. A shortened muscle will not allow increased movement into the range without additional sustained stretching. (Be sure to rule out sciatic nerve involvement before attempting this differentiation test.)

■ Translatoric joint play tests

Evaluate joint play using traction, compression, and gliding in all of the translatoric directions in which a joint is capable of moving. Attempt to direct joint play movement forces primarily toward a particular joint within the mobile segment, keeping in mind that even such specific joint play movements will affect the entire mobile segment.

Joint play range of movement is greatest in the resting position of the joint and therefore easiest to feel in this position. The practitioner with advanced skill also evaluates joint play outside the resting position, where a naturally smaller range of movement can make the movement more challenging to palpate.

There are two ways to test joint play:

1) *Without fixation:* Apply vibrations, oscillations, or small amplitude joint play movements while you palpate the joint space. Apply no fixation or stabilization. This method of joint play testing is especially useful for spinal joint testing and is usually used for screening prior to attempting a fixation technique.

2) *With fixation:* Fixate one joint partner and move the other through the fullest possible range of joint play movement. Feel for changes in the resistance to the movement through Grade II, past the first stop, and into Grade III for end-feel. Determine whether there is normal movement quality through the range and if there is hypo- or hypermobility.

Traction and compression tests

Traction and compression tests in the spine are usually performed as general translatoric (linear) movements that affect several segments or an entire spinal region. Segmental traction and compression tests are technically very difficult to perform and are used only by the most skilled manual therapists.

If the patient has symptoms with **spinal traction tests** in the normal resting position, use three-dimensional positioning to find a position of greater comfort (i.e., the actual resting position) and reevaluate the patient's response to traction. (See page 90, *If traction exacerbates symptoms,* for an additional discussion on the sources of symptoms provoked by traction.) Keep in mind that the small, monosegmental spinal muscles may also be affected by the traction test if they are very shortened or tight.

If a general **spinal compression test** produces the patient's complaints, you may need to limit further evaluative techniques that cause joint compression, for example, resistive tests or other techniques that produce secondary joint compression forces.

If compression tests in the resting position are negative, and if no other tests of function provoke or increase the patient's complaint, compression tests should also be performed in various three-dimensional positions. In some subtle joint dysfunctions, this may be the only way to locate a patient's lesion.

Since traction often relieves and compression often aggravates joint pain, these joint play movements help determine if an articular lesion exists. Resisted movements produce some joint compression, so it is important to test joint compression separately and before resisted tests.

It is important to test joint compression separately and before resisted tests, since resisted movements also produce joint compression.

Gliding tests

Gliding primarily tests those structures belonging to the anatomical joint. Gliding movements are also important for determining the specific direction of joint movement restrictions. The skilled manual therapist evaluates gliding movement both in the joint's resting position and in various positions outside the resting position.

Segmental joint play is primarily evaluated with translatoric gliding, comparing one mobile segment with neighboring segments. There should be no significant mobility differences in adjacent segments.

Segmental joint play gliding is usually first assessed by palpating between two vertebrae during a rapid oscillatory movement parallel to the treatment plane in the intervertebral disc joint. If this oscillatory test reveals restriction or symptoms, it is followed with a slower and more thorough assessment of joint play gliding range and end-feel in all directions using manual techniques to stabilize adjacent segments.

■ Resisted movements

Resisted tests simultaneously evaluate neuromuscular integrity, the contractile elements, and, indirectly, the status of associated joints and vascular supplies. While it is useful to evaluate the status of the spinal muscles themselves, it can be more difficult to interpret resisted tests of the spinal muscles than of the extremity muscles for two reasons. First, overlapping nerve supplies in the spinal muscles do not allow isolation of single muscles for strength testing or symptom localization, and second, spinal muscle contractions produce compression in underlying joints which may be symptomatic. To rule out underlying joints as a source of symptoms, it is important to assess the status of these joints.

There are three general methods of performing resisted tests: manual muscle testing (standard positions and methods); machines (for example, tensiometers and various isokinetic testing devices); and specific functional maneuvers (for example, proprioceptive neuromuscular facilitation techniques).

When testing spinal muscle performance with manual resistance, the potentially strong muscle contractions are best controlled if the therapist induces the force. The patient attempts to "hold" (in response to your instruction, "Don't let me move you," rather than "Push" or "Pull") while you try to move the spinal region in the desired direction.

According to Cyriax, a resisted test must elicit a maximal muscle contraction while the joint is held still near its mid-position (resting position). Not allowing movement during a resisted test will help eliminate the joint as the source of pain; however, a certain amount of joint compression and gliding is inevitable. To exclude pain arising as a result of joint dysfunction, compression tests should be performed *before* the resisted test. Therefore, if compression tests provoke pain, resisted tests are of limited value. Cyriax interprets resisted tests in the following ways:

Painful and strong	=	minor lesion of a muscle or tendon
Painful and weak	=	major lesion of a muscle or tendon
Painless and weak	=	neurological lesion or complete rupture of a muscle or tendon
Painless and strong	=	normal

■ Passive soft tissue movements

Soft tissues are examined similarly to joints, using passive movements to assess the quantity and quality of movement and pain. There are two major types of passive soft tissue movements: physiological and accessory movements.

Physiological movements (muscle length and end-feel)

Tests of soft tissue length and end-feel are performed by moving a limb or bone so that muscle attachments are moved maximally apart (lengthened). It is often necessary to use combined movements to achieve maximal tissue lengthening. Examining soft tissue end-feel during lengthening is particularly important to help differentiate joint from soft tissue dysfunction and to determine the type of soft tissue dysfunction. For example, muscle spasm will have a less firm end-feel than a muscle contracture.

It is not unusual for joint structures to limit movement before a position of muscle stretch can be attained, especially in the presence of chronic joint disorders with associated degenerative changes. Muscle length testing requires that you be knowledgeable about muscle functions, muscle attachments, and muscle relationships to each joint they cross. (These techniques are thoroughly described in the textbooks *Muscle Stretching in Manual Therapy, Vol. I and Vol. II* and *Autostretching* by Olaf Evjenth and Jern Hamberg.)

Accessory soft tissue movement

Examination of accessory soft tissue movement tests the elasticity, mobility, and texture of soft tissues. Accessory soft tissue movement cannot be performed actively, but is tested by passively manipulating soft tissues in all directions. Skillful technique can help pinpoint localized changes in soft tissue texture due to, for example, scar tissue, edema, adhesions, and muscle spasm.

Muscle play is an accessory soft tissue movement. Muscle play testing involves manually moving muscles in transverse, oblique, and parallel directions in relation to the muscle fibers. A passive lateral movement of muscle is one example of muscle play.

■ Additional tests

Additional examination procedures may be necessary, including assessment of coordination, speed, endurance, functional work capacity, and work site ergonomic evaluations. These exams do not always have to be complicated, expensive, or require special equipment in order to give valid, useful and important information.

4 OMT evaluation

The OMT evaluation is a clinical reasoning process that generally begins with a broad preliminary impression or hypothesis (e.g., 'appears to be a back or hip problem'), which then leads to a series of tests and critical analyses designed to support or negate the initial hypothesis. The hypothesis generation and testing continues until sufficient information is obtained to make a diagnostic decision.

The clinical reasoning process continues throughout the treatment regimen through reassessment, to provide support for the chosen treatment intervention, or perhaps to signal the need for further data collection and problem clarification (additional examination or referral for other specialist consultation).

The course of the OMT evaluation is influenced by a mixture of factors, including the patient – his or her needs, expectations, values and beliefs; professional and institutional canon; resource constraints and funding; the purpose of the patient visit; and the setting in which the manual therapist practices.

■ Goals of the OMT evaluation

The OMT evaluation is directed toward three goals:

1) **Physical diagnosis**
   To establish a physical, or biomechanical, diagnosis.
2) **Indications and contraindications**
   To identify indications and contraindications to treatment.
3) **Measuring progress**
   To establish a baseline for measuring progress.

■ Physical diagnosis

The physical diagnosis is based on a model of somatic dysfunction that assumes a highly interdependent relationship between musculoskeletal symptoms and signs.[1] In the presence of somatic dysfunction, there is a correlation between the patient's musculoskeletal signs and the production, increase, or alleviation of symptoms during a relevant examination procedure. The skilled manual therapist can hear (via the patient history) and see and feel (via the physical exam) a patient's physical diagnosis.

Musculoskeletal conditions that respond well to treatment by manual therapy typically present with a clear relationship between signs and symptoms. An OMT evaluation that shows *no correlation between signs and symptoms* usually indicates that the patient's problem originates from outside of the musculoskeletal system and that mechanical forms of treatment such as manual therapy are less likely to help.

Common characteristics of somatic dysfunction

Symptoms (history)

- pain, weakness, stiffness, numbness, headache, dizziness, nausea, etc.

Signs (physical examination findings)

A. Soft tissue changes
   - altered tissue tension, elasticity, shape, texture, color, temperature, etc.

B. Functional changes
   - impaired strength, endurance, coordination
   - impaired mobility:
     - joints (e.g., hypomobility or hypermobility)
     - soft tissues (e.g., contractures)
     - neural and vascular elements (e.g., entrapment syndromes, neural tension signs)

A manual therapist skilled in segmental mobility testing can often palpate a somatic dysfunction before it can be medically diagnosed. For example, symptoms of nontraumatic origin

1 The concept of somatic dysfunction was originally used by osteopaths to better describe and reflect the many somatic interrelated aspects of a musculoskeletal disorder.

(usually pain) associated with arthroses, discopathies, or segmental pain syndromes with radiating pain are often associated with a palpable alteration in movement quality (e.g., an abnormal end-feel). In the early stages of pathology, this subtle alteration in movement quality may be palpable long before there is restriction in range of movement and before the pathology is apparent on diagnostic imaging studies.

The role of the manual therapist in making a **physical diagnosis** varies in different practice settings. Most often a referring physician establishes a **medical diagnosis** that implicates the musculoskeletal system and rules out serious pathology that might mimic a musculoskeletal disorder. In this case, the manual therapist typically omits the organ system review and family history from the OMT evaluation. Emphasis is on the more detailed biomechanical and functional assessment necessary to identify the structures involved (refinement of the medical diagnosis) and the functional status of their involvement (the physical diagnosis).

The manual therapist confirms the initial physical diagnosis of somatic dysfunction with a low-risk **trial treatment** as an additional evaluation procedure. For example, traction is the most common trial treatment for a joint hypomobility. If the trial treatment does not alleviate symptoms or if symptoms are worsened, further evaluation is necessary and a different trial treatment is tested.

The physical diagnosis is further refined through ongoing assessments of each subsequent treatment. The results of these reassessments are an ongoing part of the evaluation process.

■ Indications and contraindications

No treatment performed on a living subject is guaranteed to be free of risk or complications. Conscientious patient evaluation and appropriate selection of techniques minimize the potential risks of manual treatment.

Indications

Indications for treatment by manual therapy are based more on the physical diagnosis than on the medical diagnosis.

Restricted joint play (hypomobility) and an abnormal end-feel are the two most important criteria for deciding if mobilization is indicated. Grade III stretch mobilization is indicated when a movement restriction (hypomobility) has an abnormal end-feel and appears related to the patient's symptoms. Hypomobility presenting with a normal end-feel and no symptoms is not considered pathological, and is not treated. In such cases, the movement restriction is either due to a congenital anatomical variation, or the symptoms in that area are referred from another structure.

In patients who cannot yet tolerate examination or specific treatment with a biomechanically significant force, within-the-slack (Grades I-IISZ) mobilizations and other palliative modalities provide short-term symptom relief. These symptom control treatments are primarily used as a temporary measure to prepare a patient to tolerate further specific examination or more intensive treatments (for example, a Grade III stretch movement) that will produce a more lasting effect.

In patients with hypomobility due to muscle spasm in the absence of tissue shortening, relaxation mobilizations in the Grade I - II range are generally effective.

In the presence of excessive joint play (hypermobility), stabilizing (limiting) measures are indicated and Grade III stretch mobilization is contraindicated.

Contraindications

Contraindications to joint mobilization are relative and depend on many factors, including the vigor of the technique, the medical and physical diagnoses, the stage of pathology, the relationship between specific musculoskeletal findings such as joint play range of movement and joint play end-feel, and the patient's symptoms. In other circumstances good professional judgment limits the use of any manual contact technique, for example, in the case of patient resistance to treatment or unwillingness to cooperate.

Grade I and II "within-the-slack" mobilizations are seldom contraindicated, but many contraindications exist for Grade III stretch mobilizations. There are additional specific contraindications for Grade III manipulative (high velocity thrust) techniques which are performed so quickly that the patient is unable to abort the procedure. Thrust procedures require a high level of skill and knowledge to apply safely and are not covered in this basic book.

General contraindications to Grade III stretch mobilization relate primarily to health problems that reduce the body's tolerance to mechanical forces and therefore increase the risk of injury from stretch mobilization treatment. For example:

- pathological changes in the spine due to neoplasm, inflammation, infections (e.g., spondylitis, discitis), or osteopenia (e.g., osteoporosis, osteomalacia)
- active collagen vascular disorders
- massive degenerative changes in the spine (e.g., spondylosis, osteoarthrosis, uncovertebral arthrosis)
- loss of skeletal or ligamentous stability in the spine (e.g., secondary to inflammation or infection or after trauma)
- certain congenital anomalies of the spine (e.g., dysplasia, aplasia, hyperplasia, neoplasia)
- anomalies or pathological changes in vessels
- coagulation problems (e.g., anticoagulation factors, hemophilia)
- dermatological problems aggravated by skin contact and open or healing skin lesions

Grade III stretch mobilization is contraindicated for joints with active inflammation. However, the presence of a progressive inflammatory disease, such as rheumatic disease (e.g., ankylosing spondylitis) is not an absolute contraindication for Grade III stretch mobilization. During a quiescent stage of illness when the joint involved is not inflamed, it can often be safely stretched beyond its slack.

Mobilization may also be contraindicated in certain autonomic nervous system disorders because mobilization can affect autonomic responses. For example, in patients with autonomic disturbances associated with diabetes mellitus there have been reported cases of thoracic mobilization triggering hyperventilation, low sugar levels, or loss of consciousness.

Specific contraindications to Grade III stretch mobilization techniques include:

- decreased joint play with a hard, nonelastic end-feel in a hypomobile movement direction
- increased joint play with a very soft, elastic end-feel in a hypermobile movement direction
- pain and protective muscle spasm during mobilization
- positive screening tests, for example, pain induced by compression tests

Screening tests identify conditions that contraindicate specific mobilization techniques and should be conducted before the therapist treats any particular spinal region. For example, rotatory techniques are contraindicated for the cervical spine in the presence of positive vertebral artery screening tests and are contraindicated in the lumbar spine with certain stages of disc pathology. Such screening tests must be performed or monitored before each treatment session because for some conditions the physical diagnosis and stage of pathology can fluctuate. These tests are essential to ensure safety even when practicing on asymptomatic fellow students in a classroom setting.

■ Measuring progress

Changes in a patient's condition are assessed by monitoring changes in one or more dominant symptoms and comparing these changes with routine screening tests and the patient's dominant signs. Symptoms in the spine may include pain, changes in sensation, a feeling of greater strength or ease of motion, or reduced fatigue. Physical signs of spinal origin may include altered joint play, range of movement, reflexes, or changes in muscle performance.

A relevant sign is one that is reproducible and related to the patient's chief complaints. That is, the sign improves as the patient's symptoms improve, and the sign worsens as the patient's symptoms worsen. For example, when a patient reports increased numbness and tingling in the foot, the straight-leg raise test shows more limited movement.

Periodic reassessment of the patient's chief complaints and dominant physical signs during a treatment session guides treatment progression. If reassessment reveals normalization of function (e.g., mobility) along with decreased symptoms, then treatment may continue as before or progress in intensity. When reassessment during a treatment session indicates that function is not normalizing or that symptoms are not decreasing, be alert to the need for further evaluation to determine a more appropriate technique, positioning, direction of force, or treatment intensity.

■ Elements of the OMT evaluation

OMT evaluation

A. Screening exam: An abbreviated exam to quickly identify the region where a problem is located and focus the detailed examination.

B. Detailed exam:

1. ***History***: Narrow diagnostic possibilities; develop early hypotheses to be confirmed by further exam; determine whether or not symptoms are musculoskeletal and treatable with OMT.
   - *Present episode*
   - *Past medical history*
   - *Related personal history*
   - *Family history*
   - *Review of systems*
2. ***Inspection***: Further focus the exam.
   - *Posture*
   - *Shape*
   - *Skin*
   - *Assistive devices*
   - *ADL*
3. ***Tests of function***: Differentiate articular from extraarticular problems; identify structures involved (see Chapter 3).
4. ***Palpation***
   - *Tissue characteristics*
   - *Structures*
5. ***Neurologic and vascular examination***

C. Medical diagnostic studies: *Diagnostic imaging, lab tests, electro-diagnostic tests, punctures*

D. Diagnosis and trial treatment

Through the physical examination the therapist *correlates* the patient's signs with their symptoms. A *relationship* between musculoskeletal signs and symptoms suggests a mechanical component to a problem that should respond well to treatment by manual therapy. The constellation of signs and symptoms revealed during the physical examination indicates the nature and stage of pathology and forms the basis of a treatment plan. For instance, before treating a patient who is unable to flex the lumbar spine, you must first determine if the limitation is due to pain (e.g., lumbar radiculopathy), hypomobility (e.g., soft tissue contracture, intraarticular swelling, a disc herniation, nerve root adhesion), weakness (e.g., peripheral neuropathy, primary muscle disease), or a combination of those disorders.

The OMT practitioner must make three major differential diagnostic decisions when evaluating spinal somatic dysfunction:

» Determine whether the somatic dysfunction is primarily in the segment (e.g., the "anatomical joint") or associated soft tissues, including neural structures (e.g., the "physiological joint").

» Determine if joint hypo- or hyper-mobility is present, and whether it is pathological (i.e., associated with an abnormal end-feel.

» Determine whether treatment should be directed toward pain control or biomechanical dysfunction.

■ Screening exam

The screening examination is an abbreviated exam intended to quickly identify the region of the body where a problem is located. It serves to define or focus additional examination and in some cases leads to a diagnosis and immediate treatment. The screening exam leads to one of the following three things:

» **A diagnosis** may be made if the physical signs are obvious, correlate well with the history and confirm your initial impressions;

» **Further detailed examination** may follow if insufficient data is collected and a diagnosis cannot be made;

» **Contraindications** to further examination or treatment may be uncovered and lead you to refer the patient to an appropriate specialist.

For experienced practitioners, there is no set sequence in which you perform screening examination procedures. The circumstances surrounding each particular problem determine how much and in which order you proceed.

Be careful not to over-examine, aggravate the patient's condition, or cause unnecessary pain during the screening examination. On the other hand, make sure you are thorough enough to gather all important information.

You must plan the examination from the very moment you meet the patient. And you must be prepared to modify your screening plan spontaneously based on emerging information during the process.

In practice, the screening exam is usually brief and results in either a provisional diagnosis or further, more detailed examination. It should give you a good idea of the type of problem and where it exists. If the diagnosis is still unclear or you wish to confirm your impressions, examine the patient further in the detailed examination (described later in this chapter).

Screening examination skills require mastery of the detailed examination in addition to much thought and clinical experience. Novice practitioners rarely conduct an efficient screening examination. We therefore recommend that novice practitioners first follow and master the detailed examination before relying heavily on screening examination findings.

Novice practitioners should first master the detailed examination before relying heavily on screening examination findings.

Components of the screening examination

Begin the screening exam by interviewing the patient for a brief **history** of the problem. You need enough information to determine where in the body to begin examination and which examination procedures will be most useful. A skillful examiner quickly gets the patient to describe their problem and the immediate circumstances preceding the onset. This brief history, if skillfully gathered and interpreted, can give you a description of the patient's symptoms and functional limitations, define the anatomical location of the problem, and identify any precautions.

Inspection begins from the very moment you meet the patient and start taking the history. Note static postures, respiration, and antalgic positions. The region to be examined should be visible so you can see swelling, discoloration, deformities, and skin changes. Observe the patient moving for valuable clues to the type and severity of their dysfunction. For example, watch how the patient gets up to move from the waiting room to the exam room and undress. These observations may lead you to ask further questions of the patient and guide you in planning further examinations.

The physical testing component of the screening examination varies, depending on the information obtained from the history. Use **active** and, if necessary, **passive movement** to further define the anatomical location and mechanical nature of the dysfunction. The emphasis in the screening exam is on the interpretation of active movements. Try to anticipate which movements will be painful. If you provoke symptoms early or often in the examination you may make the rest of the exam difficult or impossible to interpret, so it may be unwise to test painful movements first. However, a carefully administered provocation test, applied while under the patient's control, may rapidly focus in on the diagnosis.

Use selected **resisted movements** to quickly screen muscle strength and the status of contractile elements and nerve supply. Since active, passive, and resisted movements can provoke symptoms, they give clues as to the structures at fault and the origin of symptoms. Perform additional **symptom localization** screening tests if you need to more clearly identify mechanical aspects of the problem.

The goal of **superficial palpation** in the screening exam is to quickly identify obvious changes in the characteristics of soft tissues or underlying joints. Palpation may confirm information obtained in the history or observed during inspection or active movements. Unsuspected information may also be uncovered which may require additional examination. For example, you might suspect neurological dysfunction if the patient does not feel your touch or is hypersensitive to palpation.

Superficial palpation sometimes leads to more specific examination using **passive joint and soft tissue movement** tests. Accessory joint mobility, stability, and pain are assessed with joint play movements. Passive soft tissue movements help assess the quality and texture of muscles, tendons, ligaments, and other soft tissues.

A **neurological or vascular exam** may be performed at any time during the screening exam, especially if some potentially serious condition is suspected which contraindicates further examination or treatment. For example, the patient may describe symptoms that suggest central nervous system pathology. In that case you might begin the screening examination with a neurological examination before any other test.

■ Detailed exam

A good patient history will often narrow diagnostic possibilities, however, an appropriate physical examination is still necessary to confirm the diagnosis.

Components of the detailed examination

1. History
2. Inspection
3. Tests of function (see *Chapter 3*)
4. Palpation
5. Neurological and vascular examination

History

During the history, you begin forming early hypotheses which subsequently must be confirmed or eliminated by further examination. In this way the history guides you in planning an appropriate physical examination.

a. Present episode
b. Past medical history
c. Related personal history
d. Family history
e. Review of systems

After obtaining the history, you should have in mind a list of possible diagnoses. Sometimes the history is so clear that you are confident of the diagnosis and, therefore, the physical exam may be brief and directed to confirm your impressions. On the other hand, the history may be so vague or confusing that many possible diagnoses must be explored. In this case the detailed exam must be broader in order to explore more possibilities.

If the physical examination does not confirm your initial impressions, further and more detailed questioning of the patient is necessary.

Present Episode

Obtain a complete description of all the patient's complaints and the events leading up to the current episode. Define any mechanical characteristics of the patient's complaint and identify cause-related or symptom-aggravating factors.

It is important to determine if the complaint is mechanical in nature. Non-mechanical symptom behavior raises the suspicion of more ominous diagnoses and may lead to a broader exam or referral to an appropriate medical specialist.

If the patient reports symptoms only during certain times, for example, in the evenings, it may be necessary to schedule the physical examination during that symptomatic period.

Symptoms (chief complaint):

- » Location: anatomical site or area of symptoms
- » Time: behavior of symptoms over a twenty-four-hour period
- » Character: quality and nature of symptoms
- » Influences: aggravating and alleviating factors
- » Association: related or coincidental signs and symptoms
- » Irritability: how easily symptoms are provoked and alleviated
- » Severity: degree of impairment and pain

History and course of complaint (chronology): Trace the chronology of relevant events leading up to the present episode.

- » Date of onset
- » Manner of onset: sudden, traumatic, or gradual
- » Pattern of recurrence: previous manner of onset; related events; duration, frequency, and nature of episodes
- » Previous treatments and their effect

Past medical history

A complete medical history is especially important if you suspect the patient's problem is not musculoskeletal or mechanical in nature. Identify all major past health problems and recognize their possible relation to the patient's current complaints. Obtain the results of previous medical tests and treatments for further useful information. Remember that systemic and visceral diseases can mimic musculoskeletal disorders and their symptoms may even be temporarily alleviated with physical therapy procedures.

General health

» General health status

» Weight (recent weight loss or gain)

» Last physical examination (date and results)

» Medical tests (dates and results)

» Treatments, including medications (date, type, and effect)

» Major illnesses

» Hospitalizations, operations, injuries, accidents

Lifestyle

» Sleep, diet, drugs (including coffee, alcohol, tobacco), activity level

Related personal history

Details about the patient's personal background and everyday environment may give insight into possible aggravating or complicating factors. Listening to a patient's typical day's or week's activities, especially occupational and recreational, often provides clear evidence as to the cause of the person's problem. Social, psychological, and financial hardships should also be considered, as they can greatly influence the success of treatment.

» Occupation (past and present work; future job requirements)

» Recreational activities

» Psychosocial status, including financial hardship

» Home environment (marital status, children ...)

» Typical day's activities

» Environmental factors (exposure to environmental pollutants ...)

Family history

Identify any patterns of recurring health problems in the patient's family or any possible genetic or familial conditions. Some joint and connective tissue disorders have a genetic cause or familial link.

» Age and/or cause of parents' and grandparents' deaths

» Hereditary, genetic and chronic diseases (parents, grandparents, siblings, children)

Review of systems

Answers to questions about each organ system and anatomical region can uncover symptoms not previously identified. A complete review of organ systems is especially important to rule out pathologies that might mimic musculoskeletal disorders in patients who come to the physical therapist without a medical referral. It can be difficult to determine whether symptoms are of visceral or musculoskeletal origin. For example, nerve root irritation in the thoracic spine can mimic symptoms of angina pectoris and make diagnosis difficult. The following systems should be reviewed:

» Integument (skin)
» Bones, joints, muscles
» Hematopoietic system
» Immune system
» Endocrine system
» Cardiovascular system
» Respiratory system
» Gastrointestinal system
» Genitourinary system
» Nervous system
» Lymph nodes
» Head
» Eyes
» Ears
» Nose
» Throat
» Mouth
» Neck
» Breasts

Inspection

Initial observations of the patient provide information which helps you further focus the exam. For example, watch the patient get up or down from sitting or take their shoes off for clues as to the body region where a problem exists. Make a mental note as to various areas of potential dysfunction and subsequently clarify these impressions with detailed examination.

Observe the patient both in static postures (static inspection) and while moving (dynamic inspection). Perform the static inspection with the patient in standing, sitting, and/or lying positions. The dynamic inspection includes selected daily activity movements and continue during other tests of function.

» Posture: habitual, antalgic, or compensatory body positions

» Shape: general body type, changes in normal contours, deformities, swelling, atrophy

» Skin: color changes, scars, callouses, trophic and circulatory changes

» Activities of daily living: gait, dressing, undressing, getting in and out of a chair

» Assistive devices: use of cane, crutches, corsets, prostheses

Tests of function

(see *Chapter 3: Tests of function*)

Overview of function tests

A. **Active and passive rotatoric (angular) movements:** Identify location, type (i.e., hypo- or hyper-mobility), and severity of dysfunction.
   - *Standard (anatomical, uniaxial) movements*
   - *Combined (functional, multiaxial) movements*

B. **Translatoric joint play movements:** Further differentiate articular from nonarticular lesions; identify directions of joint restrictions.
   - *Traction*
   - Compression
   - *Gliding*

C. **Resisted movements:** Test neuromuscular integrity and status of associated joints and vascular supply.

D. **Passive soft tissue movements:** Differentiate joint from soft tissue dysfunction and the type of soft tissue involvement.
   - *Physiological movements (muscle length, neural mobility)*
   - *Accessory movements (muscle play)*

E. **Additional tests**

Palpation

Palpation progresses from superficial tissues to deep structures and reveals asymmetries and deviations. Compare palpation findings in weight-bearing postures (standing, sitting) with findings in non-weight-bearing postures (lying). Some subtle palpation findings may only be detectable during activity. Palpation *during* many tests of function, *especially* passive movement testing, is therefore an essential part of an OMT evaluation.

Tissue characteristics

- » Temperature
- » Pulses
- » Thickness
- » Symmetry
- » Crepitus
- » Moisture
- » Contour and shape
- » Texture
- » Tenderness
- » Mobility and elasticity

Structures

- » Nerves
- » Fat
- » Muscle
- » Tendon
- » Ligament
- » Joint capsule
- » Skin and subcutaneous tissue
- » Tendon sheaths and bursae
- » Fascia
- » Blood vessels
- » Bone, joint space

Palpation of the spine, pelvis, and ribs is difficult because the therapist must feel small articulations through deep layers of soft tissue, and asymmetries in the shape of bones and soft tissue are common. For this reason palpation findings indicating a positional fault are sometimes unreliable and should always be confirmed with specific mobility and localization tests.

Specific palpation of nerves follows the neural pathway, particularly at the most common sites of impingement, for example, the intervertebral foramina of the cervical spine.

Neurologic and vascular tests

Any suspicion of neurologic or vascular involvement should initially be considered a positive finding.

Neurologic tests

- » Deep tendon reflex testing
- » Muscle strength and fatigability testing, including repeated resisted tests, especially of key muscles
- » Sensory testing (light touch, pinprick, vibration, and position sense)
- » Tension signs and neural mobility tests
- » Girth measurements
- » Cranial nerve examination
- » Special neurologic tests (e.g., coordination, balance)
- » Reflex testing for central nervous system pathology (Babinski's sign, clonus, spasticity)

Identification of nerve root syndromes is one of the most important parts of the OMT evaluation. Regeneration of injured nerve root tissue is unpredictable and sometimes incomplete. Therefore, avoid maneuvers that could further damage these sensitive structures during examination and treatment. If nerve root symptoms are dominant, you may not be able to comfortably and safely proceed with the evaluation until you treat and relieve the compromised nerve tissue. You may also need to modify and limit techniques both for evaluation and later treatment. For example, rotational movements around the longitudinal axis of the spine are contraindicated as they would further compromise spinal nerve roots.

Nerve root lesions can present with symptoms and signs in the affected nerve root's sclerotome, dermatome, and/or myotome. Normal anatomical variations and overlapping nerve supplies require that you test key nerve tissues, especially key muscle strength and reflexes, at several innervation levels above and below a suspected spinal lesion. See *Chapter 7: Notes on Spinal Syndromes* for reference charts to guide the examination.

Neurologic screening tests (for example, quick tests for strength by standing on tiptoes, standing on heels) are sometimes performed at the very beginning of the physical examination to quickly alert you to the possible presence of a nerve root lesion. Follow-up these neurologic screening tests with more specific neurologic examination in the implicated nerve distribution.

No single neurologic test is sufficient to determine a diagnosis. Neurologic tests overlap other tests of function and must be interpreted in light of an entire constellation of signs and symptoms. For example, reduced strength can be a by-product of muscle, joint, or neurologic dysfunction. In addition, positive findings from any nerve test that involves limb movement (particularly nerve tension and mobility tests) can originate from a variety of tissues, including nerves, joints, and muscles. Separately assess the joints and muscles involved in each test and consider these when interpreting findings.

Mobility of neural tissue

If mobility of the dura mater, a nerve root, or a peripheral nerve is impaired by compression (for example, secondary to disc lesions) or adhesions (for example, secondary to scarring), any additional neural tension resulting from limb movement or spinal joint positioning can cause more pressure, more pain, decreased functional movement, and decreased conduction of the nerve.

Nerve mobility is tested with specific movements that move nerves relative to their adjacent structures. The therapist first places the nerve under tension and then moves the tensioned nerve in a cranial or caudal direction. For example, the sciatic nerve can be tensioned with a straight leg raise combined with neck flexion and foot dorsiflexion. By increasing the cranial tension with increased neck flexion while simultaneously releasing the distal tension with plantarflexion of the ankle or flexion of the knee, the therapist moves the nerve in a cranial direction. Conversely, the therapist can move the nerve in a caudal direction by taking up tension at the distal end and releasing the cranial tension. If no symptoms result from these movements, then there is no restraint by adhesion or compression of neural tissue.

Test nerve mobility in weight-bearing positions (e.g., sitting, standing) as well as in non-weight-bearing positions (e.g., lying, traction/unloading) as impaired nerve mobility may only be apparent in one or the other posture. If nerve mobility tests in standard positions are inconclusive, test the patient's nerve mobility in the various positions in which the patient reports symptoms.

Vascular Tests

» Vertebral artery (see *Cervical Figure 12*)

» Pulses

» Bruits

The most important vascular test before treatment of the cervical spine is the vertebral artery test. Perform the test in both weight-bearing positions (e.g., sitting) and non-weight-bearing positions. If the test provokes symptoms suggesting vertebral artery insufficiency, avoid rotational techniques (around the longitudinal axis of the spine) during cervical and thoracic evaluation and treatment procedures.

■ Medical diagnostic studies

» Diagnostic imaging (e.g., X-ray, CT scan, MRI)

» Laboratory tests (e.g., analysis of blood and other body fluids)

» Electrodiagnostic tests (e.g., EMG, EEG)

» Endoscopy, arthroscopy

» Punctures (e.g., biopsy, aspiration)

■ Diagnosis and trial treatment

A trial treatment is an essential evaluation tool. If examination findings implicate a joint condition which is treatable, confirm your diagnostic hypothesis with a trial treatment. If the diagnosis involves shortened tissues or irritable neurological symptoms, several trial treatments may be required before you can confirm the diagnostic hypothesis.

Before initiating a treatment plan, you should be confident in your answers to the following questions.

» Is there good correlation between the history and the physical exam?

» What is the patient's diagnosis (i.e., source of symptoms, mechanism of symptoms, contributing factors)? What are the treatment priorities?

» Do I have enough information to begin treatment or should I reexamine the patient? Should I refer this patient for further evaluation?

» What is the prognosis? Can I help this patient? What treatment do I have to offer?

» Are there precautions or contraindications to treatment?

» What is the patient's experience and understanding of their problem? What is the impact of this problem in their life? What are their expectations of treatment?

Notes

5 Spinal joint mobilization

The mobilization techniques presented in this book evolved largely as a result of the following observations:

» One can *see* and *measure* decreased active movement and *feel* restricted joint play in the associated joint.

» Following treatment with passive translatoric movements, there is usually an increase in active movement, an increase in passive joint play, and decreased pain.

Joint mobilization is perhaps the most important component of OMT practice. Hands-on skill in joint mobilization enhances both diagnostic acumen and treatment effectiveness. During mobilization treatment, the skilled practitioner constantly monitors patient responses to support their diagnostic hypotheses and chosen course of action, to elicit the formation of new hypotheses, and perhaps signal the need for further evaluation and problem clarification. The use of mobilization techniques as additional tests of hypotheses, guides the practitioner in their in-treatment clinical decisions to modify and improvise their approach.

See *Chapter 6: OMT Treatment* for an overview of the many other components of orthopedic manual therapy practice that complement and support mobilization treatments.

■ Goals of joint mobilization treatment

Spinal joint mobilization differs from extremity joint mobilization. When treating extremity joints, mobilization usually targets just one joint. When treating the spine a mobile segment with three joints is moved and closely related sensitive structures like nerves and intervertebral discs are affected.

Mobilization treatment is based on a specific biomechanical assessment of joint hypomobility and hypermobility.

If the patient's symptoms are associated with an abnormal end-feel and a slight or significant **hypomobility** (Class 1 or 2), use Grade II relaxation-mobilization or Grade III stretch-mobilization techniques to improve joint function. Class 0 ankylosed joints cannot be mobilized.

If the patient's symptoms are associated with a slight or significant **hypermobility** (Class 4 or 5), apply stabilizing (limiting) treatment to normalize joint function. Complete instabilities (Class 6 dislocations or ligamentous laxity with unstable vertebrae) usually require medical intervention.

If the biomechanical status of the joint cannot be determined due to severe pain, spasm, paraesthesia, or other symptoms, or if stretching techniques cannot be tolerated, treatment is first directed toward symptom control (for example, Grades I-II relaxation mobilization or other treatment modalities). Once the patient can tolerate biomechanical assessment and treatment, the focus of treatment can shift to the appropriate mobilization for hypomobility or stabilization for hypermobility.

Goals of joint mobilization

1. **Pain-relief mobilization**

   To ease severe pain, spasm, and paraesthesia, and to help normalize joint fluid viscosities that interfere with movement.

2. **Relaxation mobilization**

   To relax muscles, decrease pain and facilitate movement ease.

3. **Stretch mobilization and manipulation (quick mobilization)**

   To stretch shortened joint tissues, increase movement range and correct positional faults.

■ Mobilization techniques

Spinal joint mobilization

1. **Pain-relief mobilization**
   - Grade I - IISZ in the (actual) joint resting position.
2. **Relaxation mobilization**
   - Grade I - II in the joint (actual) resting position.
3. **Stretch mobilization**
   - Grade III in the joint (actual) resting position
   - Grade III at the point of restriction.
4. **Manipulation (quick mobilization)**
   - Grade III, high velocity, short amplitude, low force traction-manipulation in the (actual) resting position.

■ Pain-relief mobilization

If the patient has severe pain or other symptoms (e.g., spasm, paraesthesia) such that the biomechanical status of the joint cannot be confirmed or that Grade III stretching techniques cannot be tolerated, direct treatment toward symptom control. Symptom-control treatment should be applied only in the Slack Zone of the Grade I - II range.[1]

Grade I and II Slack Zone mobilizations, particularly intermittent traction movements, also help to normalize joint fluid viscosities and thus improve joint movement when movement is restricted by joint fluids rather than by shortened periarticular tissues.

Pain-relief traction mobilization (Grade I - IISZ)

Intermittent Grade I and II traction-mobilizations in the Slack Zone, applied in the resting position or actual resting position (i.e., three-dimensional positioned traction), is the initial trial treatment of choice for symptom control.

Remember to apply mobilizations for pain relief within the Slack Zone, staying well short of the Transition Zone.

As soon as decreased symptoms allow the patient to tolerate full biomechanical testing with end-feel assessment, the focus of treatment can shift to the appropriate mobilization for hypomobility or stabilization for hypermobility.

Vibrations and oscillations

Short amplitude, oscillatory joint movements other than traction are also used for the treatment of pain. These movements are usually applied manually, but the use of mechanical devices such as vibrators may also be effective in the application of very high frequency and very short amplitude movement. These movements can decrease pain and muscle spasm, therefore improving mobility without stretching tissues.

Vibrations and oscillations can also be applied in the Grade IITZ and III range, interspersed with stretch mobilizations, to minimize discomfort.

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1 In some countries, practitioners refer to *Grade I and II Slack Zone mobilizations for pain relief* as "passive movements" and reserve the term "mobilization" for the treatment of hypomobility.

■ Relaxation mobilization

Relaxation mobilizations differ from pain-relief mobilizations in that they can be applied anywhere in the Grade I-II range, including both the Slack Zone and through the increasing resistance of the Transition Zone. It is important to differentiate relaxation mobilizations from the more gentle and benign Grade I-II pain-relief traction mobilizations which are applied only within the Slack Zone.

Apply relaxation joint mobilizations as *intermittent Grade I and II movements in the actual resting position* to relax muscles, decrease pain and facilitate ease of movement. Use them in cases where joint movement is limited by muscle spasm rather than by shortened tissues. Relaxation mobilizations are also useful as preparation for more intensive treatments (for example, a Grade III stretch mobilization) which can be more effective when the patient's muscles are fully relaxed.

Relaxation mobilizations should not produce or increase pain.

Following is a review of joint relaxation mobilization techniques. See Chapter 6 for a discussion of soft tissue relaxation mobilization techniques.

Relaxation-traction mobilization

Grade I - II

Apply intermittent traction-mobilizations in the actual joint resting position within the Grade I or II range, including the Transition Zone. Slowly distract the joint surfaces, then slowly release until the joint returns to the starting position. Rest the joint a few seconds in the starting position before you repeat the procedure. Between each traction movement, readjust three-dimensional positioning (the actual resting position) of the involved joint as joint tissue response allows. You may need to interrupt the traction procedure and reposition the joint in different dimensions until the new actual resting position is found and repeated traction relieves symptoms. There should be a natural progression in joint position toward the resting position of the joint.

Avoid tissue stretching. Stay well within the Grade I and II range and do not mobilize into the Grade III range where tissue stretching occurs. Subtly and continuously modify joint positioning, mobilization forces, and the rhythm and amplitude of the traction procedure based on the patient's response to treatment.

Evaluate the effect of these carefully graded traction forces. You should observe an immediate improvement in signs and symptoms if your treatment approach is correct.

■ Stretch mobilization

Grade III stretch mobilizations are one of the most effective means for restoring normal joint play. Stretching shortened connective tissues in muscles, joint capsules and ligaments can increase and maintain mobility and delay progressive stiffness and loss of range of movement in chronic musculoskeletal disorders.

Hypomobility presenting with a hard end-feel is characteristic of a bony limitation and should not be stretched. Restricted range of movement presenting with a normal end-feel is a normal anatomical variation, is rarely symptomatic, and is not stretched as a primary treatment. However, such "normal" joints may be stretched in order to release stress to a vulnerable neighboring hypermobile joint.

Grade III stretch mobilization is only indicated, and only effective, when a hypomobility is associated with an abnormal end-feel, is related to the patient's symptoms, and there are no contraindications.

Sustain a stretch mobilization for a minimum of seven seconds, up to a minute or longer, as long as the patient can comfortably tolerate the stretch. In viscoelastic structures, the longer a stretch is sustained the greater and more lasting the mobility gain. We instruct students to apply at least 30 to 40 seconds of stretch with the assistance of a mobilization belt in the larger joints. For greatest effect, continue the treatment for 10-15 minutes in a cyclic manner.

Fixation of one joint partner is absolutely essential for an effective stretch mobilization.

It is not necessary to release the joint completely between stretch mobilizations. A return to the end of the Grade II range, just easing off the stretch into the Transition Zone, is adequate before repeating the process.

Normally the time a stretch is sustained is more critical than the amount of force used. Poor gains in range are more commonly due to insufficient duration of stretch, rather than insufficient force. However, you must apply enough force to stretch the shortened tissue. To determine the most effective amount of force to use, begin with forces approaching, but not exceeding, what the patient safely tolerates during daily activities. In some larger joints, for example, in the lumbar spine, shoulder, elbow, hip and knee joints, the force of Grade III stretch traction-mobilizations can be significant.

Grade III stretch mobilizations should not produce or increase the patient's dominant symptoms (chief complaint). However, a sensation of stretching in the form of slight local discomfort is a normal response to stretch-mobilization. A Grade III stretch mobilization should be discontinued if it produces protective muscle spasm, severe pain, or symptoms at locations other than the site being treated. Such a response to treatment suggests the need to reposition the joint, alter the intensity or direction of treatment, or discontinue stretch-mobilization treatment. (See page 90, *If traction treatment exacerbates symptoms*.)

Grade III stretch-mobilizations usually produce immediate improvement within the first treatment session. You should see, hear, and feel a difference in the patient's dominant signs and symptoms. Lasting effects may require several treatments.

Preparation for stretch mobilization

Soft tissue dysfunction can alter joint movement and decrease the effectiveness of joint stretch-mobilizations. That is why treatment often begins with procedures to decrease pain and muscle spasm or increase soft tissue mobility. These adjunct procedures may also make the joint mobilization easier to perform and produce a longer lasting effect.

Treatment to improve circulation and thereby elevate soft tissue temperatures is useful preparation for Grade III stretch mobilizations. Warming tissues surrounding the joint prior to Grade III mobilizations makes them easier to stretch. Effective warming can be achieved by surface heat application or deep heat application (e.g., ultrasound, diathermy). However, the most effective way to "warm-up" tissues is with exercise.

The most effective way to improve circulation and "warm-up" soft tissues is with exercise.

Cooling tissues after stretch mobilization treatment often helps preserve mobility gains for a longer period of time. We do not recommend cold application *prior to or during* stretch technique, since cooled tissues can be more easily injured from overstretching.

Progression of stretch-mobilization treatments

One of the most frequently asked questions, and also hardest to answer is, "How much treatment is enough?" The easiest answer is, "As much as necessary and as little as possible." Although the answer is clever and accurate it rarely satisfies students. I therefore provide the following general guidelines which are both conservative and safe. With experience, the nuances of clinical decision-making will become more apparent and you will find answers to these difficult questions.

If reassessment reveals increased range of movement or normalization of end-feel and decreased symptoms, then Grade III stretch-mobilization treatment may continue. If there is marked improvement in one treatment session, it is wise to discontinue additional treatments that day. Chronic cases and significant (Class 1) hypomobilities may require several treatment sessions before a change is apparent.

If reassessment indicates no change in mobility or symptoms, reevaluate joint positioning and the vigor (i.e., time and force) and direction of treatment or reconsider whether mobilization is indicated at all, perhaps by referring the patient for further medical diagnostic evaluation.

Discontinue stretch mobilization when gains in the patient's symptoms and range of movement plateau and the patient can perform active movement throughout this range.

It is important to stretch a joint in all restricted directions in which the joint would normally move. However, some stretch-mobilizations into some movement patterns and directions are safer, while other stretch mobilizations have greater risk of patient injury and must be applied with skill and caution. In addition, a joint can be restricted in one direction (e.g., flexion) and hypermobile in another direction (e.g., extension). In this case mobilization may be indicated for the restricted flexion and contraindicated for the hypermobile extension.

Novice practitioners should begin stretch mobilization treatments with a sustained traction mobilization pre-positioned in the resting position (or actual resting position) and progressively re-position nearer and nearer to the point of restriction, as tissue response tolerates and allows. If the mobility gains produced by stretch-traction mobilization plateau, the practitioner may progress to stretch-glide mobilizations, first with the joint pre-positioned in the resting position, then progressing toward the point of restriction, just as for stretch-traction mobilization treatment.

Stretch mobilization is more effective and better controlled when joint stretching is carefully timed to occur during periods of maximum muscle relaxation. Reflex inhibition relaxation techniques such as PNF contract-relax and hold-relax techniques (i.e., active relaxation, post-isometric relaxation) and contraction of antagonists (i.e., reciprocal inhibition) can be very effective.

Stretch-traction mobilization

Grade III

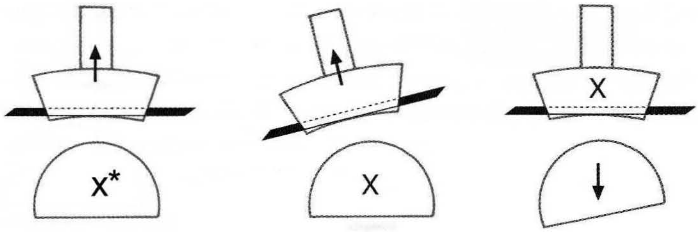
A series of sustained Grade III stretch-traction mobilizations in the joint resting position is the recommended initial treatment for joint hypomobility. Apply stretch-traction mobilization at a right angle to the treatment plane (Figure 5.1a).

The orientation of the treatment plane in a vertebral segment is determined by the orientation of the caudal surface of the cranial vertebra in the disc joint.

In stretch traction techniques where the caudal vertebra is stabilized (Figure 5.1b), the spacial orientation of the treatment plane changes each time the cranial vertebra assumes a new three-dimensional position. This is often the case with cervical and thoracic traction techniques. Whether the cranial vertebra is pre-positioned in the actual resting position or at the point of restriction, the spacial orientation of the treatment plane follows the new position of the cranial vertebra, and the angle of the traction forces changes accordingly.

If the traction force is applied to the caudal vertebra in a segment, the spacial orientation of the treatment plane does *not* change (Figure 5.1c). This is usually the case with lumbar traction techniques. While the sacrum or the caudal vertebra in the segment is pre-positioned, the stabilized cranial vertebra remains stationary, as does the treatment plane. The direction of the traction force always remains at a right angle to the stationary treatment plane, independent of the position of the caudal joint partner (Figure 5.1c).

Figure 5.1
Traction at a right angle to the treatment plane. Vertebrae labelled with an "x" are stabilized.



* *Note in Figure 5.1a, you can alternatively fixate the concave joint partner and mobilize the convex joint partner.*

Grade III traction mobilization in the (actual) resting position can stretch any soft tissue that crosses the joint and limits joint movement, including muscle connective tissues, joint capsules and ligaments. As a trial treatment, apply about ten stretch-traction mobilizations. If reassessment reveals improvement, continue with this and progress toward the true resting position. Progress the stretch-traction mobilization in nonresting positions as improvement allows.

Grade III traction mobilization at the point of restriction is applied with the joint pre-positioned near the limit of range in the restricted movement direction. This maneuver will increase joint mobility primarily in the pre-positioned direction. For example, to increase a flexion restriction, pre-position the joint at the limit of the flexion range and apply the stretch-traction mobilization in that position. Skilled practitioners pre-position and stretch in more than one dimension, for example, in flexion with abduction (bi-axial joint) or flexion with abduction and external rotation (tri-axial joint). Progress the stretch-traction mobilization further into the restriction as improvement allows.

Treatment is often successful with skillful pre-positioning at the point of restriction combined with stretch-traction mobilization alone. However, in some cases, especially to treat the last degrees of restriction, it can be necessary to use stretch-glide mobilization as well.

Stretch-glide mobilization

Grade III

Stretch-glide mobilizations performed in the same direction as the restriction, directly stretch the tissues restricting joint movement. Progress to Grade III stretch-glide mobilizations if and when stretch-traction mobilization no longer produces adequate mobility gains (e.g., the last degree of restriction), or to re-position a positional fault.

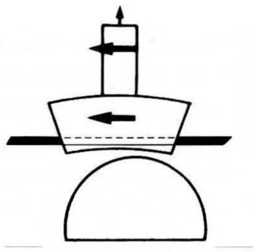


Figure 5.2
Gliding parallel to the treatment plane.

Glide-mobilizations produce some intra-articular compression, more so with stiffer joints. To facilitate the glide mobilization and reduce these compressive forces acting on the joint, combine it with a Grade I traction movement (see the tiny arrow in Figure 5.2 above). In joints with advanced degenerative changes, or which are painful when compressed, it may be necessary to use additional traction force or less gliding force in order to avoid pain during treatment. In cases where joint compression testing produces nerve root symptoms, stretch-glide mobilization is contraindicated.

Progress joint pre-positioning in the same way as for stretch-traction mobilization. Start in the actual resting position, progress toward the true resting position, and gradually re-position the joint nearer and nearer to the point of restriction, as improvement allows. For best effect when the joint is pre-positioned at the movement limit, ease off the limit a little before applying the stretch-glide mobilization.

Apply vertebral stretch-glide mobilizations parallel to the treatment plane in the joint. Remember that the spacial orientation of the treatment plane follows the orientation of the cranial vertebra in the segment. When applying glide-mobilization to the cranial vertebra in the segment, the treatment plane and treatment direction changes to follow the pre-positioning orientation of the cranial vertebra. When applying glide-mobilization to the caudal vertebra in the segment, the treatment plane remains stationary, and the direction of the glide force does not change regardless of the pre-positioning orientation of the caudal vertebra.

The most effective stretch-glide mobilizations move a joint in the direction of most restricted gliding. However, if performed with poor technique or with excessive force they can injure sensitive joint structures. Stretch-glide mobilization in a severely restricted gliding direction (Class 1 hypomobility) may produce joint compression and be too painful for a patient to tolerate. In this case, return to Grade III stretch-traction mobilizations carefully applied in less restricted and less symptomatic positions. Once mobility status improves to a slight hypomobility (Class 2), progress again to specific Grade III stretch-glide mobilization in the most restricted gliding direction.

■ Manipulation

While effective in skilled hands, manipulation also carries risk of serious injury. OMT practitioners must understand the indications and contraindications to manipulation in order to prevent patient injury.

Manipulation technique

We have worked for many years to perfect translatoric linear thrust techniques, rather than rotatory thrusts. A linear thrust is technically more difficult to perform than a rotatory thrust, however it is far safer and just as effective. Risks to the patient increase with rotatory manipulation, especially in the cranio-vertebral region. Our linear thrust techniques are primarily applied as traction, however some are applied in a gliding direction. We no longer teach rotatory manipulation techniques either for the extremity joints (since 1979) or for the spine (since 1991).[2]

We practice manipulation as a high velocity, small amplitude, low force, *linear* movement in the actual resting position, applied with a quick impulse ("thrust," or "quick mobilization") to a joint showing a suitable end-feel, to effect joint separation and restore translatoric glide.

A common misconception among MT practitioners, is that a manipulation is a continuation of a stretch-mobilization. It is true that the practitioner first confirms that the patient can safely tolerate a low-force manipulation by applying a brief Grade III stretch-mobilization. However, after this stretch-mobilization "screening test," the stretch is released into the Grade II range before taking up the slack again, this time tightening the tissues through the Transition Zone into the Grade III range and immediately applying the low-force thrust at the point of the actual pathological stop.

2 International Federation of Orthopedic Manipulative Therapists' (IFOMT) Educational Standards (1992, 1999 and 2000) recognize the risks inherent in rotation manipulations, especially in the cranio-vertebral region, and recommend manipulative techniques which "eliminate rotary stresses and emphasize glide and distraction movements."

If a gentle, low-force manipulation is not successful, practitioners should not use more force, but rather return to relaxation or stretch mobilizations until the joint state is amenable to a low-force manipulation.

Manipulation education

IFOMT guidelines recommend a specific sequence of education that begins with extremity joint mobilization and progresses to extremity joint manipulation, before the practitioner begins to learn spinal manipulation. However, some basic spinal manipulations consisting of gentle spinal traction-thrusts ("quick mobilizations") in the actual resting position, can be safely taught in entry-level programs. These gentle spinal thrusts are a safe way for novice practitioners to practice and develop their thrust speed, and are also useful as screening tests and to differentiate a temporarily hypomobile "locked" joint from a permanently hypermobile joint. (See *Appendix: Notes for entry-level instruction*, page 329.)

Training in basic joint manipulations, particularly the relatively safe traction manipulations applied *in the joint resting position* presented in this book series, can begin early in MT education. However, most spinal manipulations are advanced and should be used only by those with long-term training and clinical supervision during OMT post-professional training.

■ If traction treatment exacerbates symptoms

It is rare for traction to increase a patient's symptoms. If it does, you should:

» **Adjust joint positioning.** Continuously monitor changes in the actual resting position and adjust the joint's three-dimensional positioning as needed.

» **Alter traction force.** Early in the healing process a patient may tolerate only minimal forces.

» **Correct an underlying positional fault.** A positional fault can occur in both hypomobile and hypermobile joints. It is a condition in which joint partners are in an abnormal position, most often involving a hypermobile joint stuck in an unusual joint position. While minor positional faults often correct with a Grade II traction mobilization, strongly fixated positional faults may first need correction with a Grade III stretch glide-mobilization or manipulation.

» **Discontinue traction treatment.** In some cases, for instance with certain acute soft tissue lesions (e.g., ligamentous strain), traction treatment may be contraindicated along with any form of stretch to the injured fibers. In this case, treatment is postponed until some healing occurs. Stretch-traction treatment may also be contraindicated in cases where symptoms are produced in an adjacent hypermobile joint which cannot be adequately locked to prevent pain during treatment.

■ Avoiding high-risk manual treatment

Rotation mobilization

Avoid general rotation joint mobilizations. While general rotational techniques for the spine (mobilization around the longitudinal axis) can be effective in some cases, for example in elderly patients with lumbar facet joint arthrosis, they can also be very dangerous. Because general rotational mobilizations offer the promise of quick results and are relatively easy to perform, they are often misused by novice practitioners.

General spinal rotation mobilization is one of the most potentially dangerous techniques for the patient.

Rotational techniques should not be used if there is any suspicion or history of disc involvement, vertebral artery involvement, or irritation of nerve structures. In these cases, even techniques that produce a lesser vertebral rotation (e.g., muscle stretching techniques) can produce damaging compression forces.

The safest way to increase spinal joint rotation range, is to use a Grade III stretch-traction mobilization in conjunction with specific three-dimensional positioning. Pre-position the specific spinal joint at the point of its restricted rotation, and then apply a Grade III traction mobilization at a right angle to the disc joint treatment plane. Admittedly, the skilled application of three-dimensional stretch-traction mobilization is technically more difficult to apply than a general rotational mobilization, but it is safer and, in skilled hands, just as effective.

If three-dimensional stretch-traction mobilization does not completely restore the rotation movement, consider a referral to a more experienced practitioner skilled in advanced manipulative technique.

Joint compression

Avoid joint compression techniques, as they can too easily aggravate a joint condition. Techniques that produce indirect compression in the joint should also be used with caution, particularly in cases where compression tests are symptomatic.

While some practitioners believe that passive manual joint compression can stimulate cartilage nutrition and regeneration and apply it for that purpose, particularly in certain extremity joints, we do not teach it.

Little is known about the physiological effects of manual joint compression treatment or whether an interspersed traction component is essential for its efficacy. Critical to the maintenance of articular cartilage is its fluid supply of nutrients by diffusion. This fluid nutrient transfer is facilitated by *changes in joint loading* which create pressure changes. Therefore, it has been hypothesized that compression may be a useful joint mobilization technique. Following the same logic, and based on my nearly 60 years of clinical experience, I believe our intermittent traction approach may also provide the necessary pressure changes to facilitate articular cartilage nutrition.

Rolling, gliding, and compression are physiological stresses joints experience with normal movement. In fact, these stresses are *necessary* for the maintenance of articular cartilage. When there is an imbalance of rolling, gliding and compression, joints begin to show the effects of wear and tear, marking the onset of degenerative joint disease (DJD). For example, too much compression may occur with excessive running or jumping activities which can lead to DJD. On the other hand, not enough stress to the joint, as with prolonged immobilization in a cast or bed rest, can also lead to degenerative joint disease.

If joint compression occurs during a patient's treatment program, the amount of load-bearing is increased gradually and monitored closely to avoid pain. Therapists use standard protocols for graduated return to full weight-bearing in the lower extremity joints. The progression usually begins with toe-touch weight-bearing using two crutches and progresses to one crutch, then a cane, and eventually full weight-bearing. Another common progression starts with active assisted movement, then active movement, and finally resisted movement. These progressions represent a kind of *graduated compression therapy* which the patient controls based on their tolerance to the activity. Premature load-bearing treatment can lead to joint swelling and additional injury to the patient.

Many seemingly benign daily activities produce joint compression and can aggravate a patients symptoms. For example, sidelying induces significant compression both through the shoulder girdle joint complex, in the cervical and upper thoracic spine, and in the hip joint. Management of this patient would likely include instruction in how to position pillows under the thorax and neck to reduce shoulder and spinal compression during sidelying sleep. Management of this patient would also likely *avoid* additional joint compression during manual treatment.

Be aware that our gliding techniques often also have a compression effect, especially at the end range of motion. If a glide-mobilization technique is painful, increase its traction component. If, with increased traction, the glide mobilization procedure continues to be painful, discontinue this technique.

If joint compression tests are symptomatic, it makes little sense to use joint compression as treatment. I have observed too many instances where patients have been injured with joint compression treatment, especially in the hands of inexperienced practitioners.

■ Notes

6 OMT treatment

Mobilization is one part of the greater scope of OMT practice, and is generally most effective when supplemented with other procedures and modalities. The sequencing of these adjunctive procedures can influence the outcome of mobilization techniques. For example, a stretch mobilization preceded by heat application often produces greater mobility gains, and ice application and specific home exercise following a stretch mobilization can better preserve mobility gains.

■ Elements of OMT

OMT Treatment

A. To relieve symptoms

1. ***Immobilization***
2. ***Thermo-Hydro-Electro (T-H-E) therapy***
3. ***Pain relief mobilization (Grade I - IISZ)*** *(see Chapter 5)*
4. ***Special procedures***

B. To increase mobility

1. ***Soft tissue mobilization***
   a. **Passive soft tissue mobilization**
   b. **Active-facilitated soft tissue mobilization**
2. ***Joint mobilization*** *(see Chapter 5)*
   a. **Relaxation mobilization (Grade I - II)**
   b. **Stretch mobilization (Grade III)**
   c. **Translatoric manipulation**
3. ***Neural tissue mobilization***
4. ***Specialized exercise***

C. To limit movement

1. ***Supportive devices***
2. ***Specialized exercises***
3. ***Increasing movement in adjacent joints***

D. To Inform, instruct, and train

Treating related areas of impairment

In addition to treating the primary joint lesion, the manual therapist also evaluates and treats related areas of impaired function. For example, with a somatic dysfunction at C2, it may be necessary to relax and stretch the scaleni (which are "facilitated" and shortened by local irritation of the C3 nerve root), to mobilize the first rib (which is elevated by the shortened scaleni), and to instruct the patient in effective and safe ways to use and maintain newly acquired mobility.

Reassessment

There is continuous improvisation in OMT treatment, as the practitioner tests their diagnostic hypotheses and adjusts the sequence and dosage of their treatments. The OMT practitioner must be able to simultaneously perceive and interpret multiple physical, psychological and social patient cues and adjust their treatment and responses to the evolving treatment session. The patient is an active participant in this process, as their "pain experience" and expectations can affect treatment outcomes.

Reassessment is important at the beginning and end of each treatment session as well as during the treatment session. If retesting reveals increased range of motion or decreased pain, then treatment may continue as before. If retesting reveals a *marked* improvement in range of motion, I advise novice practitioners to stop treatment for that day and continue the treatment on a subsequent day. I make this recommendation because novice practitioners all too often overtreat the patient in the mistaken belief that "more is better."

Under no circumstances should treatment result in discomfort or pain which persists beyond the day.

There is no substitute for clinical experience. OMT expertise can only be attained through the clinical experience of encountering a problem, and engaging in a clinical reasoning process of critical analysis that allows for self-correction and adaptation of practice. Such clinical evidence is the most important criteria upon which treatment decisions are made.

■ Treatment to relieve symptoms

Symptom control treatments can be indicated for both hypermobile and hypomobile joint conditions and in the presence of nerve root findings. Use symptom control techniques when:

» severe pain or other symptoms (for example, an empty end-feel) interfere with biomechanical assessment of the joint

» end-range-of-movement treatment is contraindicated or cannot be tolerated (e.g., in certain stages of disc pathology)

» inflammatory processes, disc pathology, or increased muscle reactivity around a symptomatic joint decrease gliding movement and restrict functional movement without structural soft tissue shortening (e.g., in the presence of normal muscle length or a normal or even a lax joint capsule)

In cases where nerve root irritation or the status of the intervertebral disc interferes with assessment of the biomechanical status of the joint (for example, due to severe pain or spasm), or when the nature of the condition does not allow for biomechanically based treatment, direct treatment toward symptom relief and decompression of neural structures.

Immobilization

With some clinical conditions, immobilization is appropriate and necessary for a prescribed time. Selecting the correct general or specific immobilization method as well as *timing when and how long* to immobilize is important to the success of treatment. Acutely severe, painful and inflammatory conditions, instabilities, and recent post-surgeries may benefit from a prescribed duration of immobilization. General bed rest may be the only alternative with certain painful, inflammatory conditions, especially in the weight-bearing joints. Specific immobilization methods such as the use of casts, splints, braces, and taping can be used to protect a joint while the patient continues to function.

A cervical collar, lumbar corset, back belt, or tape application can limit movement of the affected spinal region (i.e., local immobilization) and may even provide pain-relieving decompression at the same time. Crutches can also limit movement and provide symptom-relieving decompression. If a short period of bed rest (i.e., general immobilization) is indicated, coach the patient to find a position of comfort (the actual resting position) and to learn autotraction techniques (e.g., pulling with the arms at the headpiece of the bed, pushing caudally at the iliac crests while lying, or pushing down on armrests while sitting).

Thermo-Hydro-Electro (T-H-E) therapy

The judicious use of various forms of cold, heat, water, or electrotherapy can be an effective means to modulate pain, enhance relaxation, and reduce swelling. Integrated with manual therapy, modalities are used in preparation for mobilization and afterwards to prevent or limit treatment-related soreness. As with all treatments, selecting the correct technique, and determining when and how long to use it, is critical.

Pain-relief mobilization (Grade I-II SZ)

Gentle, short-amplitude passive joint movements, including intermittent manual traction in the Grade I range and through the Grade II Slack Zone, mechanical vibration, and manual oscillation techniques, are often used for the treatment of pain. These techniques can be effective whether the underlying joint pathology is hypomobile or hypermobile, and can effectively prepare a patient to progress toward more specific treatments.

See *"Pain-relief mobilization"* in *Chapter 5: Joint Mobilization.*

Special procedures for pain relief

Acupuncture, acupressure, and various forms of soft tissue mobilization have long been used for pain relief through reflex pain modification, inhibition of muscle spasm, and the reduction of swelling. These are safe treatments even in the presence of serious musculoskeletal dysfunction.

■ Treatment to increase mobility

Soft tissue mobilization can facilitate Grade III stretch mobilization by loosening tight soft tissues that limit joint movement. In practice, treatment often begins with soft tissue treatments such as functional (pumping) massage and muscle stretching to increase soft tissue mobility. In some cases, particularly with chronic disorders, both periarticular tissues and muscles are restricted near the same point in the range. In such cases it is necessary to alternate Grade III stretch joint mobilization with soft tissue mobilization or muscle stretching and to take care not to move joints beyond their natural or actual range of movement during the soft tissue procedures.

Soft tissue mobilization

Whether or not a particular technique is viewed as soft tissue mobilization depends on the viewpoint of the clinician. Soft tissue treatments can affect many structures including joints, nerves and blood vessels. What distinguishes the soft tissue treatment from other forms of treatment is that the clinician uses soft tissue assessment to monitor change. The intention is to change soft tissues; assessment is made by monitoring soft tissues. The clinician continuously monitors tissue response and instantaneously modifies treatment.

Good manual soft tissue technique requires sensitivity to constantly fluctuating patient responses. The clinician must recognize these subtle changes and immediately and continuously modify the treatment.

Just as joint movements are classified as either translations (i.e., joint play accessory movements) or rotations (i.e. physiological bone movements), so are soft tissue movements.

Accessory soft tissue movements or "muscle play" cannot be performed actively. Friction massage, a passive lateral movement of muscle, is one example of muscle play.

Physiological soft tissue movements can be performed actively or passively. Traditional muscle stretching, and the lengthening and shortening movements that occur with muscle contraction and relaxation, are examples of physiological soft tissue movements. Treatment using physiological soft tissue movements generally utilize limb movement (bone rotations) to alter soft tissue tension.

Some forms of soft tissue mobilization such as functional/ pumping massage are most effective when we allow the underlying joints to move as well. We often encourage and guide underlying joint movement by using a coupled movement pattern during soft tissue mobilization.

Soft tissue mobilization techniques can be broadly classified according to the amount of patient participation as either "passive" or "active-facilitated." The level and type of patient participation to use is an important clinical decision. Patient participation can vary from none at all, to the patient controlling most of the mobilizing force. Patient participation depends on many factors, including the chronicity and painfulness of the problem as well as the patient's willingness and ability to move.

Passive soft tissue mobilization

During passive soft tissue mobilization (STM) the patient does nothing but relax while the practitioner provides all the movement and force. This method is especially useful for soft tissue shortening and is also appropriate for treatment of certain acute soft tissue injuries where the objective is early movement with minimal tissue elongation or stretching. However, this approach may not be effective if the patient has difficulty relaxing while they are passively moved. There are many forms of passive STM, including classical massage, functional massage (Evjenth), and friction massage (Cyriax).

Active-facilitated soft tissue mobilization

Contract-relax followed by passive physiological lengthening of soft tissues (muscle stretching). Following a muscle contraction there is a brief period of relaxation when the muscle can be more easily stretched. During the relaxation phase, the practitioner stretches the soft tissues by moving muscle attachments maximally apart and holding them there. This kind of passive stretching can be uncomfortable and even painful in the stretched tissues, but should not increase the patient's primary symptoms. The patient must be able to relax despite discomfort. Refer to the books by Evjenth and Hamberg for the definitive description of these muscle stretching techniques.[1]

Contract-relax followed by passive accessory mobilization of soft tissues. Following a muscle contraction there is a brief period of relaxation when the muscle can be more easily mobilized. During the relaxation phase, the muscle can be passively moved in a variety of ways depending on how the muscle responds. The practitioner times the soft tissue mobilization to take full advantage of the relaxation period. This technique is useful for passive manipulation of a muscle in cases where the muscle will not easily relax.

Contract with simultaneous mobilization of soft tissues. The practitioner uses resistance to guide the patient's movement in order to actively elongate specific muscles. Simultaneously, the practitioner passively manipulates the antagonistic muscle. An example is manipulation of the hamstring muscles while simultaneously resisting knee extension (quadriceps activation). This technique takes advantage of the neurological phenomena called "reciprocal inhibition" and can be quite strong. This is

1 See Evjenth and Hamberg, *Muscle Stretching in Manual Therapy, Volumes I and II,* 1984 Alfta Rehab Forlag, Sweden, for a description of muscle stretching techniques.

useful when patients have difficulty relaxing while they are passively moved. It is also useful for more forceful or vigorous stretching. Patients seem to tolerate this technique well, perhaps because they control much of the force.

Muscle stretching principles

Integrate passive stretching with active-facilitated soft tissue relaxation techniques whenever possible. Before stretching, test muscle length, end-feel, and the underlying joints to make sure stretching is indicated.

» To test muscle length, position muscle attachments maximally apart, taking into consideration both primary and secondary muscle functions.

» Determine that shortened muscles, and not a joint stop, is limiting movement.

» Examine underlying joints to insure they can withstand the stresses imposed on them during stretching. Stretching muscles over joints that are unstable, inflamed, or have decreased joint play can result in their injury.

» Examine associated structures, including nerves and blood vessels, to rule out contraindications to muscle stretching. For example, check for vertebral artery patency before stretching the scaleni muscles; check for sciatic nerve mobility before stretching the hamstring muscles.

When stretching muscles, observe the following principles:

» Warm the muscle prior to stretching, with exercise or passive heat applications, to facilitate relaxation.

» Precede stretching with an isometric contraction of the muscle to be stretched to obtain maximal relaxation.

» If the muscle crosses more than one joint, apply the stretch movement through the least painful, most stable, and largest joint.

» It is generally more effective and comfortable for the patient, to stretch using a lower force sustained for a longer time (60 seconds or more) than greater force for shorter time. Applying stretching force for a longer time is more likely to result in plastic deformation of soft tissues rather than the more temporary elastic changes.

Joint mobilization to increase mobility

The goal of joint mobilization and manipulation is to restore joint play, and thus normalize roll-gliding, which occurs during active movements. Grade III joint mobilization techniques restore normal joint gliding by stretching the joint capsule and other periarticular soft tissues beyond their shortened slack.

See *Chapter 5: Spinal joint mobilization.*

Neural tissue mobilization

In cases where an overt or suspected nerve root condition is accompanied by severe symptoms, treatment often begins before the physical evaluation is complete. The neurological examination should still be performed, possibly with creative application of each test maneuver in the patient's symptomatic postures. For example, if the patient reports symptoms when standing, and not when lying down, then the examination procedure may only test positive when the patient stands. Defer less critical biomechanical joint assessments and physical examination maneuvers that could risk further injury until the patient can tolerate them safely.

Intermittent traction is the safest and often the most effective treatment for nerve root lesions. **Grade I and II traction mobilization** can reduce nerve root irritation by improving metabolic exchange via the vascular system and by improving drainage of waste products from the inflamed nerve tissue. Apply a trial treatment with intermittent traction as for the patient with severe symptoms, first within the Grade I and II range, but with more frequent reassessment of neurological status (e.g., key muscle strength and reflexes, tension signs, nerve mobility) during and between traction maneuvers. Continuously monitor changes in the patient's actual resting position and adjust three-dimensional joint positioning as changes take place in the involved segment. Other symptom control procedures may also be useful.

In cases where nerve root symptoms are associated with segmental hypomobility, progress the traction to a **stretch traction mobilization (Grade III)** with three-dimensional positioning. Grade III stretch-traction mobilization can improve the spacial relationships between the involved structures, adapt the nerve root to a new tension relationship, and in some cases, improve disc and neurostructural placement.

Once nerve root findings are no longer dominant, progress treatment to other procedures for any associated hypomobility or hypermobility. Because spinal rotation-mobilizations (around the longitudinal axis) can aggravate a nerve root condition, avoid them in patients with a history or suspicion of nerve root involvement.

In certain clinical situations when joint and soft tissue mobilization techniques have not succeeded in alleviating symptoms, neural tissue mobilization may be indicated. There are specific techniques for mobilizing nerves in relation to their perineural tissue which, when appropriately applied, can be effective. *I do* *not recommend these techniques for the novice practitioner as they may involve the provocation of neurological symptoms,* and I do not discuss neural tissue mobilization techniques in this book.

Specialized exercise to increase mobility

The therapeutic application of exercises is the cornerstone of physical therapy. Almost all physical therapy patients should have exercise as part of their treatment program. Exercise should begin as early as possible and each patient should have a home exercise program.

No uniform regimen of exercise is applicable to all patients with hypomobility. Just like mobilization, exercise should be specifically tailored for the individual, and should be based on examination findings. We do not recommend the routine issue of preprinted exercise protocols based exclusively on a medical diagnosis.

For exercise to effectively complement mobilization, it must be administered by the same clinician providing the mobilization treatment and not delegated to some other practitioner as an afterthought.

Automobilization (self-mobilization) exercise is useful for all patients with joint hypomobility to maintain or increase mobility. Automobilization exercises should be tailored to each individual's needs. For example, while some patients with restricted lumbar lordosis may benefit from spinal extension exercise, there are many patients whose symptoms worsen with spinal extension exercises, including those with spondylolisthesis, kissing spines, stenosis of the spinal canal, or with pain from working in prolonged extension postures.

In patients with both hypomobility and hypermobility in nearby spinal segments, the patient may need stabilization training to protect the hypermobile area during mobilization exercise for the hypomobile area. (See also *Autostretching* by Olaf Evjenth and Jern Hamberg.)

■ Treatment to limit movement

Hypermobile joints are often misdiagnosed as hypomobile and therefore mismanaged by practitioners unskilled in passive movement testing. Misdiagnosis is common when hypermobile vertebrae, especially a significant hypermobility (Class 5), gets "stuck" outside of its normal resting position (i.e., in a positional fault). The skilled application of traction and gliding test maneuvers sometimes releases the joint and clearly reveals the underlying hypermobility. In other cases, the positional fault may need correction with Grade III stretch-glide mobilization or manipulation before the underlying hypermobility becomes apparent. The nature of the end-feel determines whether the hypermobility is a normal anatomical variation (and should not be treated) or whether it is pathological (and might benefit from treatment).

The management of hypermobility limits or minimizes joint movement in the excessively mobile directions. This is accomplished in four ways, often concurrently, by: 1) specialized exercises, 2) increasing movement in kinetically related (i.e., adjacent) stiff joints, 3) taping, orthoses, and other supportive and controlling applications, and 4) instruction in body mechanics and ergonomics. Hypermobility treatment is a long-term process and requires persistence and patience from both patient and therapist.

Grade III stretch mobilization is contraindicated for hypermobile joints.

Supportive devices

Supportive devices such as lumbosacral belts and cervical collars can help to protect involved joints during an acute stage. These devices can also be used after treatment is completed when the patient works in unusual postures, during prolonged activities such as sitting, while playing sports, or if symptoms are recurrent. Most often lumbar belts are made of elastic material to minimize the muscle wasting associated with prolonged rigid immobilization. They are only used if needed and are always supplemented with strengthening exercises.

In more serious and chronic cases, a rigid support may be necessary (e.g., body jacket, leather corset). In these cases, a strengthening program (usually isometric) is essential to counteract the deconditioning that accompanies rigid immobilization.

Specialized exercises for hypermobility

Specialized muscle training is necessary to limit and control excessive movements. It is common for the small one- and two-joint spinal muscles (i.e., multifidus, rotatores) to be atrophied from disuse at a hypermobile segment. Controlled contractions of these muscles, first facilitated by the manual therapist and later continued with autostabilization exercises by the patient, can be an important first treatment step.

Patients with hypermobility must also change any habitual motor behaviors that stretch a vertebral segment in a hypermobile direction. This usually involves a long-term movement reeducation program emphasizing coordination and kinesthetic retraining in a variety of functional postures (including lying, sitting, standing) until the patient can demonstrate safe behaviors in timing, recruitment, and intensity of muscle activity around the hypermobile segment.

Slight hypermobilities (Class 4), while often asymptomatic, are still at risk for overstretching injuries during activities that place the joint at end ranges of movement and can progress to a symptomatic (Class 5) hypermobility. For this reason, specialized muscle training and ergonomic instruction are important whether or not the hypermobility is symptomatic.

Increasing movement in adjacent joints

Increasing movement in adjacent joints will decrease movement forces through the hypermobile joint during functional activities and will increase the opportunity for a hypermobile segment to heal and stabilize. For example, a hypermobile lumbar segment will be stretched less often and less forcefully during daily activities if the adjacent thoracic and lumbar spinal segments and the hip joints can contribute their full range of movement to a given activity. Movement in joints proximal and distal to the hypermobile segment can be enhanced with joint and soft tissue mobilization, automobilization, and other specialized exercises. Mobilize adjacent hypomobile joints as soon as possible, even if they are asymptomatic.

■ To inform, instruct, and train

Patient education takes time, but often saves time in the end as it leads to active participation by the patient and clearer communication between patient and health care provider. Many disturbances of the locomotor system are chronic, recurrent conditions which require self-management by the patient both at home and at work. Our manual therapy system stresses the role of the patient in reestablishing and maintaining normal mobility, in preventing recurrence, and in improving musculoskeletal health.

In addition to home exercises, we instruct patients in activities of daily living (ADL), body mechanics, and ergonomics. Instruction should be given not only in home exercise, but in methods for pain relief, for example traction, ice, heat or taping.

Home instruction is especially important if the patient's activities exacerbate neurological symptoms. Patients can be taught how to monitor their neurological signs and use them as a guide to determine safe activity levels.

Patients need instruction in what postures and movements to avoid and in developing new and more healthful ways of moving and working. Training programs emphasize coordination, kinesthetic retraining, strength, and endurance until the patient can demonstrate consistent and safe behaviors in timing, recruitment, and intensity of muscle activity during a variety of functional activities.

Therapeutic training can be provided on an individual basis, or in groups (e.g., back school). Ideally, patients will continue their training even after discharge from formal treatment, preferably at a facility with physical therapists as training instructors.

Psychosocial factors can interfere with the education and training of patients with pain and disability. A successful treatment outcome often depends on the practitioner's ability to recognize and manage complex interactions between pain and deconditioning, fear and avoidance, depression, anger and frustration, iatrogenics, family, socioeconomic and occupational factors in these patients.

■ Research

Many challenges confound the conduct of useful research in the manual therapies. The validity of clinical trials is complicated by the many variables which confound accurate determinations of cause and effect in musculoskeletal disorders, and by the difficulties in developing valid measurement tools for manual interventions. Work is ongoing in the areas of inter- and intrarater reliability studies for manual techniques, however, all too often a manual therapy novice performs the manual techniques in a research study, rather than a master practitioner. This will, of course, impact the research results. There is also much work to be done in the development of accurate and meaningful functional diagnoses and assessment measures for monitoring changes in patient response. For researchers with a pioneering spirit, creativity, and determination, this is indeed an exciting new arena for study.

7 Spinal syndromes

Notes on spinal syndromes

Information about cervical and lumbar syndromes is widely published elsewhere, and are discussed only briefly here. However, there is little information available about the thoracic syndromes commonly seen by manual therapists, and so we discuss those syndromes in more detail.

Also important to the orthopedic manual therapist are the subtle autonomic and visceral changes associated with spinal dysfunction and treatment in general, and the visceral disorders that mimic and are mimicked by spinal dysfunction. Although there are few clinical studies of these phenomena, such symptoms are commonly reported by patients and are important to monitor during OMT evaluation and treatment.

Cervical syndromes

Upper and mid-cervical spine disorders (occiput to C4) sometimes present with symptoms of headache, migraine, dizziness, dysphasia, globus sensations, hoarseness, general irritability, autonomic reactions, and disturbances in hearing, sight, cognition, concentration, and memory. The relationship between these symptoms and restricted upper cervical mobility has not been adequately researched. However, there are numerous clinical reports of symptomatic improvement after mobilization treatment. The close proximity of the vertebral artery and nerves, medulla oblongata, cerebellum, pons, the vagus and hypoglossal nerves, and the sympathetic ganglions of the neck may explain why mobilization of the upper cervical spine alleviates such symptoms.

Lower cervical spine dysfunctions (C4 to T3) present primarily with local pain and symptoms radiating into the upper thoracic area, shoulder girdle, and arm. However, clinicians often report that mobilization in this region influences symptoms that seem to originate in the upper cervical spine. It is possible that decreased mobility in one part of the spine (e.g., lower cervical or thoracic) disturbs function and provokes symptoms in another region (e.g., upper cervical). Manual therapists sometimes augment mobilization treatment for upper cervical symptoms with mobilization to the lower cervical and upper thoracic regions, at least on a trial basis.

■ Thoracic syndromes

The anatomy of the thoracic spine is not substantially different from that of other spinal regions except that the spatial relationships in the spinal canal and the intervertebral foramen are larger than in other regions. This is probably why thoracic nerve root irritation is rare. On the other hand, the numerous small joints in this region, including the costovertebral and costotransverse joints, make the thoracic region more susceptible to painful joint restrictions, including the facet syndrome.

With a segmental hypomobility in the thoracic region, careful manual evaluation, particularly end-feel testing, reveals a characteristic mobility restriction between two vertebrae. Local symptoms center on the affected vertebral joint, usually with tight and painful paravertebral musculature on the involved side. Associated symptoms can also include pain in the corresponding intercostal area, hyperesthesia in the area of the associated dermatome, dominant pain in the anterior aspect of the thorax, and antalgic postures.

Injuries to the thoracic spine can produce a painful segmental hypomobility in both children and adults. However, patients over the age of fifty become more susceptible to thoracic segmental hypomobility as a result of the degenerative changes common in this age group (e.g., osteochondrosis or spondylosis). Thoracic symptoms can be aggravated when older patients become bedridden, alarming both the patient and the health care provider because the associated severe pain and dyspnea can raise suspicions of heart or pulmonary involvement. The OMT evaluation revealing a painful segmental restriction can be critical to the differential diagnosis in these cases. A successful trial treatment of specific mobilization techniques can confirm the therapist's tentative diagnosis.

Painful thoracic joint syndromes can be mistakenly attributed to intercostal neuralgia or myogenic syndromes, even if local pain persists in the involved area of the spine. The characteristic radiating pain associated with thoracic segmental dysfunctions, if dominant, can also mimic internal organ diseases, making differential diagnosis in the thoracic region difficult. Many internal organs share a common innervation with the thoracic spine, so symptoms can be similar with heart, gallbladder, nephrolithiasis, appendicitis, and thoracic spinal disorders. The terms *pseudoangina pectoris, pseudodyskinesia*, and *pseudo-appendicitis* are used to describe these diagnostic problems.

In a 1963 study, Bechgaard compared hospital admission diagnoses with discharge diagnoses in seventy-five patients with thoracic segmental pain syndromes (Table 1). The admission diagnoses all related to visceral disorders. However, in 85 percent of these cases, symptoms were permanently relieved with mobilization, local anaesthetic injection, or traction tests, and the discharge diagnosis was changed to segmental pain syndrome.

Table 1
Hospital admission diagnoses with cases of thoracic segmental pain syndrome

Diagnosis	*Number of cases*	*Effective Treatment*		*Positive thoracic x-ray*
		Anesthesia	*Mobilization*	
Angina Pectoris	8	2	5	1
Coronary Artery Thrombosis	5	1	3	
Heart Disease	10	2	4	4
Hyperventilation	5		5	
Pneumothorax	1			
Dyspnea	9	2	7	2
Gall Bladder	8	3	4	3
Kidney Disease	1	1		1
Chest Pain	28	1	24	5
TOTALS	**75**	**12**	**52**	**16**

1 *Manipulation av Ryggraden*, Läromedelsförlagen, Scandinavien University Books, 1972

The "facilitated segment" phenomenon further confuses attempts to distinguish between visceral and somatic problems, especially in the thoracic spine. Any irritation within structures that share nervous innervation may decrease the pain threshold in the related vertebral segment. For example, not only can irritation of a thoracic nerve root mimic symptoms of angina pectoris, but actual angina pectoris with symptoms in the thorax, shoulder, and arm can irritate the thoracic spine (via a facilitated segment) and cause or aggravate problems there. Angina pectoris symptoms may even be temporarily relieved with thoracic mobilization.

Movement restrictions in the costovertebral and costotransverse joints are difficult to differentiate from other segmental syndromes. If the symptoms are of articular origin, pressure applied to the rib or movement of the rib in a cranial or caudal direction increases symptoms. Older people who have been bedridden for a period of time and athletes often exhibit these costal syndromes. In extreme cases, the severity of the pain may require the patient to be hospitalized.

Tumors in the thoracic spine may irritate a thoracic nerve root and produce symptoms similar to segmental dysfunction.

■ Lumbar syndromes

Lumbar spine syndromes simultaneously affecting a disc and facet joints are frequently seen by manual therapists. In addition to the more common disc, synovial joint, and nerve root pathologies, the lumbar spine is also susceptible to facet joint blocking by the meniscoids and to disc joint irritation by microrupture of the annulus. The movement restrictions and antalgic postures associated with these conditions stem both from irritation of free nerve endings within the injured lumbar structures themselves and from pressures and irritation secondary to swelling and inflammatory exudate from neighboring injured tissues.

Acute low back pain, or lumbago, originating from a lumbar segment, is often misdiagnosed as a muscle sprain or spasm, because pain is localized in the paravertebral musculature. However, any spasm or increased tension of the back extensor musculature would create or emphasize a lumbar lordosis, and most cases of acute low back pain are associated instead with a flattened or kyphotic lumbar curvature with an antalgic lateral shift.

Acute low back pain often recurs and can progress to a chronic lumbar dysfunction associated with degenerative discs and nerve root involvement. With nerve root involvement, patients describe varying forms of lower extremity pain and paraesthesia. These symptoms must be differentiated from pseudoradicular pain of visceral origin. Visceral pain that mimics a nerve root problem and refers pain into the lower extremities is unlikely to benefit from mobilization treatment.

■ Neurologic evaluation of nerve root syndromes

The differential diagnosis of nerve root syndromes requires a working knowledge of the innervation patterns of the spinal nerve roots (including dermatomes, myotomes, and sclerotomes) and the peripheral nerves. Normal anatomical variations and overlapping patterns of segmental innervation require testing not only the key muscles and dermatomes in the suspected spinal region, but also the key muscles and dermatomes in the spinal segments above and below the suspected lesion. We recommend that the practitioner use the following reference charts on innervations and the more common nerve root syndromes as a guide to the neurologic evaluation of patients with suspected nerve root involvement.

■ Sensory innervation of the skin

When testing for sensory paraesthesias, the manual therapist differentiates patterns of peripheral nerve innervation from segmental cutaneous innervation (dermatome). Figure 7.1 and Figure 7.2 demonstrate the overlap between these multiple sources of cutaneous innervation. When a patient reports diffuse sensory disturbance there can be a significant amount of dermatomal overlap. Patterns of peripheral innervation are more clearly delineated.

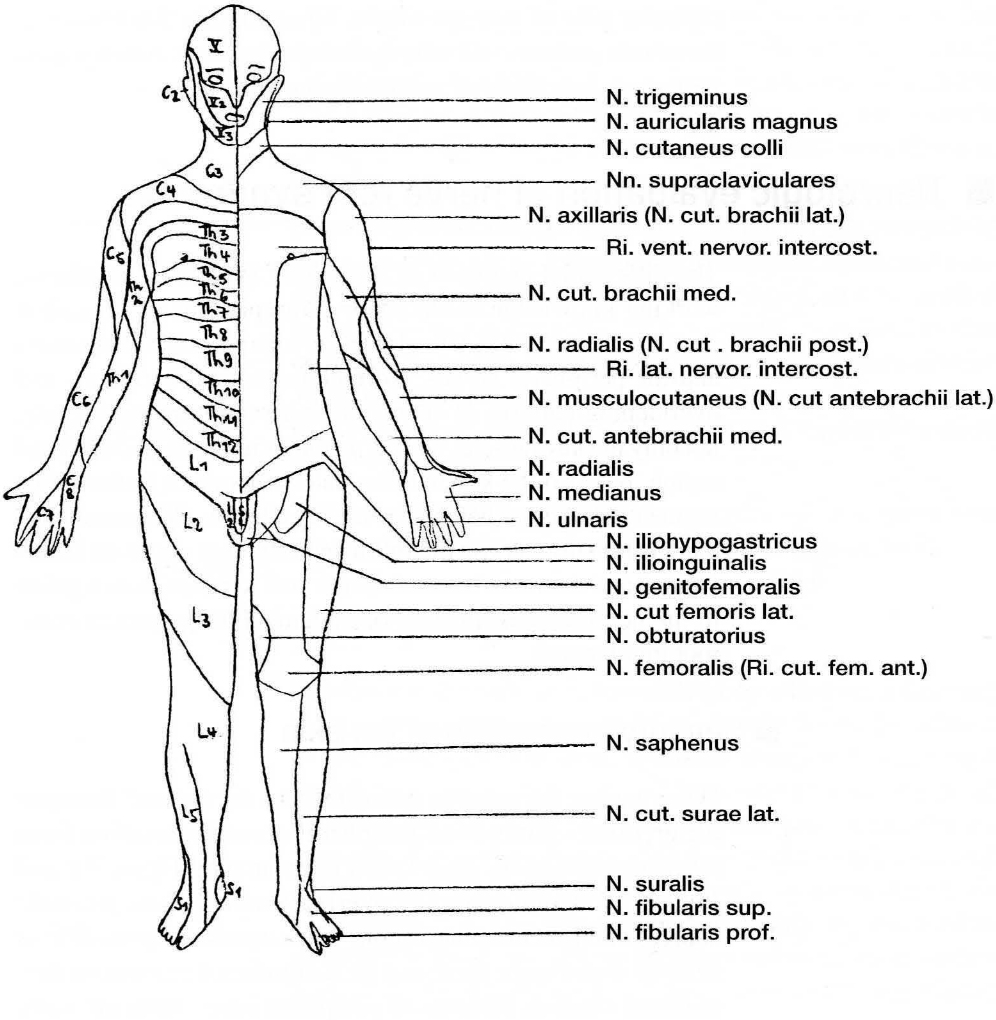


Figure 7.1
Dermatomes and peripheral innervation of the ventral side of the human body

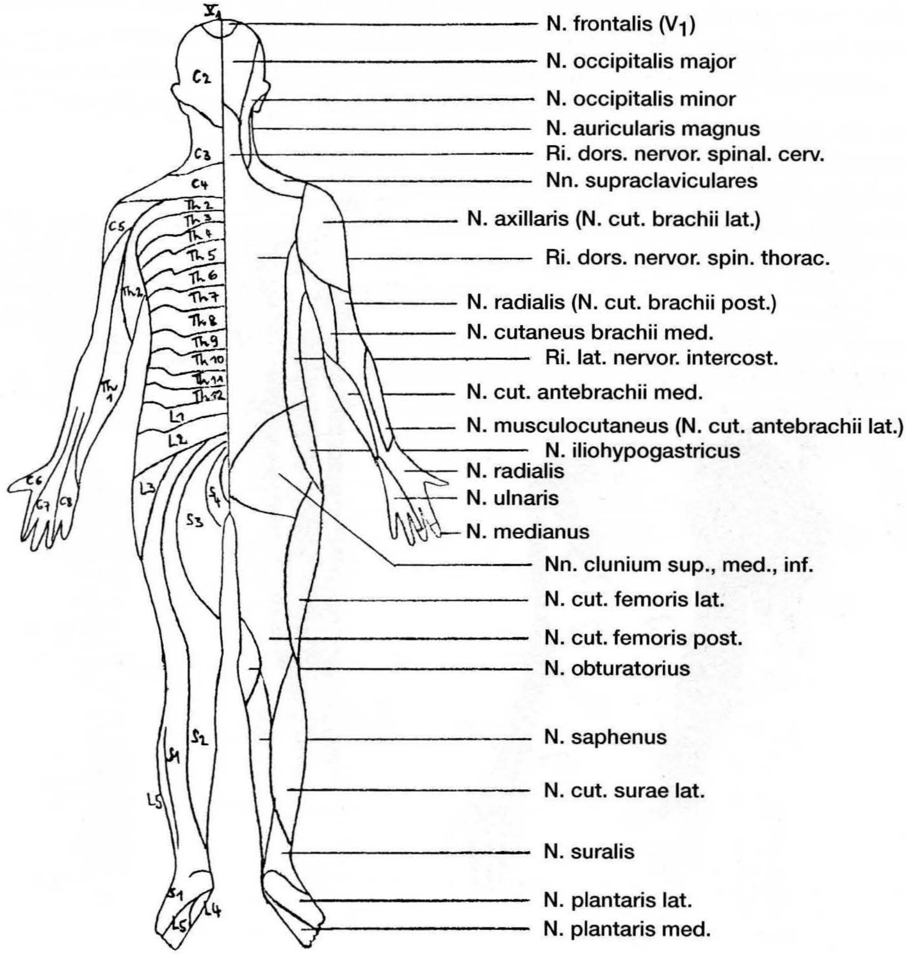


Figure 7.2
Dermatomes and peripheral innervation of the dorsal side of the human body

■ Sensory innervation of deep structures

The segmental innervation of muscles (myotome), ligaments, and the periosteum (sclerotome) often differs from segmental cutaneous innervation (dermatome), especially in the extremities, the shoulder girdle, and the pelvis. For example, at the inferior angle of the scapula, the periosteum, the vascular supply, and the muscles are innervated by C8 (Figure 7.3) while the overlying skin is innervated by the T6 and T7 nerve roots (Figure 7.2).

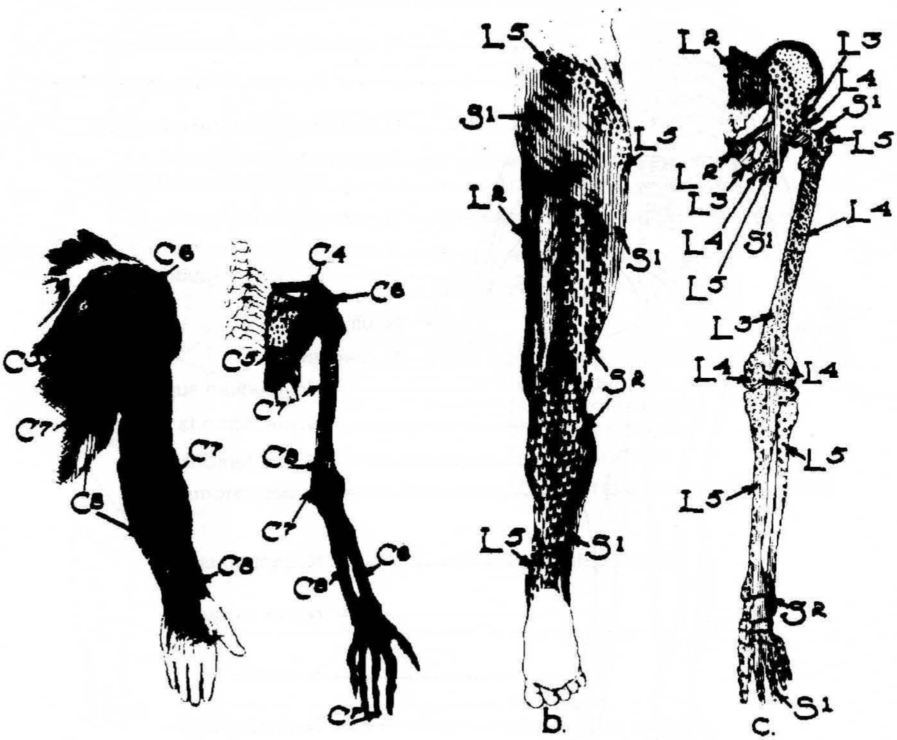


Figure 7.3
Myotomes and sclerotomes of the right upper extremity with the shoulder girdle and the right lower extremity, dorsal view (from Inman and Saunders, 1944)

■ Motor innervation

In the presence of motor loss, the manual therapist first determines whether the weakness is of peripheral or central origin. Monoradicular lesions are distal to the ventral horn and therefore can only be flaccid (not spastic). These paresis can be differentiated with the use of manual muscle testing, evaluation of muscle atrophy, and electromyography or chronaximetry.

Almost all muscles in the body, even the smallest, are innervated by more than one nerve root. Those muscles innervated **mainly** by one root are the key muscles most useful in the evaluation of spinal nerve root lesions. Any loss of function or atrophy in a key muscle implicates a possible nerve root lesion at a particular spinal segment.

Monoradicular loss can also present with atrophy of certain small distal muscles of the extremities, indicating that the remaining nerve root(s) involved in innervation of this muscle cannot offset the weakness caused by the involved nerve.

■ Common nerve root syndromes

Table 2: Cervicothoracic nerve root syndromes

Root	Key Muscle(s)	Reflex	Dermatome
C1	Intrinsic upper cervical flexors and extensors between O-C1		
C2	Intrinsic upper cervical rotators between C1-C2		Posterior head
C3	Scaleni		"Shawl"
C4	Diaphragm		"Epaulets"
C5	Biceps brachii Infraspinatus and supraspinatus	Biceps tendon reflex	Shoulder and lateral side of upper arm
C6	Brachioradialis Wrist extensors	Brachioradialis reflex Radialperiosteal reflex	Forearm (radial side) Thumb and index finger
C7	Triceps brachii Wrist flexors Finger extensors Abductor pollicis brevis Opponens pollicis	Triceps tendon reflex	Forearm (dorsal side) Middle and index finger
C8	Flexor digitorum Adductor pollicis Abductor digiti minimi	Thumb reflex	Forearm (ulnar side) Small and ring fingers
T1	Interossei		Arm (medial side)

Table 3: Lumbosacral nerve root syndromes

Root	Key Muscle(s)	Reflex	Dermatome
L1-2	Cremaster	Cremasteric reflex	Waist "backbelt"
L2-3	Hip adductors	Adductor reflex	Ventral thigh down to the knee
L4	Tibialis anterior Quadriceps (vastus medialis)	Patellar tendon reflex	Medial side of lower leg down to the malleolus
L5	Extensor hallucis longus Extensor digitorum longus and brevis Tibialis posterior	Tibialis posterior reflex Semitendinous reflex	Dorsal foot Big toe
S1	Peroneals Triceps surae (primarily gastrocnemius, medial)	Achilles tendon reflex	Lateral foot and sole Small toe

TECHNIQUES

■ Common nerve root syndromes

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C6	Brachioradialis Wrist extensors	Brachioradialis reflex Radial periosteal reflex	Forearm (radial side) Thumb and index finger
C7	Triceps brachii Wrist flexors Finger extensors Abductor pollicis brevis Opponens pollicis	Triceps tendon reflex	Forearm (dorsal side) Middle and index finger
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L5	Extensor hallucis longus Extensor digitorum longus and brevis Tibialis posterior	Tibialis posterior reflex Semitendinosus reflex	Dorsal foot Big toe
S1	Peroneals Triceps surae (primarily gastrocnemius, medial)	Achilles tendon reflex	Lateral foot and sole Small toe

8 Technique principles

■ Learning manual techniques

It takes years of study and practice to achieve mastery in Orthopedic Manual Therapy. Just as with mastery of a musical instrument, the theory and basic technique can be learned quickly, but it takes years of practice to play well.

Practitioners new to manual therapy are often dangerously heavy-handed. It may take much practice before a practitioner can reliably sense when they are approaching the first stop and can accurately sense the end-feel. To attempt a Grade III stretch-mobilization before mastering this skill runs the risk of injuring the patient or student practice partner with overstretching or unwanted compression forces.

Novice practitioners should first master test techniques, especially Grade I and II movements, before attempting Grade III stretch-mobilization techniques. When practicing mobilization on asymptomatic subjects, we recommend students use only within-the-slack Grade II mobilization forces to avoid tissue injury or joint overstretching.

One cannot learn orthopedic manual therapy from books and classroom teaching alone. Students must take the time to observe the intricacies and effectiveness of treatment delivered by a master clinician and must work to develop their own manual skills in a supervised clinical setting with real patients.

Learning specific manual mobility testing in the spine

Segmental movement tests are an excellent method for monitoring change in a patient's physical status and for assessing a patient's response to treatment. But the technique is only as good as the therapist using it. The skill to feel and judge specific vertebral movements takes time, talent, and frequent practice.

We find that the practice of soft tissue treatments, especially functional massage, helps develop passive movement skills. After some time working with soft tissues, you will begin to feel the presence of bones and joints beneath the soft tissues and how these structures move. Later you will develop the ability to judge how much these structures move in relation to each other and whether the quality of movement is normal.

Applying manual techniques

A written description of a manual technique cannot adequately address the many nuances in patient handling that are critical to effective practice. For this, supervised clinical practice is essential. However, certain principles are prerequisite to the skilled application of manual techniques. Application of these principles will ensure efficient and safe use of the therapists's body and effective treatment for the patient.

Variations in functional joint anatomy

Generally, if joint play end-feel is normal, the joint is normal, regardless of asymmetries or deviations from established norms in range or direction of movement.

There is considerable normal anatomical variation from individual to individual, and considerable asymmetry from one side of the body to the other within an individual. The skilled OMT practitioner makes treatment decisions primarily on the basis of abnormal quality of movement, not on printed norms for movement.

For example, during joint play testing of the acromioclavicular joint you may discover that the concave joint surface of the acromion faces more medially on one side of the body and faces more laterally on the other side of the body. Or you may discover that, while your patient's total range of cervical rotation is within established norms, there is 10° more right rotation than left rotation, both with *normal end-feels*. Such findings are likely the result of asymmetrical orientations of the facet joints, rather than joint pathology. Years of participation in an activity which is asymmetrical can also lead to asymmetrical adaptations in anatomical structure, for example, in sports such as tennis, golf and javelin throwing.

If joint play end-feel is normal in all directions, the joint is normal, regardless of asymmetries or deviations from established norms in range or direction of movement.

■ Objective

The difference between a joint testing technique and a joint treatment technique is not always obvious. Joint play testing techniques can also be applied in the resting position as gentle Grade I and II traction mobilizations for pain relief or relaxation. Grade III stretch-mobilization techniques can sometimes also be used for symptom localization and end-feel testing.

With changes in grip, fixation, and positioning, many joint mobilizations can be adapted for use as a test, as a treatment for pain relief and relaxation, or as a stretch-mobilization. In addition, with changes in joint position the effect of the test or treatment can be much more specific. In the following chapters, we suggest the best application for each technique in its title:

» **"Test"** indicates that the technique is usually used for testing only. We illustrate linear, translatoric tests with straight arrows and rotatoric tests with curved arrows. We also indicate whether the objective of the test is for "mobility and symptom screening" or to "evaluate segmental range and quality of movement, including end-feel" using Grade I, II, and III movements.

» **"Test and mobilization"** indicates that the technique can be used for testing joint play (Grade II), for traction pain-relief mobilization in the resting position (Grade I and IISZ), for relaxation (Grade I through IITZ), and also for stretch-traction mobilizations (Grade III). Both test and mobilization procedures usually use the *same grip*.

» **"Test and stretch mobilization"** indicates that the technique is recommended both for testing joint play (Grade II) and for stretch-mobilizations (Grade III) with *manual* fixation. Both test and mobilization procedures usually use the *same grip*.

» **"Stretch mobilization"** indicates that the technique is adapted with *alternate grips*, locking techniques, or stronger fixation (for example, with straps) for more effective stretch-mobilizations (Grade III). Stretch mobilizations are generally applied with the joint pre-positioned outside the resting position as far as the restriction allows.

The technique objectives outlined in this basic book are guidelines only. Skilled practitioners will adapt and modify the techniques as the patient's condition and treatment goals dictate.

■ Starting position

Patient's position

Techniques should be applied in a sequence that is efficient and requires a minimum of patient repositioning.

First, place the patient's body in a position of comfort to encourage relaxation and minimize muscle tension, then position the specific joint(s) to be mobilized.

For most evaluation and basic mobilization techniques, position the patient so that the involved joints are in the resting position or in the actual resting position. In these positions the muscles surrounding the involved joint usually also relax. However, repeated trials may be necessary to find the best starting position, for example, the actual resting position for pre-positioned pain-relieving, three-dimensional traction.

» **If the patient is in a standing position** the feet should be somewhat separated and parallel to each other for stability.

» **If the patient is in a sitting position** the feet should be supported on the floor to contribute to the stability of the body necessary for proper positioning of the spine during evaluation and treatment.

» **If the patient is prone** it is usually necessary to place an appropriately sized pillow under the patient's stomach (even if the patient has a protruding abdomen) to position the lumbar spine in the resting position. A pillow may also be necessary under the thorax to maintain a resting position there. In some cases it is necessary to lower the head piece of the treatment table in order to achieve a resting position and adequate muscle relaxation in the spine.

The head piece of a manual therapy treatment table should have an opening for the patient's nose and mouth so they need not rotate their necks in order to breath. Cervical rotation both increases tension of the cervical muscles and influences movement in the rest of the spine.

» **If the patient is sidelying** the hip and knee joints should be flexed to provide stability. In sidelying, the patient's position should approximate the normal spinal curvatures observed in standing. The therapist should also monitor spinal position from the patient's posterior side (in the frontal plane). In many cases, especially with females with a broad pelvis, it is necessary to place a pillow or a roll under the patient's waist to control spinal sidebending.

» **If the patient is supine** the patient's head should be supported directly by the table or by a pillow, and the patient's legs should be slightly abducted and relaxed. In order to position the lumbar spine in the actual resting position, it may be necessary to place a pillow under the patient's knees, to have the patient in a hooklying position, or to place a positioning pillow under the lumbar area.

The therapist must often modify some other positions to accommodate the characteristics and flexibility of individual patients. For example, if the recommended treatment position asks the patient to "fold the hands behind the neck," the patient should lift the elbows as high as possible and attempt to lace the fingers behind the neck. Patients with short arms or stiff shoulders who are not able to assume this posture may place their hands to the sides of the neck or head instead. The same limitation may apply to the recommended position "hands grasp opposite shoulders." In this case, the patient may only have adequate range to grasp the opposite arms.

Therapist's position

It is important that you assume an ergonomically and biomechanically sound posture as close as practical to the patient. Such a posture requires a wide base of support, flexed hips and knees, and natural lumbar lordosis. Adjust the height of the treatment table to ensure efficient and effective body mechanics.

■ Hand placement and fixation/stabilization

During most basic joint test and mobilization techniques, you move one hand with the patient's body and keep the other hand stable for palpation, stabilization (i.e., minimizing movement in adjacent joints) or fixation (i.e., preventing movement in one joint partner). Both your moving hand and your palpating/stabilizing hand monitor the quality and quantity of movement.

The skilled manual therapist should be able to perform stabilizing/fixating and moving/mobilizing functions equally well with either hand, from either side of the patient. The techniques in this book are accompanied by photographs (figures) that show a technique after it has been performed, i.e., in the terminal position. To perform the same technique on the opposite side of that shown in the picture, simply stand on the opposite side of the patient and switch your stabilizing and moving hands. Students should practice testing and mobilization techniques on both sides to train both hands for both functions.

Grip

Grips for testing maneuvers and gentle Grade I and II mobilizations differ from grips for longer duration stretch-mobilizations. Grips for testing and gentle mid-range mobilizations use a smaller contact surface, sometimes using only your fingers for the grip. Grips for longer duration stretch-mobilizations use the broader contact surfaces of your hand along with more efficient therapist body mechanics and stronger fixation. In larger joints the grip may be reinforced with straps or your body.

The less contact pressure the manual therapist uses, the more sensitive the therapist's hands are for monitoring movement quality. Excessive pressure not only masks feedback about movement quality, but can distort the movement. Since only a small degree of movement is available at any individual spinal segment, excessive contact pressure can produce movement throughout the spinal kinetic chain and result in a loss of stabilization at neighboring segments.

In practice, a well-placed grip close to the joint space of two adjacent joint partners, can also produce a Grade I traction sufficient to neutralize, or decompress, the joint and thus facilitate the test or mobilization procedure.

Modify and adjust your grip for patient comfort. For example, it may be necessary to push aside sensitive soft tissue structures such as nerves, muscles, or tendons. Or you may need to adjust your grip away from tender bony prominences.

Therapist's stable hand

With many mobilization techniques, the therapist keeps one hand stable while the other moves. Your stable hand provides fixation and is usually positioned just proximal to the joint space. The fingers of your stable hand are also used to palpate the joint space. It is much easier to palpate movement in a joint if your palpating finger is stable and not moving.

During most specific passive joint function tests and some mobilizations, your stable hand palpates with one finger, for example, at the targeted spinal segment. If necessary, the rest of your hand *stabilizes* neighboring structures, for example, adjacent spinal segments. Many therapists use the index finger as the palpating finger (as illustrated in this book), but individual therapists may find another finger more sensitive or more comfortable to use. (In this text, an **"X"** on the techniques figures identifies the therapist's stable hand.)

The **palpating finger** is positioned at the targeted joint space with contact to both joint partners. The most commonly used contacts for movement palpation in the spine are:

Occiput	—>	mastoid process
Atlas	—>	posterior vertebral arch & transverse process
Cervical Spine (C2 - C7)	—>	facet joints and spinous processes
Thoracic Spine	—>	spinous processes
Lumbar Spine	—>	spinous processes
Sacroiliac Joint	—>	sacral sulcus

When testing spinal flexion and extension, place your palpating finger between the spinous processes from the posterior side. Your palpating finger monitors spinous process separation with flexion and monitors approximation with extension. During combined movement testing with a rotation or sidebending component, your palpating finger is placed on the lateral side of the spinous processes. The side of choice is the side to which the spinous processes are moving during that particular movement; for example, with right rotation, your palpating finger is placed to the left of the spinous processes.

When testing end-feel, slightly increase the contact pressure in your stable hand, and if necessary the forearm of your stable hand, to fixate one joint partner. Stabilize neighboring joints by increasing the contact area of your grip. With adequate fixation, an end-range test technique can be used as a specific Grade III mobilization.

Fixation is an important component of specific Grade III stretch mobilization techniques, which are performed slowly and sustained for longer periods of time. The fixating action of your hand can be enhanced with the use of locking techniques (see Joint locking, page 23) which position adjacent spinal segments so that they will be unable to follow the movement. Fixation can also be supplemented with wedges, belts, and other external fixating devices. External fixating devices are usually not necessary for specific movement testing because these tests use such short duration, small movements.

Therapist's moving hand

With smaller joints, your mobilizing hand grips the joint partner to be moved as close to the joint space as possible. With larger joints, both your hands and body may move together to apply the movement while fixation is provided by a strap or wedge.

Your moving hand performs the testing or treatment procedure. This hand should be placed as specifically as possible (e.g., "place your small finger against the arch of the atlas") so that the movement occurs as specifically as possible at the targeted segment or tissue.

■ Procedure

Joint pre-positioning

A uniaxial joint can be pre-positioned within one plane of movement; a biaxial joint in two planes; and a triaxial joint in three planes.

For the best effect and to avoid pain, carefully pre-position the spinal segment prior to applying a test or treatment procedure. Pre-positioning is achieved with a rotatoric movement, indicated by a curved arrow in the illustrations which follow. In contrast, the mobilization technique itself is applied as a very short, linear movement.

Effective spinal segment pre-positioning depends on joint pathology, the patient's symptoms, and the desired effect of the treatment.

If the intent of the technique is pain relief or relaxation, begin treatment in the actual resting position. As the condition tolerates, reposition the joint nearer to the resting position.

If the intent of the technique is stretching, the spinal segment can be positioned three-dimensionally anywhere within the available range-of-motion. Begin in the resting position and progress toward the restriction outside the resting position. The closer the joint position to the limit of movement, the more effective – and risky – the technique.

Pre-positioning cannot be based solely on established norms or typical movement patterns, as actual patient joint characteristic can vary widely. Even coupled (for maximal movement) and noncoupled (for minimal movement or joint locking) patterns can vary between patients. Be sure to carefully assess coupled and noncoupled movement patterns for each joint and in each patient if you plan to use them.

Mobilization technique

Mobilization techniques should be performed slowly, so that the patient may interrupt treatment at any time. Vary the speed and rhythm of the test movement or mobilization for best effect.

- **For joint play testing including end-feel** (Grade I, II or III), move slowly and ease into the Grade III range;
- **For pain relief** (Grade I - IISZ), use oscillations or slow, repetitive, intermittent traction movements, staying well short of the Transition Zone;
- **For relaxation** (Grade I - IITZ), apply slow intermittent traction mobilizations, staying well short of the First Stop;
- **For stretching** (Grade III), apply linear traction or glide movements even more slowly and sustain each stretch for at least 30 - 40 seconds, ideally a minute or more. For the longest lasting effect, repeat the stretch in a cyclic manner for a 10 - 15 minute session or to patient tolerance. Note that home exercise is usually necessary to maintain the mobility gains.

During stretch-glide mobilizations, apply a simultaneous Grade I traction to facilitate the gliding and reduce joint compression. Even in cases where it is very difficult to sustain a simultaneous Grade I force during a glide-mobilization it is important to sustain as much decompression in the joint as possible, for as long as possible.

Use sound ergonomic principles. Stand close to the patient with your feet apart to maintain a solid base of support. Use gravity and your body weight to generate forces whenever possible.

In a specific spinal manual therapy procedure, the therapist attempts to produce movement primarily in the targeted segment or tissue and avoids unnecessary movement in neighboring structures. Spinal segmental tests start with the targeted segment in a pain-free or resting position. After testing, return that segment to the initial resting position so the next segment can be evaluated in its resting position.

The patient's movement is produced and controlled not only through by hand movement but also through your body movement. (In the techniques figures presented in this book, an arrow indicates the direction of movement.) Move your own body around an axis of motion in the targeted spinal segment or tissue. This requires that you have a thorough understanding of spinal axes of movement and the physical capacity to accurately perform a specific movement.

A common error of novice manual therapists is to stand still and use only their hands and arms to move the patient. This creates an axis of movement between themselves and the patient and reduces or distorts movement at the targeted segment or tissue. Since accurate palpation of movement quantity and quality depends not only on the sensitivity of the therapist's palpating hands but also on the specificity with which a movement is produced, novice manual therapists must practice and perfect their own body movements before they can accurately evaluate and effectively treat with specific manual therapy techniques.

For some sidelying techniques, you must lift the part of the patient's body to be moved or place it off the edge of table to avoid friction against the treatment table.

Therapist safety and treatment effectiveness are further enhanced by:

» Diligent use of body mechanics to protect your body from the rigors of long hours of manual therapy practice (e.g., by absorbing movement forces through your legs rather than through your back).

» Adjustable treatment tables, fixation belts, sand bags, wedges, and other ergonomic and patient positioning aids. Such assistive devices are frequently used in our system.

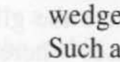
» Allowing the patient to assist a "passive" movement actively. This lessens the effort exerted by the manual therapist to produce and control a particular movement, but can only be used if the patient can assist without creating muscular tension at the segment targeted for evaluation or treatment.

Symbols

In the photographs which describe each technique in this book, we use the following symbols:

X = Fixation or stabilization

→ = Direction of linear movement (testing and treatment)

 = Direction of rotatoric movement (testing and pre-positioning prior to linear treatment)

Recording

Documentation of specific evaluation findings, manual treatment techniques, and ongoing changes in patient status can become cumbersome without the use of special symbols, shorthand, or abbreviations. Following are some examples of timesaving documentation methods especially applicable to OMT practice.

Identifying an intervertebral segment

When identifying an intervertebral segment, we often name only the cranial vertebra (e.g., C2 identifies the C2-C3 mobile segment, and C2 movement is movement between C2 and C3). When describing the *direction* of segmental movement, we describe the movement in terms of the cranial vertebra in relation to its adjacent caudal vertebra. Even when the cranial vertebra is fixated and the caudal vertebra is moved, the movement is still described as a "relative" movement of the cranial vertebra. For example, when the cranial vertebra (C2) is fixated and the caudal vertebra (C3) is rotated to the right, we describe the movement as left rotation of C2.

The Star Diagram

The "star diagram" is a useful shorthand for recording certain specific evaluation findings and treatment directions in the spine. This method of recording uses a combination of longer lines which form the star (star lines), shorter lines crossing the star lines (cross lines), and arrows. Many clinicians keep a rubber stamp of the star diagram handy for conveniently updating patient records.

Figure 8.1
Star diagram

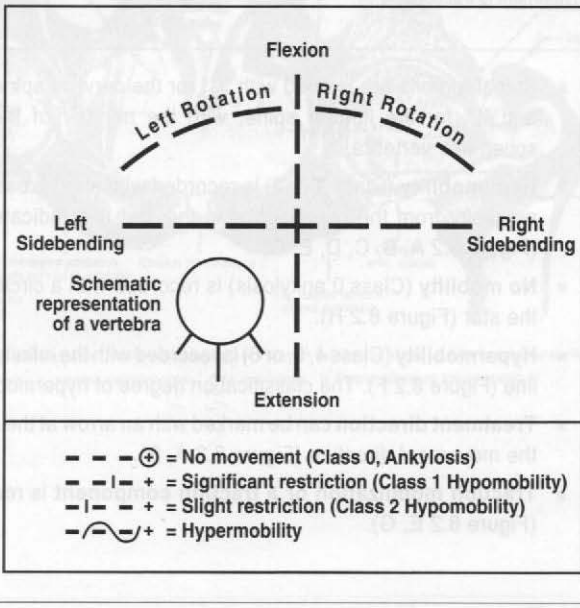
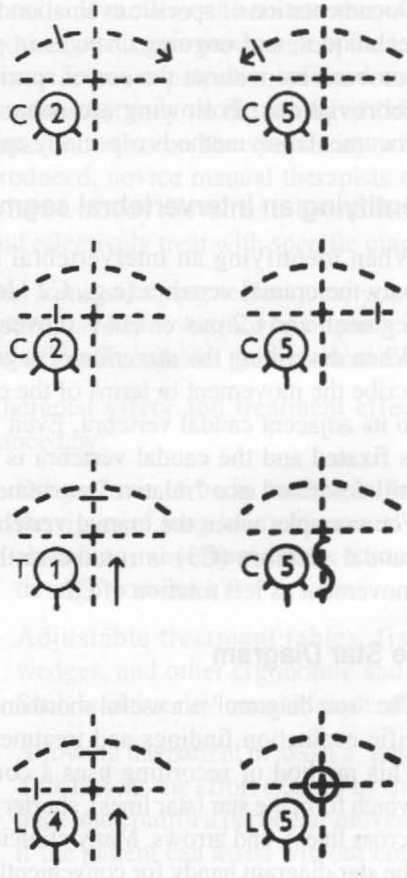


Figure 8.2
Star diagram examples



A
C2 in relation to C3 is significantly restricted (Class 1 hypomobility) into left rotation. Linear treatment is in the opposite ("free") direction.

B
C5 in relation to C6 is slightly restricted (Class 2 hypomobility) into left rotation. Linear treatment is in the same direction.

C
C2 in relation to C3 is significantly restricted (Class 1 hypomobility) into left sidebending.

D
C5 in relation to C6 is slightly restricted (Class 2 hypomobility) into right sidebending.

E
T1 in relation to T2 is significantly restricted (Class 1 hypomobility) into flexion. Treatment is traction.

F
C5 in relation to C6 is hypermobile (Class 4 or 5 hypermobility) into extension.

G
L4 in relation to L5 is significantly restricted (Class 1 hypomobility) into flexion and slightly restricted (Class 2 hypomobility) into left sidebending. Treatment is traction.

H
L5 in relation to the sacrum has no movement (Class 0 ankylosis, e.g., sacralization).

- Spinal regions are labeled with "C" for the cervical spine, "T" for the thoracic spine, and "L" for the lumbar spine, with the number of the segment written into the schematic vertebra.
- **Hypomobility** (Class 1 or 2) is recorded with short cross lines situated such that the proximity from the center point in the star line indicates the degree of restriction (Figure 8.2 A, B, C, D, E, G).
- **No mobility** (Class 0 ankylosis) is recorded with a circle around the center cross of the star (Figure 8.2 H).
- **Hypermobility** (Class 4, 5, or 6) is recorded with the infinity symbol on the indicated star line (Figure 8.2 F). The classification degree of hypermobility can also be noted here.
- **Treatment direction** can be marked with an arrow at the end of the star line indicating the movement direction (Figure 8.2 A, B).
- **Traction mobilization or a traction component** is recorded with a vertical arrow (Figure 8.2 E, G).

9 Pelvis

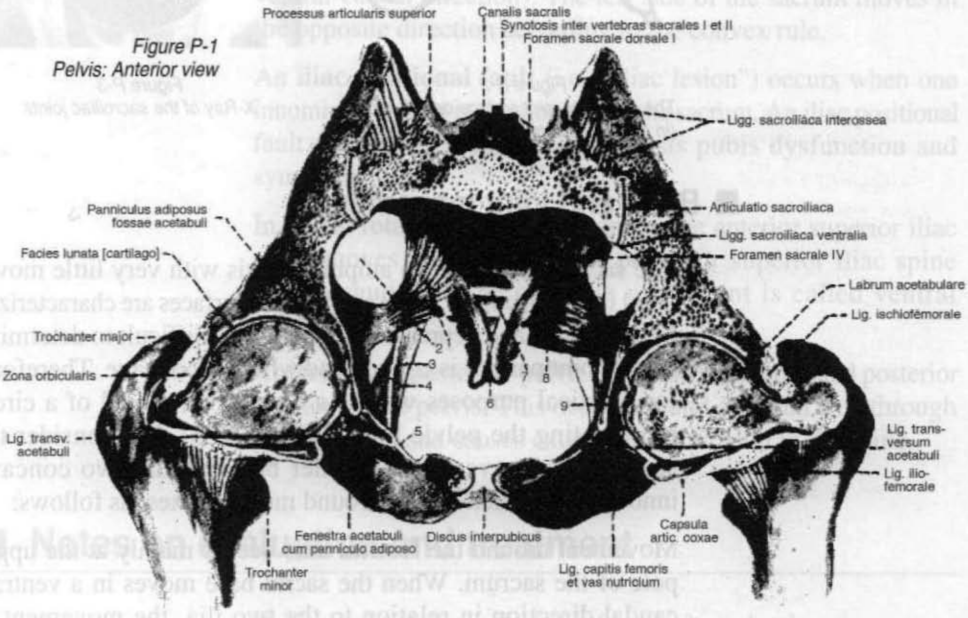
Functional anatomy and movement

Anatomy

The pelvis is a bony ring formed by the **sacrum** and **two innominate bones** (Figure P-1). Each innominate consists of three parts: the **ilium**, the **ischium**, and the **pubis**. The innominates articulate anteriorly to form the symphysis pubis, and posteriorly with the sacrum to form the sacroiliac joint amphiarthroses.

Portions of the ilium, ischium, and pubis form the acetabulum. It articulates with the femur at the hip joint. The iliofemoral, pubofemoral, and ischiofemoral ligaments reinforce the hip joint capsule and connect each innominate with the femur.

Figure P-1
Pelvis: Anterior view



The sacrum articulates with L5 at the lumbosacral junction. The iliolumbar ligament connects the iliac crest with the transverse processes of L5 and/or L4. The cranial aspect of the sacrum (at the lumbosacral junction) is called the base, and the caudal aspect (at the sacrococcygeal junction) is called the apex.

The sacroiliac joint surfaces are usually L-shaped (Figure P-2), with the cranial aspect (superior pole) oriented in a dorsal-ventral direction and the caudal aspect (inferior pole) in a cranial-caudal direction. There is significant individual variation in sacroiliac joint structure and function. In some people, the superior pole is longer than the inferior, or the opposite may be true. Sometimes the shape of the sacroiliac articulation more closely approximates the letter C.

Figure P-2
The sacroiliac joint surface on the sacrum (in prone position, adapted from Kapandji)

Figure P-3
X-Ray of the sacroiliac joints

■ Bone and joint movement

The sacroiliac joint is an amphiarthrosis with very little movement (perhaps only 1° or 2°) and its joint surfaces are characterized by elevations and depressions that make it difficult to determine which joint partner is convex and which is concave. Therefore, for practical purposes we use a conceptual model of a circle representing the pelvic bones (Figure P-3). We consider the sacrum the convex joint partner between the two concave innominates which moves around multiple axes, as follows:

Movement around the **frontal axis** occurs mainly at the upper pole of the sacrum. When the sacral base moves in a ventral-caudal direction in relation to the two ilia, the movement is called **nutation**. The opposite movement of the sacral base in a dorsal-cranial direction is called **counter-nutation**.

Movement around the **sagittal axis** occurs mainly at the lower pole of the sacrum and is called **lateral flexion** to the right and left. During lateral flexion to the right, the right upper pole of the sacrum (point 3 in Figure P-4) moves caudally, and the left pole (point 2 in Figure P-4) moves cranially. (The coccyx moves to the left.)

Movement around the **vertical (longitudinal) axis** occurs mainly at the upper pole of the sacrum and is described as **right and left rotation**. When the right side (point 3 in Figure P-4) moves ventrally, the left side (point 2 in Figure P-4) moves dorsally.

A **sacral positional fault** (i.e., "sacral lesion") involves both sacroiliac joints without movement of the innominates relative to each other. Therefore, there is no associated dysfunction or symptoms at the symphysis pubis.

One type of sacral positional fault is called sacral ventralization and caudalization. This commonly occurs after a fall on an ischial tuberosity. With a fall on the right ischial tuberosity, the forces transmitted through L5 push the sacrum into right lateral flexion and left rotation. This results in ventral-caudal movement of the sacral joint surface (point 3 in Figure P-4 moves in a ventral-caudal direction). The left side of the sacrum moves in the opposite direction according to the convex rule.

An **iliac positional fault** (i.e., "iliac lesion") occurs when one innominate moves in relationship to the sacrum. An iliac positional fault commonly results in symphysis pubis dysfunction and symptoms.

In dorsal rotation of the innominate, the anterior superior iliac spine moves cranially and the posterior superior iliac spine moves caudally. The opposite movement is called ventral rotation.

Anterior and posterior pelvic tilt involves anterior and posterior rotation of the pelvis. This occurs around a frontal axis through the hip joints and causes extension and flexion in the spine.

■ Notes on evaluation and treatment

During general musculoskeletal and gait evaluation, movement occurs simultaneously in the lumbar spine, pelvis, and hip (this body region is sometimes referred to as LPH). A movement dysfunction in one of these joints can produce dysfunctional movement in the other joints, making it difficult to differentiate

Pelvis

Pelvis

the structures primarily involved. In addition, lumbar lesions often refer pain into the sacroiliac joint and hip areas, further complicating physical diagnosis. In order to confirm a lesion in the sacroiliac joint, the practitioner must rule out hip joint and lumbar spine involvement.

Specific examination of the sacroiliac joint requires a functional evaluation, including passive localization tests. Specific functional tests are also necessary to determine if a sacroiliac joint is hyper- or hypomobile. (The "lifting" test, Pelvis Technique Figure 5, is especially useful to screen for mobility status.) Tests performed in weight-bearing positions are important, because some sacroiliac joint lesions can only be detected in this position.

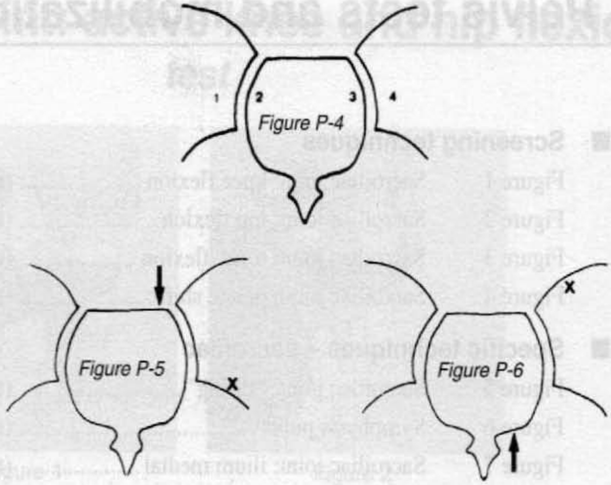
With positional faults, mobilization direction is determined more by symptomatic response to mobility testing than by palpation findings. If the testing force decreases the positional fault, symptoms usually decrease. If the testing force increases the positional fault, symptoms usually increase. In most cases, mobilization treatment for a sacroiliac positional fault is in the symptom-relieving direction.

In an example of a sacroiliac upper pole positional fault test (Figure P-4, right side), ventral pressure applied to point 4 alleviates pain, and the same pressure applied to point 3 produces pain. We deduce that the iliac positional fault is dorsal (a relative ventral sacral positional fault) which could be corrected with mobilization of the ilium in a ventral direction (see *Sacroiliac joint: Ilium ventral – Figures 13 and 14).*

In a similar test for the sacroiliac lower pole, a cranial pressure (the arrow in Figure P-6) alleviates pain, and caudal pressure (the arrow in Figure P-5) produces pain. We deduce that the sacral positional fault is caudal on the right side. With positional faults of the innominate, symphysis pubis symptoms are often produced with local provocation tests. These symptoms decrease with mobilization to reduce the positional fault of the innominate. In this case, the fault could be corrected with mobilization of the sacrum in a cranial direction (see *Sacroiliac joint: Sacrum cranial – Figure 12).*

With many chronic joint disorders, for example, during a quiescent stage of ankylosing spondylitis, there may be no sacroiliac positional fault, but rather restricted movement in all directions. In these cases, the practitioner mobilizes the sacroiliac joint in all restricted directions.

Conceptual models for sacroiliac function tests and treatment of sacroiliac positional faults.



Improper patient positioning during sacroiliac joint testing can make a normal sacroiliac joint appear symptomatic or restricted, because symptoms are being referred from other areas, most commonly the lumbar spine. This may be the reason behind the claims of some practitioners that the majority of their patients have primary sacroiliac joint dysfunctions.

It is important during prone sacroiliac joint testing to maintain a lumbar resting position and minimize lumbar movement because a lumbar lesion can refer symptoms to the sacroiliac joint area and confuse findings there. In order to maintain a lumbar resting position during prone tests, it is almost always necessary to put a cushion under the patient's abdomen, even in obese patients. In addition, slight lumbar sidebending to the tested side will decrease iliolumbar ligament tension so that sacroiliac movement is not hindered and will not produce lumbar movement.

It is important to realize that palpation over bony prominences on the pelvis can produce pain from the periosteum. This pain should not be confused with pain caused by joint movement.

Pelvis

Pelvis tests and mobilizations

Note

Before practicing any mobilization technique in the pelvic region, students should rule out sacroiliac symptoms referred from the lumbar spine or hip, and screen their partners using the following evaluation procedures:

Sacroiliac joint: active knee and hip flexion *test*

Figure 1
using active knee flexion

Figure 2
using active hip flexion

■ Figure 1

Objective:

- **Test:** General mobility and symptom screening.

Starting position:

- The patient stands.
- Face the patient's back.

Hand placement:

- Palpate movement with your thumbs contacting the patient's ilium and sacrum at the sacral sulci.
- Support the patient's pelvis with your hands to aid their balance.

Procedure:

- The patient flexes each knee slightly, alternating right and left sides, so that the pelvis drops on the side of the flexed knee.

Comments:

- Symptoms are most common on the weight-bearing side.

■ Figure 2

- With the hip flexion screening test, note the order in which the sacroiliac joints engage in the movement. Usually, a ventral-caudal movement of the sacrum on the weight-bearing side occurs first. This is followed by dorsal movement of the ilium and sacrum on the non-weight-bearing side, and finally dorsal movement of the sacrum on the weight-bearing side again.

Sacroiliac joint: active trunk flexion and passive pelvic shift *test*

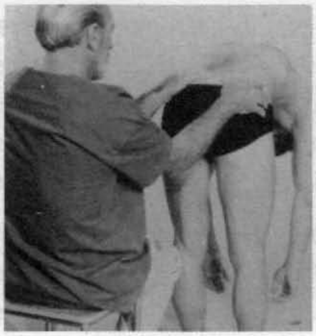


Figure 3
using active trunk flexion

Figure 4
using passive pelvic shift

■ Figure 3

Objective:

- **Test:** General mobility and symptom screening.

Starting position:

- The patient stands.
- Sit facing the patient's back.

Hand placement:

- Palpate movement with your thumbs at the PSIS (or PIIS).
- Support the patient's pelvis with your hands.

Procedure:

- The patient bends forward as far as possible or until symptoms occur.

Comments:

- Note if one PSIS moves cranially earlier than the other. During spinal flexion, L5 moves ventrally on the sacrum and the sacral base moves ventrally (nutation) between the two ilia until the sacroiliac ligaments become taut. Once the sacroiliac ligaments are taut, the ilia rotate together with the sacrum ventrally. If one sacroiliac joint is restricted, its ligaments will become taut before the ligaments of the other sacroiliac joint. This results in the PSIS on the restricted side moving earlier and in a cranial direction relative to the nonrestricted side.

■ Figure 4

- With the pelvic shift test, the therapist shifts the patient's pelvis from right to left.
- Observe and compare the amount of resistance offered by the patient's body in response to these movements.
- Symptoms are usually on the weight-bearing side.

Sacroiliac joint "lifting test" *test*

Figure 5 – skeleton

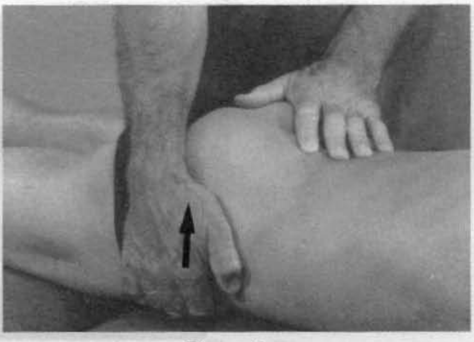


Figure 5

■ Figure 5

Objective:

- **Test:** Specific range and quality of movement, including end-feel.

Starting position:

- The patient lies prone with a cushion under the stomach to maintain a lumbar resting position in lordosis. Make sure the cushion is not under the pelvis.
- Stand facing the patient's left side.

Hand placement:

- **Therapist's stable hand:** Palpate movement with your left index finger contacting the patient's ilium and sacrum at the sacral sulcus.
- **Therapist's moving hand:** With your right hand, grasp the ventral side of the patient's right pelvis.

Procedure:

- Lift the patient's ilium with your right hand.
  a) Apply Grade I oscillatory joint play movements.
  b) Apply Grade II and III movements to assess movement quantity and quality, including end-feel. In this case, stabilize the sacrum with your left hand and lift the ilium dorsally and medially with your right hand.
- Compare both sides.

Comments:

- This test is often effective for revealing hypermobility.

Symphysis pubis
test

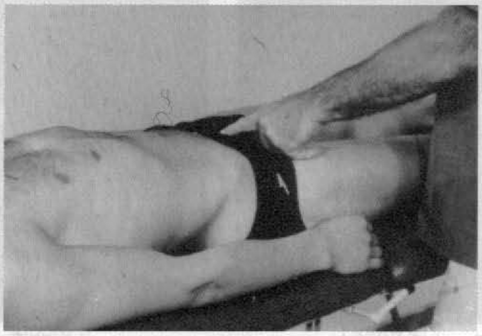


Figure 6

■ Figure 6

Objective:

- **Test:** Specific range and quality of movement, including end-feel.

Starting position:

- The patient lies supine.
- Stand facing the patient's right side.

Hand placement:

- **Therapist's stable hand:** With your left index finger, palpate movement on the patient's symphysis pubis.
- **Therapist's moving hand:** With your right hand, grip the patient's right leg at the distal thigh and hold the leg against your body.

Procedure:

- With your right hand and body, alternately push and pull the patient's right leg cranially and caudally in various leg positions, e.g., into more or less abduction or adduction and internal or external rotation:
  a) Apply Grade I oscillatory joint play movements.
  b) Apply Grade II and III movements to assess movement quantity and quality of movement, including end-feel.

  The patient can also perform these test movements actively.

Comments:

- Pain from palpation pressure is common at the symphysis pubis and must be differentiated from pain caused by joint movement.
- If there are local symptoms or abnormal mobility with this test, an "ilium lesion" is likely. If hypomobile, apply mobilization to the ilium *(Figures 13-16)*.
- If there are no local symptoms with this test, a "sacrum lesion" is more likely. If hypomobile, apply mobilization to the sacrum *(Figures 9-12)*.

Sacroiliac joint: ilium medial
test

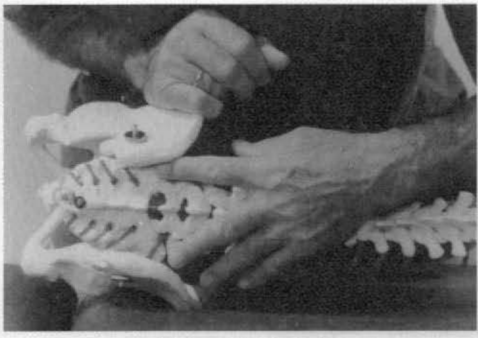


Figure 7 – skeleton

Figure 7

■ Figure 7

Objective:

- **Test:** Specific range and quality of movement, including end-feel. This test stretches (gaps) dorsal sacroiliac joint structures and compresses the symphysis pubis.

Starting position:

- The patient lies on the right side with a pillow supporting their waist.
- Stand facing the patient.

Hand placement:

- **Therapist's stable hand:** With your left index finger, palpate movement over the patient's left sacroiliac joint.
- **Therapist's moving hand:** Place the ulnar side of your right hand on the patient's left ilium (ASIS).

Procedure:

- Apply a Grade II or III medial-ventral movement to the ilium using your right hand and body.
- Compare both sides.

Comments:

- When the sacroiliac joint is hypermobile, this test commonly produces symptoms.

Pelvis

Pelvis

Sacroiliac joint: ASIS medial and lateral
test for hypermobility


Figure 8a
ASIS medial


Figure 8b
ASIS lateral

■ Figure 8a

Objective:

- **Test:** Symptom provocation screening. This test opens (gaps) the dorsal aspect of the sacroiliac joints, stretching dorsal joint structures and compressing the symphysis pubis. A symptomatic response may be associated with hypermobility.

Starting position:

- The patient lies supine.
- Stand facing the patient's right side.

Hand placement:

- Place your forearms or hands on the lateral side of the patient's anterior superior iliac spines.

Procedure:

- Apply a Grade II or III medial movement by simultaneously squeezing each ASIS together with your forearms and hands.

■ Figure 8b

- Figure 8b illustrates a similar technique which opens (gaps) the ventral aspect of the sacroiliac joints and separates the symphysis pubis. In this case, the therapist simultaneously applies a lateral movement to each ASIS, moving them apart from one another.

Sacroiliac joint: sacrum (base) dorsal

test and stretch mobilization

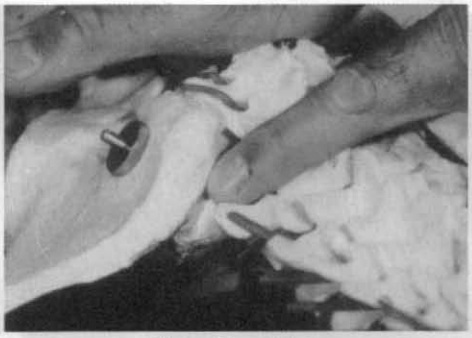


Figure 9 – skeleton

Figure 9

■ Figure 9

Objective:

- **Test:** Specific range and quality of movement, including end-feel, for dorsal movement of the base of the sacrum (counter-nutation).
- **Test sacral positional fault:** If this test relieves symptoms, we assume the presence of a sacral positional fault in nutation. If this test provokes symptoms, we assume the presence of a sacral positional fault in counter-nutation.
- **Stretch mobilization:** For restricted dorsal movement of the base of the sacrum and reposition of a sacral positional fault in nutation.

Starting position:

- The patient lies prone with a cushion under the abdomen.

Hand placement:

- **Therapist's stable hand:** With your left index finger contacting the patient's ilium and sacrum, palpate movement at the left or right sacral sulcus.
- **Therapist's moving hand:** Place the heel of your right hand on the caudal aspect (apex) of the patient's sacrum. Avoid pressure on the sensitive coccyx.

Procedure:

- **Test:** Press ventrally with your right arm. Apply a Grade I, II or III movement. Evaluate range of movement. Compare both sides.
- **Stretch mobilization:** Pre-position the patient's sacrum as far as the restriction allows, by leaning your body weight over your right hand. Apply a Grade III ventral movement to the apex of the sacrum to produce a dorsal movement at the base of the sacrum.

Comments:

- Differentiate symptoms arising from the lumbosacral junction, as this test also produces movement there.

Sacroiliac joint: sacrum ventral
test and stretch mobilization

Figure 10 – skeleton

Figure 10 – on the right side

■ Figure 10

Objective:

- **Test:** Specific range and quality of movement, including end-feel, for ventral movement of the sacrum, primarily in the cranial aspect of the sacroiliac joint (left rotation around its longitudinal axis).
- **Test sacral positional fault:** If this test relieves symptoms, we assume the presence of a right dorsal positional fault of the sacrum. If this test provokes symptoms, we assume the presence of a right ventral (in relation to the ilium) positional fault of the sacrum.
- **Stretch mobilization:** For restricted ventral movement of the sacrum or repositioning of a left-rotated sacral positional fault.

Starting position:

- The patient lies prone. For mobilization, place a cushion under the patient's abdomen to minimize lumbar extension. The patient's lumbar spine should remain immobile during the test and treatment.

Hand placement:

- Place your right thumb, pointing cranially, on the right aspect of the base of the patient's sacrum.
- Place the ulnar side of your left hand on top of your right thumb.

Procedure:

- **Test:** Press ventrally with both hands. Apply a Grade I, II or III movement. Compare findings with those obtained using the test described in *Figure 13*.
- **Stretch mobilization:** Pre-position the patient's sacrum as far as the restriction allows, by leaning your body weight over your arms. Apply a Grade III ventral movement to the patient's sacrum by leaning your body weight over your arms.

Sacroiliac joint: sacrum caudal
test and stretch mobilization

Figure 11 – skeleton

Figure 11 – on the right side

■ Figure 11

Objective:

- **Test:** Specific range and quality of movement, including end-feel, for movement of the sacrum, primarily in the caudal aspect of the sacroiliac joint.
- **Test sacral positional fault:** If this test relieves symptoms, we assume the presence of a right cranial positional fault of the sacrum. If this test provokes symptoms, we assume the presence of a right caudal positional fault of the sacrum.
- **Stretch mobilization:** For restricted caudal movement of the sacrum or repositioning of a right cranial sacral positional fault.

Starting position:

- The patient lies prone with a cushion under the abdomen.
- Stand facing the patient's left side.

Hand placement and fixation:

- **Therapist's stable hand:** Fixate the patient's ilium in a cranial direction with your right hand on the patient's right ischial tuberosity.
- **Therapist's moving hand:** Place the ulnar side of your left hand on the right cranial aspect of the patient's sacrum.

Procedure:

- **Test:** Press cranially with your right arm. Apply a Grade I, II or III movement. Compare findings with those obtained using the test described in *Figure 12*.
- **Stretch mobilization:** Pre-position the patient's sacrum as far as the restriction allows. Apply a Grade III caudal movement to the patient's sacrum using your left hand.

Sacroiliac joint: sacrum cranial
test and stretch mobilization

Figure 12 – skeleton

Figure 12 – on the right side

■ Figure 12

Objective:

- **Test:** Specific range and quality of movement, including end-feel, for cranial movement of the sacrum, primarily in the caudal aspect of the sacroiliac joint.
- **Test sacral positional fault:** If this test relieves symptoms, we assume the presence of a right caudal positional fault of the sacrum. If this test provokes symptoms, we assume the presence of a right cranial positional fault of the sacrum.
- **Stretch mobilization:** For restricted cranial movement of the sacrum or reposition of a right caudal sacral positional fault.

Starting position:

- The patient lies prone with a cushion under the abdomen.

Hand placement and fixation:

- **Therapist's stable hand:** Fixate the patient's ilium in a caudal direction with the web space of your left hand on the patient's right iliac crest.
- **Therapist's moving hand:** Place the ulnar side of your right hand on the right side of the apex of the patient's sacrum. Avoid pressure on the sensitive coccyx.

Procedure:

- **Test:** Press cranially with your right arm. Apply a Grade I, II or III movement. Compare findings with those obtained using the test described in *Figure 11.*
- **Stretch mobilization:** Pre-position the patient's sacrum as far as the restriction allows. Apply a Grade III cranial movement to the patient's sacrum using your right hand.

Comments:

- Differentiate symptoms arising from the lumbosacral junction, as this test also produces compression there.

Sacroiliac joint: ilium ventral

test and stretch mobilization

Figure 13 – skeleton

Figure 13 – on the right side

■ Figure 13

Objective:

- **Test:** Specific range and quality of movement, including end-feel, for ventral movement of the ilium, primarily in the cranial aspect of the sacroiliac joint.
- **Test iliac positional fault:** Often provokes symptoms when the right ilium is fixated in ventral rotation. Often alleviates symptoms when the right ilium is fixated in dorsal rotation.
- **Stretch mobilization:** For restricted ventral movement of the ilium or reposition of a right dorsal iliac positional fault.

Starting position:

- The patient lies prone. Place a pillow under the patient's abdomen, leaving the ASIS unsupported.
- Stand facing the patient's left side.

Hand placement and fixation:

- **Therapist's stable hand:** With the ulnar side of your right hand, fixate with ventral pressure on the left caudal aspect of the sacrum.
- **Therapist's moving hand:** Place the ulnar side of your left hand on the patient's right iliac crest.

Procedure:

- **Test:** Press in a ventral-caudal-lateral direction with your left hand. Apply a Grade I, II or III movement. Compare findings with those obtained using the test described in *Figure 10*.
- **Stretch mobilization:** Pre-position the patient's ilium as far as the restriction allows, by leaning your body weight over your left hand. Apply a Grade III linear movement in a ventral direction. To prevent left rotation of the patient's pelvis during treatment, reinforce fixation by supporting your body weight over your fixating hand.

Sacroiliac joint: ilium ventral
stretch mobilization (prone)

Figure 14 – skeleton

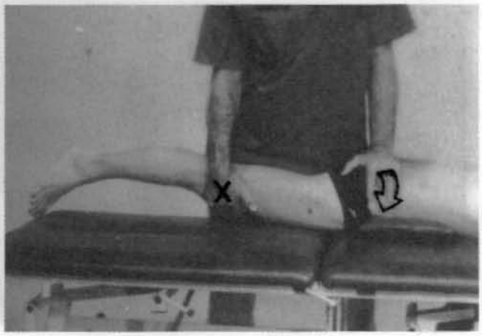


Figure 14 – on the right side

■ Figure 14

Objective:

- **Stretch mobilization:** For restricted ventral movement of the ilium.

Starting position:

- The patient lies prone. To avoid lumbar lordosis during the procedure, position the patient's left hip in maximal flexion with the left lower extremity off the edge of the table and the foot on the floor.
- Stand facing the patient's left side. Place your left foot against the patient's foot to stabilize their left leg.

Hand placement and fixation:

- **Therapist's stable hand:** Position and fixate the patient's right hip in extension by lifting the distal femur with your right hand. If possible, angle the treatment surface to support the position. The patient's lumbar spine should be in its resting position or in some kyphosis.
- **Therapist's moving hand:** Place the ulnar side of your left hand on the patient's right iliac crest.

Procedure:

- Pre-position the patient's ilium as far as the restriction allows by leaning your body weight over your left hand and lifting the patient's right leg.
- Apply a Grade III linear movement in a ventral direction using your left hand and body as a unit.

Comment:

- This is the "ilium ventral" mobilization of choice if the patient can tolerate the prone position.

Sacroiliac joint: ilium ventral rotation

stretch mobilization (sidelying)

Figure 15 – skeleton

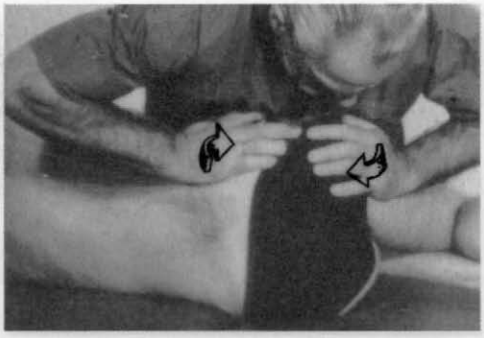


Figure 15 – on the right side

■ **Figure 15**

Objective:

- **Stretch mobilization:** For restricted ventral rotation of the ilium.

Starting position:

- The patient lies on the left side with a pillow supporting their waist. The left hip is in maximal flexion to produce a dorsal rotation of the left ilium and sacrum which indirectly stabilizes the sacrum and prevents it from following the ventral rotation of the right ilium. The right hip is only slightly flexed.
- Stand facing the patient.

Hand placement:

- Place your right hand on the patient's right iliac crest.
- Place the heel of your left hand on the patient's right ischial tuberosity.

Procedure:

- Pre-position the patient's ilium as far as the restriction allows, using both hands.
- Apply a Grade III linear movement in a ventral direction to the patient's ilium, using only your right arm.

Comment:

- This is the "ilium ventral" mobilization of choice if the patient cannot tolerate the prone position.

Sacroiliac joint: ilium dorsal rotation
stretch mobilization

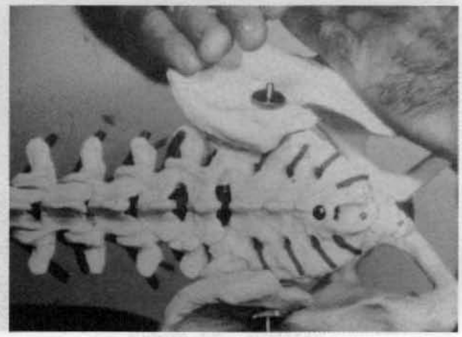


Figure 16 – skeleton

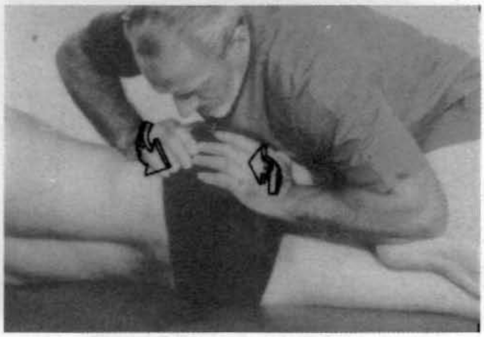


Figure 16 – on the right side

■ Figure 16

Objective:

- **Stretch mobilization:** For restricted dorsal rotation of the ilium.

Starting position:

- The patient lies on the left side. The left hip is extended to produce a ventral rotation of the left ilium and sacrum which indirectly stabilizes the sacrum and prevents it from following the dorsal rotation of the right ilium. The right hip and the knee are flexed.
- Stand facing the patient.

Hand placement:

- Place the ulnar side of your right hand on the patient's right iliac crest.
- Place the heel of your left hand on the patient's right ischial tuberosity.

Procedure:

- Pre-position the patient's ilium as far as the restriction allows, using both hands.
- Apply a Grade III linear movement in a dorsal direction to the patient's ilium, using only your right hand.

Sacrococcygeal joint

test and mobilization

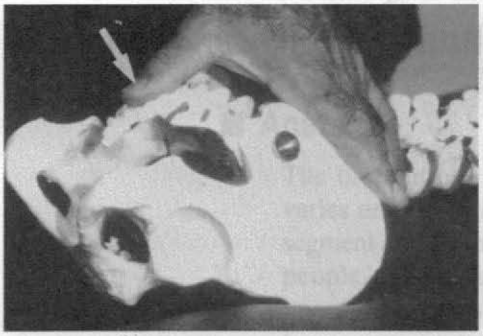


Figure 17a – coccyx ventral

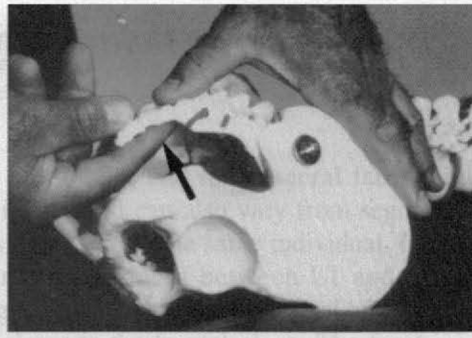


Figure 17b – coccyx dorsal

■ Figure 17a

Objective:

- **Test:** Specific mobility test for ventral movement of the coccyx.
- **Test coccygeal positional fault:** Palpate positional fault.
- **Mobilization:** For restricted ventral movement of the coccyx or repositioning of a dorsal coccygeal positional fault.

Starting position:

- The patient lies prone. The legs may be placed off the table with the hips flexed and feet on the floor.

Hand placement:

- Place your left thumb on the patient's coccyx. Place your right thumb on top of your left thumb for reinforcement.

Procedure:

- Use both thumbs to press the patient's coccyx in a ventral direction. Evaluate coccyx range of movement.

■ Figure 17b

- Use a similar technique to move the coccyx in a dorsal direction.

  Test: Place your right index finger (in a sterile glove) on the ventral side of the coccyx through the rectum and your right thumb on the dorsal side of the coccyx, and move dorsally. With your left thumb, palpate coccyx mobility in relation to the sacrum.

  Mobilization: For restricted dorsal movement or repositioning of a ventral coccygeal positional fault.
- Use the same grip to apply traction treatment, a useful initial procedure, and for lateral mobilization or treatment of a lateral positional fault.

■ Notes

Pelvis

10 Lumbar spine

Functional anatomy and movement

Anatomy

The orientation of the lumbar and lumbosacral facet joints varies among individuals, and can also vary from segment to segment and from side to side in the same individual. In most people, the lumbar facet surfaces between L1 and L5 are oriented near the sagittal plane. At the lumbosacral junction, the facets are oriented closer to the frontal plane. The facet joint surfaces are large and almost flat.

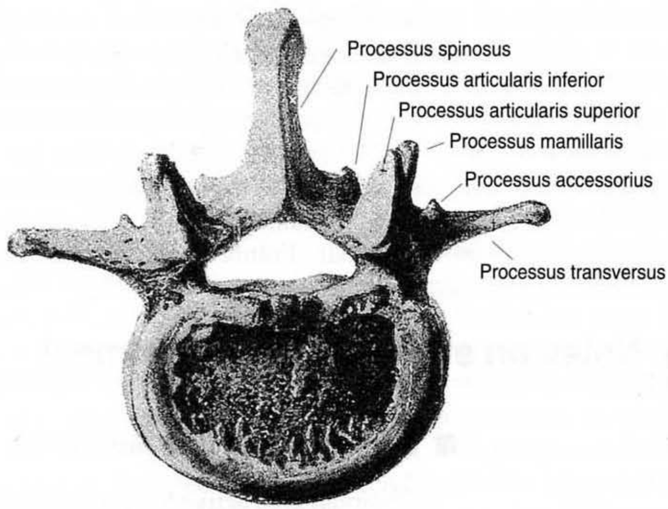


Figure L-1
The third lumbar vertebra viewed from above

Bone and joint movement

The resting position of the lumbar spine is usually a lordotic curve. During activity this lordotic curve can increase and decrease, and in some young and flexible people can even reverse into a kyphosis. Accurate assessment of the lumbar curvature can be difficult because anatomical variations can influence visual inspection. For example, people with a typical normal lumbar lordosis but with very long lumbar posterior spinous processes are sometimes mistakenly assessed as having a "flat-back" posture.

Most movement in the lumbar spine is in the sagittal plane with flexion and extension movement following the Concave Rule: The inferior facet (processus articularis inferior) on the cranial

Lumbar

vertebra in the intervertebral segment functions as a concave surface which allows the cranial vertebra to move ventrally during flexion and dorsally during extension.

Coupled movement – Pure lumbar rotation and pure sidebending (i.e., standard anatomical movements) are quite limited in the lumbar spine due to the orientation of the facet joints. Lumbar rotation and sidebending range can be increased when performed simultaneously in a coupled movement pattern. When the lumbar spine is in the resting position (usually a slight lordosis) or in an extended position, coupled rotation and sidebending usually occurs to opposite sides, for example, simultaneous lumbar extension, left rotation, and right sidebending (Lumbar Figure 7). In marked lumbar flexion, coupling usually takes place with rotation and sidebending to the same side (Lumbar Figure 5).

Noncoupled movement – A noncoupled movement pattern has less range and a firmer end-feel in comparison to a coupled movement. For example, rotation and sidebending to opposite sides usually produces a noncoupled movement when the lumbar spine is in flexion (Lumbar Figure 6). Rotation and sidebending to the same side produce a noncoupled movement when the lumbar spine is in the resting position or in extension (Lumbar Figure 8). Noncoupled movements are used for "locking" techniques.

■ Notes on evaluation and treatment

■ Evaluation of active movement

Observation of active lumbar movement can be confusing if the therapist becomes distracted by thoracic spine movement. Folding the patient's shirt so that the thoracic area is covered and just the low back remains in view can help the therapist concentrate on lumbar movement.

■ Combined movement patterns

The skillful use of combined movement patterns is essential for evaluation, joint mobilization, soft tissue mobilization, exercise training, and other patient management procedures designed to specifically produce or limit movement in the lumbar spine. The therapist must have the skill to use and analyze combined movement patterns in any patient posture (e.g., standing, lying) and during any functional activity. A novice manual therapist must practice combined movement evaluations frequently (e.g., Lumbar Figures 1-8), to become skilled in applying them to patient positioning and movement. Much practice is also necessary to enable a therapist to recognize normal anomalies in combined movement patterns.

A useful training method to help the manual therapist become familiar with lumbar combined movements follows:

The therapist stands on the left side of the prone subject. The therapist's left hand stabilizes the lower part of subject's thorax while the right hand is placed under the subject's right ASIS. The therapist's right hand elevates the right side of the pelvis to rotate the pelvis to the right. This produces a relative left rotation in the lumbar spine, with the thoracic spine stabilized against the plinth. To determine the direction of the sidebending that couples with this left lumbar rotation, the therapist alternately positions the subject's legs to the left and to the right to induce left or right lumbar sidebending. In each sidebending position, the therapist elevates the subject's pelvis to assess whether left lumbar rotation decreases with a harder end-feel (noncoupled) or increases with a softer end-feel (coupled). In most subjects, with the subject in lumbar extension (lying prone without a pillow under the abdomen) the greatest rotation range and the softest end-feel (coupled movement) occur when both legs are positioned to the right so that the lumbar spine is in right sidebending. When the subject's legs are positioned to the left side, inducing a left sidebending at the lumbar spine, the therapist assesses less left lumbar rotation range and a harder end-feel (noncoupled movement). The therapist follows the same procedure to assess combined movements in lumbar flexion, first positioning the subject with pillows under the abdomen. Now the greatest left lumbar rotation range and the softest end-feel will occur with the patient in left sidebending, since in lumbar flexion, rotation and sidebending couple to the same side.

■ Nerve root irritation

In the presence of lumbar nerve root involvement a number of physical examination maneuvers may need to be deferred until the acute nerve root irritation subsides and the patient's condition improves. Even simply positioning the patient on the wrong side may exacerbate an acute nerve root condition. In these cases we recommend an immediate trial treatment with pre-positioned, three-dimensional traction. This is an effective treatment for many nerve root conditions and can be safely used even before the physical examination is completed.

Lumbar tests and mobilizations

Screening techniques

Nerve mobility tests

Localization techniques

Note

Before practicing any lumbar mobilization technique students should screen their partners using the following evaluation procedures:

When symptoms are present in the lower extremities, students should screen their partners using these additional procedures:

Active lumbar flexion and extension
test

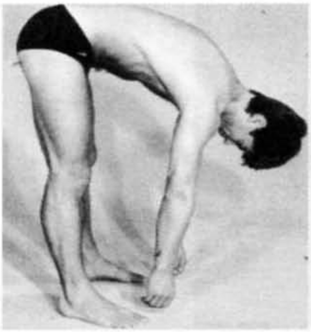


Figure 1 – flexion

Figure 2 – extension

■ Figure 1

Objective:

- **Test:** General mobility and symptom screening.

Starting position:

- The patient stands with feet slightly apart.

Procedure:

- The patient bends forward into lumbar flexion.
- At the end of the patient's active movement, apply overpressure to assess the presence of additional passive movement range.
- Observe range of lumbar flexion and the way the movement is performed. Note symptom behavior throughout the movement.

■ Figure 2

- Use a similar method to evaluate active lumbar extension.

Chapter 10, Lumbar Spine, Fig. 2, page 159:
The picture in the book
should show extension:

Lumbar

Active lumbar sidebending
test

Figure 3 – to the right side

■ Figure 3

Objective:

- **Test:** General mobility and symptom screening.

Starting position:

- The patient stands with feet slightly apart.

Procedure:

- The patient sidebends to the right.
- At the end of the patient's active movement, apply overpressure to assess the presence of additional passive movement range. Apply the passive overpressure by grasping the patient's right distal forearm and slowly pulling it toward the floor.
- Observe range of lumbar sidebending and the way the movement is performed. Note symptom behavior throughout the movement. Compare both sides.

Active lumbar rotation
test

Figure 4 – to the right

■ Figure 4

Objective:

- **Test:** General mobility and symptom screening.

Starting position:

- The patient sits on the treatment table. To fixate the pelvis, position the patient's legs on either side of the treatment table or place a fixation belt across the patient's upper thighs.

Procedure:

- The patient rotates the trunk to the right, rotating around a vertical axis.
- At the end of the patient's active movement, apply overpressure to assess the presence of additional passive movement range.
- Observe range of lumbar rotation and the way the movement is performed. Note symptom behavior throughout the movement. Compare both sides.

Comments:

- Following this test, evaluate the quality of passive movement from the zero position through the entire range of movement, including end-feel characteristics.
- Evaluate active coupled movements using the same method, including
  a) flexion with sidebending and rotation to the same side, and
  b) extension with sidebending and rotation to opposite sides.
- Evaluate active noncoupled movements using a similar method.

Active lumbar flexion with combined sidebending and rotation

test

Figure 5
with coupled right side-
bending and right rotation

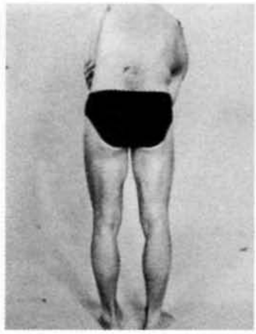


Figure 6
with noncoupled right
sidebending and left rotation

■ Figure 5

Objective:

- **Test:** General mobility and symptom screening.

Starting position:

- The patient stands with feet slightly apart.

Procedure:

- The patient bends forward into slight lumbar flexion, with simultaneous coupled sidebending and rotation to the right.
- At the end of the patient's active movement, apply overpressure to assess the presence of additional passive movement range.
- Observe range of lumbar flexion with combined sidebending and rotation. Observe the way the movement is performed. Note symptom behavior throughout the movement. Compare both sides.

■ Figure 6

- Use a similar method to evaluate the active noncoupled movement of flexion with sidebending to the right and rotation to the left.

Active lumbar extension with combined sidebending and rotation

test

Figure 7
with coupled right side-bending and left rotation

Figure 8
with noncoupled right side-bending and right rotation

■ Figure 7

Objective:

- **Test:** General mobility and symptom screening.

Starting position:

- The patient stands with feet slightly apart.

Procedure:

- The patient bends backward into slight lumbar extension, with simultaneous coupled rotation to the left and sidebending to the right.
- At the end of the patient's active movement, apply overpressure to assess the presence of additional passive movement range.
- Observe range of lumbar extension with combined sidebending and rotation. Observe the way the movement is performed. Note symptom behavior throughout the movement. Compare both sides.

■ Figure 8

- Use a similar method to evaluate the active noncoupled movement of extension with rotation and sidebending to the right.

Lumbar traction
test and mobilization

Figure 9a
in the resting position

Figure 9b
in the actual resting position

■ Figure 9a

Objective:

- **Test:** Symptom alleviation or provocation screening.
- **Mobilization:** For restricted movement or symptom relief.

Starting position:

- The patient stands with feet slightly apart, and the lumbar spine in the resting position.
- Stand behind the patient. You may need to stand on a stool to position your arms at or above the height of the patient's arms.

Hand placement:

- Hold the patient just below the rib cage, with your arms in an interlocked grip.

Procedure:

- Lean slightly backward to apply a Grade I, II, or III traction force.

Comments:

- Self mobilization: The patient grasps an overhead bar with feet on the floor, then bends the knees and relaxes the body to traction the lumbar spine.

■ Figure 9b

- Use the same method for lumbar traction in the actual resting position. To determine the actual resting position, monitor symptomatic response to lumbar traction in various combinations of flexion, sidebending and rotation (e.g., flexion, sidebending and rotation to the right illustrated above).

Lumbar compression
test

Figure 10

■ Figure 10

Objective:

- **Test:** Symptom provocation screening.

Starting position:

- The patient stands with feet slightly apart.
- Stand behind the patient.

Hand placement:

- Place your hands on top of the patient's shoulders or grip around the lower part of the patient's rib cage.

Procedure:

- Press the patient's shoulders (or trunk) in a caudal direction.

Comments:

- Symptomatic response to lumbar compression is also tested in varying three-dimensional pre-positioned starting positions.

Lumbar

Sciatic nerve
test (standing and sitting)

Figure 11a – in standing

■ Figure 11a

Objective:

- **Test:** Symptom localization. Determine if movement of the sciatic nerve is restricted in relation to the surrounding tissue.
- Use the standing position as a screening test or when the patient reports greater symptoms in standing than when sitting or lying.

Starting position:

- The patient stands.
- Sit facing the patient.

Procedure:

- The sciatic nerve (with the tibial and peroneal nerves) including the associated nerve root and the spinal cord, is maximally lengthened with hip flexion, knee extension, ankle dorsiflexion, and spinal flexion.
- Elevate the patient's extended lower extremity (passive straight leg raise) until the movement stops and symptoms are produced. If movement is restricted due to shortened and/or symptomatic dorsal thigh musculature, and if a resisted contraction (post-isometric relaxation technique) increases range of movement, apply the appropriate stretching or relaxation techniques for the musculature.
- If the resisted contraction does not alleviate symptoms or increase hip flexion range, suspect a sciatic nerve irritation. To confirm these findings, place the hip joint in a symptom-free position of less flexion. At this point place the patient's ankle in more dorsiflexion and/or the neck in flexion. If the same symptoms appear or increase in intensity, sciatic nerve root involvement is likely.

"SLUMP" TEST.

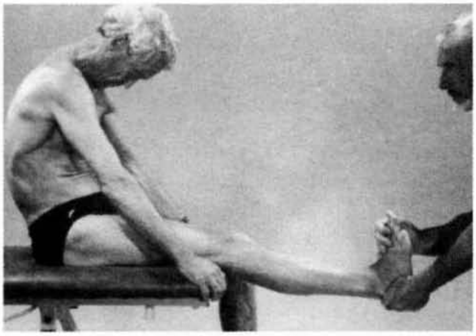


Figure 11b – in sitting

Comments:

- Before testing nerve mobility or neural tension signs, all joints moved during the test must be individually assessed for mobility and symptoms. During joint testing, avoid placing the nerve or muscles in stretched positions which could confuse your findings.
- If nerve irritation is present, the patient's response to local pressure on the nerve will be more sensitive. Palpate the sciatic nerve at the following sites: the ischial foramen, the popliteal fossa, and behind the head of the fibula. Apply the "Bowstring Test."

■ Figure 11b

- Use the sitting position for sciatic nerve testing when the patient reports greater symptoms in sitting than in standing or lying.
- The patient should sit for a period of time before the test if symptoms occur only after prolonged sitting.

Lumbar

Sciatic nerve
test (supine and sidelying)

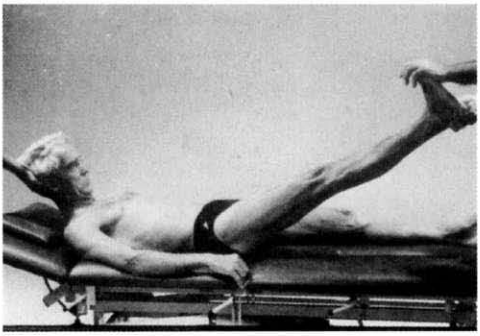


Figure 11c – in supine

■ Figure 11c

Objective:

- **Test:** Symptom localization. Determine if movement of the sciatic nerve is restricted in relation to the surrounding tissue.
- Non-weightbearing sciatic nerve tests may reveal different results than weightbearing tests (i.e., standing and sitting).

Starting position:

- The patient lies supine in the resting position.
- Stand at the caudal end of the treatment table facing the patient.

Procedure:

- The sciatic nerve, including its associated nerve root and the spinal cord, is maximally lengthened with hip flexion, knee extension, ankle dorsiflexion, and neck flexion.
- Elevate the patient's extended lower extremity (passive straight leg raise) until the movement stops or symptoms are produced. The average range of movement for this test is approximately 70º-75º. If movement is restricted due to shortened and/or symptomatic dorsal thigh musculature, and if a resisted contraction (post-isometric relaxation technique) increases range of movement, apply the appropriate stretching or relaxation techniques for the musculature.
- If the resisted contraction does not alleviate symptoms or increase hip flexion range, suspect a sciatic nerve irritation. To confirm these findings, place the hip joint in a symptom-free position of less flexion. At this point place the patient's ankle in more dorsiflexion and/or the neck in flexion. If the same symptoms appear or increase in intensity, sciatic nerve root involvement is likely. You may find it necessary to use an assistant to position the patient's neck in flexion.

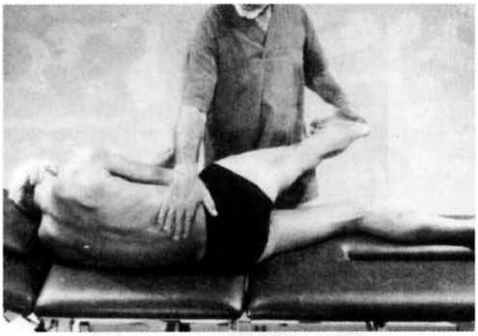


Figure 11d – in sidelying

Comments:

- Before testing nerve mobility or neural tension signs, all joints moved during the test must be individually assessed for mobility and symptoms. During joint testing, avoid placing the nerve or muscles in stretched positions which could confuse your findings.
- If nerve irritation is present, the patient's response to local pressure on the sciatic nerve will be more sensitive. Palpate the nerve at the following sites: the ischial foramen, the popliteal fossa, and behind the head of the fibula. Apply the "Bowstring Test."

■ Figure 11d

- This test can also be performed in sidelying. In the sidelying position, it may be easier for you to perform the test without an assistant.
- If during this test lumbar flexion produces local symptoms, position the lower extremity in less flexion until lumbar flexion is released and the symptoms disappear. Then use your right hand to fixate the patient's lumbar spine in this modified position during the test.

Femoral nerve
test (standing)

Figure 12a

Lumbar

■ **Figure 12a**

Objective:

- **Test:** Symptom localization. Determine if movement of the femoral nerve is restricted in relation to the surrounding tissue.
- Use the standing position for testing when the patient reports greater symptoms in standing than in prone or sidelying.

Starting position:

- The patient stands on the left leg and holds on to the treatment table.
- Stand behind the patient.

Procedure:

- The femoral nerve (with the saphenous nerve), including the associated nerve root and the spinal cord, is maximally lengthened with hip extension, knee flexion, ankle plantar flexion, and neck flexion.
- The therapist flexes the patient's right knee while maintaining hip extension, until the movement stops or symptoms are produced. If the movement is restricted due to shortened and/or symptomatic quadriceps musculature, and if a resisted contraction (post-isometric relaxation technique) increases range of movement, apply the appropriate stretching or relaxation techniques for the musculature.
- If the resisted contraction does not alleviate symptoms or increase knee flexion, suspect femoral nerve irritation. To confirm these findings, place the knee joint in a symptom-free position of less flexion. At this point place the ankle in more plantar flexion (possibly with additional pronation and abduction of the foot) and/or the neck in flexion. If the same symptoms appear or increase in intensity, femoral nerve root involvement is likely.

Lumbar

Comments:

- Before testing nerve mobility or neural tension signs, all joints moved during the test must be individually assessed for mobility and symptoms. During joint testing, avoid placing the nerve or muscles in stretched positions which could confuse your findings.
- If nerve irritation is present, the patient's response to local pressure on the nerve will be more sensitive. Palpate the femoral nerve at the femoral triangle below the inguinal ligament.

Lumbar

Femoral nerve
test (prone and sidelying)

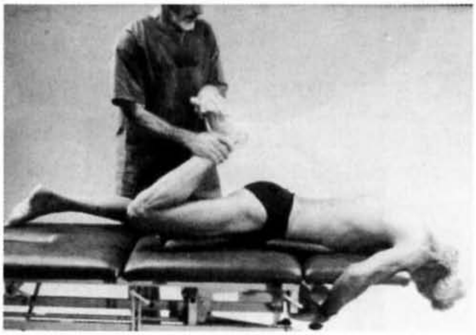


Figure 12b – in prone

■ Figure 12b

Objective:

- **Test:** Symptom localization. Determine if movement of the femoral nerve is restricted in relation to the surrounding tissue.

Starting position:

- The patient lies prone. The patient's head and neck are positioned beyond the edge of the treatment table.
- Stand facing the patient's left side.

Procedure:

- The femoral nerve, including its associated nerve root and the spinal cord, is maximally lengthened with hip extension, knee flexion, ankle plantar flexion, and neck flexion.
- Flex the patient's right knee until the movement stops or symptoms are produced. If the movement is restricted due to shortened and/or symptomatic quadriceps musculature, and if a resisted contraction (post-isometric relaxation technique) increases range of movement, apply the appropriate stretching or relaxation techniques for the musculature.
- If the resisted contraction does not alleviate symptoms or increase knee flexion, suspect a femoral nerve irritation. To confirm these findings, place the knee joint in a symptom-free position of less flexion. At this point place the ankle in more plantar flexion (possibly with additional pronation and abduction of the foot) and/or the neck in flexion. If the same symptoms appear or increase in intensity, femoral nerve root involvement is likely.

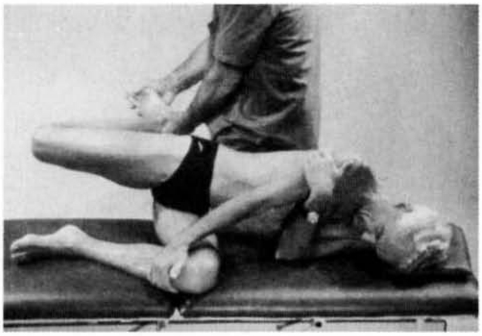


Figure 12c – in sidelying

Comments:

- Before testing nerve mobility or neural tension signs, all joints moved during the test must be individually assessed for mobility and symptoms. During joint testing, avoid placing the nerve or muscles (especially the iliopsoas) in stretched positions which could confuse your findings.
- If nerve irritation is present, the patient's response to local pressure on the nerve will be more sensitive. The femoral nerve should be palpated at the femoral triangle below the inguinal ligament.

■ Figure 12c

- This test can also be performed in the sidelying position. In sidelying, the patient's spine can be flexed further. In this case, the left (bottom) leg is maximally flexed (without symptoms in the lumbar spine) and fixated with the assistance of the patient as shown.

Differentiating lumbar spine, sacroiliac joint, muscle, and nerve
test

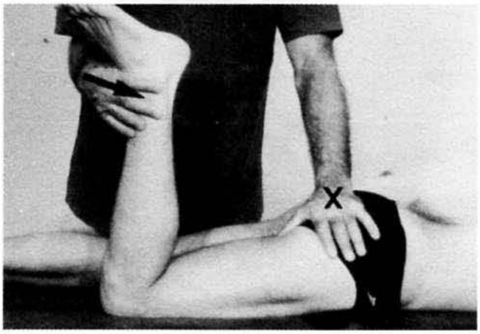


Figure 13 – differentiating test

Lumbar

■ Figure 13

Objective:

- **Test:** Symptom localization. Use the following four differentiating tests when a patient can perform full knee flexion with hip flexion (tested in side-lying), but has limited knee flexion with hip extension (in prone) and reports symptoms in the ventral thigh.

Starting position for all four tests:

- The patient lies prone.
- Stand beside the patient's thigh.

Hand placement, fixation, and procedure:

Test A - Test for spasm or shortening in the **rectus femoris**:

- **Therapist's stable hand:** With your left hand, fixate the patient's ilium.
- **Therapist's moving hand:** With your right hand, passively flex the patient's right knee until symptoms are produced or the movement stops. If the rectus femoris is shortened or in spasm: 1) this movement should produce symptoms only in the ventral thigh; 2) if the movement is limited by spasm, a resisted quadriceps contraction (post-isometric relaxation technique) at the limit of range should increase range of movement; 3) if the rectus femoris is shortened, sustained stretching should increase range.

Test B: Test for **femoral nerve** irritation (see also Figures 12a, b, and c.):

- **Therapist's stable hand:** With your left hand, fixate the patient's ilium.
- **Therapist's moving hand:** With your right hand, passively flex the patient's right knee. With femoral nerve involvement: 1) this movement will produce symptoms in the ventral thigh and possibly also the lower leg; 2) a resisted contraction of the quadriceps at the limit of range will *not* increase range of movement, and sustained stretching will worsen symptoms.

Test C: Test for **sacroiliac joint involvement**:

- **Therapist's stable hand:** With your left hand, fixate the patient's sacrum.
- **Therapist's moving hand:** With your right hand, passively flex the patient's right knee. If the patient reports no symptoms in the sacroiliac joint region, sacroiliac joint involvement is unlikely.

Test D: Test for **lumbar spine involvement**:

- **Therapist's stable hand:** With your left hand, fixate the patient's lower thoracic spine.
- **Therapist's moving hand:** With your right hand, passively flex the patient's right knee. This may increase lumbar lordosis. If the lumbar spine is involved the patient may report symptoms.

Comments:

- These techniques contribute useful information which may help differentiate between joint, muscle, and nerve involvement in the lumbosacral region. However, additional evaluation is required to confirm the differential diagnosis.

Lumbar segment: cranial vertebra ventral
test

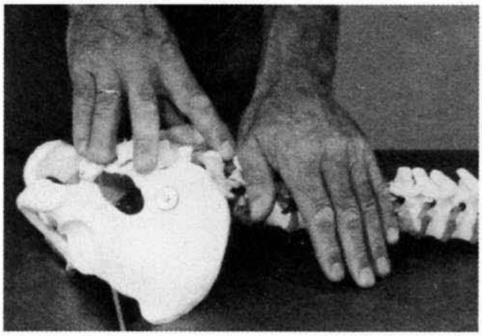


Figure 14a – skeleton

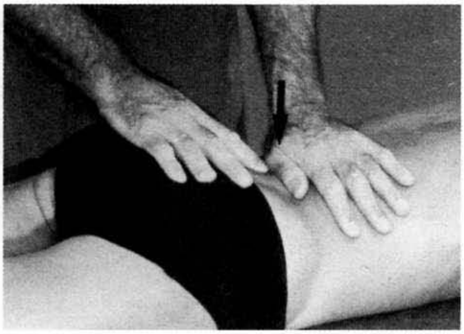


Figure 14a

■ Figure 14a

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient lies prone with a cushion under the stomach to maintain a normal lumbar lordosis. Avoid excessive lumbar lordosis.
- Stand facing the patient's left side.

Hand placement:

- **Therapist's stable hand:** Place the palpating finger of your right hand dorsally between the two spinous processes of the segment to be tested.
- **Therapist's moving hand:** Place the thenar eminence of your left hand on the spinous process of the cranial vertebra. Alternatively, you can place a wedge with its peaks pointing caudally on the transverse processes of the cranial vertebra.

Procedure:

- With your left arm and thenar eminence, apply a Grade I, II or III ventral movement to the cranial vertebra.

Comments:

- Figure 14b on the following page illustrates an alternate test.

Lumbar segment: caudal vertebra ventral
test

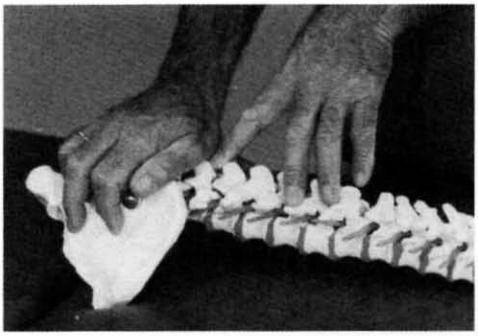


Figure 14b – skeleton

Figure 14b

■ Figure 14b

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient lies prone with a cushion under the stomach to maintain a normal lumbar lordosis. Avoid excessive lumbar lordosis.
- Stand facing the patient's left side.

Hand placement:

- **Therapist's stable hand:** Place the palpating finger of your left hand dorsally between the two spinous processes of the segment to be tested.
- **Therapist's moving hand:** Place the thenar eminence of your right hand on the spinous process of the caudal vertebra. Alternatively, you can place a wedge with its peaks pointing cranially on the transverse processes of the caudal vertebra.

Procedure:

- With your right arm and thenar eminence, apply a Grade I, II or III ventral pressure to the caudal vertebra.

Comments:

- Figure 14a illustrates an alternate test.

Lumbar "springing" *test*


Figure 15 – skeleton


Figure 15

■ Figure 15

Objective:

- **Test:** Segmental range and quality of movement, including end-feel. The lumbar "springing test" can localize a lesion within *two* vertebral segments. The caudal vertebra moves ventrally relative to the cranial vertebra. This is also the case with movement of the sacrum relative to L5.

Starting position:

- The patient lies prone with a cushion under the stomach to maintain a normal lumbar lordosis. Avoid excessive lumbar lordosis.

Hand placement:

- **Therapist's stable hand:** Place your left index and middle fingers pointed in a cranial direction (or the peaks of a mobilization wedge) on the transverse processes of the caudal vertebrae of the segment to be tested.
- **Therapist's moving hand:** Place the ulnar side of your right hand on top of the distal aspect of the pre-positioned left index and middle fingers.
- When using a wedge, hold the wedge with your left hand. Palpate with your right index finger between the two specified spinous processes through the access between the peaks of the wedge.

Procedure:

- Lean your body weight through your arms to apply a Grade I, II or III ventral movement to the patient's vertebra.
- Start the test caudally to separate the superior facets of the caudal vertebra from the inferior facets of the cranial vertebra. When testing the next cranial segment, the previously tested (now caudal) joints are compressed and the cranial joints are separated.

Comments:

- With positive finding, progress to *Figure 16, Lumbar segment: rotation* to isolate the lesion to a specific segment.

Lumbar segment: rotation
test (lateral pressure to spinous processes)

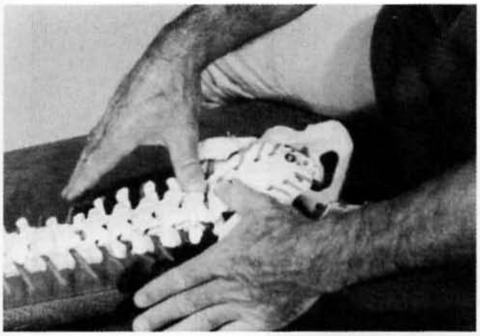


Figure 16 – skeleton

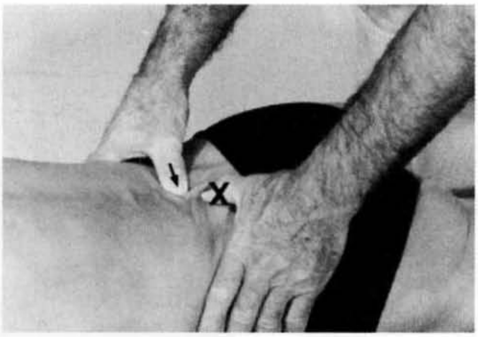


Figure 16

Lumbar

■ Figure 16

Objective:

- **Test:** Segmental range and quality of movement, including end-feel. This test is specific to one segment. Since the orientation of the lumbar facet joints limits pure rotation, this test is primarily used to localize symptoms and the rotational direction involved.

Starting position:

- The patient lies prone with a cushion under the stomach to maintain a normal lumbar lordosis. Avoid excessive lumbar lordosis.

Hand placement and fixation:

- **Therapist's stable hand:** With your left thumb, fixate the lateral side (shown here on the left) of the spinous process of the caudal vertebra of the segment to be tested.
- **Therapist's moving hand:** Place your right thumb laterally on the spinous process (shown here on the right) of the cranial vertebra of the segment to be tested.

Procedure:

- To apply a Grade I, II or III right rotation to the cranial vertebra, move the cranial spinous process to the left with your right thumb.
- To apply a Grade I, II or III left rotation test to the cranial vertebra, fixate the caudal spinous process on the right with your right thumb and move the cranial spinous process to the right with your left thumb. Avoid ventral pressure.

Comments:

- To differentiate periosteal pain from joint pain, palpate each spinous process before the test. If palpation is painful, perform the test with ventral pressure to the related transverse processes. (See *Figure 10, Thoracic segment: rotation.*)

Lumbar segment: translatoric joint play
test

Figure 17

Lumbar

■ Figure 17

Objective:

- **Test:** Segmental range and quality of movement, including end-feel. Evaluate joint play (linear movement) of the patient's vertebra, parallel to the treatment plane of the vertebral disc joint.

Starting position:

- The patient lies on the left side. To avoid lateral flexion of the lumbar spine, a pillow is placed under the patient's waist. The patient's hips and knees are flexed. The amount of hip flexion (approximately 60º) will vary depending on the actual resting position of the tested vertebral segment.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your right palpating finger dorsally between the two spinous processes of the segment to be tested. Use the remaining part of your right hand to provide stabilization cranial to the segment.
- **Therapist's moving hand:** With your left hand, grasp the dorsal aspect of the patient's calves and knees. The patient's knees contact your body.

Procedure:

- With your left arm and body, alternately push and pull longitudinally in an ventral-dorsal direction through the patient's thighs to produce:

  a) small Grade I oscillatory movements to assess joint play.

  b) Grade II or III movements to assess movement quantity and quality, including end-feel.
- Test in both right and left sidelying positions.

Comments:

- In many cases, hip flexion exceeding 60º produces lumbar flexion. Therefore, it is important to accurately monitor lumbar resting position throughout the patient positioning and movement procedure.

Lumbar traction
test and mobilization

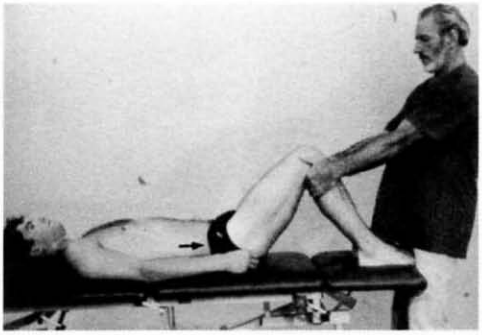


Figure 18a

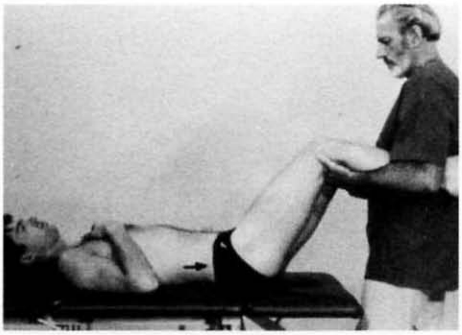


Figure 18b

■ Figure 18a

Objective:

- **Test:** Symptom alleviation or provocation screening.
- **Mobilization:** For restricted movement or symptom relief.

Starting position:

- The patient lies supine with hips and knees flexed. The lumbar spine should be positioned in the actual resting position for this test. For stretch mobilization (Grade III), the patient's upper trunk may be stabilized against the treatment table with a belt around the body just below the rib cage.
- Stand with one leg in front of the other at the caudal end of the treatment table and fixate the patient's feet.

Hand placement:

- Place your hands around the proximal aspect of the patient's calves.

Procedure:

- Pull the patient's legs toward you as you lean your body backward to apply a Grade I, II or III traction movement.

■ Figure 18b - Alternate method

- Hold the patient's lower legs against your body. To apply traction in the actual resting position, pre-position the patient three-dimensionally into sidebending (move the patient's legs and pelvis to the right or left), lumbar flexion or extension (alter the patient's hip and knee angles), and rotation.

Lumbar traction
stretch mobilization (belt and harness)

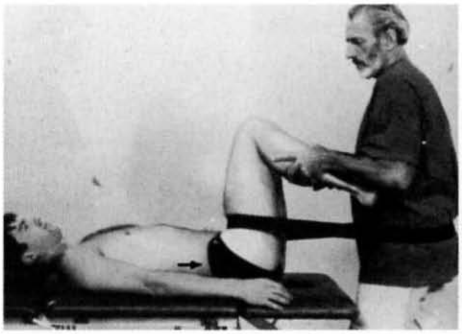


Figure 19a – with belt

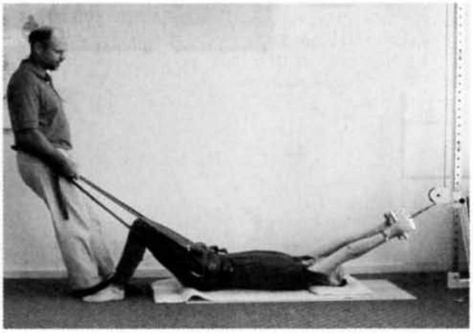


Figure 19b – with the Morgan Traction Harness

■ Figure 19a

Objective:

- **Mobilization:** For restricted movement or symptom relief. When applying traction for longer periods, use a traction belt.

Starting position:

- The patient lies supine. The hips and knees are slightly flexed. The patient's upper trunk may be stabilized against the treatment table with a belt.
- Stand with one leg in front of the other between the patient's legs.

Hand placement:

- Use both arms to hold and stabilize the patient's lower legs against your body. Wrap the traction belt around both your hips and the proximal aspect of the patient's thighs.

Procedure:

- Pre-position the targeted lumbar segment as far as the restriction allows.
  - For *flexion or extension*, adjust the patient's hip and knee angles.
  - For *sidebending*, position the patient's legs and pelvis to the right or left.
  - For *rotation*, place a wedge under one side of the pelvis.
- Apply a Grade III traction by leaning backward and shifting your body weight onto your posterior leg.

Comments:

- To better control the movement, use a belt just below the patient's rib cage to secure their torso to the treatment table.

■ Figure 19b

- Use a mobilization traction harness when it is necessary to apply more forceful traction or to gain greater control in patient positioning. The patient can enhance the effect by holding or pulling actively with their arms.

Lumbar segment L1 to L4: traction
test and mobilization

Figure 20 – skeleton

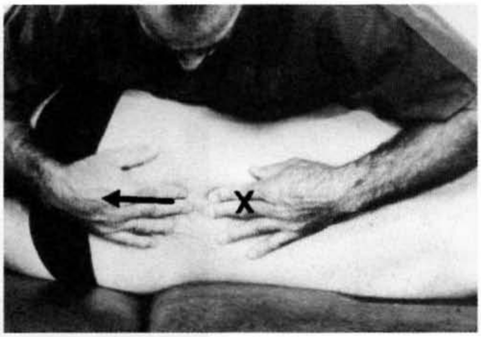


Figure 20 – L3-L4

■ Figure 20

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.
- **Mobilization:** Specific mobilization to increase range or reduce symptoms. This technique is effective in the vertebral segments from L1 to L4. For segmental traction treatment of L5-S1, see Figure 21.

Starting position:

- The patient lies on the right side with hips flexed to between 60° and 90°. The segment to be treated is in the actual resting position.

Hand placement and fixation:

- **Therapist's stable hand:** Place your left forearm and hand against the patient's spine. With your left index and middle fingers, fixate the cranial vertebra of the segment to be treated (shown here at L3).
- **Therapist's moving hand:** Place your right arm and hand against the sacrum. Place your right index and middle fingers on the caudal vertebra of the segment to be treated (shown here at L4). Use the right side of your body as an extension of your moving hand, with contact to the patient's thighs and anterior pelvis.

Procedure:

- Apply a Grade I, II, or III traction to the targeted segment by moving your right arm and body together as a unit in a caudal direction. The position of the patient's lumbar spine should not change during the movement. Remember to keep your fixating left arm stable throughout.
- This technique can also be used for traction joint play.

Comments:

- A mobilization wedge can serve as an alternate method to fixate the cranial vertebra of the targeted segment.

Lumbar segment L5-S1: traction
stretch mobilization

Figure 21 – L5-S1

■ Figure 21

Objective:

- **Stretch mobilization:** Specific mobilization, most often applied to the L5-S1 segment.

Starting position:

- The patient lies on the right side. The hips are flexed to approximately 60º to position the L5-S1 segment in the resting position.
- Stand facing the patient.

Hand placement and fixation:

- **Therapist's stable hand:** Place your left hand against the patient's spine. Place your thumb or index and middle fingers on the L5 spinous process.
- **Therapist's moving hand:** Place the medial aspect of your right forearm and elbow on the patient's sacrum. Use the right side of your body as an extension of your moving hand, with contact to the patient's thighs and anterior pelvis.

Procedure:

- Using your right arm and body, pre-position the L5-S1 segment as far as the restriction allows. Maintain this position throughout the technique.
- Apply a Grade III traction by moving your right arm and body together as a unit in a caudal direction.

Comments:

- Use a mobilization wedge as an alternate fixation for the L5 vertebra.
- This technique can be used for L4 traction if there are no contra-indications to L5-S1 traction. In this case L4 is fixated and traction is produced simultaneously in both the L4-L5 and L5-S1 segments.

Lumbar segment: flexion
test (sitting)

Figure 22

- **Figure 22**

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient sits on the treatment table. The patient's arms are folded across the chest with hands on opposite shoulders or behind the neck.
- Stand facing the patient's left side.

Hand placement and stabilization:

- **Therapist's stable hand:** With your right finger, palpate dorsally between the two spinous processes of the segment to be tested. Use the remaining part of your hand to stabilize the trunk caudal to the segment.
- **Therapist's moving hand:** Place your left arm on the patient's crossed arms and grasp the patient's right shoulder with your left hand.

Procedure:

- With your left hand, guide the patient's trunk forward into flexion until movement occurs in the lumbar segment to be tested.
- Control the movement to avoid excessive thoracic movement and to produce specific movement in a lumbar segment.
- With the therapist's guidance, some patients can actively assist this specific movement.
- Apply a Grade II or III flexion movement.

Lumbar segment: flexion with coupled sidebending and rotation

test and stretch mobilization

Figure 23 – flexion coupled with right sidebending and right rotation

Lumbar

■ Figure 23

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.
- **Stretch mobilization:** For restricted flexion, sidebending or rotation in a lumbar segment.

Starting position:

- The patient sits on the treatment table. The patient's arms are folded across the chest with hands on opposite shoulders.
- Stand facing the right side of the patient.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your left palpating finger laterally (to the left) between the two spinous processes of the segment to be tested. Use the remaining part of your hand to stabilize caudal to the segment.
- **Therapist's moving hand:** Place your right arm on the patient's crossed arms and grasp the patient's left side with your right hand.

Procedure:

- **Test:** With your body and right arm, guide the patient's trunk forward into flexion with coupled sidebending and rotation to the right, until movement occurs in the lumbar segment to be tested. Apply a Grade II or III movement.
- **Stretch mobilization:** Pre-position the targeted lumbar segment as far as the restriction allows. Apply a Grade III linear movement in a ventral direction.

Comments:

- For better fixation, secure the patient's thighs to the treatment table/chair with a belt.

Lumbar segment: flexion
test (sidelying)

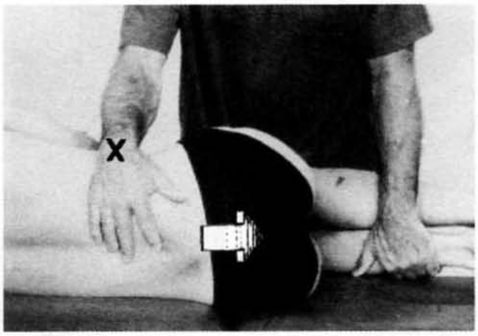


Figure 24a

■ **Figure 24a**

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient lies on the left side with hips and knees flexed. The patient's knees extend off the edge of the table. Place a pillow under the patient's waist to avoid lateral flexion of the lumbar spine.
- Stand facing the patient.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your right palpating finger dorsally between the two spinous processes of the segment to be tested. Use the remaining part of your right hand to stabilize cranial to the segment.
- **Therapist's moving hand:** With your left hand, grasp the dorsal aspect of the patient's calves and knees. The patient's knees contact your body.

Procedure:

- Use your body and left arm as a unit to guide the patient's knees in a cranial direction, until movement occurs in the segment to be tested.
- Apply a Grade I, II, or III flexion movement.

Lumbar segment: flexion
stretch mobilization

Figure 24b – skeleton

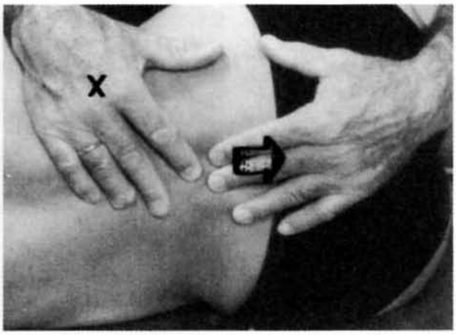


Figure 24b

Lumbar

■ Figure 24b

Objective:

- **Stretch mobilization:** For restricted flexion in a lumbar segment.

Starting position:

- The patient lies on the left side with a pillow supporting their waist. The hips and knees are flexed.
- Stand facing the patient.

Hand placement and fixation:

- **Therapist's stable hand:** Place your right hand on the right dorsal aspect of the patient's lumbar spine. Use your fingers to fixate the transverse processes or the spinous process of the cranial vertebra of the targeted segment (shown here at L4).
- **Alternate fixation:** Press a mobilization wedge over the transverse processes of the cranial vertebra of the targeted segment.
- **Therapist's moving hand:** Place your left hand on the sacrum. Place your fingers on the transverse processes or spinous process of the caudal vertebra of the targeted segment (shown here at L5). Your body contacts the patient's knees and acts as an extension of your moving hand.

Procedure:

- Pre-position the targeted lumbar segment into flexion as far as the restriction allows, using your left hand and body to guide the movement.
- Apply a Grade III linear mobilization in a caudal-ventral direction.

Lumbar segment: rotation in flexion
test (initiated cranially)

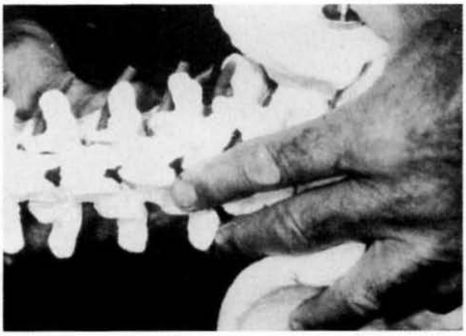


Figure 25a – skeleton

Figure 25a – to the right

■ Figure 25a

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient lies on the left side with the hips and knees flexed. The lumbar spine is in flexion. Do not place a pillow under the patient's waist, as the movement should be coupled with right sidebending to maximize rotation to the right in flexion.
- Stand facing the patient.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your left palpating finger laterally (to the left) between the two spinous processes of the segment to be tested. Use the remaining part of your left hand to stabilize caudal to the segment on the dorsal surface of the patient's pelvis. For additional stabilization, press your body against the patient's body caudal to the segment.
- **Therapist's moving hand:** Place your right forearm on the ventral and right lateral surface of the patient's lower rib cage. Place your fingers on the lateral (shown here on the right) side of the spinous process of the cranial vertebra of the segment to be tested.

Procedure:

- With your right arm, rotate the patient's lower thoracic and upper lumbar spine to the right until movement occurs in the segment to be tested.
- The spinous process of the cranial vertebra of the tested segment should move more than the caudal spinous process to the left (towards the table).
- Apply a Grade I, II or III rotation movement.

Lumbar

Lumbar segment: rotation in flexion
stretch mobilization (initiated cranially)

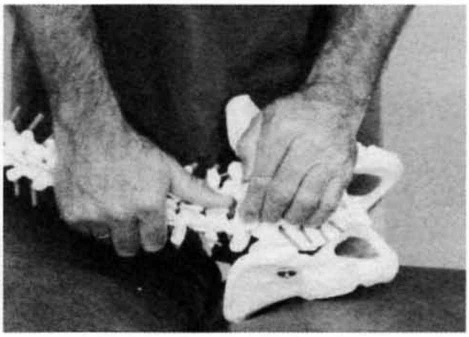


Figure 25b – skeleton

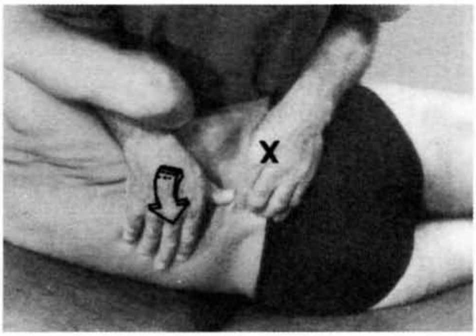


Figure 25b – to the right

■ Figure 25b

Objective:

- **Stretch mobilization:** For restricted rotation or flexion in a lumbar segment.

Starting position:

- The patient lies on the left side. The hips and knees are flexed. The lumbar spine is in flexion. Elevate the patient's torso into right sidebending with an adjustable treatment table or a pillow. This facilitates right lumbar rotation in flexion with combined right sidebending in a coupled movement pattern.
- Stand facing the patient.

Hand placement and fixation:

- **Therapist's stable hand:** Place your left hand on the patient's right dorsal pelvis. Fixate the left side of the spinous process of the caudal vertebra of the targeted segment with your fingers. Use the left side of your body as an extension of your fixating hand, with contact to the ventral side of the patient's lower trunk and pelvis.
- **Therapist's moving hand:** Place your right forearm on the lateral-ventral aspect of the patient's right lower rib cage. Place your thumb or middle and index fingers on the right side of the spinous process of the cranial vertebra of the targeted segment.

Procedure:

- Pre-position the targeted lumbar segment as far as the restriction allows, using your right arm to rotate the patient's lower thoracic and upper lumbar spine to the right.
- Apply a Grade III linear mobilization in a lateral direction.

Lumbar segment: rotation in flexion
test (initiated caudally)

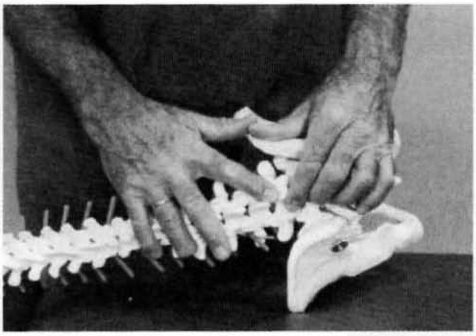


Figure 26a – skeleton

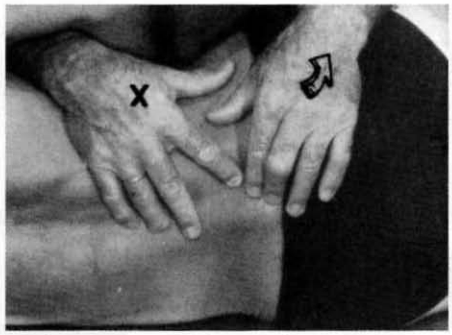


Figure 26a – relative rotation to the right

■ Figure 26a

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient lies on the left side. The left (bottom) leg is extended; the right leg is positioned in flexion on top of the left leg. The lumbar spine is in flexion. Do not place a pillow under the patient's waist. The movement should be coupled with right sidebending to maximize rotation to the right in flexion.
- Stand facing the patient.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your right palpating finger laterally (to the right) between the two spinous processes of the segment to be tested. With the remaining part of your right hand, stabilize cranial to the segment. Use your body to provide additional stabilization cranial to the segment.
- **Therapist's moving hand:** Place your left index and middle fingers on the lateral (shown here on the left) side of the spinous process of the caudal vertebra. Place the remaining part of your left hand and forearm on the patient's dorsal pelvis.

Procedure:

- With your left hand, rotate the patient's pelvis to the left so that the segment to be tested rotates (relatively) to the right. The spinous process of the caudal vertebra of the tested segment should move more than the cranial spinous process to the right (away from the table).
- Apply a Grade I, II or III rotation movement.

Lumbar segment: rotation in flexion
stretch mobilization (initiated caudally)

Figure 26b – skeleton

Figure 26b – relative rotation to the right

■ Figure 26b

Objective:

- **Stretch mobilization:** For restricted rotation or flexion in a lumbar segment.

Starting position:

- The patient lies on the left side. The left (bottom) leg is extended to facilitate pelvis rotation; the right leg is positioned in flexion on top of the left leg. The lumbar spine is in flexion. Elevate the patient's pelvis with an adjustable treatment table or a pillow to induce right sidebending. Right lumbar rotation in flexion is enhanced when combined with right sidebending in a coupled movement pattern.
- Stand facing the patient.

Hand placement and fixation:

- **Therapist's stable hand:** Place your right forearm on the lateral-ventral aspect of the patient's right lower rib cage. Use your thumb or middle and index fingers to fixate laterally on the spinous process (shown here on the right) of the cranial vertebra of the targeted segment. Use the right side of your body as an extension of your fixating hand, with contact to the patient's upper ventral trunk.
- **Therapist's moving hand:** Place your left hand on the patient's right dorsal pelvis. Place your fingers laterally on the spinous process (shown here on the left) of the caudal vertebra of the targeted segment.

Procedure:

- Pre-position the targeted lumbar segment as far as the restriction allows, using your left arm to rotate the patient's pelvis to the left and slightly in a cranial direction (emphasizing right sidebending).
- Apply a Grade III linear mobilization in a ventral direction.

Lumbar segment: extension
test (sitting)

Figure 27

■ Figure 27

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient sits on the treatment table. The patient's arms are folded across the chest with hands on opposite shoulders or behind the neck.
- Stand facing the patient's left side.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your right palpating finger dorsally between the two spinous processes of the segment to be tested. Use the remaining part of your hand to stabilize the trunk caudal to the segment.
- **Therapist's moving hand:** Place your left arm on the patient's crossed arms and grasp the patient's right shoulder with your left hand.

Procedure:

- With your left hand, guide the patient's trunk backward into extension until movement occurs in the lumbar segment to be tested.
- Apply a Grade I, II or III extension movement.
- Control the movement to avoid excessive thoracic movement and to produce specific movement in a lumbar segment.
- With the therapist's guidance, some patients can actively assist this specific movement.

Lumbar segment: extension with coupled sidebending and rotation

test and stretch mobilization

Figure 28 – extension coupled with left sidebending and right rotation

■ Figure 28

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.
- **Stretch mobilization:** For restricted extension, sidebending or rotation in a lumbar segment.

Starting position:

- The patient sits on the treatment table. The patient's arms are folded across the chest with hands on opposite shoulders or behind the neck.
- Stand facing the right side of the patient.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your left palpating finger laterally (to the left) between the two spinous processes of the segment to be tested. Use the remaining part of your left hand to stabilize caudal to the segment.
- **Therapist's moving hand:** Reach around the patient's chest and under the arms with your right arm and grasp their left side.

Procedure:

- **Test:** With your body and right arm, guide the patient's trunk backward into extension with coupled sidebending to the left and rotation to the right, until movement occurs in the segment to be tested. Apply a Grade II or III movement. Compare both sides.
- **Stretch mobilization:** Pre-position the targeted lumbar segment as far as the restriction allows. Apply a Grade III linear movement in a dorsal direction.

Comments:

- For better fixation, secure the patient's thighs to the treatment table/chair with a belt.

Lumbar segment: extension
test (sidelying)

Figure 29a – in sidelying

■ Figure 29a

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient lies on the left side with hips and knees flexed and a pillow supporting their waist. The patient's upper body is positioned in the middle of the table. The patient's lower body is placed at the edge of the table with knees extending off the edge.
- Stand facing the patient.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your right palpating finger dorsally between the two spinous processes of the segment to be tested. Use the remaining part of your right hand to stabilize cranial to the segment.
- **Therapist's moving hand:** With your left hand, grasp the ventral aspect of the patient's distal lower leg. Use your body as an extension of your moving hand with contact against the patient's knees.

Procedure:

- With your body and left arm, produce extension in the segments to be tested by moving the patient's legs and pelvis in a dorsal direction. Maintain fixed knee and hip joint angles during the lumbar movement.
- Apply a Grade I, II, or III extension movement.

Lumbar segment: extension

stretch mobilization

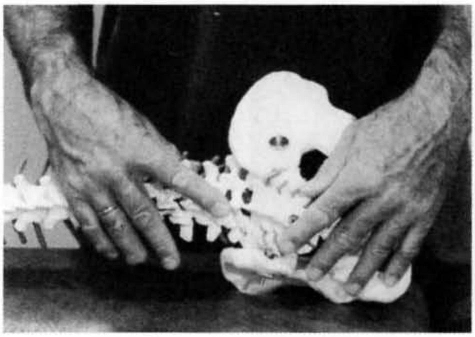


Figure 29b – skeleton

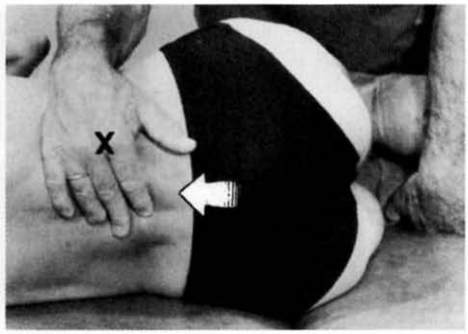


Figure 29b – L5-S1

■ Figure 29b

Objective:

- **Stretch mobilization:** For restricted extension in a lumbar segment.

Starting position:

- The patient lies on the left side with a pillow under the waist to maintain the resting position. The hips and knees are flexed.
- Stand facing the patient.

Hand placement and fixation:

- **Therapist's stable hand:** Place your right index finger between the two spinous processes of the segment to be stretched. With your index finger, fixate dorsally on the spinous process of the cranial vertebra of the targeted segment (shown here at L5). Use the remaining part of your right hand to stabilize cranial to the segment.
- **Therapist's moving hand:** With your left hand, grasp the dorsal aspect of the patient's calves and knees. Use your body as an extension of your moving hand with contact against the patient's knees.

Procedure:

- Pre-position the targeted lumbar segment into extension as far as the restriction allows, by moving the patient's legs and pelvis in a dorsal direction. Maintain fixed knee and hip joint angles during the lumbar movement.
- Apply a Grade III linear mobilization in a dorsal direction.

Lumbar segment: rotation in extension
test (initiated cranially)

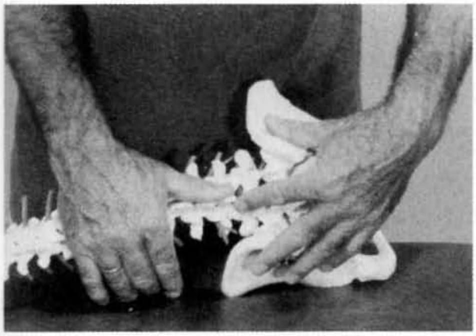


Figure 30a – skeleton

Figure 30a – to the right

Lumbar

■ Figure 30a

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient lies on the left side with the hips and knees flexed. The lumbar spine is in extension. Place a pillow under the patient's waist to support left sidebending. Rotation to the right in extension is facilitated when combined with left sidebending.
- Stand facing the patient.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your left palpating finger laterally (to the left) between the two spinous processes of the segment to be tested. Use the remaining part of your left hand to stabilize the patient's dorsal pelvis caudal to the segment. For additional stabilization, place your body in contact with the patient's ventral pelvis.
- **Therapist's moving hand:** Place your right forearm on the patient's ventral/lateral lower rib cage. Place your thumb or index finger on the lateral (shown here on the right) side of the spinous process of the cranial vertebra of the tested segment.

Procedure:

- With your right arm, rotate the patient's lower thoracic and upper lumbar spine to the right until movement occurs in the segment to be tested. The spinous process of the cranial vertebra of the tested segment should move more than the caudal spinous process to the left (towards the table).
- Apply a Grade I, II or III rotation movement.

Lumbar segment: rotation in extension
stretch mobilization (initiated cranially)

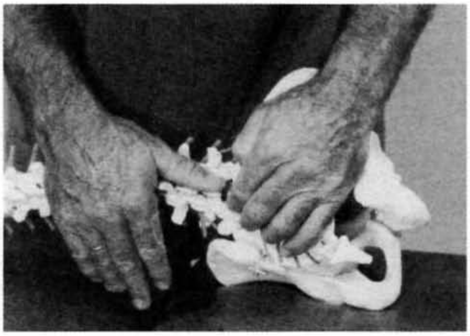


Figure 30b – skeleton

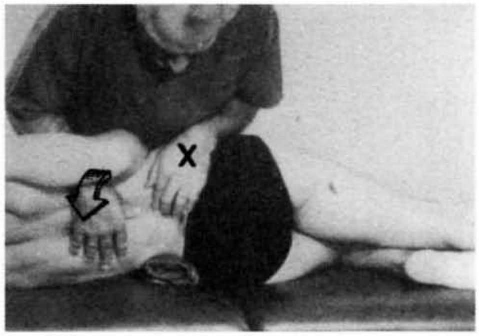


Figure 30b – to the right

■ Figure 30b

Objective:

- **Stretch mobilization:** For restricted rotation or extension in a lumbar segment.

Starting position:

- The patient lies on the left side. The lumbar spine is in extension. The left (bottom) leg is flexed to help fixate the pelvis. The right (top) leg is extended which pulls the right pelvis caudally to reinforce left lumbar sidebending. Left sidebending can also be reinforced with a pillow under the patient's waist. Lumbar right rotation in extension is facilitated when combined with left sidebending in a coupled movement pattern.
- Stand facing the patient.

Hand placement and fixation:

- **Therapist's stable hand:** Place your left hand against the patient's right dorsal pelvis. With your fingers, fixate laterally on the spinous process (shown here on the left) of the caudal vertebra of the targeted segment. Use the left side of your body as an extension of your fixating hand, with contact to the patient's ventral trunk and pelvis.
- **Therapist's moving hand:** Place your right forearm on the patient's right lateral/ventral lower rib cage. Place your thumb or middle and index fingers laterally on the spinous process (shown here on the right) of the cranial vertebra of the targeted segment.

Procedure:

- Pre-position the targeted lumbar segment as far as the restriction allows, using your right arm to rotate the patient's lower thoracic and upper lumbar spine to the right.
- Apply a Grade III linear mobilization in a lateral direction.

Lumbar segment: rotation in extension
test (initiated caudally)

Figure 31a – skeleton

Figure 31a – to the right

Lumbar

- **Figure 31a**

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient lies on the left side. The left (bottom) leg is extended to facilitate pelvis rotation; the right leg is positioned in flexion on top of the left leg. The lumbar spine is in extension. Place a cushion under the patient's waist to facilitate left sidebending. Right rotation in extension is facilitated when combined with left sidebending.
- Stand facing the patient.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your right palpating finger laterally (to the right) between the two spinous processes of the segment to be tested. Stabilize cranial to the segment with the remaining part of your right hand. For additional stabilization, place your body in contact with the patient's body cranial to the segment .
- **Therapist's moving hand:** Place your left index and middle fingers on the lateral (shown here on the left) side of the spinous process of the caudal vertebra. Place the remaining part of your left hand and forearm on the patient's dorsal pelvis.

Procedure:

- With your left hand, rotate the patient's pelvis to the left until movement occurs in the segment to be tested. This produces a relative right rotation in the segment. The spinous process of the segment's caudal vertebra should move more than the cranial spinous process to the right (away from the table).
- Apply a Grade I, II or III rotation movement.

Lumbar segment: rotation in extension
stretch mobilization (initiated caudally)


Figure 31b – skeleton


Figure 31b – relative rotation to the right

■ Figure 31b

Objective:

- **Stretch mobilization:** For restricted rotation or extension in a lumbar segment.

Starting position:

- The patient lies on the left side. The left (bottom) leg is extended and the right leg is positioned in flexion on top of the left leg to facilitate pelvis left rotation (a relative right rotation of the lumbar spine). The lumbar spine is in extension. Place a pillow under the patient's waist to facilitate left sidebending. Lumbar right rotation in extension is facilitated when combined with left sidebending.
- Stand facing the patient.

Hand placement and fixation:

- **Therapist's stable hand:** Place your right forearm on the patient's right lateral-ventral lower rib cage. With your thumb or middle and index fingers, fixate laterally on the spinous process (shown here on the right) of the cranial vertebra of the targeted segment. Use the right side of your body as an extension of your fixating hand, with contact to the patient's ventral upper trunk.
- **Therapist's moving hand:** Place your left hand on the patient's right dorsal pelvis. Place your fingers laterally on the spinous process (shown here on the left) of the caudal vertebra of the targeted segment.

Procedure:

- Pre-position the targeted lumbar segment as far as the restriction allows (relatively) to the right, by using your left arm to rotate the patient's pelvis to the left. At the same time, pull the patient's pelvis in a caudal direction to facilitate left sidebending.
- Apply a Grade III linear mobilization in a ventral direction.

Lumbar soft tissue and joint: cranial and lateral

mobilization (prone)

Figure 32a – cranial

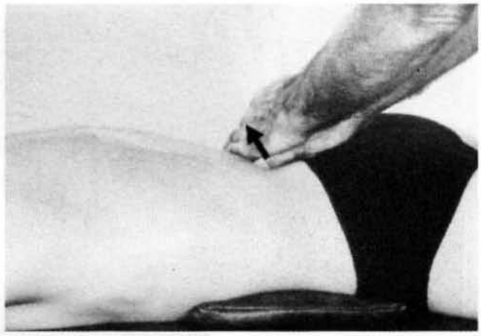


Figure 32b – lateral

■ Figure 32a

Objective:

- **Mobilization:** For restricted soft tissue or joint mobility in the lumbar region.

Starting position:

- The patient lies prone with a cushion supporting the stomach.
- Stand facing the patient's right side of the patient.

Hand placement:

- Place your left index and middle fingers, pointing cranially, flat against the patient's paraspinal muscles on one side.
- Place the ulnar side of your right hand on top of your left fingertips.

Procedure:

- Move your hands in a cranial direction as far as the patient's skin will allow, simultaneously pressing down into the muscle. Rhythmically apply and release the pressure without losing contact with the skin.

Comments:

- Apply the technique to both sides of the lumbar spine.

■ Figure 32b

- Use a similar technique for lateral mobilization of the lumbar paraspinal muscles. Lay your right thumb (pointing cranially) horizontal to the patient's paraspinals on one side (shown here right). Place the heel of your left hand on top of the length of your thumb. Apply lateral pressure (away from the spine). To avoid stretching or irritation of the skin, draw the skin medially (toward the spine) before the start of each soft tissue movement.
- Use the same hand placement to apply mobilization in a cranial direction along the lateral side of the spinous processes.

Lumbar soft tissue and joint: lateral
mobilization (sidelying)

Figure 32c

Lumbar

■ Figure 32c

Objective:

- **Mobilization:** For restricted soft tissue or joint mobility in the lumbar region.

Starting position:

- The patient lies on the left side.
- Stand facing the patient.

Hand placement:

- With your fingers, grasp the medial aspect of the patient's right paraspinals. Place one forearm on the patient's rib cage and your other forearm on the patient's iliac crest.

Procedure:

- With your fingers, pull the patient's paraspinals laterally and at the same time use your forearms to passively sidebend the patient's lumbar spine toward the opposite side. For additional sidebending movement, use your forearms to separate the patient's thorax and pelvis. Rhythmically apply and release the pressure, allowing the spine to return to the starting position after each movement.

Comments:

- The sidebending component of this technique also produces a small amount of lumbar rotation. This rotation movement is enhanced when combined with a coupled movement pattern. In a sidelying position, the patient's lumbar spine can be positioned in flexion or extension. In flexion, left sidebending will also rotate the lumbar vertebrae to the left in a coupled movement; in extension, the associated rotation will instead occur to the right.

Lumbar soft tissue and joint: medial
mobilization

Figure 32d

Figure 32e – alternate method

■ Figure 32d

Objective:

- **Mobilization:** For restricted soft tissue or joint mobility in the lumbar region.

Starting position:

- The patient lies on the left side.
- Stand facing the patient.

Hand placement:

- Place the heel of your right hand on the patient's right medial quadratus lumborum and right paraspinals.
- Place your left hand on the patient's right pelvis.

Procedure:

- Your right hand pushes the patient's paraspinal muscles medially while your left hand pushes the hip cranially to passively sidebend the lumbar spine to the right. Rhythmically apply and release the pressure, allowing the spine to return to the starting position after each movement.

■ Figure 32e

- This technique is easily modified to mobilize the paraspinal soft tissues on the opposite side without changing the patient's position. With your right fingers, grasp the patient's left quadratus lumborum and left paraspinals. With your right hand, pull the paraspinal muscles medially while your left hand pushes the patient's hip caudally to passively sidebend the lumbar spine to the left.

Comments:

- These techniques can be combined with coupled spinal movements.

■ Notes

Lumbar

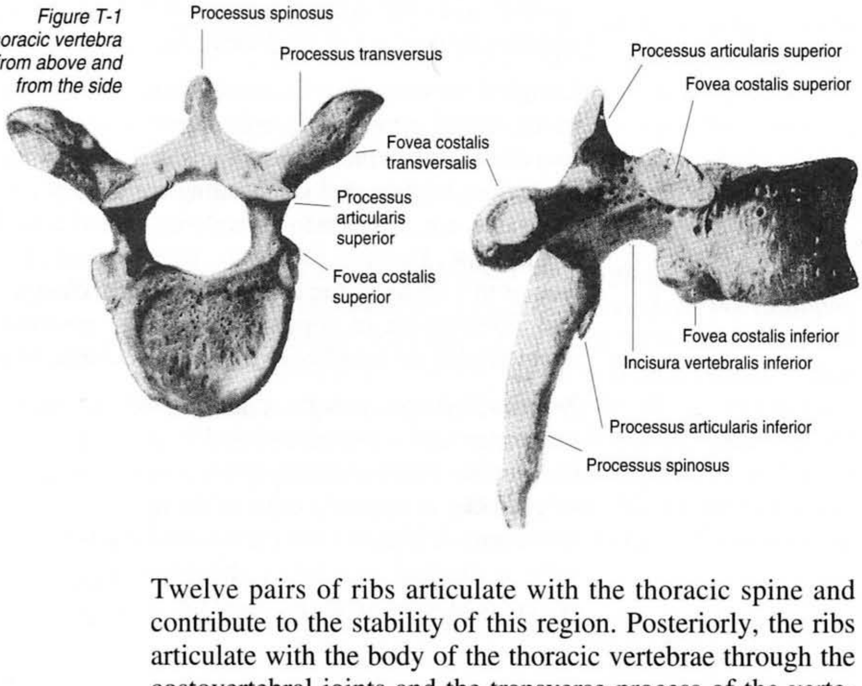
11 Thoracic spine and ribs

Functional anatomy and movement

Anatomy

The orientation of the thoracic facet joints varies among individuals, and can also vary from segment to segment and from side to side in the same individual. In most people, the thoracic spinal facet joint surfaces are angled about 60° toward the transverse plane (Figure T-1), oriented in a dorsal/caudal to ventral/cranial direction. The superior facets face dorsally and somewhat cranially and laterally, and the inferior facets face ventrally and somewhat caudally and medially. The facet joint surfaces are round and almost flat.

Figure T-1
The 6th thoracic vertebra viewed from above and from the side



Twelve pairs of ribs articulate with the thoracic spine and contribute to the stability of this region. Posteriorly, the ribs articulate with the body of the thoracic vertebrae through the costovertebral joints and the transverse process of the vertebrae through the costotransverse joints. Anteriorly, the first ten ribs are connected to the sternum. The upper ribs hang slightly below the transverse processes, rotating around a nearly frontal axis in a dorsal-ventral movement, increasing and decreasing the ventral-dorsal dimension of the thorax, and less so the lateral dimension of the thorax. The lower ribs are positioned directly anterior to the transverse processes, rotating around a nearly sagittal axis in a lateral-medial movement, expanding the thorax laterally and a little ventrally.

■ Bone and joint movement

In the resting position there is a kyphosis in the thoracic spine. During flexion the kyphosis is increased (Thoracic Figure 1). During extension the thoracic kyphosis is reduced and may change into a lordosis (Thoracic Figure 2). Both movements follow the Concave Rule.

Combined movement patterns

The skilled use of combined movement patterns is essential for evaluation, joint mobilization, soft tissue mobilization, exercise training, and other patient management procedures designed to specifically produce or limit movement in the thoracic spine.

Coupled movement – Thoracic rotation and sidebending can be increased when performed simultaneously in a coupled movement. When the thoracic spine is in the resting position or in flexion, rotation and sidebending are usually coupled to the same side, e.g., rotation to the right is coupled with sidebending to the right (Thoracic Figure 3). With marked thoracic extension or in a lordosis, the coupling normally changes to rotation and sidebending to opposite sides, e.g., rotation to the left coupled with sidebending to the right (Thoracic Figure 5).

Noncoupled movement – A noncoupled movement pattern has less range and a firmer end-feel in comparison to a coupled movement. Thoracic noncoupled movements are rotation and sidebending to opposite sides in the resting position or in flexion (Thoracic Figure 4) or rotation and sidebending to the same side in marked extension (Thoracic Figure 6). Thoracic noncoupled movements are used for "locking" techniques.

■ Notes on evaluation and treatment

The ribs restrict all thoracic movements, especially extension. Therefore, when evaluating and treating the thoracic spine attention should be paid to the ribs, especially with chronic problems. To maximize thoracic mobility during treatment, the rib cage should be in its most relaxed position. Time the mobilization with the patient's expiration.

Since the upper ribs articulate below the transverse processes, a lesion at this level is commonly associated with a ligamentous strain. The lower ribs articulate with the superior aspect of the transverse processes; therefore these joints are more prone to arthrotic changes.

A successful thoracic mobilization may not result in the desired outcome if an associated rib restriction is not addressed. For example, the rib can be locked in a positional fault. Asthma patients sometimes have a rib positional fault in a cranial position, and ankylosing spondylitis patients sometimes have a rib positional fault in a caudal position.

The interpretation of rib position palpation findings can be complex, and cannot provide a diagnosis without additional movement tests. In practice, it is difficult to assess whether there is less-than-normal distance between ribs, and even more difficult to assess whether there is greater-than-normal distance between ribs, as there is significant anatomical variation from person to person.

Indirect tests using inspiration and expiration may also be necessary to confirm the presence of a fixated rib. For example, if the practitioner notes decreased space between the 4th and 5th ribs, and suspects that the 5th rib is fixated cranially, then the practitioner can palpate whether the 4th rib moves cranially in relation to the 5th rib during inspiration (which rules out the possibility that the 4th rib is fixated caudally), and whether the 5th rib moves caudally in relation to the 4th rib during expiration (which rules out the possibility of a cranial fixation of the 5th rib).

A "group-lesion" of the ribs is also possible, in which there is a positional fault of more than one rib in a caudal or cranial position. In this case, we recommend an additional test incorporating breathing. For example, pain during inspiration implicates a caudal rib fixation, while pain during expiration implicates a cranial rib fixation.

If palpation reveals a narrowing between two ribs, the recommended treatment moves the superior rib cranially and with fixation of the caudal rib. This is effective both when the caudal rib is fixated cranially and when the cranial rib is fixated caudally. In addition to the passive movement of the arm, the patient may be asked to participate in the treatment by breathing: inhaling when treating a caudally fixated rib and exhaling with treatment of a cranially fixated rib.

Rib mobilization is usually initiated with traction at the costotransverse joint (Thoracic Figures 26-27) and followed with mobilization of ribs in relation to other ribs (Thoracic Figures 28 and 30).

■ Thoracic tests and mobilizations

Thoracic spine

■ Screening techniques

■ Localization techniques

■ Traction techniques

■ Techniques with a flexion component

Note

Before practicing any thoracic mobilization technique students should screen their partners using the following evaluation procedures:

Active thoracic flexion and extension
test

Figure 1 – flexion

Figure 2 – extension

■ Figure 1

Objective:

- **Test:** General mobility and symptom screening.

Starting position:

- The patient sits on the treatment table.

Procedure:

- The patient bends forward into thoracic flexion.
- At the end of the patient's active movement, apply overpressure to assess the presence of additional passive movement range.
- Observe range of thoracic flexion and the way the movement is performed. Note symptom behavior throughout the movement.

Comments:

- Following this test evaluate passive movement quality from the zero position through the entire range of movement, including end-feel characteristics.

■ Figure 2

- Use a similar method to evaluate active and passive thoracic extension.

Active thoracic flexion with combined sidebending and rotation

test

Figure 3 – coupled right sidebending and right rotation

Figure 4 – noncoupled right sidebending and left rotation

■ Figure 3

Objective:

- **Test:** General mobility and symptom screening.

Starting position:

- The patient sits on the treatment table.

Procedure:

- The patient bends forward into flexion with simultaneous coupled sidebending and rotation to the right.
- At the end of the patient's active movement, apply overpressure to assess the presence of additional passive movement range.
- Observe range of coupled thoracic flexion with sidebending and rotation to the same side. Note the way the movement is performed. Note symptom behavior throughout the movement. Compare both sides.

Comments:

- Following this test evaluate passive movement quality from the zero position through the entire range of movement, including end-feel characteristics.

■ Figure 4

- Use a similar method to evaluate active and passive noncoupled movements in thoracic flexion with sidebending and rotation to opposite side (e.g., sidebending to the right and rotation to the left).

Active thoracic extension with combined sidebending and rotation

test

Figure 5 – coupled right sidebending and left rotation

Figure 6 – noncoupled right sidebending and right rotation

■ Figure 5

Objective:

- **Test:** General mobility and symptom screening.

Starting position:

- The patient sits on the treatment table.

Procedure:

- The patient bends backward into extension with simultaneous coupled sidebending to the right and rotation to the left.
- At the end of the patient's active movement, apply overpressure to assess the presence of additional passive movement range.
- Observe range of coupled thoracic extension with rotation and sidebending to opposite sides. Note the way the movement is performed. Note symptom behavior throughout the movement. Compare both sides.

Comments:

- Following this test, evaluate passive movement quality from the zero position through the entire range of movement, including end-feel characteristics.

■ Figure 6

- Use a similar method to evaluate active and passive noncoupled movements in thoracic extension with sidebending and rotation to the same side (e.g., sidebending and rotation to the right).

Thoracic traction
test and mobilization (sitting)

Figure 7a
in resting position

■ **Figure 7a**

Objective:

- **Test:** Symptom alleviation or provocation screening.
- **Mobilization:** For restricted movement or symptom relief.

Starting position:

- The patient sits on the treatment table with arms folded across the chest.
- Stand behind the patient.

Hand placement:

- Use both arms to hold the patient's elbows.

Procedure:

- **Test and mobilization:** Lean slightly backward to apply a Grade I, II, or III traction force primarily to the thoracic spine.
- **Specific mobilization**: Use a wedge to fixate the cranial or caudal vertebra of the targeted thoracic segment. Position the wedge between the patient's body and your chest.

  For caudal fixation the wedge points caudally, its peaks on the transverse processes of the caudal vertebra of the targeted segment. Your body remains stable while your arms apply the traction movement.

  For cranial fixation (a less specific technique), the wedge points cranially with its peaks on the transverse processes of the cranial vertebra of the targeted segment. The caudal vertebra has no fixation. Straighten your previously bent knees to lift the patient cranially. There is no contact between you and the patient below the wedge.
  Apply a Grade II or III traction movement.
- **Stretch mobilization:** Secure the patient's thighs to the treatment table/ chair with a belt for fixation. Apply a Grade III traction movement.

Figure 7b
in actual resting position

■ **Figure 7b**

- **Test:** To determine the actual resting position, monitor symptomatic response to thoracic traction in various combinations of flexion, sidebending and rotation (e.g., flexion, sidebending and rotation to the right illustrated above).
- **Pain-relief mobilization:** Apply Grade IISZ traction movements in the actual resting position.
- **Relaxation mobilization:** Apply Grade II traction movements (including movement into the Transition Zone) in the actual resting position.
- **Stretch mobilization:** Pre-position the patient's thoracic spine as far as the restriction allows. Secure the patient's thighs to the treatment table/ chair with a belt for fixation. Apply a Grade III traction movement.

Thoracic compression
test

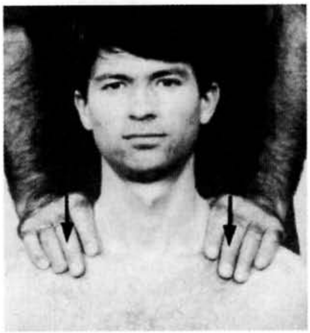


Figure 8

■ Figure 8

Objective:

- **Test:** Symptom provocation screening

Starting position:

- The patient sits on the treatment table.
- Stand behind the patient.

Hand placement:

- Place your hands on top of the patient's shoulders.

Procedure:

- Press the patient's shoulders in a caudal direction. Spinal curvatures should not change during the test; for example, there should be no increase in thoracic kyphosis or lumbar lordosis. To help maintain the patient's spinal curvatures during the test, stabilize the patient's trunk against your body.

Comments:

- Symptomatic response to thoracic compression is also tested in varying three-dimensional pre-positioned starting positions.
- Alternative hand placement: Place one hand on the ventral aspect of the patient's chest and your other hand on the dorsal aspect of the patient's upper thoracic spine.

Thoracic "springing"
test

Figure 9 – skeleton

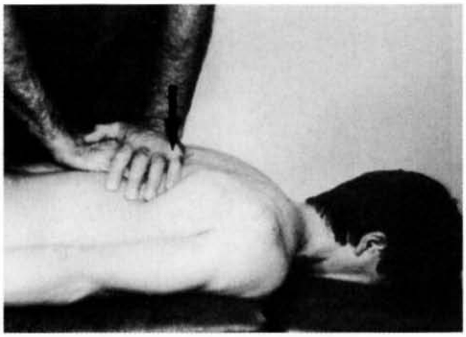


Figure 9

■ Figure 9

Objective:

- **Test:** Segmental range and quality of movement, including end-feel. The thoracic "springing test" can localize a lesion to within *two* vertebral segments. The caudal vertebra moves ventrally relative to the cranial vertebra.

Starting position:

- The patient lies prone with a cushion under the chest to maintain the normal kyphosis.

Hand placement:

- **Therapist's stable hand:** Place your right index and middle fingers pointed in a cranial direction (or the peaks of a mobilization wedge) on the transverse processes of the caudal vertebrae of the segment to be tested.
- **Therapist's moving hand:** Place the ulnar side of your left hand on top of the distal aspect of the pre-positioned right index and middle fingers.
- When using a wedge, hold the wedge with your right hand. Palpate with your left index finger between the two specified spinous processes through the access between the peaks of the wedge.

Procedure:

- Lean your body through your arms. Apply each test movement at right angles to the treatment plane of the targeted joint: in a ventral-cranial direction for the lower thoracic spine and in a ventral-caudal direction for the upper thoracic spine.
- Start the test caudally to separate the superior facets of the caudal vertebra from the inferior facets of the cranial vertebra. When testing the next cranial segment, the previously tested (now caudal) joints are compressed and the cranial joints are separated.
- Apply Grade I, II or III ventral vertebral movements.

Comments:

- With positive findings, progress to *Figure 10: Thoracic segment: rotation,* to isolate the lesion to a specific segment.

Thoracic segment: rotation

test (lateral pressure to spinous processes)

Figure 10 – skeleton

Figure 10

(P) πονος

5 ← κουνουμε
6 P ← σταθεροποιουμε
7 ← κινητοποιουμε.
8 ← ξεκιναμε την εξεταση σε επιπεδα τους απο κατω

■ Figure 10

Objective:

- **Test:** Segmental range and quality of movement, including end-feel. Localizes a symptomatic joint dysfunction in one segment in one direction of rotation.

Starting position:

- The patient lies prone with a cushion under their chest to maintain the normal kyphosis.
- Stand facing the patient's right side.

Hand placement and fixation:

- **Therapist's stable hand:** With your left thumb, fixate the lateral side (shown here on the left) of the spinous process of the caudal vertebra of the segment to be tested.
- **Therapist's moving hand:** Place your right thumb laterally on the spinous process (shown here on the right) of the cranial vertebra of the segment to be tested.

Procedure:

- To apply a Grade I, II or III right rotation to the cranial vertebra, move the cranial spinous process to the left with your right thumb.
- To apply a Grade I, II or III left rotation to the cranial vertebra, fixate the caudal spinous process on the right with your right thumb and move the cranial spinous process to the right with your left thumb.
- Avoid ventral pressure.

Comments:

- To differentiate periosteal pain from joint pain, palpate each spinous process before the test. If palpation is painful, perform the test with ventral pressure to the related transverse processes.

Thoracic segment: translatoric joint play
test

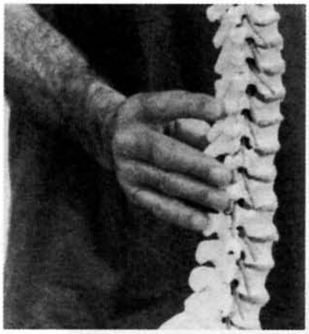


Figure 11a – skeleton

Figure 11a – sitting

■ Figure 11a

Objective:

- **Test:** Segmental range and quality of movement, including end-feel. Evaluate joint play (linear movement) of the patient's vertebra, parallel to the treatment plane of the vertebral disc joint.

Starting position:

- The patient sits on the treatment table with arms folded across the chest and hands on opposite shoulders.
- Stand facing the patient's left side.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your right palpating finger dorsally between the two spinous processes of the segment to be tested. Use the remaining part of your right hand to provide stabilization to the caudal segments.
- **Therapist's moving hand:** Place your left arm around the patient's crossed arms, elevating the patient's arms slightly off the chest.

Procedure:

- With your body and left arm, alternately push and pull longitudinally in an ventral-dorsal direction through the patient's arms to produce:
  a) small Grade I oscillatory movements to assess joint play, and
  b) Grade II and III movements to assess movement quantity and quality, including end-feel.

Comments:

- Adapt hand placement for traction joint play.

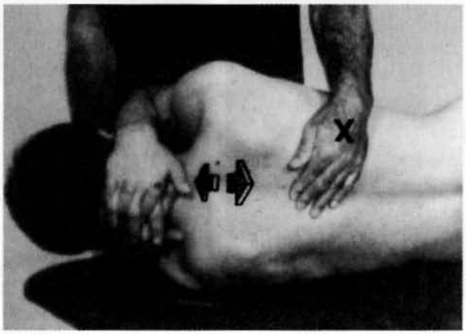


Figure 11b – sidelying

■ Figure 11b

- Perform the same test sidelying for non-weightbearing joint play assessment. Test in both right and left sidelying positions.
- If the patient cannot clasp hands behind the neck, the arms can be folded across the chest with hands on opposite shoulders. In this case, grasp the patient's left shoulder with your right hand and support the patient's head and neck with your arm.
- Apply a Grade I, II or III movement.

Comments:

- Adapt hand placement for traction joint play.

Thoracic traction
mobilization (supine)

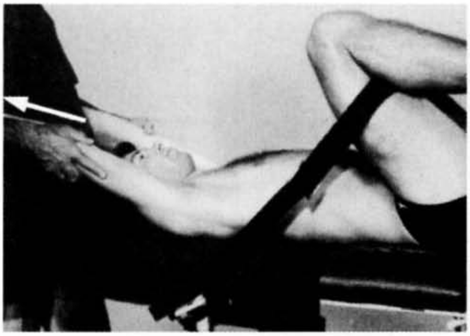


Figure 12a – with hands

Figure 12b – with belt

■ Figure 12a

Objective:

- **Mobilization:** For restricted movement or symptom relief.

Starting position:

- The patient lies supine with hips and knees flexed.
- Stand with one leg in front of the other at the cranial end of the treatment table, facing the patient.

Hand placement and fixation:

- Fixate the patient's lower trunk with a belt wrapped around the table and the distal femur. Hold the patient's arms against your body and grasp the patient's upper arms proximal to the elbows.
- A belt can also be used around the table and the patient, below the rib cage.

Procedure:

- To apply thoracic traction, lean backward, shifting your body weight onto your posterior leg. Apply Grade II or III movements.

■ Figure 12b

- Use the same method to apply traction in an actual resting position (in this case flexion with sidebending and rotation to the right).
- Wrap a traction belt around your hips and the cranial vertebra of the targeted segment to make the traction procedure easier and more precise.

Thoracic segment: facet joint traction
stretch mobilization

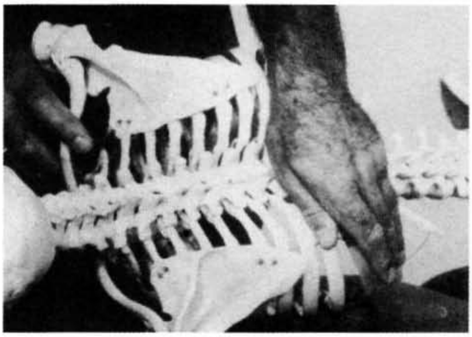


Figure 13a – skeleton


Figure 13a – initial position

■ Figure 13

Objective:

- **Stretch mobilization:** For restricted movement in a specific thoracic facet joint.

Starting position:

- The patient lies supine. The patient's arms are folded across the chest with hands on opposite shoulders.
- Stand facing the patient's left side.
- With your right hand, pull the patient's right shoulder and upper trunk toward you almost to a sidelying position toward the left.

Hand placement and fixation:

- **Therapist's stable hand:** To **traction (separate) the right facet joint**, fixate the right transverse process of the caudal vertebra of the segment to be treated with your left thenar eminence (with an adducted thumb).

  To **traction (separate) both facet joints**, fixate the caudal vertebra of the segment with your thenar eminence on the spinous process. Alternatively, you can place your thenar eminence on the right transverse process and your flexed third finger on the left transverse process of the caudal vertebra of the segment to be treated (i.e., pistol grip).
- **Therapist's moving hand:** With your right hand, roll the patient's upper trunk back to a supine position. During this positioning maneuver your left hand remains in contact with the patient's back. Place your right hand and forearm over the patient's crossed arms. Use your chest as an extension of your moving hand with contact to the patient's elbows.

Figure 13b – skeleton

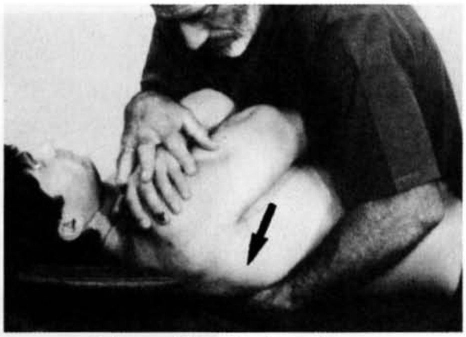


Figure 13b – final position

Procedure:

- Apply a Grade III linear mobilization with your right arm and body, to move the patient's upper trunk in a dorsal direction. To produce separation of the facet joint(s), direct the movement at a right angle to the treatment plane through the facet joints and maintain flexion in the patient's upper trunk cranial to the targeted segment throughout the procedure.
- Apply force only during the patient's exhalation.

Thoracic segment: flexion

test (sidelying)

Figure 14

■ **Figure 14**

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient lies on the left side with hands clasped behind the neck.
- Stand facing the patient.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your left palpating finger dorsally between the two spinous processes of the segment to be tested. Stabilize caudal to the segment with the remaining part of your left hand.
- **Therapist's moving hand:** Place your right hand beneath the patient's head and neck and grasp the patient's clasped hands. Use your body as an extension of your moving hand with contact to the patient's elbows.

Procedure:

- With your right hand, move the patient's elbows caudally to produce flexion until movement occurs in the thoracic segment to be tested.
- Apply a Grade I, II or III flexion movement.

Comments:

- If the patient cannot clasp hands behind the neck, the arms can be folded across the chest with hands on opposite shoulders. In this case, grasp the patient's left shoulder with your right hand and support the patient's head and neck with your arm.

Thoracic segment: flexion
test (sitting)

Figure 15a

■ Figure 15a

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient sits on the treatment table with arms folded across the chest and hands on opposite shoulders. To help isolate movement within the targeted segment, the lumbar and thoracic vertebrae caudal to the segment can be pre-positioned in a curvature opposite the test movement In this case, the caudal vertebrae are pre-positioned in extension.
- Stand facing the patient's left side.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your right palpating finger dorsally between the two spinous processes of the segment to be tested. Use the remaining part of your hand, to stabilize the thoracic spine and ribs caudal to the segment.
- **Therapist's moving hand:** Place your left arm on the patient's crossed arms and grasp the patient's right shoulder.

Procedure:

- With your left hand, guide the patient's trunk forward until flexion occurs in the thoracic segment to be tested.
- Apply a Grade I, II or III flexion movement.

Comments:

- In an alternate starting position, the patient's hands are folded behind the neck. However, in some patients this position restricts thoracic movement.
- With the therapist's guidance, some patients can actively assist this specific movement.

Thoracic segment: flexion
stretch mobilization

Figure 15b

■ Figure 15b

Objective:

- **Stretch mobilization:** For restricted flexion in a thoracic segment.

Starting position:

- The patient sits on a treatment table or chair. The patient holds their hands behind their neck. To help isolate movement within the targeted segment, the lumbar and thoracic vertebrae caudal to the segment can be pre-positioned in a curvature opposite the mobilizing force. In this case, the caudal vertebrae are pre-positioned in extension.
- Stand facing the patient's left side.

Hand placement and fixation:

- **Therapist's stable hand:** Adjust the backrest of a treatment chair to fixate the caudal vertebra of the segment to be treated. The patient leans against the backrest for additional fixation. Through an opening in the backrest, palpate between the spinous processes of the targeted segment to assure that movement takes place there. A wedge (pointing caudally) can be used for fixation if a treatment chair is unavailable.
- **Therapist's moving hand:** Place your left arm on the patient's forearms and grasp the patient's right arm.

Procedure:

- Pre-position the targeted thoracic segment as far as the restriction allows, using your body and left arm to guide the patient's trunk forward into thoracic flexion by moving the patient's elbows in a caudal and slightly dorsal direction. The dorsal movement component of the mobilization is essential to maintain fixation of the caudal vertebra. For additional fixation, secure the patient's thighs to the treatment table/chair with a belt.
- Apply a Grade III linear mobilization in a caudal (dorsal) direction.

Thoracic segment: flexion with coupled sidebending and rotation

test

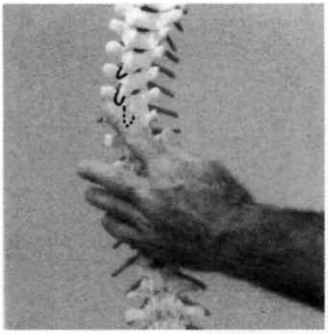


Figure 16a – skeleton

Figure 16a – coupled right sidebending and right rotation

■ **Figure 16a**

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient sits on the treatment table. The patient's arms are folded across the chest with hands on opposite shoulders.
- Stand facing the patient's right side.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your left palpating finger laterally (to the left) between the two spinous processes of the segment to be tested. With the remaining part of your hand, stabilize the thoracic spine and ribs caudal to the segment
- **Therapist's moving hand:** Place your right arm over the patient's crossed arms and grasp the patient's left shoulder.

Procedure:

- With your body and right arm, guide the patient's thoracic spine forward into flexion with simultaneous coupled sidebending and rotation to the right until movement occurs at the thoracic segment to be tested.
- Apply a Grade II or III movement. Compare both sides.

ΜΕ ΜΙΑ ΣΦΗΝΑ ΚΑΤΩ ΑΠΟ ΤΟΥ ΓΛΩΤΟΥΣ ΓΙΑ ΝΑ ΚΛΗΔΩΣΟΥΜΕ ΜΕ NO-COUPLED ΤΟΥ ΥΠΟΚΙΜΕΝΟΥΣ ΣΠΟΝΔΥΛΟΥΣ.

Thoracic segment: flexion with coupled sidebending and rotation

stretch mobilization

Figure 16b – skeleton

Figure 16b – with right sidebending and right rotation

■ Figure 16b

Objective:

- **Stretch mobilization:** For restricted flexion, sidebending or rotation in a thoracic segment.

Starting position:

- The patient sits on the treatment table with arms folded across the chest and hands on opposite shoulders. The thoracic spine is in flexion. The patient's pelvis may be fixated against the treatment table with a belt. Facilitate locking of the caudal vertebrae with a wedge under the patient's left ischial tuberosity to maintain left sidebending. Left sidebending in flexion produces a coupled left rotation, which prevents the caudal vertebrae from following the mobilization into right rotation.
- Stand facing the patient's right side.

Hand placement and fixation:

- **Therapist's stable hand:** With your left thumb, palpate laterally (to the left) between the two the spinous processes of the segment to be treated, to assure that movement takes place there. Fixate (lock) the vertebrae caudal to the targeted segment in pre-positioned flexion with sidebending to the left.
- **Therapist's moving hand:** Place your right arm on the patient's crossed arms and grasp the patient's left shoulder.

Procedure:

- Pre-position the targeted thoracic segment as far as the restriction allows, using your body and right arm to guide the patient's thoracic spine forward into flexion with simultaneous coupled sidebending and rotation to the right.
- Apply a Grade III linear mobilization in a ventral direction.

Thoracic & Ribs

Thoracic segment: extension
test (sitting)

Figure 17a

■ Figure 17a

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient sits on a treatment chair with arms folded across the chest and hands on opposite shoulders. To help isolate movement within the targeted segment, the lumbar and thoracic vertebrae caudal to the segment can be pre-positioned in a curvature opposite the test movement. In this case, the caudal vertebrae are pre-positioned in flexion, reinforced by hip flexion.
- Stand facing the patient's left side.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your right palpating finger dorsally between the two spinous processes of the segment to be tested. With the remaining part of your hand, stabilize on the thoracic spine and ribs caudal to the segment.
- **Therapist's moving hand:** With your left arm, reach around the patient's chest and under the patient's arms. Place your left hand on the patient's right shoulder

Procedure:

- With your body and right arm, guide the patient's thoracic spine backward into extension until movement occurs at the thoracic segment to be tested.
- Apply a Grade I, II or III extension movement.

Thoracic segment: extension
stretch mobilization (sitting)

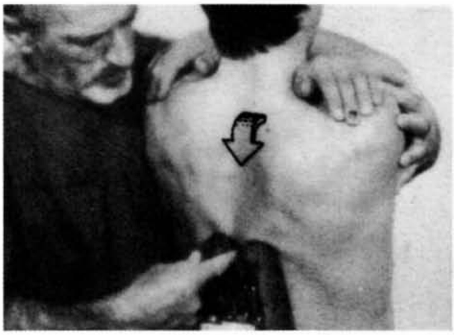


Figure 17b

Figure 17c – with traction

■ Figure 17b

- **Stretch mobilization:** For restricted extension in a thoracic segment.

Starting position:

- The patient sits on a treatment chair with arms folded across the chest and hands on opposite shoulders. To help isolate movement within the targeted segment, the lumbar and thoracic vertebrae caudal to the segment can be pre-positioned in a curvature opposite the mobilizing force. In this case, the caudal vertebrae are pre-positioned in flexion, reinforced by hip flexion.

Hand placement and fixation:

- **Therapist's stable hand:** Adjust the backrest of the treatment chair to fixate the caudal vertebra of the segment to be treated. The patient leans against the backrest for additional fixation. If a treatment chair is unavailable, use a wedge pointed in a caudal direction.
- **Therapist's moving hand:** With your left arm, reach around the patient's chest and under the patient's arms. Place your left hand on the patient's right shoulder.

Procedure:

- Pre-position the targeted thoracic segment as far as the restriction allows, using your body and right arm to guide the patient's thoracic spine into extension. Through an opening in the backrest, palpate between the spinous processes of the targeted segment to assure that movement takes place there.
- Apply a Grade III linear mobilization in a dorsal direction.

■ Figure 17c

- To combine traction with thoracic segmental mobilization in extension, fixate the caudal vertebra of the segment to be treated with your right hand. Put your left leg on a chair. Rest the patient's crossed arms on your left femur. Abduct your left leg to move the patient's thoracic spine into extension.

Thoracic segment: extension
test (sidelying)

Figure 18a

■ Figure 18a

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient lies on the left side with hands clasped behind the neck.
- Stand facing the patient.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your left palpating finger dorsally between the two spinous processes of the segment to be tested. Stabilize caudal to the segment with the remaining part of your left hand.
- **Therapist's moving hand:** Place your right hand beneath the patient's head and neck and grasp the patient's clasped hands. Use your body as an extension of your moving hand with contact to the patient's elbows.

Procedure:

- With your right arm, move the patient's elbows cranially to produce thoracic extension until movement occurs in the segment to be tested.
- Apply a Grade I, II or III extension movement.
- During the test you may need to reposition the patient to create sufficient space in which to move. Position the patient's upper body near the edge of the table with the patient's upper arms and elbows extending beyond the edge.

Comments:

- If the patient cannot clasp hands behind the neck, the arms can be folded across the chest with hands on opposite shoulders. In this case, grasp the patient's left shoulder with your right hand and support the patient's head and neck with your arm.

Thoracic segment: extension
stretch mobilization (sidelying)

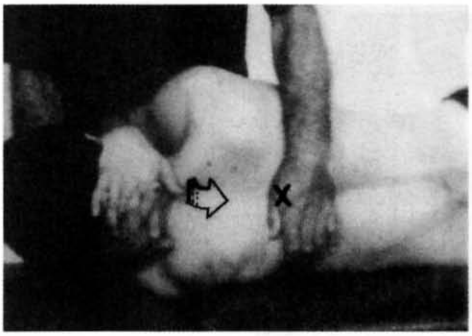


Figure 18b

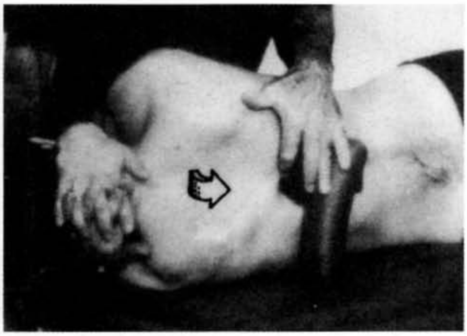


Figure 18c – with wedge and post

■ Figure 18b

Objective:

- **Stretch mobilization:** For restricted extension in a thoracic segment.

Starting position:

- The patient lies on the left side with hands clasped behind the neck and elbows in contact with your body.
- Stand facing the patient.

Hand placement and fixation:

- **Therapist's stable hand:** Place your left thenar eminence on the caudal vertebra of the segment to be treated. Use the remaining part of your left hand to fixate caudal to the segment.
- **Therapist's moving hand:** Place your right hand under the patient's head and neck and grasp their clasped hands.

Procedure:

- Pre-position the targeted thoracic segment as far as the restriction allows, using your right arm and body to move the patient's arms in a cranial direction while guiding the patient's thoracic spine into extension.
- Apply a Grade III linear mobilization in a dorsal direction.

■ Figure 18c

- Use a wedge to fixate the caudal vertebra of the treated segment. Position the wedge between the transverse processes of the caudal vertebra of the treated segment and a post on the treatment table. Use your left palpating finger to assure that the linear mobilization takes place in the targeted segment.

Thoracic segment: rotation
test (initiated cranially)

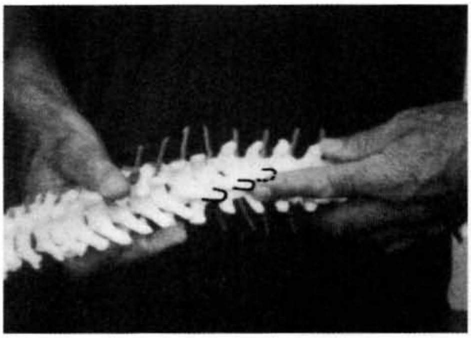


Figure 19a – skeleton

Figure 19a – with coupled left sidebending and extension

■ Figure 19a

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient lies on the left side. Place a pillow under the patient's waist to facilitate left sidebending. Thoracic right rotation in extension is facilitated when combined with left sidebending in a coupled movement pattern. The patient's arms are folded across the chest with hands on opposite shoulders to stabilize the shoulder girdle and minimize movement there.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your left palpating finger laterally (to the left) between the two spinous processes of the segment to be tested. Use the remaining part of your left hand to stabilize the thoracic spine and ribs caudal to the segment.
- **Therapist's moving hand:** Place your right hand on top of the patient's right shoulder and left hand.

Procedure:

- With your right arm, move the patient's shoulder dorsally and slightly cranially to produce thoracic right rotation until movement occurs in the segment to be tested. The cranial component of the movement facilitates right rotation with a coupled left sidebending and extension.
- Apply a Grade I, II or III rotation movement.

Thoracic segment: rotation
stretch mobilization (initiated cranially)

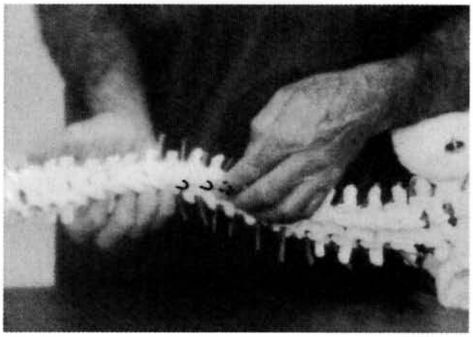


Figure 19b – skeleton

Figure 19b – with coupled left sidebending and extension

■ Figure 19b

Objective:

- **Stretch mobilization:** For restricted rotation or extension in a thoracic segment.

Starting position:

- The patient lies on the left side. The thoracic spine is in extension. Place a pillow under the patient's waist to facilitate left sidebending. Thoracic right rotation in extension is facilitated when combined with left sidebending in a coupled movement pattern. The patient's arms are folded across the chest with hands on opposite shoulders to stabilize the shoulder girdle and minimize movement there.
- Stand facing the patient.

Hand placement and fixation:

- **Therapist's stable hand:** With your left arm and hand, fixate the patient's thoracic spine and ribs. Place your fingers laterally (to the left) on the spinous processes of the caudal vertebrae of the segment to be treated.
- **Therapist's moving hand:** Place your right hand on top of the patient's right shoulder and left hand.

Procedure:

- Pre-position the targeted segment as far as the restriction allows, using your right arm to move the patient's shoulder dorsally and slightly cranially to produce thoracic right rotation. The cranial component of the movement facilitates right rotation with a coupled left sidebending and extension.
- Apply a Grade III linear mobilization in a dorsal direction.

Thoracic segment: extension with coupled sidebending and rotation

test

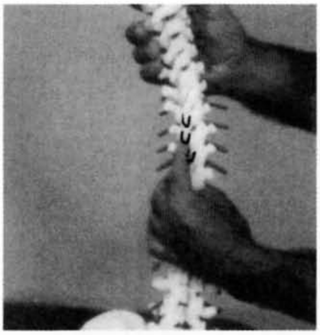


Figure 20a – skeleton

Figure 20a – coupled left sidebending and right rotation

■ Figure 20a

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient sits on the treatment table with arms folded across the chest and hands on opposite shoulders.
- Stand facing the patient's right side.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your left palpating finger laterally (to the left) between the two spinous processes of the segment to be tested. With the remaining part of your hand, stabilize the thoracic spine and ribs caudal to the segment.
- **Therapist's moving hand:** With your right arm, reach around the patient's chest under the patient's arms. With your right hand, grasp the patient's right shoulder.

Procedure:

- With your body and right arm, guide the patient's thoracic spine into right rotation and left sidebending with slight extension until movement occurs in the segment to be tested.
- Apply a Grade II or III rotation movement. Compare both sides.

Thoracic segment: extension with coupled sidebending and rotation

stretch mobilization

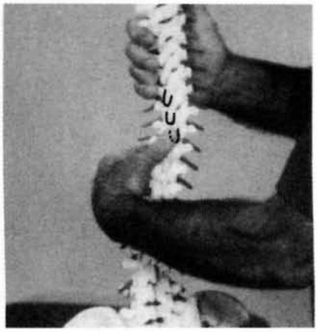


Figure 20b – skeleton

Figure 20b – left sidebending and right rotation

■ Figure 20b

Objective:

- **Stretch mobilization:** For restricted extension or rotation in a thoracic segment.

Starting position:

- The patient sits on the treatment chair with arms folded across the chest and hands on opposite shoulders. The thoracic spine is in extension.
- Stand facing the patient's right side.

Hand placement and fixation:

- **Therapist's stable hand:** With your left thumb, palpate laterally (to the left) between the two spinous processes of the segment to be treated, to assure that movement takes place there. Fixate (lock) the vertebrae caudal to the targeted segment in pre-positioned extension with sidebending to the right.
- **Therapist's moving hand:** With your right arm, reach around the patient's chest and under the patient's arms. Grasp the patient's left shoulder with your right hand.

Procedure:

- Pre-position the targeted segment as far as the restriction allows, using your body and right arm to guide the patient's thoracic spine into right rotation and left sidebending with slight extension.
- Apply a Grade III linear mobilization in a dorsal direction.

Comments:

- Facilitate locking of the caudal vertebrae with a wedge under the patient's right ischial tuberosity to maintain right sidebending. Right sidebending in extension produces a coupled left rotation, which prevents the caudal vertebrae from following the mobilization into right rotation.

Thoracic soft tissue and joint: cranial and lateral
mobilization

Figure 21a – cranial

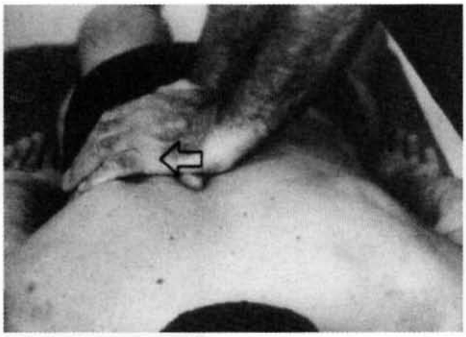


Figure 21b – lateral

■ Figure 21a

Objective:

- **Mobilization:** For restricted soft tissue or joint mobility in the thoracic region.

Starting position:

- The patient lies prone with a cushion under their chest to maintain the normal kyphosis.
- Stand facing the patient's left side.

Hand placement:

- Place your right index and middle fingers, pointing cranially, flat against the patient's paraspinal muscles on one side (shown here on the right).
- Place the ulnar side of your left hand on top of the fingertips of your right hand.

Procedure:

- Move your hands in a cranial direction as far as the patient's skin will allow, simultaneously pressing down into the muscle. Rhythmically apply and release the pressure without losing contact with the skin.
- Apply the technique to both sides of the thoracic spine.

■ Figure 21b

- Use a similar technique for lateral mobilization of the paraspinal muscles. Lay your right thumb (pointing cranially) horizontal to the patient's paraspinals on one side (shown here right). Place the heel of your left hand on top of the length of your thumb. Apply lateral pressure (away from the spine). To avoid stretching or irritation of the skin, draw the skin medially (toward the spine) before the start of each soft tissue movement.
- With the same hand placement, treatment can be applied in a cranial direction along the lateral side of the spinous processes.

Thoracic soft tissue and joint: lateral
mobilization

Figure 21c

■ Figure 21c

Objective:

- **Mobilization:** For restricted soft tissue or joint mobility in the thoracic region.

Starting position:

- The patient lies on the left side.
- Stand facing the patient.

Hand placement:

- With your fingers, grasp the medial aspect of the patient's right paraspinals. Place one forearm on the patient's rib cage and your other forearm on the patient's iliac crest.

Procedure:

- With your fingers, pull the patient's paraspinals laterally and at the same time use your forearms to passively sidebend the patient's thoracic spine toward the opposite side. For additional sidebending movement, use your forearms to separate the patient's thorax and pelvis. Rhythmically apply and release the pressure, allowing the spine to return to the starting position after each movement.

Comments:

- The sidebending component of this technique also produces a small amount of thoracic rotation. This rotation is enhanced when combined with a coupled movement pattern. In a sidelying position, the patient's thoracic spine can be positioned in flexion or extension. In flexion, left sidebending will also rotate the thoracic vertebrae to the left in a coupled movement; in extension, the associated rotation will instead occur to the right.

Thoracic soft tissue and joint: flexion and extension with coupled sidebending and rotation
mobilization

Figure 21d – flexion with coupled right sidebending and right rotation

Fig 21e – extension with coupled right sidebending and left rotation

■ Figure 21d

Objective:

- **Mobilization:** For restricted soft tissue or joint mobility in the thoracic region.

Starting position:

- The patient lies on the right side with the thoracic spine in flexion. Place a pillow under the thorax to produce right sidebending for the coupled movement.
- Stand facing the patient.

Hand placement:

- Place your right thenar eminence on the patient's left paraspinals.
- Place your left hand on the patient's left shoulder.

Procedure:

- With your left hand, move the patient's left shoulder in a ventral-cranial direction to produce right trunk rotation. Simultaneously push your right thenar eminence medially toward the treatment table to stretch the musculature. Rhythmically apply and release the pressure, guiding the trunk back to the starting position after each movement.

■ Figure 21e

- Use a similar method for soft tissue mobilization in extension with coupled sidebending to the right and rotation to the left. With your left hand, move the patient's shoulder in a dorsal-cranial direction to produce left trunk rotation.

First rib: ventral-caudal
test

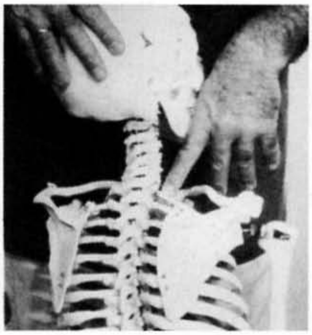


Figure 22a – skeleton

Figure 22a

■ Figure 22a

Objective:

- **Test:** Specific range and quality of movement, including end-feel.

Starting position:

- The patient sits with the cervical spine (including T1) rotated to the right. The position and stabilization of T1 in right rotation prevents it from rotating to the left during this test.
- Stand behind the patient.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your left upper arm and elbow on top of the patient's left shoulder. Stabilize the head and neck with your forearm and hand. Grasp the top of the patients head.
- **Therapist's moving hand:** Place the radial side of your right index finger on the dorsal aspect of the patient's first rib.

Procedure:

- With your right hand, move the patient's first rib in a ventral and slightly caudal direction.
- Apply a Grade I, II or III movement.
- If restriction is present, the test may be repeated for more specific assessment:
  a) in a ventral direction, to assess traction in the costotransverse joint, and
  b) in a caudal direction, to assess restricted movement or a cranially fixated rib.
- Compare both sides.

First rib: ventral-caudal
stretch mobilization

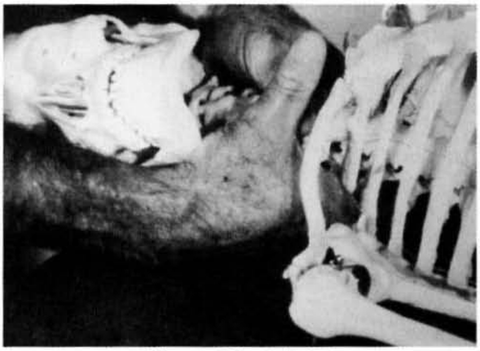


Figure 22b – skeleton

Figure 22b

■ Figure 22b

Objective:

- **Stretch mobilization:** For restricted first rib ventral or caudal movement.

Starting position:

- The patient lies supine. The patient's head and cervical spine (including T1) are rotated to the right. The position and stabilization of T1 in right rotation prevents it from rotating to the left during the movement. During the mobilization, palpate T1 to monitor this position.
- Stand at the cranial end of the treatment table, facing the patient.

Hand placement and fixation:

- **Therapist's stable hand:** With your left forearm, fixate the left side of the patient's head and cervical spine. Your left hand can rest on the patient's sternum.
- **Therapist's moving hand:** Place the radial side of your right index finger on the patient's first rib. Use your body as an extension of your moving hand by supporting your elbow on your ventral pelvis.

Procedure:

- Pre-position the first rib as far as the restriction allows, using your right hand and body to move the first rib in a ventral and slightly caudal direction to produce traction (separation) in the costotransverse joint.
- Apply a Grade III linear movement in a ventral-caudal direction.

Comments:

- For a cranially fixated rib, the mobilization is only in a caudal direction.

Upper ribs: separation and approximation
test

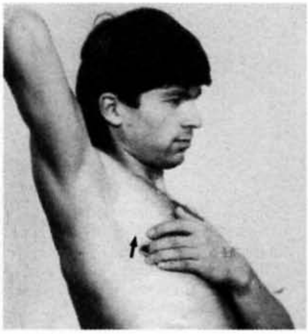


Figure 23a – separation

Figure 23b – approximation

■ Figure 23a

Objective:

- **Test:** Specific mobility and symptom screening.

Starting position:

- The patient sits.
- Stand facing the lateral-dorsal aspect of the patient's trunk.

Hand placement:

- Place your palpating finger between the two upper ribs to be tested. (In the photograph above, the patient points to the palpation point.)

Procedure:

- The patient flexes the arm into full elevation, with simultaneous inhalation and thoracic extension.
- Symptom distribution and behavior are often more clear if the patient points to the site of symptoms as they occur during the test.
- Compare both sides.

■ Figure 23b

- Use a similar method to evaluate rib approximation. In this case, the patient lowers the arm with simultaneous exhalation and thoracic flexion.

Lower ribs: separation and approximation
test

Figure 24a – separation

Figure 24b – approximation

■ Figure 24a

Objective:

- **Test:** Specific mobility and symptom screening.

Starting position:

- The patient sits.
- Stand facing the right lateral-dorsal aspect of the patient's trunk.

Hand placement:

- Place your palpating finger between the two right lower ribs to be tested. (In the photograph above, the patient points to the palpation point.)

Procedure:

- The patient abducts the arm into full elevation with simultaneous inhalation and thoracic sidebending to the left with simultaneous thoracic extension and slight rotation to the right.
- Symptom distribution and behavior are often more clear if the patient points to the site of symptoms as they occur during the test.
- Compare both sides.

■ Figure 24b

- Use a similar method to evaluate rib approximation. In this case, the patient lowers the arm with simultaneous exhalation and thoracic side-bending to the right with simultaneous thoracic flexion and slight rotation to the left.

Ribs
test

Figure 25 – skeleton

Figure 25

■ Figure 25

Objective:

- **Test:** General mobility and symptom screening. Evaluate rib position and determine whether one or several ribs are prominent, rotated, or fixated, taking into account normal variations in structural anatomy.

Starting position:

- The patient sits on the treatment table. The patient's thoracic spine is slightly flexed.
- Stand facing the patient's left side.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your left hand on the patient's chest. Your body contacts the patient's trunk for additional stabilization.
- **Therapist's moving hand:** Place your right thenar eminence on the patient's right side at the angle of the ribs.

Procedure:

- With your right hand, press with gentle pressure over the angles of the ribs in a caudal direction.
- Compare both sides.

Specific rib: ventral
test and stretch mobilization (sitting)

Figure 26 – skeleton

Figure 26

■ Figure 26

Objective:

- **Test:** Specific range and quality of movement in the costotransverse joint, including end-feel.
- **Stretch mobilization:** For restricted ventral rib movement (separation in the costotransverse joint).

Starting position:

- The patient sits on the treatment table. The patient's arms are folded across the chest.
- Stand facing the patient's left side.

Hand placement and fixation:

- **Therapist's stable hand:** Place your left hand over the patient's chest. Bend the patient's thoracic spine forward slightly with simultaneous right rotation and left sidebending. Fixate the patient's body in this position. By positioning and fixating the thoracic spine in right rotation, the vertebra is prevented from rotating to the left during the test. Your body contacts the patient's trunk for additional stabilization.
- **Therapist's moving hand:** Place the radial side of your right proximal index finger on the angle of the rib to be tested, with your MCP joint just lateral to the transverse process of the articulating vertebra.

Procedure:

- **Test:** Press in a ventral direction with your right arm to produce a Grade I, II or III movement.
- **Stretch mobilization:** Pre-position the targeted rib as far as the restriction allows. Apply a Grade III linear movement to the rib in a ventral direction.

Specific rib: ventral
stretch mobilization (sidelying)

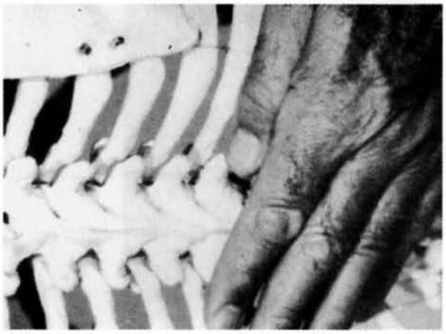


Figure 27a – skeleton

Figure 27a – initial position

■ Figure 27

Objective:

- **Stretch mobilization:** For restricted ventral rib movement (separation in the costotransverse joint).

Starting position:

- The patient lies supine. The patient's arms are folded across the chest with hands on opposite shoulders.
- Stand facing the patient's left side.
- With your right hand, pull the patient's right shoulder and upper trunk toward you, almost to a sidelying position toward the left.

Hand placement and fixation:

- **Therapist's stable hand:** Use your left thenar eminence (with an adducted thumb) to fixate the right rib to be treated. The tip of your thumb should be just lateral to the transverse process of the articulating vertebra.
- **Therapist's moving hand:** With your right hand, roll the patient's upper trunk back to a supine position, keeping your left hand in stable contact with the patient's rib. Then place your right hand and forearm over the patient's crossed arms with your chest in contact with the patient's elbows.

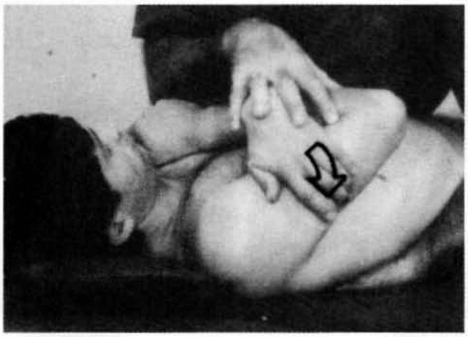


Figure 27b – final position

Procedure:

- Pre-position the targeted joint using your right arm and body, then rotate the patient's upper trunk further to the right, to produce separation in the costotransverse joint.
- Apply a Grade III linear movement in a dorsal direction.
- Apply the mobilization only during the patient's exhalation, when the intercostal musculature is relaxed.

Upper ribs: separation
test and stretch mobilization

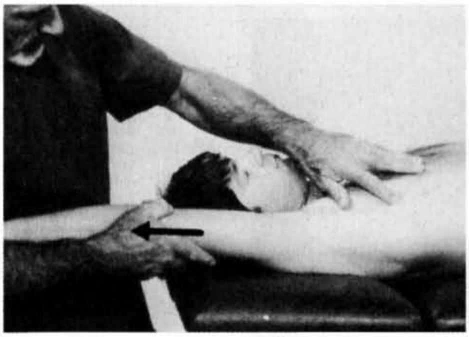


Figure 28a – test

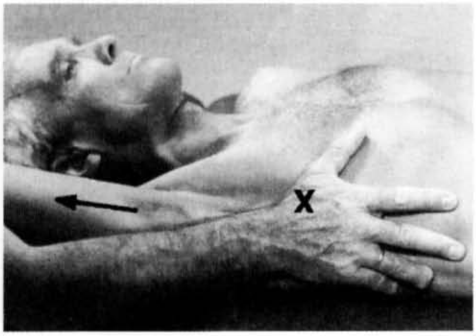


Figure 28b – mobilization

■ Figure 28a

Objective:

- **Test:** Specific range and quality of movement, including end-feel.

Starting position:

- The patient lies supine with the right arm elevated and externally rotated. If full elevation produces shoulder pain, modify the arm position for comfort.
- Stand at the cranial end of the treatment table, facing the patient.

Hand placement:

- **Therapist's stable hand:** Place your left palpating finger between the two upper ribs to be tested.
- **Therapist's moving hand:** Hold the patient's right arm against your body with your right arm and hand. Prior to grasping the arm, draw the patient's skin proximally to avoid stretching or irritating the patient's skin during the movement.

Procedure:

- With your right arm/hand and body, pull the patient's elevated arm in a cranial direction to produce separation between the patient's ribs on the right side.
- Apply a Grade I, II or III movement.

Comments:

- When the patient is in a supine position, you can also evaluate the sternocostal joints and costochondral joints by applying a slight dorsal pressure to the specified rib at each joint.

■ Figure 28b

- **Stretch mobilization:** For restricted upper rib separation, fixate the caudal rib with your right thumb and thenar eminence. Pre-position the cranial rib by pulling the patient's arm with your left hand. Apply a Grade III movement in a cranial direction.

Upper ribs: ventral
stretch mobilization

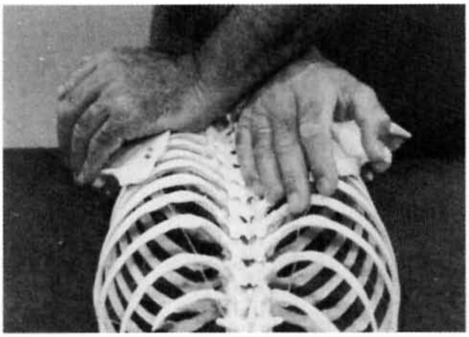


Figure 29 – skeleton

Figure 29

■ Figure 29

Objective:

- **Stretch mobilization:** For restricted upper rib ventral movement (separation in the costotransverse joint).

Starting position:

- The patient lies prone.
- Stand at the cranial end of the treatment table facing the patient.

Hand placement and fixation:

- **Therapist's stable hand:** Place the ulnar side of the right hand (fingers pointing caudally) on the right transverse processes of the patient's thoracic spine. Fixate with your pisiform on the transverse process of the specified articulating vertebra.
- **Therapist's moving hand:** Place the ulnar side of your left hand on the left rib to be treated, with your pisiform on the medial aspect of the rib angle just lateral to the transverse process. Place your fifth finger along the rib. Your moving left hand must not contact the left transverse process of the targeted articulating vertebra.

Procedure:

- Pre-position the targeted rib as far as the restriction allows, using your left hand to move the rib in a ventral and slightly lateral-caudal direction.
- Apply a Grade III linear movement in a ventral-lateral-caudal direction to separate the costo-transverse joint.

Lower ribs: separation
test and stretch mobilization

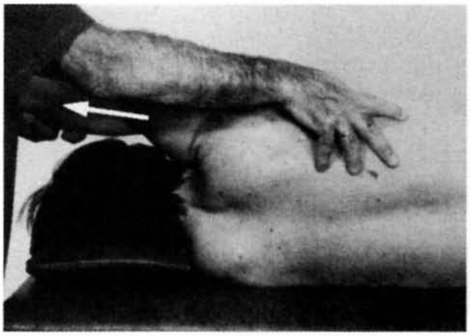


Figure 30a – test

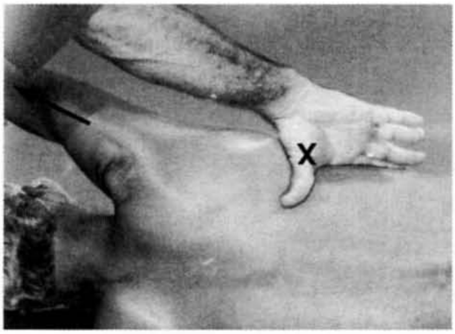


Figure 30b – mobilization

■ Figure 30a

Objective:

- **Test:** Specific range and quality of movement, including end-feel.

Starting position:

- The patient lies on the left side with the right arm elevated and externally rotated. If full elevation produces shoulder pain, modify the arm position for comfort.
- Stand at the cranial end of the treatment table, facing the patient.

Hand placement:

- **Therapist's stable hand:** Place your palpating right finger between the two lower ribs to be tested.
- **Therapist's moving hand:** Hold the patient's right arm against your body with your left arm and hand. Prior to grasping the arm, draw the patient's skin proximally to avoid stretching or irritating the patient's skin during the movement.

Procedure:

- With your left arm/hand and body, pull the patient's elevated arm in a cranial direction to produce separation between the patient's ribs on the right side.
- Apply a Grade I, II or III movement.

■ Figure 30b

- **Stretch mobilization:** For restricted lower rib separation, fixate the caudal rib with the thumb and index finger of your pronated right hand. Pre-position the cranial rib by pulling the patient's arm with your left hand. Apply a Grade III movement in a cranial direction.

Lower ribs: ventral
stretch mobilization

Figure 31– skeleton

Figure 31

■ Figure 31

Objective:

- **Stretch mobilization:** For restricted lower rib ventral movement (separation in the costotransverse joint).

Starting position:

- The patient lies prone.
- Stand beside the patient's hip, facing their left side.

Hand placement and fixation:

- **Therapist's stable hand:** Place the ulnar side of your right hand (fingers pointing cranially) on the left transverse processes of the patient's thoracic spine. With your pisiform, fixate the transverse process of the specified articulating vertebra.
- **Therapist's moving hand:** Place the ulnar side of your left hand on the right rib to be treated, your pisiform on the medial aspect of the rib angle just lateral to the transverse process. Place your fifth finger along the rib. Your moving left hand must not contact the right transverse process of the targeted articulating vertebra.

Procedure:

- Pre-position the targeted rib as far as the restriction allows, using your left hand to move the rib in a ventral and slightly lateral-cranial direction.
- Apply a Grade III linear movement in a ventral and slightly lateral-cranial direction.

Thoracic & Ribs

Intercostal transverse friction massage
mobilization

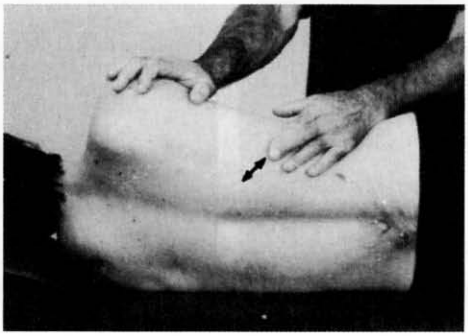


Figure 32

■ Figure 32

Objective:

- **Mobilization:** For restricted intercostal soft tissue. May also be effective for increasing intercostal range of movement.

Starting position:

- The patient lies on the left side with a pillow under their chest to facilitate a little rib separation.
- Stand facing the patient.

Hand placement and stabilization:

- **Therapist's stable hand:** With your right hand, stabilize the patient's right shoulder.
- **Therapist's moving hand:** Place your left index finger (supported by the middle finger) between two ribs on the intercostal muscle to be treated.

Procedure:

- With your left hand, apply transverse friction massage with pressure adjusted to the patient's comfort. Your fingers should not slide on the patient's skin.

12 Cervical spine (C2-T3)

Functional anatomy and movement

Anatomy

The orientation of the cervical facet joints varies among individuals, and can also vary from segment to segment and from side to side in the same individual. In most people, the facet joints form about a 45° angle with the body of the vertebrae, oriented in a dorsal/caudal to ventral/cranial direction. The facet joint surfaces are large and almost flat.

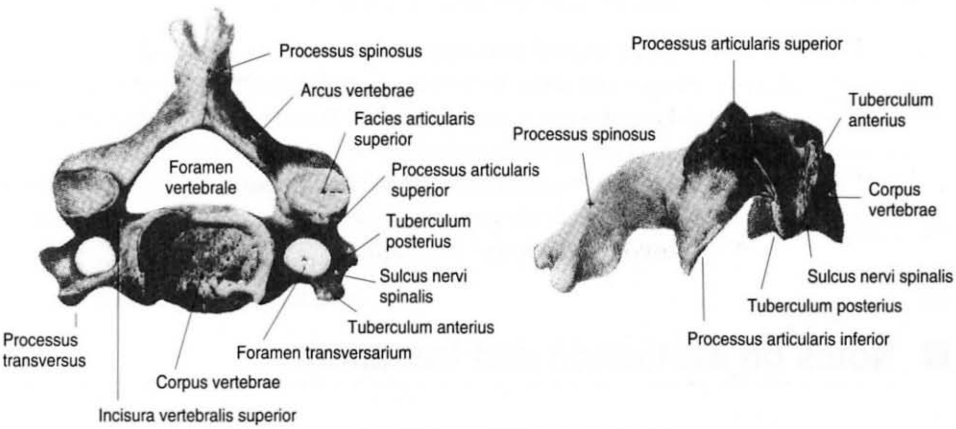


Figure C-1
The fourth cervical vertebra viewed from above and from the side

Bone and joint movement

The cervical spine has the greatest mobility of the entire spine, mostly in the sagittal plane and especially in extension.

In a resting position there is a lordosis in the cervical spine. During flexion the lordosis is eliminated or changed into a kyphosis (Cervical Figure 1). During extension the lordosis is increased (Cervical Figure 2).

Movement in the cervical spine follows the Concave Rule: The inferior facet on the cranial vertebra of the segment (processus articularis inferior) functions as a concave surface which allows the vertebra to move ventrally during flexion and dorsally during extension.

Combined movement patterns

The skilled use of combined movement patterns is essential for evaluation, joint mobilization, soft tissue mobilization, exercise training, and other patient management procedures designed to specifically produce or limit movement in the cervical spine.

Coupled movement – Cervical rotation and sidebending are usually coupled to the same side, regardless of the position of the spine in the sagittal plane. Sidebending to the right is coupled with rotation to the right in flexion (Cervical Figure 3) and in extension (Cervical Figure 5).

Noncoupled movement – Cervical rotation and sidebending to opposite sides is a noncoupled movement, and is possible in both flexion (Cervical Figure 4) and extension (Cervical Figure 6). During noncoupled movements, the range of movement is less and the end-feel is hard in comparison to the firm end-feel of coupled movements. Noncoupled cervical movements are used for "locking" techniques.

■ Notes on evaluation and treatment

Normal movement of the entire cervical spine requires that the axis freely moves on C3. The simplest way to test movement of the axis is with sidebending of the head (Cervical Figure 10). Sidebending of the head will produce an immediate rotation of the axis on C3 to the same side, as long as the ligamentous structure of the upper cervical vertebrae is intact.

The apparent rotation range of the axis can be influenced by decreased movement in the occiput-atlas and atlas-axis segments.

Careful attention should be paid to stabilizing the lower vertebrae while testing the upper cervical region.

When treating in the supine position, a small pillow placed under the occiput will help the therapist obtain access to the cervical region.

■ Cervical tests and mobilizations

Cervical spine

■ Screening techniques

■ Nerve mobility tests

■ Localization techniques

■ Traction techniques

■ Techniques with a flexion component

Cervical

■ **Techniques with an extension component**

Cervicothoracic junction

Soft tissue techniques

Note

Before practicing any cervical mobilization technique, students should screen their partners using the following evaluation procedures:

Cervical segment: translatoric joint play .... (Figure 15) 272
Cervical segment: lateral glide .... (Figure 13) 270
Vertebral artery .... (Figure 12) 269

When symptoms are present in the upper extremities, students should screen their partners using these additional procedures:

Intervertebral foramen .... (Figure 11) 268
Nerve mobility: medial, radial, and ulnar nerve .... (Figure 9a-c) 262-264

Cervical

Active cervical flexion and extension
test

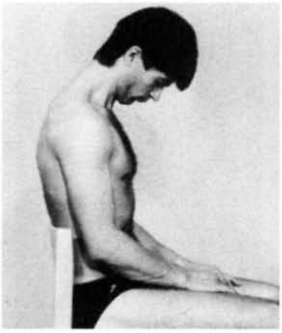


Figure 1 – flexion

Figure 2 – extension

■ Figure 1

Objective:

- **Test:** General mobility and symptom screening.

Starting position:

- The patient sits.

Procedure:

- The patient bends the head forward into cervical flexion.
- At the end of the patient's active movement, apply overpressure to assess the presence of additional passive movement range.
- Observe range of cervical flexion and extension and the way the movement is performed. Note symptom behavior throughout the movement.

Comments:

- Following this test evaluate passive movement quality from the zero position through the entire range of movement, including end-feel characteristics.

■ Figure 2

- Use a similar method to evaluate active and passive cervical extension.

Cervical

Active cervical flexion with combined sidebending and rotation

test

Figure 3 – coupled right sidebending and right rotation

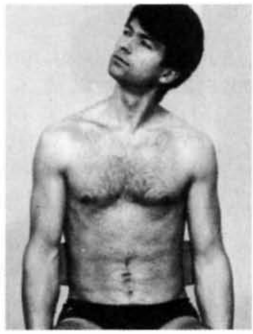


Figure 4 – noncoupled left sidebending and right rotation

■ Figure 3

Objective:

- **Test:** General mobility and symptom screening.

Starting position:

- The patient sits.

Procedure:

- The patient bends the head forward into cervical flexion with simultaneous coupled sidebending and rotation to the right.
- At the end of the patient's active movement, apply overpressure to assess the presence of additional passive movement range.
- Observe range of coupled cervical flexion with sidebending and rotation to the same side. Observe the way the movement is performed. Note symptom behavior throughout the movement. Compare both sides.

Comments:

- Following this test evaluate passive movement quality from the zero position through the entire range of movement, including end-feel characteristics.

■ Figure 4

- Use a similar method to evaluate active and passive noncoupled cervical movements in flexion with sidebending to the left and rotation to the right.

Active cervical extension with combined sidebending and rotation

test

Figure 5 – coupled right sidebending and right rotation

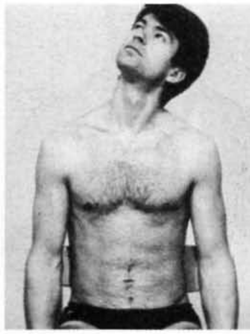


Figure 6 – noncoupled left sidebending and right rotation

■ Figure 5

Objective:

- **Test:** General mobility and symptom screening.

Starting position:

- The patient sits.

Procedure:

- The patient bends the head backward into cervical extension with simultaneous coupled sidebending and rotation to the right.
- At the end of the patient's active movement, apply overpressure to assess the presence of additional passive movement range.
- Observe range of coupled cervical extension with sidebending and rotation to the same side. Observe the way the movement is performed. Note symptom behavior throughout the movement. Compare both sides.

Comments:

- Following this test evaluate passive movement quality from the zero position through the entire range of movement, including end-feel characteristics.

■ Figure 6

- Use a similar method to evaluate active and passive noncoupled movements in extension with sidebending and rotation to opposite sides (e.g., sidebending to the left and rotation to the right).

Cervical traction
test and mobilization

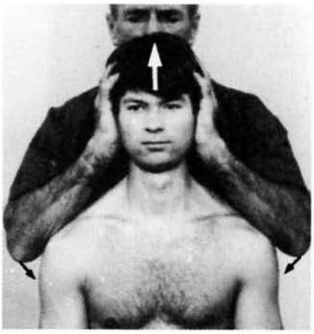


Figure 7a
in resting position

Figure 7b
in actual resting position

■ Figure 7a

Objective:

- **Test:** Symptom alleviation or provocation screening.
- **Mobilization:** For restricted movement or symptom relief.

Starting position:

- The patient sits. To enhance stabilization, the patient can lean against a chair backrest.
- Stand behind the patient.

Hand placement:

- Place your palms on the mastoid processes of the patient's skull.
- Place your forearms on top of the patient's shoulders.

Procedure:

- Press your elbows in a caudal direction to traction the patient's cervical spine. Pivot your forearms over the fulcrum provided by the patient's shoulders.
- Apply a Grade I, II or III movement.

■ Figure 7b

- **Pain-relief traction mobilization:** Treatment is most effective in the actual resting position (e.g., flexion, sidebending and rotation to the right illustrated above).
- **Stretch-traction mobilization:** Pre-position the patient's cervical spine as far as the restriction allows. The treatment direction is at a right angle to the treatment plane in the targeted disc joint.

Cervical compression
test

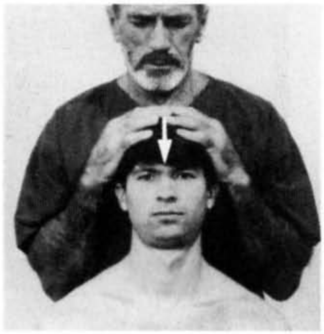


Figure 8

■ Figure 8

Objective:

- **Test:** Symptom provocation screening.

Starting position:

- The patient sits on the treatment table.
- Stand behind the patient.

Hand placement:

- Place your hands on top of the patient's head.

Procedure:

- With your hands, press the patient's head in a caudal direction to compress the cervical spine.
- Spinal curvatures should not change during the test; for example, there should be no increase in cervical lordosis. To help maintain cervical curvatures during the test, stabilize the patient's back, neck, and head against your body.

Comments:

- Symptomatic response to cervical compression is also tested in varying three-dimensional pre-positioned starting positions.

Median and radial nerve
test

Figure 9a – median nerve

■ Figure 9a - Median nerve

Objective:

- **Test:** Symptom localization. Determine if movement of the median or radial nerve is restricted in relation to the surrounding tissue.

Starting position:

- The patient lies supine (or sits).
- Stand facing the medial side of the patient's abducted arm.

Procedure:

- Fully lengthen the median nerve (including its associated nerve roots, peripheral nerve trunks, and the spinal cord) with shoulder girdle retraction and depression, shoulder extension and external rotation, elbow extension, forearm supination, wrist extension, finger extension, and cervical sidebending and rotation to the opposite side (shown here to the left). First position the patient's arm (shown here right) and then the cervical spine.
- Suspect nerve irritation if arm symptoms in the radial side of the hand and/or in the three radial fingers are produced by extremity positioning while the cervical spine is still in the resting position, or if the position cannot be achieved because of symptoms.
- To confirm nerve root findings, withdraw the position of one of the peripheral joints just enough to relieve the symptoms. The patient then sidebends and rotates the cervical spine to the opposite side (shown here to the left). If this produces symptoms again, nerve root irritation is likely.

Cervical

Figure 9b – radial nerve

- If nerve irritation is present the nerve will be more sensitive to local pressure. Palpate the median nerve at the following sites: the nerve root gutter, between the scaleni muscles, the clavicle/first rib junction, the pectoralis minor, the pronator teres, and the carpal tunnel.
- Apply the "Bowstring Test."

Comments:

- Before testing nerve mobility or neural tension signs, all joints moved during the test must be individually assessed for mobility and symptoms. During joint testing, avoid placing the nerve or muscles in stretched positions which could confuse your findings.

■ Figure 9b - Radial nerve

- Use a similar method to test the radial nerve.

Starting position:

- Stand facing the dorsal side of the patient's abducted arm.

Procedure:

- Fully lengthen the radial nerve (including its associated nerve roots, peripheral nerve trunks, and the spinal cord) much the same as for the median nerve. Position the patient proximally exactly as for the median nerve test; distally, position the patient in shoulder medial rotation, forearm pronation, wrist flexion, wrist ulnar deviation, and finger flexion.
- Palpate the radial nerve at the following sites: the nerve root gutter, between the scaleni muscles, the clavicle/first rib junction, the pectoralis minor, the radial nerve sulcus, the supinator muscle, and the anatomical snuff box.

Ulnar nerve
test

Figure 9c

■ Figure 9c

Objective:

- **Test:** Symptom localization. Determine if movement of the ulnar nerve is restricted in relation to the surrounding tissue.

Starting position:

- The patient lies supine (or sits).
- Stand facing the medial side of the patient's abducted arm.

Procedure:

- Fully lengthen the ulnar nerve (including its associated nerve roots, peripheral nerve trunks, and the spinal cord) with shoulder girdle retraction and depression, shoulder extension and external rotation, elbow flexion, forearm supination or pronation, wrist extension and radial deviation, finger extension, and cervical sidebending and rotation to the opposite side (shown here to the left). First position the patient's arm (shown here right) and then the cervical spine.
- Suspect nerve irritation if arm symptoms in the ulnar side of the hand and/or in the two ulnar fingers are produced by extremity positioning while the cervical spine is still in the resting position, or if the position cannot be achieved because of symptoms.
- To confirm nerve root findings, withdraw the position of one of the peripheral joints just enough to relieve the symptoms. The patient then sidebends and rotates the cervical spine to the opposite side (shown here to the left). If this produces symptoms again, nerve root irritation is likely.

- If nerve irritation is present the nerve will be more sensitive to local pressure. Palpate the ulnar nerve at the following sites: the nerve root gutter, between the scaleni muscles, the clavicle/first rib junction, the pectoralis minor, the ulnar nerve sulcus at the dorsal aspect of the elbow, and Guyon's canal.
- Apply the "Bowstring Test."

Comments:

- Before testing nerve mobility or neural tension signs, all joints moved during the test must be individually assessed for mobility and symptoms. During joint testing, avoid placing the nerve or muscles in stretched positions which could confuse your findings.

Upper cervical stability and mobility
test

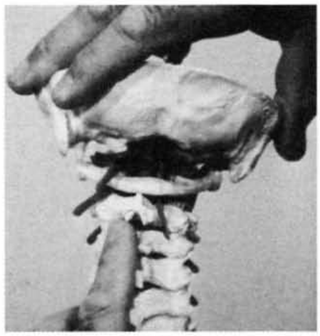


Figure 10 – skeleton

Figure10 – sidebending to the right

■ Figure 10 - Upper cervical stability test A

Objective:

- **Test:** To rule out treatment risks due to upper cervical instability, determine whether sidebending of the head produces an immediate and simultaneous rotation of C2 (spinous process moves to the side opposite the sidebending). The presence of this rotation response indicates that the upper cervical ligaments, muscles, and bony structures are intact.

Starting position:

- The patient sits on a treatment table or low chair.
- Stand facing the patient's right side.

Hand placement:

- **Therapist's stable hand:** With your left hand, grasp the dorsal aspect of the patient's neck. Place your left palpating finger on the lateral (left) side of the spinous process of C2 (axis) with contact to C3, or grip around the spinous process with your thumb and index finger.
- **Therapist's moving hand:** Place your right hand on top of the patient's head.

Procedure:

- With your right hand, sidebend the patient's head to the right.
- Perform the test to both sides.

■ Upper cervical stability test B

Objective:

- Determine if it is possible to sidebend the head without rotation at C2 (axis). If the head can sidebend while C2 is fixated, then upper cervical hypermobility is present, mobilization is *strictly contraindicated*, and the patient should be referred for further medical examination.

Starting position:

- The patient sits on a treatment table or low chair.
- Stand facing the patient's left side.

Hand placement and fixation:

- **Therapist's stable hand:** With your right index finger and thumb, fixate the spinous process of C2.
- **Therapist's moving hand:** With your left hand, grasp the right side of the patient's head. Use your body as an extension of your moving hand with contact to the left side of the patient's head.

Procedure:

- With your left hand and body, attempt to move the occiput (head) into right sidebending.

■ Differentiating upper cervical hypomobility

- Hypomobility in any or all of the three upper cervical segments could limit sidebending of the head *and* the associated rotation of C2, confusing instability test results. Special differentiating mobility tests using coupled movements help identify the restricted cervical segment. In the following examples, sidebending of the head is restricted to the right:

  To test for C2-C3 movement: Stand facing the patient's right side. Move C2 in relation to C3 into right sidebending coupled with right rotation by moving the occiput, atlas, and axis together as a unit.

  To test for CO-C1 movement: Stand facing the patient's left side. Test sidebending to the right coupled with rotation to the left of the occiput in relation to the atlas.

  To test for C1-C2 movement: Stand facing the patient's left side. Test left rotation of the atlas in relation to the axis. To relax the upper cervical ligaments to allow for maximum rotation, sidebend the upper cervical spine to the right during the test.

Cervical

Cervical intervertebral foramen
test

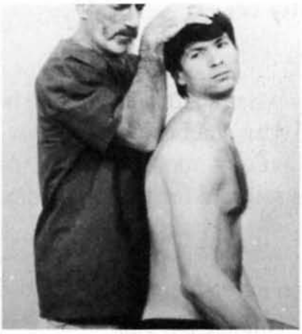


Figure 11 – extension, right sidebending and right rotation

■ **Figure 11**

Objective:

- **Test:** Symptom provocation to confirm suspected nerve root irritation. Cervical movement into extension, rotation, and sidebending to the same side narrows the intervertebral foramina and can produce or increase nerve root irritation.

Starting position:

- The patient sits on a treatment table or low chair.
- Stand behind the patient.

Hand placement and stabilization:

- **Therapist's stable hand:** With your left hand, stabilize the patient's left shoulder.
- **Therapist's moving hand:** Place your right hand on top of the patient's head.

Procedure:

- With your right hand, simultaneously extend, rotate, and sidebend the patient's head and cervical spine to the right.
- To determine the spinal level involved, move the patient in the described direction until symptoms appear, then withdraw just enough to relieve the symptoms. In this position, apply local pressure to rotate each suspected segment to the right. Apply the local pressure in a ventral-cranial direction on the lateral (right) side of the spinous process, or on the left facet of the cranial vertebra of a suspected segment.
- Symptom provocation, especially symptoms radiating to the ipsilateral arm, confirms a lesion at this segment.

Cervical

Vertebral artery
test

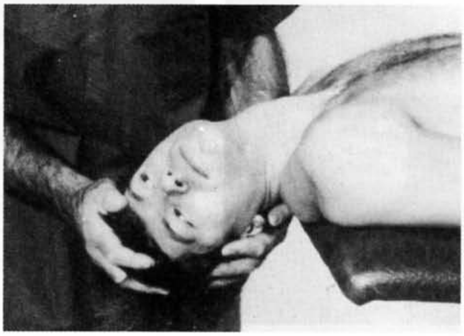


Figure 12

■ Figure 12

Objective:

- **Test:** Symptom provocation to rule out treatment risks due to vertebral artery insufficiency. Vertebral artery symptoms may include nystagmus, dizziness, altered sight or hearing, altered perception of smell or taste, and slurred speech. Monitor these symptoms throughout the movement.

Starting position:

- The patient lies supine with the head extending beyond the edge of the treatment table.

Hand placement:

- Hold the patient's head in your hands.

Procedure:

- Slowly lower the patient's head simultaneously into cervical extension with sidebending and rotation to the right, then hold the patient's head in this position. Monitor symptoms continuously.

Comments:

- This test reveals whether the vertebral artery supplies adequate blood flow to the brain. During cervical extension, rotation, and sidebending to the right, the **left vertebral artery** (on the side opposite the test movement) kinks around the atlas and becomes compromised by stretching and partial compression. In the middle and lower cervical spine the **right vertebral artery** (on the same side as the test movement) can be irritated or compressed by arthritic spurring of vertebral body structures (e.g., uncovertebral joint arthrosis). In this case, perform the test movement so as to include both the upper cervical spine and the suspected middle or lower cervical segments.
- This test is usually applied with the patient sitting, as an active test together with other active screening tests (see *Cervical Figures 1 - 6*).

Περνούμαι το slack των μυών + σταθεροποιούμαι.

Cervical segment: lateral glide

test (with and without cranial fixation)

Figure 13 – skeleton

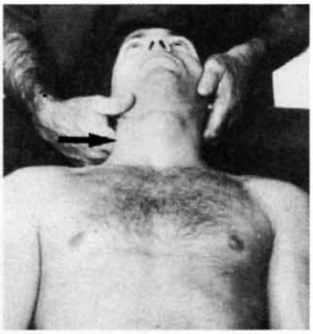


Figure 13

■ Figure 13

Objective:

- **Test:** Segmental range and quality of movement, including end-feel. This is probably the easiest test for localizing the symptomatic and restricted cervical region. By applying pressure to one vertebra without fixating the adjacent vertebrae, *two* segments are tested simultaneously (the segments cranial and caudal to the vertebra).

Starting position:

- The patient lies supine.
- Stand at the cranial end of the treatment table, facing the patient.

Hand placement:

- **Therapist's stable hand:** Place your left hand on the left side of the patient's head.
- **Therapist's moving hand:** Place the radial side of your right index finger on the right arch of the specified vertebra. Avoid pressure on the sensitive transverse process.

Procedure:

- With your right hand, press on the right side of the vertebra.
- Apply a Grade I, II or III linear movement of the vertebra to the left.
- If there are symptoms or restricted mobility, test each segment separately with cranial fixation.

Comments:

- **Additional tests:** To identify the direction of movement that is restricted or symptomatic, glide parallel to the treatment plane in the facet joint in both cranial-ventral and caudal-dorsal directions.

Cervical segment: lateral glide
test (caudal fixation)

Figure 14 – skeleton

Figure 14

■ Figure 14

Objective:

- **Test:** Segmental range and quality of movement, including end-feel. This test is specific to one segment and may also be used to identify hypermobility. Use cranial/ventral and caudal/dorsal gliding parallel to the treatment plane of the facet joints to further identify the direction of the restriction.

Starting position:

- The patient lies supine.
- Stand at the cranial end of the treatment table, facing the patient.

Hand placement and fixation:

- **Therapist's stable hand:** With the radial side of your left index finger, fixate the left arch of the caudal vertebra of the segment to be tested.
- **Therapist's moving hand:** Place the radial side of your right index finger on the right arch of the cranial vertebra. Avoid pressure on the sensitive transverse process.

Procedure:

- With your right hand, press on the right side of the vertebra.
- Apply a Grade I, II or III lateral (to the left) linear movement to the vertebra.
- Test both sides (with appropriate changes in hand placement).

Cervical segment C2 to C5: translatoric joint play
test (sitting)

Figure 15 – skeleton

Figure 15

■ Figure 15

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient sits on a treatment table or low chair.
- Stand facing the patient's left side.

Hand placement and stabilization:

- **Therapist's stable hand:** Place the palpating finger of your right hand on the right facet joint or between the two spinous processes of the segment to be tested. With the remaining part of your hand, stabilize caudal to the segment.
- **Therapist's moving hand:** Place your left hand on the right side of the patient's head and cervical spine. Place your little finger around the cranial vertebra of the segment to be tested. Use your body as an extension of your moving hand with contact to the left side of the patient's head. Be careful your body contact does not change the position of the cervical spine.

Procedure:

- With your left arm and chest, move the patient's head and cervical spine alternately in a ventral and dorsal direction parallel to the treatment plane of the vertebral disc to produce:
  a) small Grade I oscillatory movements to assess joint play.
  b) Grade II and III movements to assess movement quantity and quality, including end-feel.

  With your left hand and body apply a simultaneous Grade I traction to the cervical spine to avoid compression.

Comments:

- Use the same hand placement for testing traction joint play.

Cervical

Cervical segment C2 to C5: translatoric joint play
test (sidelying)

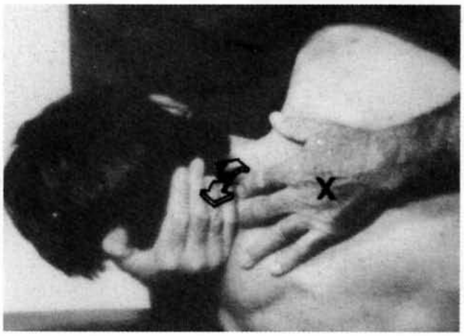


Figure 16 – C2-C5

■ Figure 16

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient lies on the left side.
- Stand facing the patient.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your left palpating finger on the right facet joint or between the two spinous processes of the segment to be tested. With the remaining part of your hand, stabilize caudal to the segment.
- **Therapist's moving hand:** Place your right forearm and hand under the patient's head and cervical spine. Place your little finger on the cranial vertebra of the segment to be tested. The patient's forehead rests on your upper arm.

Procedure:

- With your right arm, move the patient's head and cervical spine alternately in a ventral and dorsal direction parallel to the treatment plane of the vertebral disc joint to produce:
  a) small Grade I oscillatory movements to assess joint play.
  b) Grade II and III movements to assess movement quantity and quality, including end-feel.
- Test in both right and left sidelying positions.

Comments:

- Use the same hand placement for testing traction joint play.

Cervical traction
test and mobilization

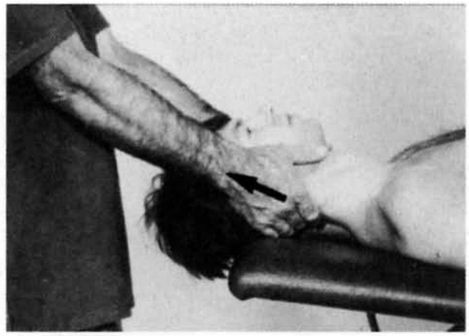


Figure 17a

■ Figure 17a

Objective:

- **Test:** Symptom alleviation or provocation screening.
- **Mobilization:** For restricted movement or symptom relief.

Starting position:

- The patient lies supine in the actual resting position.
- Stand at the cranial end of the treatment table, facing the patient.

Hand placement:

- Grasp the dorsal aspect of the patient's head. Place your palpating or mobilizing fingers on the cranial vertebra to be moved.

Procedure:

- Lean backward to apply a traction force to the cervical spine.
- Apply a Grade I, II or III movement in a cranial direction.

Cervical

Cervical traction
mobilization (belt)

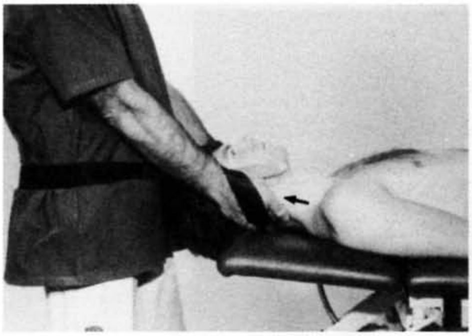


Figure 17b – resting position

Figure 17c – actual resting position

■ Figure 17b

Objective:

- **Mobilization:** For restricted movement or symptom relief.

Starting position:

- The patient lies supine.
- Stand at the cranial end of the treatment table, facing the patient.

Hand placement:

- Grasp the dorsal aspect of the patient's head and cervical spine. Place your mobilizing fingers on the cranial vertebra to be moved. Wrap a traction belt tightly around your hands and hips to fixate and support your hands on the patient. Placement of your hands between the patient's head and the traction belt serves as a pad to keep the belt from sliding, and allows you to palpate muscle spasm, if present.

Procedure:

- Lean backward slightly to apply traction to the cervical spine.
- Apply a Grade II or III movement in a cranial direction.

■ Figure 17c

- **Pain-relief and relaxation mobilization:** Use the same method to apply traction in the actual resting position (in this case, flexion with sidebending and rotation to the right).
- **Stretch-traction mobilization:** Pre-position the patient's cervical spine as far as the restriction allows.
- The spacial orientation of the treatment plane changes with pre-positioning. The treatment direction is at a right angle to the treatment plane in the targeted disc joint.

Cervical segment: flexion
test (supine)

Figure 18 – flexion

■ Figure 18

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient lies supine.
- Stand at the cranial end of the treatment table, facing the patient.

Hand placement:

- Place your right palpating finger on the right facet joint or between the two spinous processes of the segment to be tested.
- Grasp the dorsal aspect of the patient's head.

Procedure:

- With both hands, lift the patient's head and cervical spine until movement occurs in the cervical segment to be tested.
- Apply a Grade I, II or III flexion movement.

Cervical

Cervical segment: flexion
test (sitting)

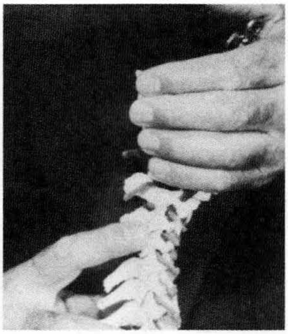


Figure 19a – skeleton

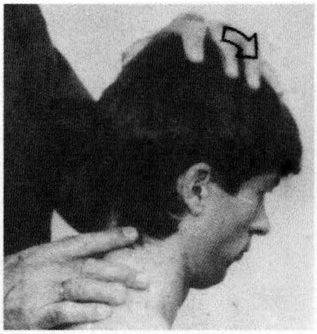


Figure 19a

■ Figure 19a

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient sits on a treatment table or low chair.
- Stand facing the patient's left side.

Hand placement and stabilization:

- **Therapist's stable hand:** Place the palpating finger of your right hand on the right facet joint or between the two spinous processes of the segment to be tested. With the remaining part of your hand, stabilize the spine caudal to the segment.
- **Therapist's moving hand:** Place your left hand on top of the patient's head.

Procedure:

- With your left hand, bend the patient's head and cervical spine forward until movement occurs in the cervical segment to be tested.
- Apply a Grade I, II or III flexion movement.
- Test and compare both sides.

Comments:

- To reduce compression, use the hand and body placement described in Figure 15 to apply a simultaneous Grade I traction to the cervical spine during the test.
- If symptoms are present during flexion in adjacent (cranial or caudal) segments not being tested, preposition and stabilize these segments in extension during the test.

Cervical segment: flexion
stretch mobilization

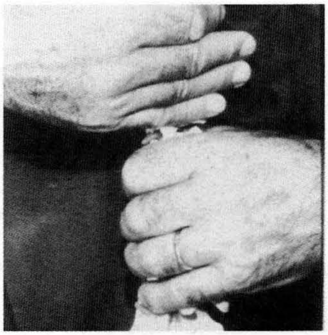


Figure 19b – skeleton

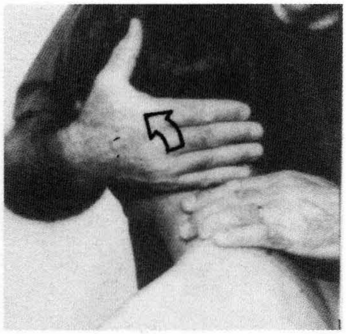


Figure 19b

■ Figure 19b

Objective:

- **Stretch mobilization:** For restricted flexion in a cervical segment.

Starting position:

- The patient sits on a treatment table or low chair.
- Stand facing the patient's right side.

Hand placement and fixation:

- **Therapist's stable hand:** With your left hand, grasp the dorsal aspect of the patient's neck. With your thumb and index finger, fixate the caudal vertebra of the segment to be moved. Your index finger also palpates the movement. With the remaining part of your left hand, fixate the spine caudal to the segment.
- **Therapist's moving hand:** Place your right hand on the left side of the patient's head and cervical spine. Place your little finger around the cranial vertebra of the segment to be moved. Your body acts as an extension of your moving hand by maintaining contact with the patient's head and following the movement.

Procedure:

- Pre-position the targeted cervical segment into flexion as far as the restriction allows, using your right hand and body to guide the patient's head and cervical spine.
- Apply Grade III linear movements in a ventral-cranial direction. Direct the movement either parallel to the treatment plane in the facet joint, or in a traction direction at a right angle to the treatment plane of the disc joint.

Comments:

- If there are symptoms during flexion in adjacent segments, pre-position and stabilize these segments in extension during the mobilization.
- It may be necessary to perform this mobilization on each side.

Cervical segment: flexion with coupled sidebending and rotation

test

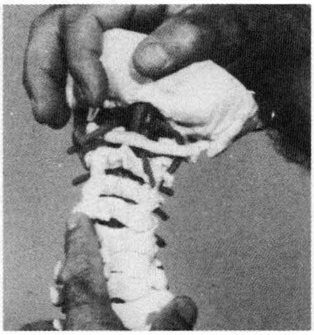


Figure 20a – skeleton

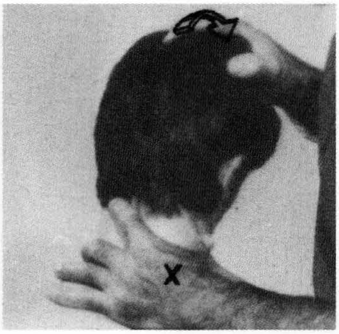


Figure 20a – right sidebending and right rotation

■ Figure 20a

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient sits on a treatment table or low chair.
- Stand facing the patient's right side.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your left palpating finger on the left facet joint of the segment to be tested. Use the remaining part of your hand to stabilize caudal to the segment.
- **Therapist's moving hand:** Place your right hand on top of the patient's head (or as described in *Figure 20b*).

Procedure:

- With your right hand, bend the patient's head and cervical spine forward into flexion with simultaneous coupled sidebending and rotation to the right until movement occurs in the segment to be tested.
- Test and compare both sides.
- Apply a Grade I, II or III movement.

Cervical segment: flexion with coupled sidebending and rotation

stretch mobilization

Figure 20b – skeleton

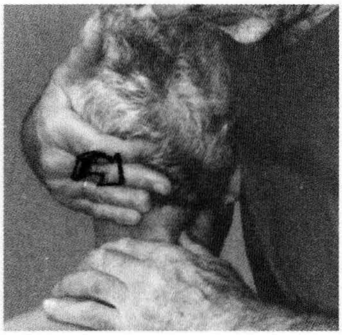


Figure 20b – right sidebending and right rotation

■ Figure 20b

Objective:

- **Stretch mobilization:** For restricted rotation, sidebending or flexion in a cervical segment.

Starting position:

- The patient sits on a treatment table or low chair.
- Stand facing the patient's right side.

Hand placement and fixation:

- **Therapist's stable hand:** With your left hand, grasp the dorsal aspect of the patient's neck. With your thumb and index finger, fixate the caudal vertebra of the segment to be moved. With the remaining part of your hand, fixate the spine caudal to the segment. Your fixating thumb also palpates the movement, and is placed so as not to restrict dorsal-caudal movement on the right side of the cranial vertebra.
- **Therapist's moving hand:** Place your right hand on the left side of the patient's head and cervical spine. Place your little finger around the cranial vertebra (left arch) of the segment to be treated. Your body acts as an extension of your moving hand by maintaining contact with the patient's head and following the movement.

Procedure:

- Pre-position the targeted cervical segment as far as the restriction allows, using your right hand and body to guide the patient's head and cervical spine into flexion with simultaneous coupled sidebending and rotation.
- Apply Grade III linear movements in a ventral-cranial direction. Direct the movement either parallel to the treatment plane in the facet joint, or in a traction direction at a right angle to the treatment plane in the disc joint.

Cervical

Cervical segment: extension (supine)

test

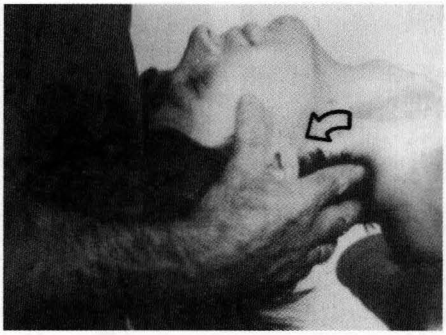


Figure 21

- **Figure 21**

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient lies supine. The head extends beyond the edge of the treatment table.
- Stand at the cranial end of the treatment table, facing the patient.

Hand placement:

- Place your right palpating finger on the right facet joint or between the two spinous processes of the segment to be tested.
- Grasp the dorsal aspect of the patient's head.

Procedure:

- With both hands, guide the patient's head and cervical spine backward until movement occurs in the cervical segment to be tested.
- Apply a Grade I, II or III extension movement.
- Test both sides.

Cervical segment: extension
test (sitting)

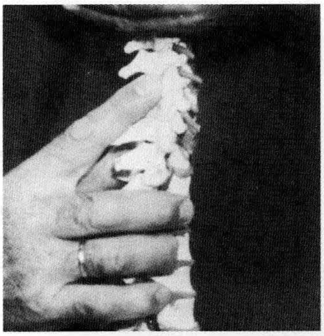


Figure 22a – skeleton

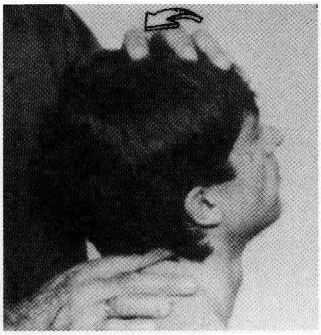


Figure 22a

■ Figure 22a

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient sits on a treatment table or low chair.
- Stand facing the patient's left side.

Hand placement:

- **Therapist's stable hand:** Place the palpating finger of your right hand on the right facet joint or between the two spinous processes of the segment to be tested.
- **Therapist's moving hand:** Place your left hand on top of the patient's head.

Procedure:

- With your left hand, bend the patient's head and cervical spine backward until movement occurs in the cervical segment to be tested.
- Apply a Grade I, II or III extension movement.
- Test both sides.

Comments:

- To reduce compression, use the hand and body placement described in Figure 15 to apply a simultaneous Grade I traction to the cervical spine during the test.
- If symptoms are present during extension in adjacent (cranial or caudal) segments not being tested, preposition and stabilize these segments in flexion during the test.

Cervical segment: extension
stretch mobilization

Figure 22b – skeleton

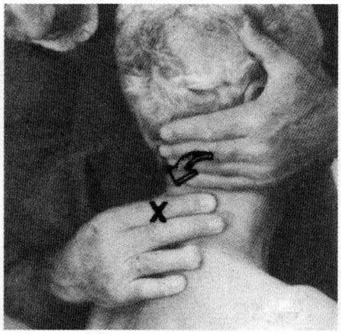


Figure 22b

■ Figure 22b

Objective:

- **Stretch mobilization:** For restricted extension in a cervical segment.

Starting position:

- The patient sits on a treatment table or low chair.
- Stand facing the patient's left side.

Hand placement and fixation:

- **Therapist's stable hand:** With your right hand, grasp the dorsal aspect of the patient's neck. With your thumb and index finger, fixate the caudal vertebra of the segment to be treated. Your index finger also palpates the movement. Use the remaining part of your hand to fixate the spine caudal to the segment.
- **Therapist's moving hand:** Place your left hand on the right side of the patient's head and cervical spine. Place your little finger around the cranial vertebra of the segment to be treated. Your chest acts as an extension of your moving hand and remains in contact with the patient's head without changing the position of the patient's cervical spine.

Procedure:

- Pre-position the targeted cervical segment as far as the restriction allows, using your left hand and body to guide the patient's head and cervical spine.
- Apply a Grade III linear movement in a dorsal direction, or as traction in a cranial direction. It may be necessary to apply the mobilization on each side.

Comments:

- If symptoms are present during extension in adjacent segments (cranial or caudal) not being treated, preposition and stabilize these segments in flexion during the mobilization.
- The treatment can also be performed in a supine position.

Cervical segment: extension with coupled sidebending and rotation
test

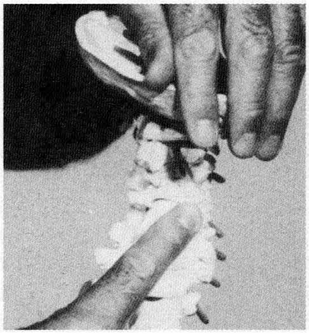


Figure 23a – skeleton

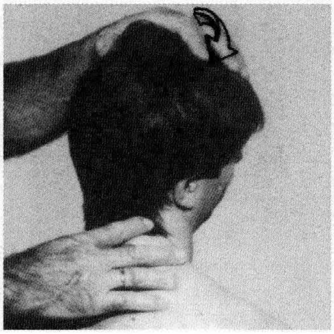


Figure 23a – right sidebending and right rotation

■ Figure 23a

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient sits on a treatment table or low chair.
- Stand facing the left side of the patient.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your right palpating finger on the right facet joint of the segment to be tested. With the remaining part of your hand, stabilize caudal to the segment.
- **Therapist's moving hand:** Place your left hand on top of the patient's head.

Procedure:

- With your left hand, bend the patient's head and cervical spine backward into extension with simultaneous coupled sidebending and rotation to the right until movement occurs in the segment to be tested.
- Apply a Grade I, II or III movement.
- Compare both sides.

Cervical segment: extension with coupled sidebending and rotation
stretch mobilization


Figure 23b – skeleton


Figure 23b – right sidebending and right rotation

■ Figure 23b

Objective:

- **Stretch mobilization:** For restricted rotation or extension in a cervical segment.

Starting position:

- The patient sits on a treatment table or low chair.
- Sand facing the patient's left side.

Hand placement and fixation:

- **Therapist's stable hand:** Place your right hand around the dorsal aspect of the patient's neck. Use your thumb and index finger to fixate the caudal vertebra of the segment to be treated. Your index finger also palpates the movement. Use the remaining part of your hand to fixate the spine caudal to the segment.
- **Therapist's moving hand:** Place your left hand on the right side of the patient's head and cervical spine. Place your little finger around the cranial vertebra (right arch) of the segment to be treated. Your chest acts as an extension of your moving hand and is placed in contact with the patient's head without changing the position of the patient's cervical spine.

Procedure:

- Pre-position the targeted segment into extension with simultaneous sidebending and rotation to the right as far as the restriction allows. Use your left hand and body to guide the patient's head and cervical spine.
- Apply a Grade III linear movement in a dorsal/caudal direction.
- Your fixating (right) index finger should not restrict dorsal-caudal movement on the right side of the cranial vertebra .

Active cervicothoracic rotation
test

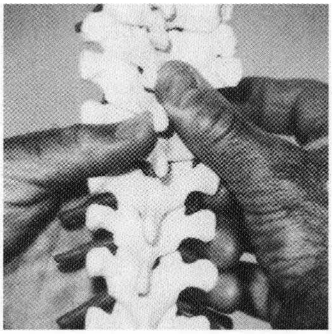


Figure 24 – skeleton

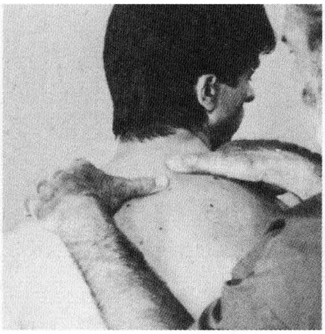


Figure 24 – to the right

■ Figure 24

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient sits on a treatment table or low chair.
- Stand behind the patient.

Hand placement:

- Place your left thumb on the lateral (left) side of the caudal spinous process of the segment to be tested.
- Place your right thumb on the lateral (right) side of the cranial spinous process of the segment to be tested.

Procedure:

- The patient rotates the head and cervical spine to the right. During this movement, your thumbs remain in contact with the spinous processes. During right rotation, the spinous process of the cranial vertebra and your right thumb will move more than the caudal spinous process to the left.
- Compare both sides.

Comments:

- Alternate hand placement: Place your index finger laterally between the two spinous processes with contact to both. Feel that the cranial spinous process presses more on the finger than does the caudal spinous process.
- If pain in the upper cervical region limits active movement of the head and cervical spine, use your right hand to stabilize the patient's upper cervical segments and passively rotate the lower cervical spine, avoiding upper cervical movement. Place your left palpating finger between the two spinous processes of the segment to be tested.

Cervicothoracic segment: flexion with coupled sidebending and rotation

test

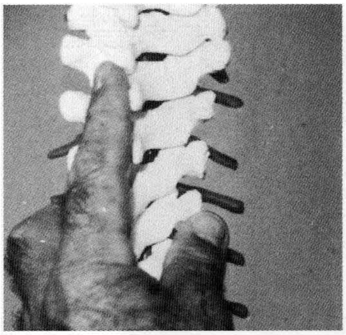


Figure 25 – skeleton

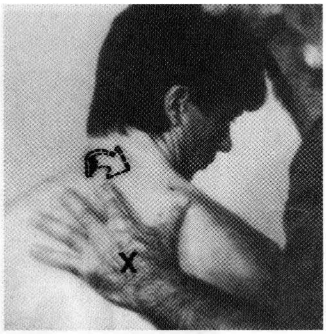


Figure 25 – right sidebending and right rotation

■ Figure 25

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient sits on a treatment table or low chair.
- Stand facing the patient's right side.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your left palpating finger between the two spinous processes of the segment to be tested. Use the remaining part of your hand to stabilize caudal to the segment.
- **Therapist's moving hand:** Place your right hand on top of the patient's head.

Procedure:

- With your right hand, guide the patient's head and cervical spine forward into flexion with simultaneous sidebending and rotation to the right until movement occurs in the cervical segment to be tested.
- Apply a Grade I, II or III movement.
- Compare both sides.

Cervicothoracic segment C5 to T3: translatoric joint play
test

Figure 26 – C5-T3

■ Figure 26

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient lies on the left side.
- Stand facing the patient.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your left palpating finger on the right facet joint or between the two spinous processes of the segment to be tested. With the remaining part of your hand, stabilize caudal to the segment.
- **Therapist's moving hand:** Place your right forearm and hand under the patient's head and cervical spine. Place your little finger on the cranial vertebra of the segment to be tested. The patient's forehead rests on your upper arm.

Procedure:

- With your right arm, produce translatoric movement by alternately moving the patient's head and cervical spine in a ventral and dorsal direction parallel to the treatment plane of the vertebral disc joint of a specific cervical or upper thoracic segment. Ensure that the vertebral movement is translatoric with no rotation component. Apply:
  a) small Grade I oscillatory movements to assess joint play.
  b) Grade II and III movements to assess movement quantity and quality, including end-feel.
- Test in both right and left sidelying positions.

Comments:

- Use the same hand placement for testing traction joint play.

Cervical

Cervicothoracic segment: flexion and extension

test and stretch mobilization

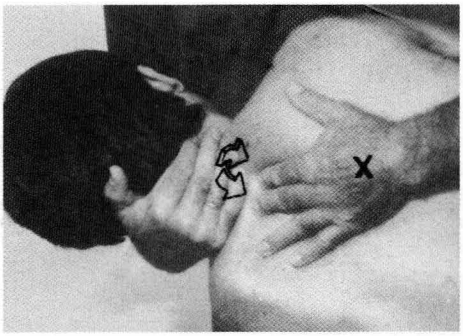


Figure 27

■ Figure 27

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.
- **Stretch mobilization:** For restricted flexion or extension in a cervicothoracic segment.

Starting position:

- The patient lies on the left side. Place a pillow under the patient's head if necessary for comfort.
- Stand facing the patient.

Hand placement and fixation:

- **Therapist's stable hand:** With your left index and middle fingers, fixate the caudal vertebra of the segment to be treated. Your index finger also palpates the movement. Use the remaining part of your left hand to fixate caudal to the segment.
- **Therapist's moving hand:** Place your right forearm and hand under the patient's head and cervical spine. Place your little finger on the cranial vertebra of the segment to be treated. The patient's forehead rests against your upper arm.

Procedure:

- **Test:** With your right hand and arm, guide the patient's head and cervical spine forward or backward. Apply Grade I, II or III flexion and extension movements.
- **Stretch mobilization:** Pre-position the targeted segment into flexion or extension as far as the restriction allows. Apply a Grade III linear movement in a ventral-cranial direction for flexion, or a dorsal-caudal direction for extension.

Cervicothoracic segment: flexion with sidebending and rotation

test

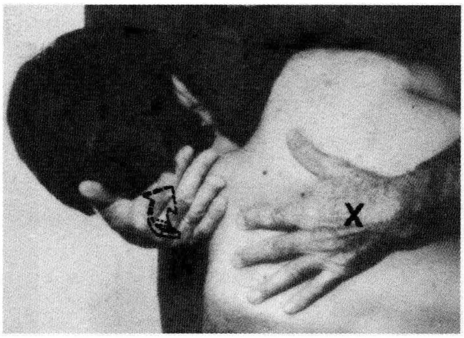


Figure 28a – test

■ Figure 28a

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient lies on the left side with the head and shoulder extending beyond the edge of the treatment table.
- Stand facing the patient.

Hand placement and stabilization:

- **Therapist's stable hand:** Place your left palpating finger between the two spinous processes of the segment to be tested. With the remaining part of your hand, stabilize caudal to the segment.
- **Therapist's moving hand:** Place your right forearm and hand under the patient's head and neck. Place your little finger on the cranial vertebra of the segment to be tested. The patient's forehead rests against your upper arm.

Procedure:

- With your right hand, guide the patient's neck into flexion with simultaneous coupled sidebending and rotation (to the same side) in the cervicothoracic segment to be tested.
- Apply a Grade I, II or III movement.

Comments:

- The same hand placement can be used to test coupled movements (i.e., flexion or extension with sidebending and rotation to the same side) and noncoupled movements (i.e., flexion or extension with sidebending and rotation to opposite sides).

Cervicothoracic segment: flexion with sidebending and rotation

stretch mobilization

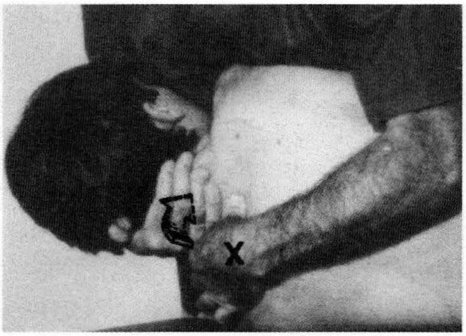


Figure 28b

■ Figure 28b

Objective:

- **Stretch mobilization:** For restricted flexion, rotation or sidebending in a cervicothoracic segment.

Starting position:

- The patient lies on the left side with the head and shoulder extending beyond the edge of the treatment table.
- Stand facing the patient.

Hand placement and stabilization:

- **Therapist's stable hand:** With your left thumb, fixate laterally (left) on the spinous process of the caudal vertebra of the segment to be treated. With the remaining part of your left hand, stabilize caudal to the segment.
- **Therapist's moving hand:** Place your right forearm and hand under the patient's head and neck. Place your little finger on the cranial vertebra of the segment to be treated. Rest the patient's forehead against your upper arm.

Procedure:

- Pre-position the targeted cervicothoracic segment as far as the restriction allows, using your right hand to guide the patient's neck into flexion with simultaneous coupled sidebending and rotation (to the same side).
- Apply a Grade III linear mobilization in a ventral-cranial direction.

Cervicothoracic segment: traction in the lower cervical and upper thoracic facet joints
mobilization

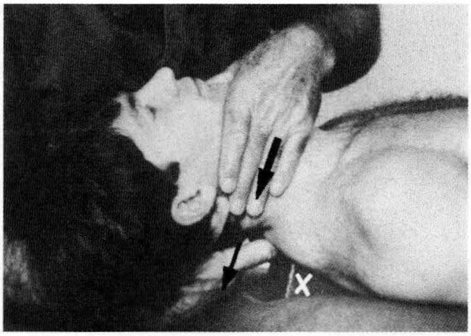


Figure 29a – lower cervical (C6-C7)

■ Figure 29a

Objective:

- **Mobilization:** For restricted mobility in a specific facet joint in the lower cervical and upper thoracic spine (C6 - T3).

Starting position:

- The patient lies supine.
- Stand facing the patient's left side.

Hand placement and fixation:

- **Fixation:** Position the peaks of a wedge to fixate the transverse processes of the caudal vertebra of the segment to be treated.
- **Therapist's moving hands:** With your right hand, grasp the dorsal aspect of the patient's head and cervical spine. Use your right palpating finger to monitor movement between the spinous processes of the segment through the access between the peaks of the wedge. With your left hand, grasp the patient's ventral mandible (mouth closed). If the patient has TMJ problems, place your hand against the maxilla. Your chest acts as an extension of your moving hand and remains in contact with the patient's head without changing the position of the patient's cervical spine.

Procedure:

- Bend your knees to move the patient's head and cervical spine in a dorsal and slightly cranial direction, producing movement at a right angle to the treatment plane of the facet joints (traction of the facet joints).
- Apply a Grade II or III movement in a dorsal/cranial direction.

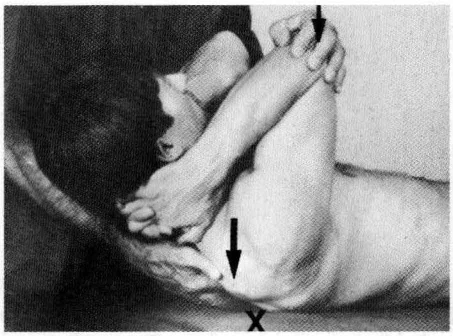


Figure 29b – upper thoracic (T1-T3)

■ Figure 29b

- **Traction of the facet joints in the upper thoracic spine (T1 - T3):** The patient's hands are clasped around the neck. Apply pressure to the patient's elbows in a dorsal direction (see arrow), or press on the sternum with the patient's head resting on a pillow.
- **Traction in the disc joint:** The patients hands are clasped around the shoulders. Push the patient's elbows in a cranial direction.

Cervical soft tissue and joint: dorsal
mobilization

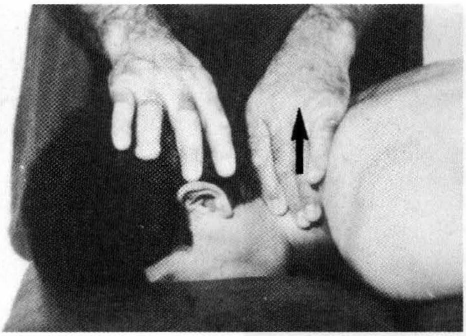


Figure 30a – one-handed technique

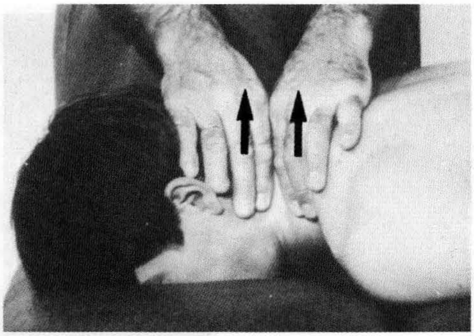


Figure 30b – two-handed technique

■ Figure 30a

Objective:

- **Mobilization:** For restricted soft tissue or joint mobility in the cervical region.

Starting position:

- The patient lies prone.
- Stand facing the patient's right side.

Hand placement:

- Place your right hand on the patient's head.
- With your left hand, grasp the paraspinal muscles of the patient's cervical spine. To avoid pinching the patient's skin, maintain your DIP and PIP joints in extension and your MCP joints in flexion.

Procedure:

- With your left hand, lift the paraspinal muscles in a dorsal direction as far as the skin will allow, simultaneously pressing into the muscle. Rhythmically apply and release the pressure without losing skin contact.

■ Figure 30b

- The soft tissue treatment can also be performed with both hands.

Cervical soft tissue and joint: ventral
mobilization (cranial stabilization)

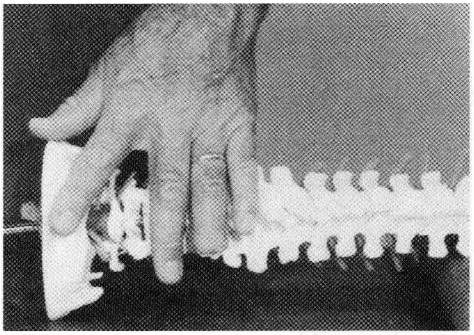


Figure 30c – skeleton

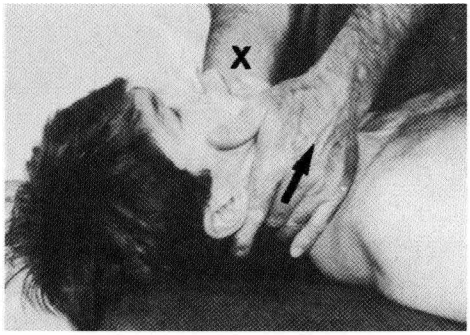


Figure 30c

■ Figure 30c

Objective:

- **Mobilization:** For restricted soft tissue or joint mobility in the cervical region with traction (separation) in the facet joint.

Starting position:

- The patient lies supine.
- Stand facing the patient's left side.

Hand placement and stabilization:

- **Therapist's stable hand:** With your right hand, stabilize the left side of the patient's head and cervical spine with your little finger on the cranial vertebra of the segment to be treated.
- **Therapist's moving hand:** With your left hand, grasp the patient's right paraspinal muscles. Place your middle finger on the right side of the caudal vertebra of the segment to be treated.

Procedure:

- With your left hand, move in a ventral-caudal direction (at a right angle to the facet joint of the targeted segment) as far as the skin will allow, simultaneously pressing into the muscle. Rhythmically apply and release the pressure without losing skin contact.

Comments:

- To produce gliding in the facet joint, stand at the cranial end of the table and change the movement direction to ventral-cranial, parallel to the treatment plane of the facet joint. This will rotate the caudal vertebra to the left, producing a relative right rotation of the cranial vertebra at the targeted segment. This right rotation will increase if simultaneously coupled with slight right sidebending of the head and cervical spine.

Cervical soft tissue and joint: ventral
mobilization (caudal stabilization)

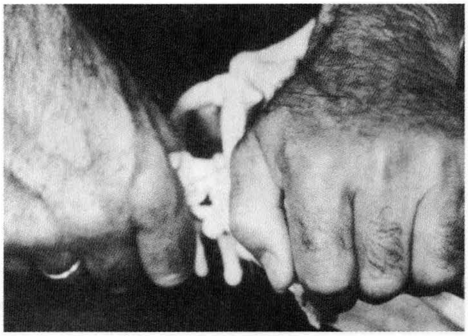


Figure 30d – skeleton

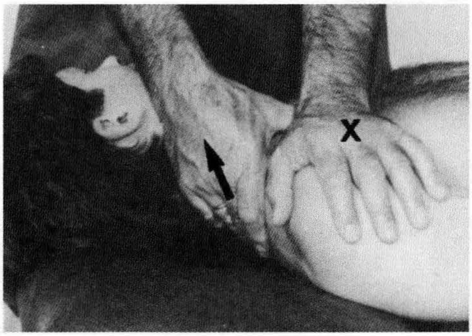


Figure 30d

■ Figure 30d

Objective:

- **Mobilization:** For restricted soft tissue or joint mobility in the cervical region with gliding in the facet joint.

Starting position:

- The patient lies supine.
- Stand facing the patient's left side.

Hand placement and stabilization:

- **Therapist's stable hand:** With your left hand, apply dorsal pressure to the patient's right shoulder, which will indirectly stabilize T1.
- **Therapist's moving hand:** With your right hand, grasp the paraspinal muscles on the patient's right side. Place the radial side of your index finger on the cranial vertebra of the segment to be treated.

Procedure:

- Move your right hand in a ventral-cranial direction, parallel to the facet joint, as far as the skin will allow, simultaneously pressing into the muscle. Rhythmically apply and release the pressure without losing skin contact.

Comments:

- In the above example, the caudal vertebra is stabilized and the cranial vertebra is rotated to the left. This left rotation will increase if simultaneously coupled with left sidebending of the cervical spine.

Cervical

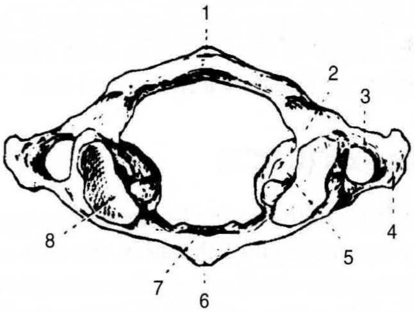
13 Upper cervical spine

■ Functional anatomy and movement

■ Anatomy

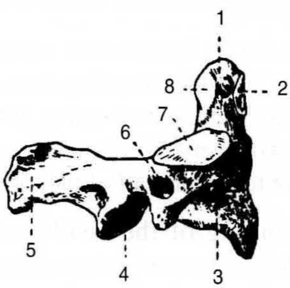
The upper cervical spine (Figures UC-1 and UC-2) consists of two segments: C0-C1 and C1-C2. There are two zygapophyseal joints between C0-C1 and C1-C2 and no intervertebral discs. In addition, the C1-C2 segment has two more articulations as the dens of axis articulates ventrally with the arch of atlas and dorsally with the transverse ligament.

Figure UC-1
Atlas viewed from above



1. Tuberculum posterius
2. Sulcus a. vertebralis
3. Foramen costotransversarium
4. Processus transversus
5. Massa lateralis
6. Tuberculum anterius
7. Fovea dentis
8. Fovea articularis superior

Figure UC-2
Axis viewed from the right



1. Dens
2. Facies articularis anterior
3. Corpus vertebrae
4. Fovea articularis inferior
5. Processus spinosus
6. Foramen costotransversarium
7. Fovea articularis superior
8. Fovea articularis posterius

Upper Cervical

■ Bone and joint movement

Occiput-atlas (C0-C1)

Flexion and extension of the upper cervical region follows the convex rule, i.e., the condyles of the occiput move dorsally with flexion (*Upper Cervical Figure 1*) and ventrally with extension (*Upper Cervical Figure 2*). In both cases the condyles roll in the same direction and glide in the opposite direction of the movement.

The small coupled movements of rotation and sidebending in the upper cervical spine take place to opposite sides in both flexion and extension. For example, rotation to the right is coupled with sidebending to the left (*Upper Cervical Figures 3 and 5*).

In upper cervical noncoupled movements, rotation and sidebending combine to the same side in both flexion (*Upper Cervical Figure 4*) and extension (*Upper Cervical Figure 6*). The range of movement is even smaller than coupled movements, and there is a firmer end-feel.

Atlas-axis (C1-C2)

Because of the strong ligamentous support between the dens and the ventral arch of the atlas, the axis of movement is the dens. During flexion, the posterior arch of the atlas moves superiorly away from the axis, while the ventral arch of the atlas moves caudally along the dens. During extension, the posterior arch of the atlas moves closer to the posterior aspect of the axis, while the ventral arch of the atlas moves cranially along the dens.

Due to strong ligamentous structures and the orientation of the joint surfaces, sidebending does not take place between the atlas and axis. Significant rotation, however, is possible in this region (approximately 45 degrees to the left and to the right) and contributes about half of the total rotation in the cervical region.

Sidebending of the head to the opposite side of rotation (coupled movement) relaxes the alar ligament on the side of the sidebending and often allows increased rotation. In contrast, sidebending of the head to the same side as the rotation (noncoupled movement) is very restricted.

■ Notes on evaluation and treatment

The ligaments of the upper cervical area play an essential role in the stability of that region, especially the alar ligaments connecting the dens of the axis to the occiput. They also contribute to the coupled movement pattern of the upper cervical spine. The other important ligament is the transverse ligament, which stabilizes the dens against the ventral arch of the atlas. These ligaments are vulnerable to injury and possible rupture due to trauma or pathological conditions such as rheumatoid arthritis. The ligaments should always be tested prior to treatment, especially before rotation or forceful traction techniques (Cervical Figure 10).

If testing reveals ligamentous laxity, then manipulation and joint mobilization are contraindicated in this area. In this case the patient should be referred to a specialist for further evaluation. The cranial nerves and the vital vascular supply passing through this region must also be checked.

Upper cervical tests and mobilizations

Screening techniques

Occiput-atlas techniques

Atlas-axis techniques

Soft tissue techniques

Note

Before practicing upper cervical mobilization techniques, students should screen their partners using the following evaluation procedures:

Upper cervical stability and mobility	(Cervical Fig. 10)	266
Vertebral artery	(Cervical Fig. 12)	269
Upper cervical segment: lateral glide	(Up Cerv Fig. 8)	305

Active upper cervical flexion and extension
test

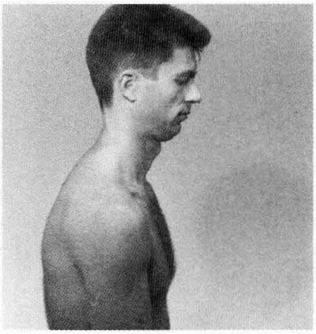


Figure 1 – flexion

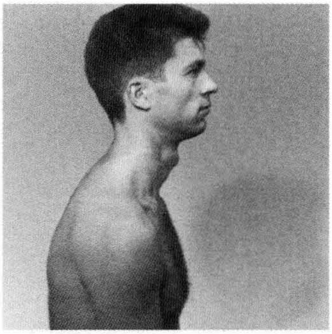


Figure 2 – extension

■ Figure 1

Objective:

- **Test:** General mobility and symptom screening.

Starting position:

- The patient sits on the treatment table.

Procedure:

- The patient tucks the chin to produce flexion in the upper cervical spine.
- At the end of the patient's active movement, apply overpressure to assess the presence of additional passive movement range.
- Observe range of movement and the way the movement is performed. Note symptom behavior during the movement.

Comments:

- Following this test evaluate passive movement quality from the zero position through the entire range of movement, including end-feel characteristics.

■ Figure 2

- Use a similar method to evaluate active upper cervical extension. In this case, the patient lifts the chin to produce extension in the upper cervical spine.

Active upper cervical flexion with combined sidebending and rotation

test

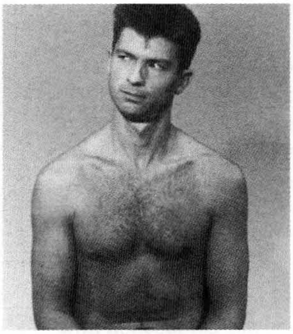


Figure 3 – coupled left sidebending and right rotation

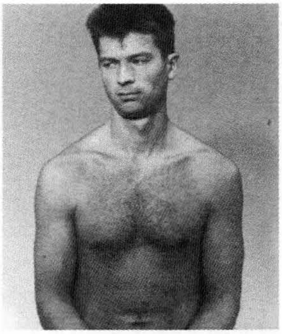


Figure 4 – noncoupled right sidebending and right rotation

■ Figure 3

Objective:

- **Test:** General mobility and symptom screening.

Starting position:

- The patient sits on the treatment table.

Procedure:

- The patient tucks the chin into upper cervical flexion with simultaneous coupled sidebending to the left and rotation to the right.
- At the end of the patient's active movement, apply overpressure to assess the presence of additional passive movement range.
- Observe range of movement and the way the movement is performed. Note symptom behavior during the movement. Compare both sides.

Comments:

- Following this test evaluate passive movement quality from the zero position through the entire range of movement, including end-feel characteristics.

■ Figure 4

- Use a similar method to evaluate active and passive noncoupled upper cervical movements in flexion with sidebending and rotation to the same side (e.g., sidebending and rotation to the right).

Active upper cervical extension with combined sidebending and rotation

test

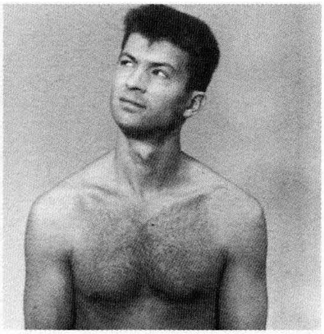


Figure 5 – coupled left sidebending and right rotation

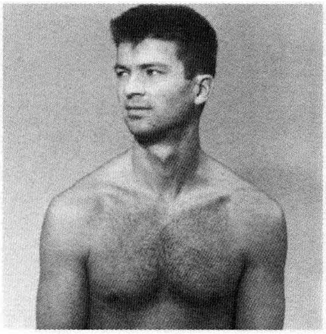


Figure 6 – noncoupled right sidebending and right rotation

■ Figure 5

Objective:

- **Test:** General mobility and symptom screening.

Starting position:

- The patient sits on the treatment table.

Procedure:

- The patient lifts the chin into upper cervical extension with simultaneous sidebending to the left and rotation to the right.
- At the end of the patient's active movement, apply overpressure to assess the presence of additional passive movement range.
- Observe range of movement and the way the movement is performed. Note symptom behavior during the movement. Compare both sides.

Comments:

- Following this test evaluate passive movement quality from the zero position through the entire range of movement, including end-feel characteristics.

■ Figure 6

- Use a similar method to evaluate active and passive noncoupled upper cervical movements in extension with sidebending and rotation to the same side (e.g., sidebending and rotation to the right).

Upper Cervical

Occiput-atlas traction
test and mobilization

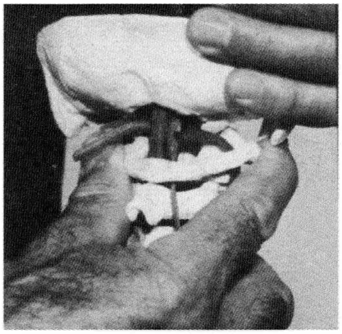


Figure 7 – skeleton

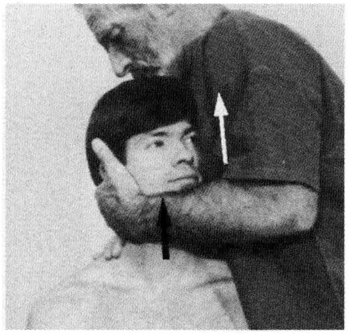


Figure 7

■ Figure 7

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.
- **Mobilization:** For restricted occiput-atlas mobility or symptom relief. This technique may also be effective for atlanto-axial joint restrictions and, with modified hand placement, in other cervical segments.

Starting position:

- The patient sits on a treatment table or low chair.
- Stand facing the patient's left side. Bend your knees slightly.

Hand placement and fixation:

- **Therapist's stable hand:** With your right hand, grasp the dorsal aspect of the patient's neck. With your thumb and index finger, fixate the atlas in a caudal direction. Your thumb and fingers also palpate the movement. Use the remaining part of your hand to fixate the spine caudal to the atlas.
- **Therapist's moving hand:** The left hand is placed on the right side of the patient's head with the little finger under the occiput. The therapist's chest acts as an extension of the moving hand and is placed in contact with the patient's head without changing the position of the patient's cervical spine.

Procedure:

- **Test:** With your left hand and body, guide movement of the patient's head. Apply a Grade I, II or III traction (separation) to the patient's atlanto-occipital joints in a cranial direction, by straightening your knees.
- **Mobilization:** Pre-position the occiput as far as the restriction allows. Apply a Grade III movement in a cranial direction.

Alternate method:

- Stand behind the patient. Cradle the patient's chin in your cubital fossa.

Upper cervical segment: lateral glide with caudal fixation

test

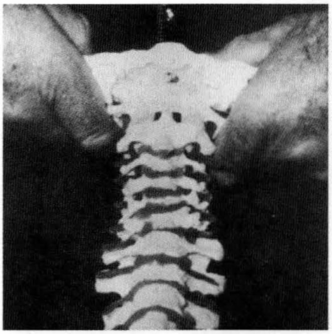


Figure 8 – skeleton

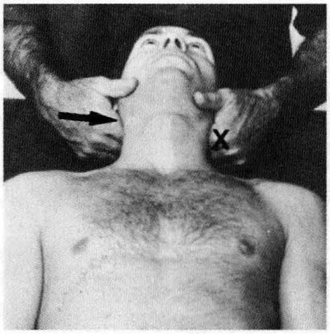


Figure 8 – atlas-axis

■ Figure 8

Objective:

- **Test:** Segmental range and quality of movement, including end-feel. Determine if the segment is hypermobile or unstable. All mobilization in the upper cervical area is *contraindicated* if this test reveals hypermobility or instability. This test can also be used to assess hypomobility between the occiput and the atlas.

Starting position:

- The patient lies supine.
- Stand at the cranial end of the treatment table, facing the patient.

Hand placement and fixation:

- **Therapist's stable hand:** With the radial side of your left index finger, fixate the left arch of the axis just dorsal to the transverse process.
- **Therapist's moving hand:** Place your right index finger on the right arch of the atlas, just dorsal to the transverse process. Avoid pressure on the sensitive transverse process.

Procedure:

- With your right hand, press on the right side of the atlas.
- Apply a Grade I, II or III linear movement to the left.

Alternate method:

- Fixate the atlas. Move the axis.

Occiput-atlas: flexion and extension
test

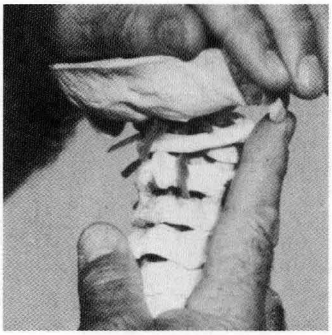


Figure 9 – skeleton

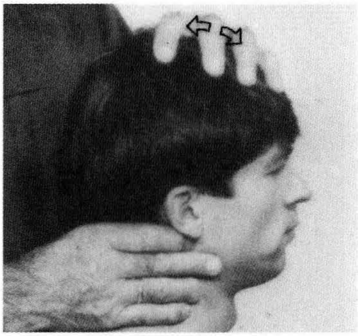


Figure 9

■ Figure 9

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient sits on a treatment table or low chair.
- Stand facing the patient's left side.

Hand placement:

- **Therapist's stable hand:** Place your right palpating finger between the patient's right mastoid process and right transverse process of the atlas. Use the remaining part of your hand to stabilize the patient's spine caudal to the atlas.
- **Therapist's moving hand:** Place your left hand on top of the patient's head.

Procedure:

- With your left hand, guide the patient's head forward or backward to produce flexion or extension in the atlanto-occipital joint.
- Apply a Grade I, II or III flexion or extension movement.
- Test and compare both sides.

Alternate method:

- To reduce compression in the tested segment, use the hand and body placement described in Figure 10 to apply a simultaneous Grade I traction to the upper cervical spine during the test.

Occiput-atlas: flexion

stretch mobilization

Figure 10 – skeleton

Figure 10 – condyles dorsal

■ Figure 10

Objective:

- **Stretch mobilization:** For restricted occiput-atlas flexion (chin tucked or retracted).

Starting position:

- The patient sits.
- Stand facing the patient's left side.

Hand placement and fixation:

- **Therapist's stable hand:** With your right hand, grasp the dorsal aspect of the patient's neck. With your thumb and index finger, fixate the atlas. Your thumb and index finger also palpates the movement. Use the remaining part of your hand to fixate the spine caudal to the atlas.
- **Therapist's moving hand:** Place your left hand on the right side of the patient's head with your little finger under the occiput. Your chest acts as an extension of your moving hand and maintains contact with the patient's head without changing the position of the patient's cervical spine.

Procedure:

- Pre-position the occiput into flexion as far as the restriction allows, using your left hand and body to guide the movement of the patient's head.
- Apply a Grade III linear movement to the patient's occipital condyles.

  a) **Traction mobilization:** move in a cranial direction

  b) **Glide mobilization:** in a dorsal direction to produce flexion in the atlanto-occipital joint (Convex Rule).

  It may be necessary to emphasize movement first on one side, then on the other.

Alternate method:

- For better fixation, the patient can be treated supine with modified hand placement.

Occiput-atlas: extension
stretch mobilization

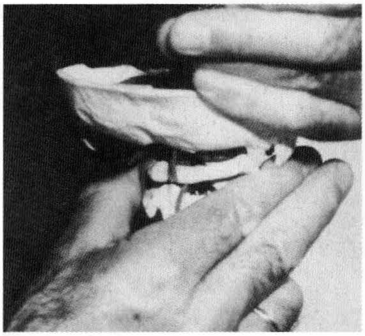


Figure 11 – skeleton

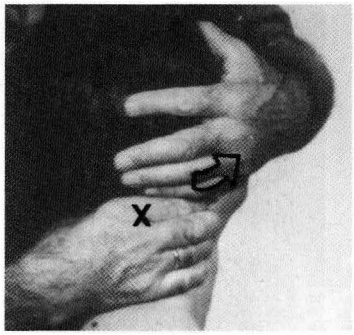


Figure 11 – condyles ventral

■ Figure 11

Objective:

- **Stretch mobilization:** For restricted occiput-atlas extension (chin up or protruding the chin).

Starting position:

- The patient sits.
- Stand facing the patient's left side.

Hand placement and fixation:

- **Therapist's stable hand:** With your right hand, grasp the dorsal aspect of the patient's neck. With your index or middle finger, fixate the ventral aspect of the right transverse process of the patient's atlas. Your index finger also palpates the movement. Use the remaining part of your hand to fixate the spine caudal to the atlas.
- **Therapist's moving hand:** Place your left hand on the right side of the patient's head with your little finger under the occiput. Your chest acts as an extension of your moving hand and maintains contact with the patient's head without changing the position of the patient's cervical spine.

Procedure:

- Pre-position the occiput into extension as far as the restriction allows, using your left hand and body to guide the movement of the patient's head.
- Apply a Grade III linear movement to the occipital condyles in a ventral direction, to produce extension in the atlanto-occipital joint (Convex Rule). It may be necessary to emphasize movement first on one side, then on the other.

Comments:

- For traction mobilization, move in a cranial direction.

Alternate method:

- With modified hand placement, the patient can be treated supine.

Occiput-atlas: coupled sidebending and rotation
test

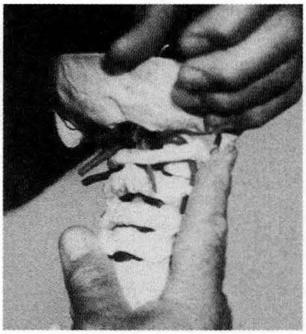


Figure 12a – skeleton

Figure 12a – right sidebending and left rotation

■ Figure 12a

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient sits on a treatment table or low chair.
- Stand facing the patient's left side.

Hand placement:

- **Therapist's stable hand:** Place your right palpating finger between the patient's right mastoid process and the right transverse process of the atlas. Use the remaining part of your hand to stabilize the patient's spine caudal to the atlas.
- **Therapist's moving hand:** Place your left hand on top of the patient's head.

Procedure:

- With your left hand, guide the patient's head into simultaneous coupled sidebending to the right and rotation to the left in the atlanto-occipital joint.
- Apply a Grade I, II or III movement.
- Test both sides.

Comments:

- For reliable evaluation findings, the degree of rotation should be equal to the degree of sidebending. Too much rotation will restrict sidebending; too much sidebending will restrict rotation.
- If the atlas-axis segment is very mobile, use the hand placement described in Figure 12b to better fixate the atlas.

Occiput-atlas: coupled sidebending and rotation

stretch mobilization

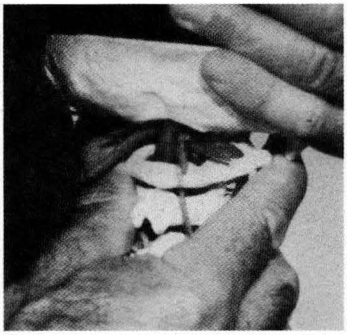


Figure 12b – skeleton

Figure 12b – right sidebending and left rotation

■ Figure 12b

Objective:

- **Stretch mobilization:** For restricted coupled sidebending and rotation in the occiput-atlas joint.

Starting position:

- The patient sits on a treatment table or low chair.
- Stand facing the patient's left side.

Hand placement and fixation:

- **Therapist's stable hand:** With your right hand, grasp the dorsal aspect of the patient's neck. Fixate the patient's atlas with the tip of your index or middle finger on the ventral aspect of the right transverse process and your thumb around the atlas. Use the remaining part of your hand to fixate the patient's spine caudal to the atlas.
- **Therapist's moving hand:** Place your left hand on the right side of the patient's head. Place your little finger on the right mastoid process. Your chest acts as an extension of your moving hand and maintains contact with the patient's head without changing the position of the patient's cervical spine.

Procedure:

- Pre-position the occiput as far as the restriction allows, using your left hand and body to guide the patient's head into coupled sidebending to the right and rotation to the left.
- Apply a Grade III linear movement in a ventral direction.

Comments:

- With modified hand placement, this method can be used for traction-mobilization in a cranial direction for any cervical segment.

Atlas-axis: flexion and extension
test

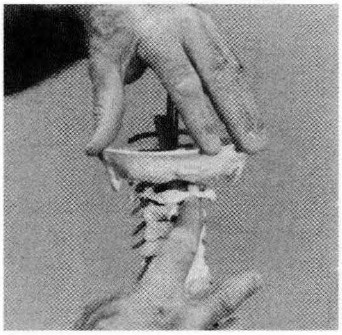


Figure 13 – skeleton

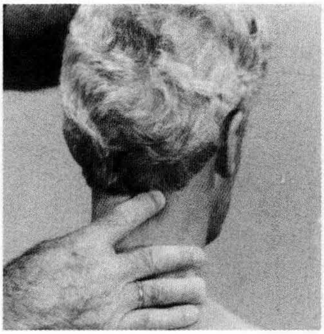


Figure 13

■ Figure 13

Objective:

- **Test:** Segmental range and quality of movement, including end-feel.

Starting position:

- The patient sits on a treatment table or low chair.
- Stand facing the patient's left side.

Hand placement:

- **Therapist's stable hand:** Place your right palpating finger between the right arch of the patient's atlas and the arch of the axis. With the remaining part of your hand, stabilize the patient's spine caudal to the axis.
- **Therapist's moving hand:** Place your left hand on top of the patient's head.

Procedure:

- With your left hand, guide the patient's head forward or backward into atlanto-axial flexion or extension, until movement occurs in the atlanto-axial joint.
- Apply a Grade I, II or III flexion or extension movement.
- Test and compare both sides.

Alternate method:

- To reduce compression in the tested segment, use the hand and body placement described in Figure 12b to apply a simultaneous Grade I traction to the upper cervical spine during the test.

Atlas-axis: rotation

test and stretch mobilization

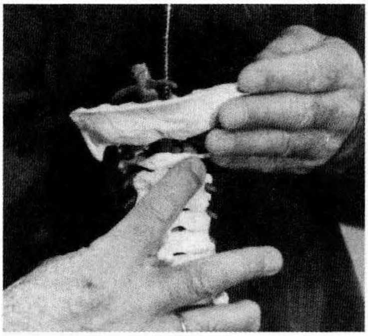


Figure 14 – skeleton

Figure 14

■ Figure 14

Objective:

- **Stretch mobilization:** For restricted atlas-axis mobility.

Starting position:

- The patient sits on a treatment table or low chair.
- Stand facing the patient's left side.

Hand placement:

Therapist's stable hand: For testing, place your right palpating finger between the right arch of the patient's atlas and the arch of the axis. For mobilization, fixate the axis with your thumb and index finger. Use the remaining part of your hand to stabilize the patient's spine caudal to the axis.

- **Therapist's moving hand:** Place your left hand on the right side of the patient's head. Place your little finger on the right arch of the atlas. Your chest acts as an extension of your moving hand and maintains contact with the patient's head without changing the position of the patient's cervical spine.

Procedure:

- Pre-position the occiput and atlas as far as the restriction allows, using your left hand and body to guide the head and atlas into left rotation. At the end-range of rotation, sidebend the head slightly to the right. This slight sidebending is in a direction opposite the rotation in a coupled movement direction, to facilitate maximum rotation of the atlas. (The coupled movement pattern increases rotation range as a result of ligamentous relaxation.)
- Apply a Grade III linear movement in a dorsal direction, using the contact from your chest on the patient's left side.
- Compare both sides.

Comments:

- The safest mobilization in this segment is pre-positioned traction mobilization.

Upper cervical soft tissue and joint: superficial and deep muscles
mobilization

Figure 15a – superficial muscles

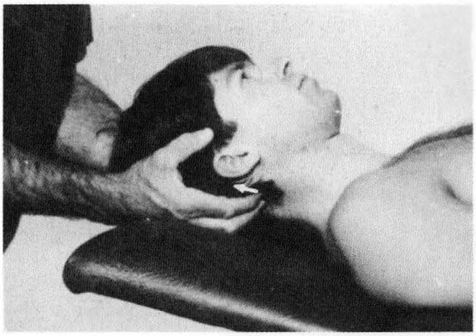


Figure 15b – deep muscles

■ Figure 15a

Objective:

- **Mobilization:** For restricted soft tissue or joint mobility in the upper cervical region, especially the superficial upper cervical muscles. This technique can be applied at any cervical segment.

Starting position:

- The patient lies supine. The patient's head is slightly rotated to the left.
- Stand at the cranial end of the treatment table, facing the patient.

Hand placement:

- **Therapist's stable hand:** With your left hand, support the left side of the patient's head.
- **Therapist's moving hand:** Place your right index finger, supported by your middle finger, on the muscular attachments in the area of the nuchal lines on the right side of the skull.

Procedure:

- With your right hand, apply transverse friction massage with pressure adjusted to the patient's comfort. Your fingers should not slide on the skin.

Comments:

- Rotate the patient's head to the right to treat the left side.

■ Figure 15b

- Use a similar technique for combined upper cervical traction and soft tissue mobilization of the deep segmental muscles. Grasp the patient's dorsal head. Use slightly flexed fingers to press into the patient's muscles between two vertebrae. While maintaining this pressure, lean slightly backward as far as the patient's soft tissues allow. Your fingers should not slide on the skin. Sustain the traction and muscle stretch for several seconds, then release and repeat rhythmically.

Occiput-atlas soft tissue and joint: rotation
mobilization

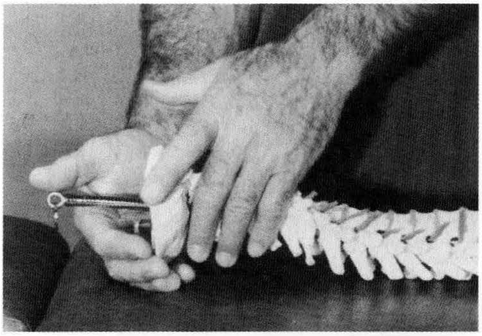


Figure 15c – skeleton

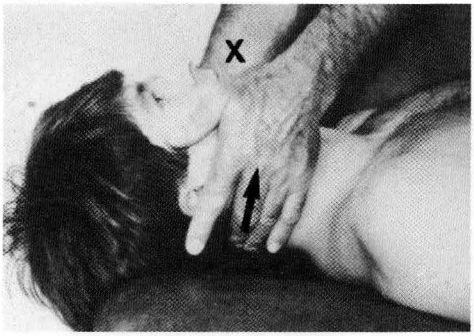


Figure 15c – relative right rotation

■ Figure 15c

Objective:

- **Mobilization:** For restricted soft tissue or joint mobility in the upper cervical region, especially in the atlanto-occipital joint.

Starting position:

- The patient lies supine.
- Stand facing the patient's left side.

Hand placement and fixation:

- **Therapist's stable hand:** With your right hand, fixate the left side of the patient's head.
- **Therapist's moving hand:** With your left hand, grasp the patient's right upper cervical soft tissues. Place your middle finger on the right arch of the patient's atlas.

Procedure:

- With your left hand, move the right side of the patient's atlas in a ventral direction, parallel to the treatment plane of the right atlanto-occipital joint, while simultaneously pressing into the muscle. Rhythmically apply and release the pressure without losing contact with the skin. There should be no movement into cervical extension during the treatment.

Comments:

- In the above example, the occiput is stabilized and the atlas is rotated to the left. This produces a relative right rotation of the occiput. The rotation component can be enhanced when coupled with slight left sidebending of the occiput.

Atlas-axis soft tissue and joint: rotation
mobilization

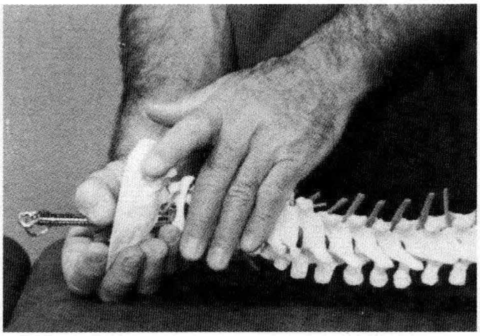


Figure 15d – skeleton

Figure 15d – relative right rotation

■ Figure 15d

Objective:

- **Mobilization:** For restricted soft tissue or joint mobility in the upper cervical region, especially restricted rotation in the atlanto-axial joint.

Starting position:

- The patient lies supine.
- Stand facing the patient's left side.

Hand placement and fixation:

- **Therapist's stable hand:** With your right hand, fixate the left side of the patient's head and atlas.
- **Therapist's moving hand:** With your left hand, grasp the soft tissue on the patient's right side. Place your middle finger on the right arch of the patient's axis.

Procedure:

- With your left hand, move the soft tissue and the right side of the patient's axis in a ventral direction, parallel to the treatment plane of the right atlanto-axial joint, while simultaneously pressing into the muscle. Rhythmically apply and release the pressure without losing contact with the skin. There should be no movement into cervical extension during the treatment.

Comments:

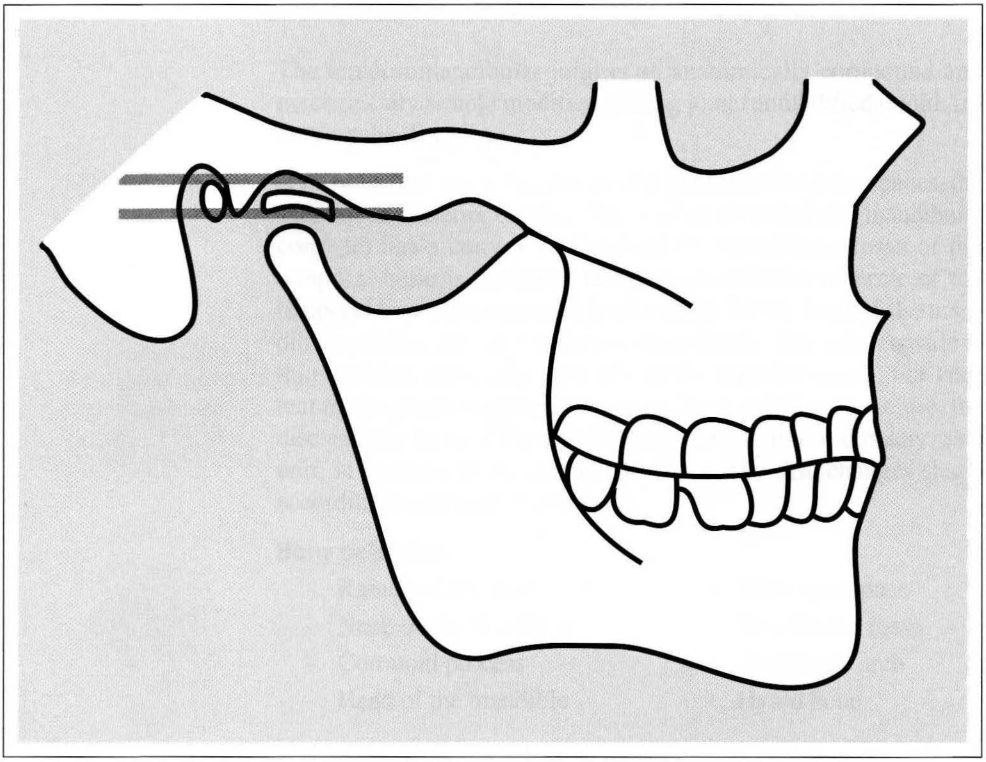
- In the above example, the occiput and atlas are stabilized and the axis is rotated to the left. This produces a relative right rotation of the atlas. The rotation component can be enhanced when coupled with slight left sidebending of the occiput.

■ Notes

Upper Cervical

CHAPTER 14

JAW



14 Jaw

■ Functional anatomy and movement

■ Temporomandibular joint

(art. temperomandibularis)

The temporomandibular joint is an anatomically compound and mechanically simple modified gliding joint (unmodified ovoid, including the disc).

A biconcave fibrous disc divides the joint into two joint spaces, the superior and inferior cavities. The head of the mandible (mandibular condyle) has a convex surface and the mandibular fossa of the temporal bone is concave. The convex articular tubercle of the temporal bone also acts as a joint partner for the head of the mandible and disc during certain jaw movements. The joint capsule is thin and lax, especially ventrally in the superior cavity, but very taut in the inferior cavity between the head and disc. Therefore, the disc and the head of the mandible move ventrally or dorsally, as a unit, in relation to the articular surfaces. The disc changes shape accordingly (convex or concave).

Bony palpation

- Ramus of the mandible
- Neck of the mandible
- Coronoid process
- Head of the mandible
- TMJ joint space
- Mandibular fossa
- Zygomatic arch
- Hyoid bone

Ligaments

- Lateral ligaments which reinforce the joint capsule

Bone movement and axes

- Mouth opening - closing: around a medial-lateral axis through the head of the mandible
- Jaw protrusion - retraction: translatoric movement without an axis
- Lateral jaw movements: around a cranial-caudal axis through the head of the mandible

End feel

- Firm

Joint movement (gliding)

- **During opening of the mouth**, both heads of the mandible simultaneously roll and glide in opposite directions (convex rule) in the inferior cavities of the temporomandibular joints; while at the same time in the superior cavity, the discs with the heads glide ventrally on the articular tubercles. When the **mouth closes** the movements are reversed.

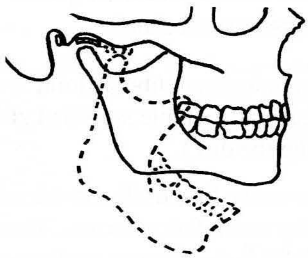


Figure 76a
Opening and closing of the jaw

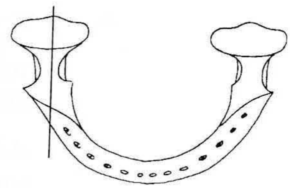


Figure 76b
Cranial-caudal axis of rotation during lateral jaw movement

- During **protraction** of the jaw, a forward gliding takes place in the superior cavity.
- During **retraction**, a dorsal gliding takes place in the superior cavity.
- During **lateral movements** of the jaw, different movements take place simultaneously in the two temporomandibular joints:

  On the side opposite to the direction of lateral gliding, the disc and mandibular head glide ventrally in the superior cavity.

  On the same side as the direction of lateral gliding, the mandibular head rotates laterally in relation to the disc in the inferior cavity, around a cranial-caudal axis (see Figure 76b).

  Example: with lateral movement to the right, rotation occurs in the right joint and ventral gliding in the left joint.

Treatment plane

- Lies on the concave surface of the mandibular fossa

Zero position:

- Mouth closed

Close-packed position

- Mouth closed

Resting position

- Mouth slightly open

■ Jaw examination scheme

Tests of function

A. Active and passive movements, including stability tests and end-feel

Elevation of the mandible	mouth closed
Depression of the mandible	mouth opened approx. 25°
Protrusion	1-2 cm
Retraction	1 cm

B. Translatoric joint play movements, including end-feel

Traction - compression		(Figure 78a)
Gliding	Ventral	(Figure 77)
	Medial	(Figure 79a)
	Lateral	(Figure 79b)

C. Resisted movements

Mouth closing	*Temporalis* *Masseter* *Medial pterygoid*
Mouth opening	*Digastric* *Lateral pterygoids* *Mylohyoid* *Geniohyoid* *Platysma* *Infrahyoid* (fixates hyoid bone during opening of the mouth)
Protrusion	*Lateral pterygoids* (origin on head and disc) *Medial pterygoids*
Retraction	*Temporales (posterior, inferior parts)* *Suprahyoids (digastrics, geniohyoids)* *Masseters* (masseters and suprahyoid muscles function only during forcible movements
Lateral movements	
To the right	*Right temporalis, left lateral pterygoid*
To the left	*Left temporalis, right lateral pterygoid*

D. Passive soft tissue movements

Physiological (muscle length, neural mobility)
Accessory (muscle play)

E. Additional tests

Trial treatment

Traction	(Figure 78b)
Ventral	(Figure 77: Objective)

■ Jaw tests and mobilizations

Mandibular head ventral glide
test and stretch mobilization

Figure 77 – test and mobilization

■ Figure 77

Objective

- **Test:** To evaluate the quantity and quality of ventral glide joint play in the TMJ, including end-feel.
- **Stretch mobilization:** For jaw protrusion and mouth opening.

Starting position

- The patient sits on a chair with a high back which supports the spine and shoulders.

Hand placement and fixation

- **Therapist's stable hand (right)**: Hold the patient's head against your body, avoiding contact with the mandible.
- **Therapist's moving hand (left):** Grip around the ramus of the patient's mandible from the posterior side.

Procedure

- **Test:** With your left hand, move the mandible in a ventral direction. Apply a Grade II or III linear movement.
- **Stretch mobilization:** Pre-position the mandibular head as far as the restriction allows. Apply a Grade III linear movement in a ventral direction.

Sequence of technique

- In cases where the patient cannot open his or her mouth, apply a bilateral TMJ Grade III caudal traction-mobilization before progressing to a ventral glide technique. Grip the rami of the mandible and apply a caudal movement to apply the bilateral traction mobilization.
- Once the patient can open his or her mouth sufficiently to allow you to insert your thumb, proceed with the techniques described in *Figures 78a and 78b.*

TMJ traction
test and stretch mobilization

Figure 78a – in sitting

Figure 78b – in lying

■ Figure 78a

Objective

- **Test:** To evaluate the quantity and quality of traction movement in the TMJ, including end-feel.
- **Stretch mobilization:** To decrease pain and increase movement in the TMJ.

Starting position

- The patient sits on a chair with a high back which supports the spine and shoulders.

Hand placement and fixation

- **Therapist's stable hand (right)**: Hold the patient's head against your body, avoiding contact with the mandible.
- **Therapist's moving hand (left):** Grip the mandible with your thumb inside the mouth over the posterior, lower molars and your fingers around the outside of the mandible.

Procedure

- **Test:** With your left hand, move the mandible in a caudal direction. Apply a Grade I, II, or III linear movement.
- **Stretch mobilization:** Pre-position the mandible in a caudal direction as far as the restriction allows. Apply a Grade III linear movement in a caudal direction.

■ Figure 78b: Alternate mobilization technique

- Adapt the same procedure with the patient lying supine.

TMJ medial and lateral glide
test and stretch mobilization

Figure 79a – medial

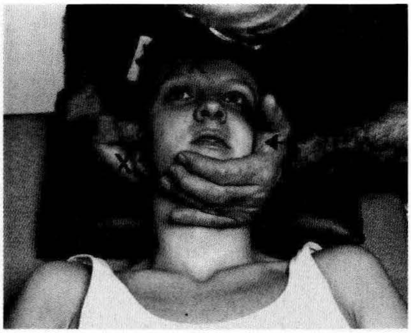


Figure 79b – lateral

■ Figure 79a

Objective

- **Test:** To evaluate the quantity and quality of medial and lateral joint play in the TMJ, including end-feel.
- **Stretch mobilization:** To increase movement in the TMJ.

Starting position

- The patient lies supine with the mouth slightly open to position the right TMJ in its resting position.

Hand placement and fixation

- **Therapist's stable hand (left)**: Hold the patient's head against your body; lean your chest against the patient's forehead and grip around the opposite side of the patient's head; palpate with your thumb in the left TM joint space.
- **Therapist's moving hand (right):** Grip the mandible with your thenar eminence just caudal to the TMJ.

Procedure

- **Test:** With your right hand, move the right mandible in a medial direction. This will also produce a lateral glide in the left TMJ which you can palpate. Apply a Grade I, II or III linear movement.
- **Stretch mobilization:** Pre-position the mandible in a medial direction as far as the restriction allows. Apply a Grade III linear movement in a medial direction.

■ Figure 79b

- Adapt the same procedure and apply a Grade I, II or III linear movement in the opposite direction. This produces a lateral glide to the right TMJ which you can palpate.

■ Notes

APPENDIX

■ Notes for entry-level MT instruction

MT evaluation and treatment techniques are based not only on knowledge of anatomy, kinesiology, and pathology, but also on knowledge of manual evaluation and treatment of joints. The ability to see and feel joint movement is important in *all* aspects of physical therapy practice, whether neurological, orthopedic, sports, cardiac, or respiratory, and should be taught as part of all basic physical therapy curricula. This is true not only for more effective treatment, but also to alert the therapist to dysfunctions requiring special protection or precautions.

Entry level practitioners should demonstrate competence in all basic mobilization and manipulation techniques in the books, *Manual Mobilization of the Joints, Volume I: The Extremities* and *Volume II: The Spine.* I wrote these books expressly for this purpose. (Other advanced texts are more appropriate for post-professional OMT training.)

Those familiar with earlier editions of these books will notice inclusion of manipulations for the first time. Low force thrust techniques utilizing a quick thrust in the joint resting position are an essential tool for the differential diagnosis and trial treatment of joint conditions. (*See Manipulation, pages 89-90.*) Such manipulative techniques should be part of the armamentarium of skills for all physical therapists, whether general practitioner or specialist.

Basic extremity joint manipulations

Low-force thrusts of all resting position "trial treatments".

Finger	fig. 1b	Toe	fig. 43b
Metacarpals	fig. 6b, 7b	Foot	fig. 50a(notes), 51a(notes), 54b
Wrist	fig. 8b	Ankle	fig. 56b
Forearm	fig. 22	Knee	fig. 64b
Elbow	fig. 24b	Hip	fig. 72a, 72b, 74a
Shoulder	fig. 28b		
Shoulder girdle	fig. 39a,b,c		

Basic spinal joint manipulations

Low-force thrusts of the resting position techniques described as "traction mobilizations for pain and hypomobility". These techniques usually appear as the first technique in each chapter. Competence in basic extremity joint manipulations is a prerequisite for training in basic spinal manipulations.

Cervical	fig. 17a,b,c	Lumbar	fig. 18a,b; 19a,b; 20, 21
Upper Cervical	fig. 7	Thoracic	fig. 12a,b; 13a,b
		Ribs	fig. 22b; 26; 27a,b

■ Reliability of segmental mobility testing

A basic premise of the OMT Kaltenborn-Evjenth Concept for spinal treatment is that it is possible to manually examine the movement between two vertebrae. However, there are continuing debates about the reliability of these specific passive movement tests. Complicating this debate are various reliability studies reporting conflicting results. This is probably due to the fact that competency in manual mobility testing varies among individuals.

It is important when conducting this type of research that the testers be competent in this method of diagnosis and treatment. In the following study, "correct" and "incorrect" determinations were based on F. Kaltenborn's findings (Instructor 1). At the time of the study in 1969, he was the most experienced instructor in the Nordic countries, had corroborated his findings over a period of many years with x-ray and film, and was generally recognized by experienced osteopaths to be competent in manual joint examination.

Abstract

Freddy Kaltenborn and Olov Lindahl, "Reproducibility of the Results of Manual Mobility Testing of Specific Intervertebral Segments," *Swedish Medical Journal (Läkartidningen)* 66:962-965, 1969

Professors Lindahl and Kaltenborn conducted a pilot study on the intertester reliability of specific manual mobility testing in the spine. Ten manual therapy instructors used specific spinal mobility testing techniques to examine 13 intervertebral segments in four patients. Of their findings, 93% were in agreement. Seven testers had 97.8% agreement. All ten testers found 6 lumbar vertebrae in the patient who had a hypermobile segment. The results of the study are summarized in following table.

Instructor	Patient 1					Patient 2		Patient 3			Patient 4				
	Occiput-Atlas Sidebending		Thoracic Sagittal Movement			Occiput-Atlas Sidebending		Thoracic Sagittal Movement			Lumbar Sagittal Movement			Correct	Incorrect
	Right	Left	6-7	7-8	8-9	Right	Left	6-7	7-8	8-9	3-4	4-5	5-6		
1	N	N	N	N	N	N	R	N	R	N	N	H	N	13	0
2	N	N	N	N	N	N	R	N	R	N	N	H	N	13	0
3	N	N	N	N	N	N	R	N	R	N	N	H	N	13	0
4	N	N	N	N	N	N	R	N	R	N	N	H	N	13	0
5	N	N	N	N	N	N	R	N	R	N	N	H	N	12	1
6	N	N	N	N	N	N	R	N	R	N	N	H	R	12	1
7	N	N	N	N	N	N	R	R	N	N	N	H	N	11	2
8	N	R	R	R	N	N	R	R	X	N	N	H	N	8	4
9	N	R	N	R	N	R	N	N	R	N	N	H	R	8	5
10	N	R	N	R	R	N	R	N	N	R	N	H	N	8	5
Correct	10	7	9	7	9	9	9	8	7	9	10	9	8		
Incorrect	0	3	1	3	1	1	1	2	2	1	0	1	2		
TOTAL														**111**	**18**

N = normal **R = hypomobile (restricted)** **1 Undecided**
H = hypermobile **X = unable to test**

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Hereford HR2 7JW
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* Out of print

■ Notes

■ Notes

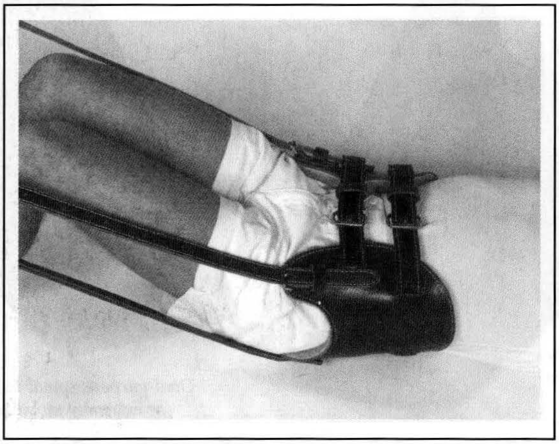
Notes

■ Notes

■ Notes

Morgan Dynamic Leather Traction Harness

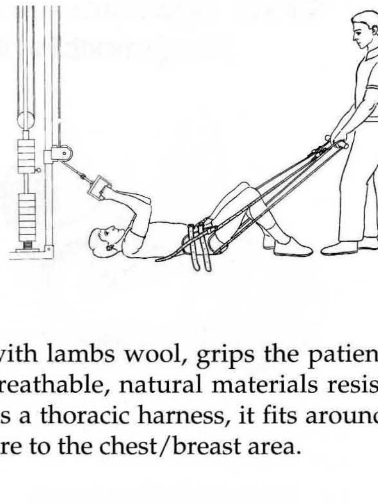
- **Leather and lambs wool comfort**
- **Handles single or double pull forces up to 300 pounds**

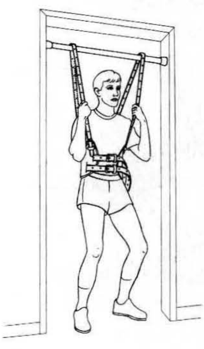


- **Heavy duty, quality construction**
- **Contours for thoracic or pelvic attachment**

Versatile

The Morgan Leather Traction Harness is really two harnesses in one. Use it for either thoracic or pelvic restraint. Its versatile construction permits a range of traction applications including traditional table traction as well as heavy traction or suspending the body. *The Morgan Harness* handles single or double pull lumbar traction in forces up to 300 pounds on patients in prone, supine, or vertical positions.





Comfortable

Contoured leather, lined with lambs wool, grips the patient comfortably and firmly. Breathable, natural materials resist soiling and perspiration. As a thoracic harness, it fits around the rib cage without pressure to the chest/breast area.

Strong

The Morgan Traction Harness is handcrafted of leather by saddle-makers to provide years of service in heavy clinical use.

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Errata

Following are errata and additions to *Manual Mobilization of the Joints, Vol II - The Spine.*

Changes and additions are <u>underlined</u>.

Chapter 8, Techniques, page 121:

"Test and mobilization" indicates that the technique can be used for testing joint play <u>(Grade II-III)</u>, for traction pain-relief mobilization in the resting position (Grade I and IISZ), for relaxation (Grade I through IITZ), and also for stretch-traction mobilizations (Grade III). Both test and mobilization procedures usually use the *same grip*.

Chapter 8, Techniques, page 121:

"Test and stretch mobilization" indicates that the technique is recommended both for testing joint play <u>(Grade II-III)</u> and for stretch-mobilizations (Grade III) with manual fixation. Both test and mobilization procedures usually use the *same grip*.

Chapter 9, Pelvis, Bone and joint movement, page 132:

The sacroiliac joint is an amphiarthrosis with very little movement (perhaps only 1° or 2°) and its joint surfaces are characterized by elevations and depressions that make it difficult to determine which joint partner is convex and which is concave. Therefore, for practical purposes we use a conceptual model of a circle <u>passing through the sacroiliac joints</u> (Figure P-3). We consider the sacrum the convex joint partner between the two concave innominates which moves around multiple axes, as follows:

Chapter 9, Pelvis, page 132/133:

Movement around the **sagittal axis** occurs mainly at the lower pole of the sacrum and is called **lateral flexion** to the right and left. During lateral flexion to the right, the right <u>side</u> of the sacrum (point 3 in Figure P-4) moves caudally, and the left <u>side</u> (point 2 in Figure P-4) moves cranially. (The coccyx moves to the left.)

Chapter 9, Pelvis, Figure 10, page 144:

Objective:

Stretch mobilization: For restricted ventral movement of the sacrum or repositioning of a <u>right</u>-rotated sacral positional fault.

Chapter 9, Pelvis, Figure 11, page 145:

Procedure:

Test: Press <u>caudally</u> with your <u>left</u> arm. Apply a Grade I, II or III mov ɜment. Compare findings with those obtained using the test described in Figure 12.

Chapter 10, Lumbar Spine, Fig. 2, page 159:

The picture in the book
should show extension: