

A survey of patient's attitude toward low back surgery in a major center in Saudi Arabia

Yaser M. Behairy, MD, FRCSC, Hayazi Al-Shehri, MD, Saleh A. Al-Azzam, MD, FRCSC, Adnan G. Al-Zahrani, MD, JBOS.

ABSTRACT

Objective: Similar to any other invasive procedure, low back surgery has potential complications. These potential complications lead many patients to refuse the surgery when it is indicated. The aim of this study was to evaluate patient's attitude toward low back surgery and identify factors that might influence their decision.

Methods: Seventy consecutive patients who attended the outpatient clinic of the King Fahad National Guard Hospital Riyadh, Kingdom of Saudi Arabia, between May 2002 and July 2002, due to chronic low back problems and who were surgical candidates were included in this study. The low back outcome score (LBOS) was used to assess these patients. The proposed surgical procedure was explained to each patient and the family and the potential complications were discussed. The patient's response to the proposed surgery was assessed. Mantel-Haenszel Chi-square test was used for statistical analysis.

Results: A total of 70 patients were included in this study. Thirty-eight were females and 32 were males. The average duration of symptoms was 3.3 years (range 0.5-20). Of the whole group of 70 patients, 31 (44%) agreed to surgery. The remaining 39 (56%) refused surgery for various reasons. There was no statistically significant difference in the demographic data or the LBOS between the 2 groups.

Conclusion: There is a relatively high refusal rate (56%) for low back surgery in the group studied. No specific influencing factor could be identified in this group. Pain and disability as measured by the LBOS does not seem to be a factor. Patient's education on the disease process and the contemplated surgery are crucial in helping them to make an informed and reasonable decision.

Saudi Med J 2003; Vol. 24 (6): 594-597

Low back pain is a common problem. It is estimated that 8 out of 10 people will suffer from low back pain at some stage during their life. It is a major cause for disability and impairment in the adult age group.¹ Even though most episodes of low back pain are self-limiting, in some patients the pain becomes chronic and interferes with activities of daily living. There are 2 main types of back pain. Mechanical pain usually results from inflammation caused by irritation or injury to the part of the axial skeleton such as the disks, facet joints, ligaments, or muscles of the back. This type of pain is usually located in the lower part of the spine and may

involve the buttock and thighs areas. The other type of pain is the neurogenic type of pain, which occurs when the spinal nerve roots are irritated or pinched such as in herniated disks or spinal stenosis. Neurogenic pain usually extends below the knee to the foot and can be associated with numbness.^{2,3} Treatment of low back problems usually starts with conservative measures such as physiotherapy, general conditioning, exercise, medications and other non-operative methods. Surgical treatment is only necessary in a small number of patients who fail conservative treatment. There is no one surgical procedure that is appropriate for all low back problems.

From the Department of Surgery, King Fahad National Guard Hospital, Riyadh, Kingdom of Saudi Arabia.

Received 23rd December 2002. Accepted for publication in final form 15th March 2003.

Address correspondence and reprint request to: Dr. Yaser Behairy, PO Box 53118, Riyadh 11583, Kingdom of Saudi Arabia. Tel. +966 (1) 2520088 Ext. 4119. Fax. +966 (1) 2520088 Ext. 4138. E-mail: ybehairy@yahoo.com

Commonly used procedures include discectomy, decompression, fusion, instrumentation or a combination of them.⁴ Careful patient selection is essential for successful low back surgery. The diagnosis should be clear and the particular pathology must be accurately identified. The patient must give a clear and consistent history and the clinical examination must correlate with the history. Investigations must confirm the diagnosis. Other detrimental factors such as psychosocial issues must be clearly identified and controlled before surgery is contemplated. Evidence suggests that presurgical psychosocial factors may be important modifiers of back pain reporting and back surgery outcome.⁵⁻⁸ Patient expectations must be assessed and a realistic goal and expected outcome must be clear to both the patient and the treating surgeon. Similar to any other invasive procedure, low back surgery has potential complications.⁹ General complications include the risk of anesthesia, bleeding, and infection. Specific complications depend on the particular procedure and may include neurological injury, dural laceration, iatrogenic instability, and hardware related problems. In some degenerative conditions, the surgery is aimed at reducing rather than eliminating the symptoms. In other instances, the disease process might evolve later on to affect levels other than the operated one, thus accounting for recurrence of the low back pain. Paralysis is probably the most feared complication after low back surgery. When compound with misunderstanding or misinformation, these potential complications lead many patients to become reluctant to undergo low back surgery, thus depriving themselves from a chance for major improvement in their symptoms when surgical treatment is known to give better results.¹⁰ The aim of this study was to evaluate patient's attitude toward having low back surgery and identify factors that might influence their decision.

Methods. From the practice of a single consultant orthopedic surgeon with interest in spinal surgery and low back problems (Behairy), a total of 210 patients with chronic low back problems attended the outpatient clinic of the King Fahad National Guard Hospital, Riyadh, Kingdom of Saudi Arabia, between May 2002 and July 2002. Seventy (33%) of these patients were surgical candidates are included in this study. To be a surgical candidate, the patient must have a clear and consistent symptoms. The clinical examination must correlate with the symptoms, and radiological investigations must confirm the pathology. Furthermore, the patient must have had an adequate trial of nonsurgical treatment including the appropriate use of physiotherapy modalities, painkillers, and nonsteroidal anti-inflammatory medications for a minimum of 6 weeks. They must have a stable mental and psychosocial environment based on the absence of any mental or psychological problems in their past or present history. They must also be fit for general anesthesia. Each patient underwent a structured interview by the treating surgeon

(Behairy). The low back outcome score (LBOS) was used to assess these patients.¹¹ The LBOS features measures of functional disability and "passive" activities such as analgesic use. Analgesic use provides a measure of patient's response to pain as recorded on the visual analog scale, and also gives a measure of how the severity of the pain is perceived by the patient in terms of need for treatment.¹² In addition to the visual analog scale, the score assesses working status, ability to undertake household chores, sports or active pursuits, need for rest, frequency of medical consultation due to LBP, and other activities such as sex life, sleeping, walking, traveling, and dressing. Overall scores can vary from 0 (very disabled) to 75 (not at all disabled). Patients are placed in one of 4 outcome categories depending on their overall scores: ≥ 65 (excellent), ≥ 50 (good), ≥ 30 (fair), and < 30 (poor). The LBOS emphasizes objective questions and has been shown to have a good internal consistency and test-retest reliability for use in clinical practice.¹³ It was developed as a quick, practical paper and pencil method of measuring outcome in patients with lumbar spine disorders. The proposed surgical procedure is explained to each patient and the family in layman terms and the potential complications are discussed. The patient's response to the proposed surgery was assessed. For those who refuse surgery, the patients were asked to express the reason for refusal from their own words. Patients who refused surgery were contacted 3 months later to find out if they had surgery somewhere else.

Results. A total of 70 patients were included in this study. Thirty-eight were females and 32 were males. Their average age was 47 years (range 12-70). Their average weight was 74 kilograms (range 50-100), and average height was 167 centimeters (range 140-180). There were 27 housewives, 12 soldiers, 10 teachers, 8 retired, 5 employees, 4 workers, 2 students, and 2 unemployed. All 70 patients (100%) had help available at home. The main diagnosis included spinal stenosis in 35 (50%) patients, herniated disk in 16 (23%), spondylolisthesis in 14 (20%), and degenerative spondylosis in 5 (7%). The average duration of symptoms was 3.3 years (range 0.5-20). Co-morbid conditions existed in 24 (34%) patients. These included hypertension in 18, diabetes in 15, and asthma in one patient. Four patients had previous surgery for their low back pain, 3 discectomies and one laminectomy. All 70 patients had a trial of conservative treatment for a minimum of 6 weeks. The type of surgery offered was discectomy in 16 patients, laminectomy in 27, instrumented fusion in 4, and decompression plus instrumented fusion in 33 patients. Of the whole group of 70 patients, 31 (44%) agreed to surgery. The remaining 39 (56%) patients refused surgery for various reasons. Those included fear of failed surgery in 22 (31%) patients, the thought that low back surgery is too dangerous in 14 (20%), fear of paralysis in 12 (17%), symptoms not bad enough in 10 (14%), and the thought

Table 1 - Demographic values.

Characteristics	All patients N=70	Agreeing N=31	Refusing N=39
Average age (years)	47	46	50
Male to female ratio	32:38	18:3	15:24
Average height (cm)	167	160	166
Average weight (kg)	74	74	73
Prevalence co-morbidity (%)	24 (34)	9 (29)	15 (38)
Average duration of symptoms (years)	3.26	2.7	3.6

Table 2 - Average values for the low back outcome score.

Average patient attribute	All patients N=70	Agreeing N=31	Refusing N=39
Pain score (0-9)	3	2.7	3.1
Work status score (0-9)	3.5	3.2	3.7
Household chores score (0-9)	3.7	3.8	3.7
Active pursuit score (0-9)	3.6	3.3	4.1
Need for rest score (0-6)	2.8	2.6	2.9
Frequency of medical consultations score (0-6)	2.2	1.9	2.4
Need for painkillers score (0-6)	2.3	1.9	2.7
Sex life score (0-6)	2.9	2.5	3.2
Sleeping score (0-3)	2.5	2.6	2.4
Walking score (0-3)	1.4	1.4	1.5
Traveling score (0-3)	2	1.9	2.1
Dressing score (0-3)	2.7	2.8	2.6
Total low back outcome score (0-75)	33	31	35

that they were too old for surgery in 6 (9%). Eighteen patients gave more than one reason for refusing the surgery. None of the 4 patients who refused due to the fear of failed surgery had low back surgery before. The patients who refused surgery tended to have a slightly higher value on the LBOS, there was no significant difference in the demographic data or the LBOS between the 2 groups (Tables 1 & 2). Eighteen of the patients who agreed to have surgery had a fair LBOS and 13 had a poor score. For the refusing patients, 4 had a good score, 22 had a fair score and 13 had a poor score. The group of patients who refused surgery was contacted 3 months after the initial interview and none of them has had surgery or changed their mind on the surgery. Mantel-Haenszel Chi-square test result was not statistically significant ($p=0.9983$), thus indicating that LBOS was not correlated with agreement for surgery.

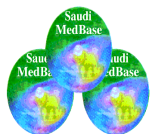
Discussion. Low back pain and the resultant disability can be acute in some conditions such as acute disk prolapse, Cauda Equina syndrome, some tumors and infections. In the majority of patients, however, especially those with degenerative problems, the onset and progression of symptoms is slow and may take years to evolve.¹⁴ The life style of most middle-aged Saudi people is a sedentary life style. Sports and active pursuits are not popular in this age group. In addition to that, social and economic factors led to the availability of immediate help at home in the form of family members or hired domestic helper. These factors, when combined with the slow and chronic nature of most low back afflictions, lead many patients to accept their symptoms and physical limitation as part of the natural aging process. Lack of knowledge and misunderstanding of the disease and the treatment options as well as misinformation on spinal surgery and the possible complications may lead patients to become reluctant to undergo surgical treatment for their conditions when they need it. With careful patient selection, low back surgery has been shown to diminish pain and decrease disability more efficiently than commonly used nonsurgical treatment.^{4,8,15-19} Modern spinal surgery is safe, effective and carries a risk rate comparable to other surgical disciplines. Valen and Rolfser²⁰ followed 350 patients who underwent low back surgery for 2-16 years, they found that the complications rate was 9.7%, most complications were not serious, and there was no mortality related to the surgery. While it is quite possible that other factors such as the specific institute and the specific surgeon might influence the patient's decision to undergo low back surgery, our study still showed a high refusal rate (56%) for low back surgery among local patients. No specific influencing factor could be identified in our study group. Pain and disability as measured by the LBOS does not seem to be a factor. Patient's education on the disease process and the contemplated surgery are crucial in helping them to make an informed and reasonable decision.

References

1. Million R, Hall W, Nilsen KH, Baker RD, Jayson MI. Assessment of the back pain progress. *Spine* 1982; 7: 204-212.
2. Waddell G. An approach to backache. *Br J Hosp Med* 1982; 28: 187-219.
3. Bogduk N. The sources of low back pain. In: Jayson M, editor. Edinburgh (UK): Churchill Livingstone; 1992. p. 61-80.
4. Fritzell P, Hagg O, Wessberg P, Nordwall A. 2001 Volvo Award Winner in Clinical Studies: Lumbar fusion versus nonsurgical treatment for chronic low back pain: a multicenter randomized controlled trial from the Swedish Lumbar Spine Study Group. *Spine* 2001; 26: 2521-2532.
5. DeBerard MS, Masters KS, Colledge AL, Schleusener RL, Schlegel JD. Outcome of posterolateral lumbar fusion in Utah patients receiving workers' compensation: a retrospective cohort study. *Spine* 2001; 26: 738-746.
6. Taylor VM, Deyo RA, Ciol M, Farrar EL, Lawrence MS, Shonnard NH et al. Patient-oriented outcome from low back surgery: a community-based study. *Spine* 2000; 25: 2445-2452.
7. Kjellby-Wandt G, Styf JR, Carlsson SG. The predictive value of psychometric analysis in patients treated by extirpation of lumbar intervertebral disc herniation. *J Spinal Disord* 1999; 12: 375-379.
8. Nork SE, Hu SS, Workman KL, Glazer PA, Bradford DS. Patient outcome after decompression and instrumented posterior spinal fusion for degenerative spondylolisthesis. *Spine* 1999; 24: 561-569.
9. Franklin GM, Haug J, Heyer NJ, McKeefrey SP, Picciano JF. Outcome of lumbar fusion in Washington State workers' compensation. *Spine* 1994; 19: 1897-1903.
10. Atlas SJ, Keller RB, Robson D, Deyo RA, Singer DE. Surgical and nonsurgical management of lumbar spinal stenosis: four-year outcomes from maine lumbar spine study. *Spine* 2000; 25: 556-562.
11. Greenough CG, Fraser RD. Assessment of outcome in patients with low back pain. *Spine* 1992; 17: 36-41.
12. Zanoli G, Srtomqvist B, Jonsson B. Visual analog scales for interpretation of back and leg pain intensity in patients operated for degenerative lumbar spine disorders. *Spine* 2001; 26: 2375-2380.
13. Holt AE, Shaw NJ, Shetty A, Greenough CG. The Reliability of the Low Back Outcome Score for Back Pain. *Spine* 2002; 27: 206-210.
14. Carey TS, Garrett JM, Jackman AM. Beyond the good prognosis. Examination of an inception cohort of patients with chronic low back pain. *Spine* 2000; 25: 115-120.
15. Slosar PJ, Reynolds JB, Schofferman J, Goldthwaite N, White AH, Keany D. Patient satisfaction after circumferential lumbar fusion. *Spine* 2000; 25: 7222-7226.
16. Javid MJ, Harded EJ. Long-term follow-up review of patients who underwent laminectomy for lumbar stenosis: a prospective study. *J Neurosurg* 1998; 89: 1-7.
17. Parker LM, Murrell SE, Boden SD, Horton WC. The outcome of posterolateral fusion in highly selected patients with discogenic low back pain. *Spine* 1996; 21: 1909-1920.
18. Atlas SJ, Deyo RA, Keller RB, Chapin AM, Atrick DL, Long JM et al. The Maine Lumbar Study, Part III. 1-year outcomes of surgical and nonsurgical management of lumbar spinal stenosis. *Spine* 1996; 21: 1787-1794.
19. Atlas SJ, Deyo RA, Keller RB, Chapin AM, Atrick DL, Long JM et al. The Maine Lumbar Study, Part II. 1-year outcomes of surgical and nonsurgical management of lumbar sciatica. *Spine* 1996; 21: 1777-1786.
20. Valen B, Rolfsen LC. [Quality assurance of back surgery. A follow-up of 350 patients treated for sciatica by means of survival analysis]. *Tidsskr Nor Laegeforen* 1998; 118: 213-219.

Related Abstract

Source: Saudi MedBase



Saudi MedBase CD-ROM contains all medical literature published in all medical journals in the Kingdom of Saudi Arabia. This is an electronic format with a massive database file containing useful medical facts that can be used for reference. Saudi Medbase is a prime selection of abstracts that are useful in clinical practice and in writing papers for publication.

Search Word: low back

Author: D. LeBlond
Institute: King Fahad National Guard Hospital, Riyadh, Kingdom of Saudi Arabia
Title: Lumbar pain secondary to enthesopathies at the spinous process: A new concept in the diagnosis and treatment of back pain
Source: NeuroSciences 1999; 4: 106-110

Abstract

Despite the advances over the 20-30 years in imaging technologies and the advent of various techniques for the assessment and rehabilitation of low back pain (LBP), it remains that more than 85% of all individuals presenting with this symptom are labeled with non-specific low back pain (NSLBP). Once the diagnoses of radiculopathy, infection, tumor and spondyloarthropathies are ruled out and the patient is said to have NSLBP, one can no longer equate radiological abnormalities to the underlying pathophysiologic pain generator. Although most clinicians are now well equipped to recognize the 'red flags' of acute LBP, we continue to serve poorly the patients labeled with acute, sub-acute and chronic NSLBP. This article will present a new concept in the assessment and treatment of patients with low back pain.

Revised Appendix

Appendix 1.

Modified Low Back Pain Disability Questionnaire^a

This questionnaire has been designed to give your therapist information as to how your back pain has affected your ability to manage in everyday life. Please answer every question by placing a mark in the **one** box that best describes your condition today. We realize you may feel that 2 of the statements may describe your condition, but **please mark only the box that most closely describes your current condition.**

Pain Intensity

- ☐ I can tolerate the pain I have without having to use pain medication.
- ☐ The pain is bad, but I can manage without having to take pain medication.
- ☐ Pain medication provides me with complete relief from pain.
- ☐ Pain medication provides me with moderate relief from pain.
- ☐ Pain medication provides me with little relief from pain.
- ☐ Pain medication provides has no effect on my pain.

Personal Care (eg, Washing, Dressing)

- ☐ I can take care of myself normally without causing increased pain.
- ☐ I can take care of myself normally, but it increases my pain.
- ☐ It is painful to take care of myself, and I am slow and careful.
- ☐ I need help, but I am able to manage most of my personal care.
- ☐ I need help everyday in most aspects of my care.
- ☐ I do not get dressed, wash with difficulty, and stay in bed.

Lifting

- ☐ I can lift heavy weights without increased pain.
- ☐ I can lift heavy weights, but it causes increased pain.
- ☐ Pain prevents me from lifting heavy weights off the floor, but I can manage if the weights are conveniently positioned (eg, on a table).
- ☐ Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned.
- ☐ I can lift only very light weights.
- ☐ I cannot lift or carry anything at all.

Walking

- ☐ Pain does not prevent me from walking any distance.
- ☐ Pain prevents me from walking more than 1 mile.^b
- ☐ Pain prevents me from walking more than ½ mile.
- ☐ Pain prevents me from walking more than ¼ mile.
- ☐ I can only walk with crutches or a cane.
- ☐ I am in bed most of the time and have to crawl to the toilet.

Sitting

- ☐ I can sit in any chair as long as I like.
- ☐ I can only sit in my favorite chair as long as I like.
- ☐ Pain prevents me from sitting for more than 1 hour.
- ☐ Pain prevents me from sitting for more than ½ hour.
- ☐ Pain prevents me from sitting for more than 10 minutes.
- ☐ Pain prevents me from sitting at all.

Standing

- ☐ I can stand as long as I want without increased pain.
- ☐ I can stand as long as I want, but it increases my pain.
- ☐ Pain prevents me from standing more than 1 hour.
- ☐ Pain prevents me from standing more than ½ hour.
- ☐ Pain prevents me from standing more than 10 minutes.
- ☐ Pain prevents me from standing at all.

Sleeping

- ☐ Pain does not prevent me from sleeping well.
- ☐ I can sleep well only by using pain medication.
- ☐ Even when I take pain medication, I sleep less than 6 hours.
- ☐ Even when I take pain medication, I sleep less than 4 hours.
- ☐ Even when I take pain medication, I sleep less than 2 hours.
- ☐ Pain prevents me from sleeping at all.

Social Life

- ☐ My social life is normal and does not increase my pain.
- ☐ My social life is normal, but it increases my level of pain.
- ☐ Pain prevents me from participating in more energetic activities (eg, sports dancing).
- ☐ Pain prevents me from going out very often.
- ☐ Pain has restricted my social life to my home.
- ☐ I have hardly any social life because of my pain.

Traveling

- ☐ I can travel anywhere without increased pain.
- ☐ I can travel anywhere, but it increases my pain.
- ☐ My pain restricts my travel over 2 hours.
- ☐ My pain restricts my travel over 1 hour.
- ☐ My pain restricts my travel to short necessary journeys under ½ hour.
- ☐ My pain prevents all travel except for visits to the physician/therapist or hospital.

Employment/Homemaking

- ☐ My normal homemaking/job activities do not cause pain.
- ☐ My normal homemaking/job activities increase my pain, but I can still perform all that is required of me.
- ☐ I can perform most of my homemaking/job duties, but pain prevents me from performing more physically stressful activities (eg, lifting, vacuuming).
- ☐ Pain prevents me from doing anything but light duties.
- ☐ Pain prevents me from doing even light duties.
- ☐ Pain prevents me from performing any job or homemaking chores.

^a© 2001 and 2007 American Physical Therapy Association.

^b 1 mile=1.6 km.

ICF CORE SETS FOR LOW BACK PAIN

Alarcos Cieza,¹ Gerold Stucki,^{1,2} Martin Weigl,² Peter Disler,³ Wilfried Jäckel,⁴ Sjef van der Linden,⁵ Nenad Kostanjsek⁶ and Rob de Bie⁷

From the ¹ICF Research Branch, WHO FIC Collaborating Center (DIMDI), IMBK, Ludwig-Maximilians-University, Munich, Germany, ²Department of Physical Medicine and Rehabilitation, Ludwig-Maximilians-University, Munich, Germany, ³Victorian Rehabilitation Research Institute, University of Melbourne and Royal Melbourne Hospital, Melbourne, Australia, ⁴Department of Quality Management and Social Medicine, University of Freiburg, Germany, ⁵Department of Internal Medicine, Division of Rheumatology, University Hospital, Maastricht, The Netherlands, ⁶Classification, Assessment, Surveys and Terminology Team, World Health Organization, Geneva, Switzerland and ⁷Department of Epidemiology, Maastricht University, Maastricht, The Netherlands

Objective: To report on the results of the consensus process integrating evidence from preliminary studies to develop the first version of a Comprehensive ICF Core Set and a Brief ICF Core Set for low back pain.

Methods: A formal decision-making and consensus process integrating evidence gathered from preliminary studies was followed. Preliminary studies included a Delphi exercise, a systematic review and an empirical data collection. After training in the ICF and based on these preliminary studies, relevant ICF categories were identified in a formal consensus process by international experts from different backgrounds.

Results: The preliminary studies identified a set of 503 ICF categories at the second, third and fourth ICF levels with 211 categories on *body functions*, 47 on *body structures*, 190 on *activities and participation* and 55 on *environmental factors*. Eighteen experts from 15 different countries attended the consensus conference on low back pain. Altogether 78 second-level categories were included in the Comprehensive ICF Core Set with 19 categories from the component *body functions*, 5 from *body structures*, 29 from *activities and participation* and 25 from *environmental factors*. The Brief ICF Core Set included a total of 35 second-level categories with 10 on *body functions*, 3 on *body structures*, 12 on *activities and participation* and 10 on *environmental factors*.

Conclusion: A formal consensus process integrating evidence and expert opinion based on the ICF framework and classification led to the definition of ICF Core Sets for low back pain. Both the Comprehensive ICF Core Set and the Brief ICF Core Set were defined.

Key words: low back pain, outcome assessment, quality of life, ICF.

J Rehabil Med 2004; suppl. 44: 69–74

Correspondence address: Gerold Stucki, Department of Physical Medicine and Rehabilitation, University of Munich, Marchioninstr. 15, DE-81377 Munich, Germany. Tel: +49 89 7095 4050. Fax: +49 89 7095 8836. E-mail: gerold.stucki@med.uni-muenchen.de

INTRODUCTION

Low back pain (LBP) has reached epidemic proportions, being reported by about 80% of the population people at some time in their lives (1). Seventy-five percent of people with LBP are between 30 and 59 years of age, i.e. in their most productive years (2). While not a disease, LBP is a major cause of disability (3). The symptoms of LBP and the associated disability bear only a poor relationship to objective data, such as the imaging evidence of degenerative disease of the spine. Therefore, many efforts have been made to try to identify meaningful outcome measures (2).

Condition-specific instruments, such as the North American Spine Society Lumbar Spine Outcome Assessment Instrument (NASS) (4), the Roland-Morris Disability Questionnaire (RMQ) (5) and the Oswestry Low Back Disability Questionnaire (ODI) (6), generic instruments, such as the Medical Outcome Study Short Form 36 (SF-36) (7) and the Nottingham Health Profile (NHP) (8) and pain specific instruments and other dimension specific instruments including scales to address depression, sleep and fatigue have been used in clinical studies to address functioning, disability and health of patients with LBP. However, there is little standardization of the use of these instruments, and comparisons among studies are difficult or impossible (9). Therefore, different recommendations have been proposed recently regarding the outcome measures to be used in studies with patients with LBP.

Deyo et al. (9) as well as Bombardier (10) considered that a Core Set of measures should include the following dimensions: symptoms, function, general well-being, work disability and satisfaction with care. Deyo et al. recommended the use of a 6-item standardized Core Set of questions to be used in all studies for back pain. Additionally, they suggested the use of this set together with an expanded, more precise battery of measures including the RMQ or the ODI, and the SF-12 (11) or the European Quality of Life instrument (EQ-5D) (12) when greater precision in measurement is desirable. Bombardier, on her part, proposes different specific instruments for some of the domains.

The WHO Low Back Pain Initiative recommends the assessment of pain, function, depression, somatic and autonomic perception, and spinal mobility based on a visual analogue pain

scale, the OID, the Modified Zung Index, the Modified Somatic Perception Questionnaire (MSPQ) (13) and the Modified Schrober's Test for Spinal Mobility, respectively (14).

Guided apparently by practical considerations rather than a theoretical framework, both recommendations vary considerably regarding the domains to be considered and the recommended instruments. It would, thus, be valuable for teaching, clinical practice and research to define what should be measured to comprehensively represent the experience of patients based on an extensive framework that can serve as a universal language understood by health professionals, researchers, policymakers, patients and patient organizations alike.

With the approval of the new International Classification of Functioning, Disability and Health (ICF, formerly ICIDH-2 <http://www.who.int/classification/icf>) (15) we can now rely on a globally agreed framework and classification to define the typical spectrum of problems in functioning of patients with LBP. For practical purposes and in line with the concept of condition-specific health status measures it would thus seem most helpful to link specific conditions or diseases to salient ICF categories of functioning (16). Such generally-agreed-on lists of ICF categories can serve as Brief ICF Core Set to be rated in all patients included in a clinical study with LBP or as Comprehensive ICF Core Set to guide multidisciplinary assessments in patients with LBP. The objective of this paper is to report on the results of the consensus process integrating evidence from preliminary studies to develop the first version of the ICF Core Sets for LBP, the Comprehensive ICF Core Set and the Brief ICF Core Set.

METHODS

The development of the ICF Core Sets for LBP involved a formal decision-making and consensus process integrating evidence gathered from preliminary studies including a Delphi exercise (17), a systematic review (18) and an empirical data collection, using the ICF checklist (19). After training in the ICF and based on these preliminary studies relevant ICF categories were identified in a formal consensus process by international experts from different backgrounds.

Eighteen experts (14 with various physicians sub-specializations, 3 occupational therapists and 1 physical therapist) from 15 different countries attended the consensus process for LBP. The decision-making process for LBP involved 3 working groups, with 6 experts, respectively. The process was facilitated by the condition co-ordinator for LBP (RB) and the 3 working-group leaders (PD, WJ and SL).

The tables on the preliminary studies presented to the participants included 503 ICF categories at the second, third, and fourth levels (211 *body functions*, 47 *body structures*, 190 *activities and participation*, 55 *environmental factors*).

RESULTS

Tables I–IV show the second-level ICF categories included in the Comprehensive ICF Core Set. Table V shows the second-level ICF categories included in the Brief ICF Core Set, as well as the rank order by component allotted to the selected ICF categories. The total number of categories in the Comprehensive ICF Core Set is 79, and the total number of categories included in the Brief ICF Core Set is 35. No categories at the third and

Table I. *International Classification of Functioning, Disability and Health (ICF) – categories of the component “body functions” included in the Comprehensive ICF Core Set for low back pain*

ICF code	ICF category title
b126	Temperament and personality functions
b130	Energy and drive functions
b134	Sleep functions
b152	Emotional functions
b180	Experience of self and time functions
b260	Proprioceptive function
b280	Sensation of pain
b455	Exercise tolerance functions
b620	Urination functions
b640	Sexual functions
b710	Mobility of joint functions
b715	Stability of joint functions
b720	Mobility of bone functions
b730	Muscle power functions
b735	Muscle tone functions
b740	Muscle endurance functions
b750	Motor reflex functions
b770	Gait pattern functions
b780	Sensations related to muscles and movement functions

fourth levels were included in the Comprehensive ICF Core Set or in the Brief ICF Core Set.

The 78 categories of the Comprehensive ICF Core Set consist of 19 (24%) categories from the component *body functions*, 5 (6%) from the component *body structures*, 29 (37%) from the component *activities and participation* and 25 (33%) from the component *environmental factors*.

The 19 categories of the component *body functions* represent 13% of the total number of ICF categories at the second level in this component. Most of the *body-functions* categories belong to chapter 7 *neuromusculoskeletal and movement-related functions* (9 categories). Chapter 1 *mental functions* is represented by 5 categories, chapter 2 *sensory functions and pain* as well as chapter 6 *genitourinary and reproductive functions* by 2 categories, and chapter 4 *functions of the cardiovascular, haematological, immunological and respiratory systems* by one category.

The 5 categories of the component *body structures* represent 9% of the total number of ICF categories at the second level in this component. Four *body-structures* categories belong to chapter 7 *structures related to movement* and one to chapter 1 *structures of the nervous system*.

The 29 categories of the component *activities and participation* represent 25% of the total number of ICF categories

Table II. *International Classification of Functioning, Disability and Health (ICF) – categories of the component “body structures” included in the Comprehensive ICF Core Set for low back pain*

ICF code	ICF category title
s120	Spinal cord and related structures
s740	Structure of pelvic region
s750	Structure of lower extremity
s760	Structure of trunk
s770	Additional musculoskeletal structures related to movement

Table III. *International Classification of Functioning, Disability and Health (ICF) – categories of the component “activities and participation” included in the Comprehensive ICF Core Set for low back pain*

ICF code	ICF category title
d240	Handling stress and other psychological demands
d410	Changing basic body position
d415	Maintaining a body position
d420	Transferring oneself
d430	Lifting and carrying objects
d445	Hand and arm use
d450	Walking
d455	Moving around
d460	Moving around in different locations
d465	Moving around using equipment
d470	Using transportation
d475	Driving
d510	Washing oneself
d530	Toileting
d540	Dressing
d570	Looking after one's health
d620	Acquisition of goods and services
d630	Preparing meals
d640	Doing housework
d650	Caring for household objects
d660	Assisting others
d710	Basic interpersonal interactions
d760	Family relationships
d770	Intimate relationships
d845	Acquiring, keeping and terminating a job
d850	Remunerative employment
d859	Work and employment, other specified and unspecified
d910	Community life
d920	Recreation and leisure

at the second level in this component. Most of the *activities and participation* categories belong to chapter 4 *mobility* (11 categories). Chapter 6 *domestic life* is represented by 5 categories, chapter 5 *self care* by 4 categories, chapter 7 *interpersonal interactions and relationships* as well as chapter 8 *major life areas* by 3 categories, chapter 9 *community, social and civic life* by 2 categories and chapter 2 *general tasks and demands* by one category.

The 26 categories of the component *environmental factors* represent 35% of the total number of ICF categories at the second level in this component. Most of the *environmental-factors* categories belong to chapter 5 *services, systems and policies* (8 categories). However, all 5 chapters of this component are represented in the Comprehensive ICF Core Set. Chapter 4 *attitudes* is represented by 6 categories, chapter 1 *products and technology* as well as chapter 3 *support and relationships* by 5 categories, and chapter 2 *natural environment and human-made changes to the environment* by 2 categories.

With respect to the Comprehensive ICF Core Set, the Brief ICF Core Set includes 10 (53%) categories from the component *body functions*, 3 (60%) from *body structures*, 12 (41%) from *activities and participation* and 10 (38%) from *environmental factors*.

The 10 categories of the component *body functions* represent 7%, the 3 categories of the component *body structures* 5%, the 12 categories of the component *activities and participation* 10%

Table IV. *International Classification of Functioning, Disability and Health (ICF) – categories of the component “environmental factors” included in the Comprehensive ICF Core Set for low back pain*

ICF code	ICF category title
e110	Products or substances for personal consumption
e120	Products and technology for personal indoor and outdoor mobility and transportation
e135	Products and technology for employment
e150	Design, construction and building products and technology of buildings for public use
e155	Design, construction and building products and technology of buildings for private use
e225	Climate
e255	Vibration
e310	Immediate family
e325	Acquaintances, peers, colleagues, neighbours and community members
e330	People in positions of authority
e355	Health professionals
e360	Other professionals
e410	Individual attitudes of immediate family members
e425	Individual attitudes of acquaintances, peers, colleagues, neighbours and community members
e450	Individual attitudes of health professionals
e455	Individual attitudes of other professionals
e460	Societal attitudes
e465	Social norms, practices and ideologies
e540	Transportation services, systems and policies
e550	Legal services, systems and policies
e570	Social security services, systems and policies
e575	General social support services, systems and policies
e580	Health services, systems and policies
e585	Education and training services, systems and policies
e590	Labour and employment services, systems and policies

and the 10 categories of the component *environmental factors* 14% of the total number of ICF categories at the second level in their respective components.

DISCUSSION

The formal consensus process integrating evidence from preliminary studies and expert knowledge at the third ICF Core Sets conference led to the definition of the Brief ICF Core Set and the Comprehensive ICF Core Set for multidisciplinary assessment.

One of the main challenges during the development of the ICF Core Sets for LBP was comprehensively to cover the wide spectrum of problems in functioning of patients with LBP without shifting attention to risk factors or predictors. The 79 categories included in the Comprehensive ICF Core Set cover not only aspects directly related to pain but also a wide spectrum of activities, social and environmental factors. This is neither a surprising nor a new insight, yet research until now has always focussed on specific viewpoints and thus specific outcome measures, thereby ignoring to some extent the overall breadth of the problem (20–22).

Although the participants were provided with the option to define the categories not only on the second, but possibly also on the third or fourth levels of the classification, after thorough discussion it was decided to keep the definition on the second

Table V. *International Classification of Functioning, Disability and Health (ICF) – categories included in the Brief ICF Core Set for low back pain. The categories per component are listed according to the conceded rank order*

ICF component	Rank order	ICF Code	ICF category title
Body functions	1	b280	Sensation of pain
	2	b152	Emotional functions
	3	b730	Muscle power functions
	4	b710	Mobility of joint functions
	5	b455	Exercise tolerance functions
	6	b134	Sleep functions
	7	b740	Muscle endurance functions
	8	b735	Muscle tone functions
	9	b715	Stability of joint functions
	10	b130	Energy and drive functions
Body structures	1	s120	Spinal cord and related structures
	2	s760	Structure of trunk
	3	s770	Additional musculoskeletal structures related to movement
Activities and participation	1	d415	Maintaining a body position
	2	d430	Lifting and carrying objects
	3	d410	Changing basic body position
	4	d450	Walking
	5	d850	Remunerative employment
	6	d859	Work and employment, other specified and unspecified
	7	d640	Doing housework
	8	d540	Dressing
	9	d240	Handling stress and other psychological demands
	10	d760	Family relationships
	11	d530	Toileting
	12	d845	Acquiring, keeping and terminating a job
Environmental factors	1	e580	Health services, systems and policies
	2	e570	Social security services, systems and policies
	3	e355	Health professionals
	4	e450	Individual attitudes of health professionals
	5	e410	Individual attitudes of immediate family members
	6	e135	Products and technology for employment
	7	e110	Products or substances for personal consumption
	8	e310	Immediate family
	9	e155	Design, construction and building products and technology of buildings for private use
	10	e550	Legal services, systems and policies

level. This may facilitate the application of the ICF Core Sets in practice as the number of categories keeps within reasonable limits.

Consistent with the main *body functions* affected in LBP, *neuromusculoskeletal- and movement-related functions* are broadly covered in the Comprehensive ICF Core Set. Other *body functions* included in the Comprehensive ICF Core Set, such as *sleep* and *energy and drive functions*, represent also key issues associated to LBP (23, 24).

The inclusion of *mental functions* including *emotional functions*, *temperament* and *personality functions*, and *experience of self* and time functions is consistent with the association between psychological factors and LBP that have been found in various cross-sectional studies (25). These factors include anxiety, depression, somatization symptoms, stressful responsibility, job dissatisfaction, mental stress at work, negative body image, weakness in ego functioning and poor drive satisfaction (26). Especially depressive mood and somatization have been found to play a crucial role in the transition from acute episode to chronic LBP (27). However, the *body function* b1602 *content*

of thought which includes in its definition somatization is not included in the Comprehensive ICF Core Set and will be a point for discussion when deciding on the final version of the Brief ICF Core Set.

It is not surprising that at the level of the *body structures*, *structures related to movement* and the *spinal cord* are included. Experimental studies suggest that LBP may originate from many spinal structures, including ligaments, facet joints, the vertebral periosteum, the paravertebral musculature and fascia, blood vessels, the anulus fibrosus and spinal nerve roots. Other common problems include spinal stenosis and disk herniation (28).

Limitations and restrictions in *activities and participation* may indeed be most relevant to patients with LBP. This is reflected by the fact that this component is represented by 29 categories, as compared with the 19 *body functions* considered relevant. The areas covered represent central functional domains of patients with LBP, including *mobility* and *self care* (29).

Personal interactions and relationships as well as *community life and recreation and leisure* were also considered relevant to

be included in a comprehensive multidisciplinary assessment by the LBP expert group. In the literature these areas have also been investigated in relation to LBP (30).

Three *activities and participation* categories referring to *work and employment* have also been included in the Comprehensive ICF Core Set. This is in line with the fact that LBP carries a high economic burden (31) being the most common cause of work-related disability in people under 45 years of age and the most expensive cause of work-related disability, in terms of workers compensation and medical expenses (26).

The broad representation of the component *environmental factors* is remarkable. The chapter *services, systems and policies* which had the highest number of categories included was discussed at length because of the important inter-country differences. For example it was argued that in countries where compensation systems cover for LBP limitations and restrictions in work and employment are more frequent as being reported in the literature (2). Acknowledging the importance of education and training programs in the management of LBP, *education and training services, systems and policies* was included in the Comprehensive ICF Core Set. In line with our current understanding of functioning and health (32–34) and predictors of disability in patients with LBP (35), *products and technology, support and relationships, attitudes of significant others*, and *health professionals* were included in the Comprehensive ICF Core Set. The possible influence of factors of the natural environment is reflected by the inclusion of the categories *climate* and *vibration*. The category *e110 products or substances for personal consumption*, which includes drugs in its definition, addresses the importance of pharmacological therapy.

Remarkably, the selection of categories for the Brief ICF Core Set does not result in a bandwidth compression, i.e. the Brief ICF Core Set still contains most of the chapters represented in the Comprehensive ICF Core Set.

Regarding the comprehensiveness of the ICF, it is most interesting to note that the panel of experts did not identify problems of patients not contained in the ICF. This emphasizes the validity of the ICF classification, which was based on a rigorous international development process. However, the wording and/or phrasing of the ICF classification sometimes led to prolonged discussions in the working groups, indicating the need for manuals and operationalizations.

The organizers of the consensus process took much care in the selection of the experts and were successful in recruiting 18 experts with different professional backgrounds from 8 different countries. Nevertheless, the results of any consensus process may differ with different groups of experts. This emphasizes the importance of the extensive validation of this first version of the ICF Core Sets from the perspectives of different professions and in different countries. The first version of the ICF Core Sets will also be tested from the patients' points of view and in different clinical settings. It is important to note that this first version of the ICF Core Sets is only recommended for validation or pilot studies.

ACKNOWLEDGEMENTS

We thank the Bone and Joint Decade and the European League against Rheumatism (EULAR) for their support for this project.

We are most grateful for the contributions made by the following experts attending the conference: Thomas Brockow, Dag Bruusgaard, Peter Disler, Catherine Dziri, Dmitry Gurevich, Manny Halpern, Franziska Heigel, Hans Jörg Huwiler, Wilfried Jäckel, H. Kaifes, Leonard Kamen, Feroz Khan, Judit Korda, Kurt Luyckx, Marvin Merino, Itzhak Siev-Ner, Sjef Van der Linden and Hiroshi Yamamoto.

REFERENCES

1. World Health Organization. WHO Technical Report Series. The burden of musculoskeletal conditions at the start of the new millennium. Geneva: World Health Organization; 2003.
2. Ehrlich GE, Khaltaev NG. Low back pain initiative. Department of Noncommunicable Disease Management. Geneva: World Health Organization; 1999.
3. Ehrlich GE. Low back pain. Bulletin of the World Health Organization 2003a; 81: 671–676.
4. Daltroy LH, Cats-Baril WL, Katz JN, Fossel AH, Liang MH. The North American Spine Society Lumbar Spine Outcome Assessment Instrument. Reliability and Validity Tests. Spine 1996; 15: 21: 741–749.
5. Roland M, Fairbank J. The Roland-Morris Disability Questionnaire and the Oswestry Disability Questionnaire. Spine 2000; 25: 3115–3124.
6. Fairbank JC, Pynsent PB. The Oswestry Disability Index. Spine 2000; 25: 2940–2952.
7. Ware JE, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). A. Conceptual framework and item selection. Med Care 1992; 30: 473–483.
8. Hunt SM, McEwen J, McKenna SP. Measuring health status: a new tool for clinicians and epidemiologists. J R Coll Gen Pract 1985; 35 (273): 185–188.
9. Deyo R, Battie M, Beurskens AJHM, et al. Outcome measures for low back pain research. A proposal for standardized use. Spine 1998; 23: 2000–2013.
10. Bombardier C. Outcome assessments in the evaluation of treatment of spinal disorders: summary and general recommendations. Spine 2000; 15; 25: 3100–3103.
11. Ware JE, Kosinski M, Keller SD. SF-12. How to score the SF-12 physical and mental health summary scales. Boston: The Health Institute, New England Medical Center; 1995.
12. The Euroqol Group. Euroqol-a facility for the measurement of health-related quality of life. Health Policy 1990; 16: 199–208.
13. Main CJ. The modified somatic perception questionnaire (MSPQ). J Psychosom Res 1983; 27: 503–514.
14. Ehrlich GE. Back pain. The J Rheumatol 2003b; 30: 26–31.
15. 1 World Health Organization. International Classification of Functioning, Disability and Health: ICF. Geneva: WHO, 2001.
16. Stucki G, Ewert T, Cieza A. Value and application of the ICF in rehabilitation medicine. Disabil Rehabil 2002; 24: 932–938.
17. Weigl M, Cieza A, Andersen A, Kollerits B, Amann E, Füssl M, et al. Identification of the most relevant ICF categories in patients with chronic health conditions: A Delphi exercise. J Rehabil Med 2004; 36: (Suppl 44): 12–21.
18. Brockow T, Cieza A, Kuhlmann H, Sigl T, Franke T, Harder M, et al. Identifying the concepts contained in outcome measures of clinical trials on musculoskeletal disorders and chronic widespread pain using the international classification of functioning, disability and health as a reference. J Rehabil Med 2004; 36: (Suppl 44): 30–36.
19. Ewert T, Fuessl M, Cieza A, Andersen A, Chatterji S, Kostansjek N, et al. Identification of the most common patient problems in patients with chronic conditions using the ICF checklist. J Rehabil Med 2004; 36: (Suppl 44): 22–29.
20. Verbunt JA, Seelen HA, Vlaeyen JW, van de Heijden GJ, Heuts PH, Pons K, et al. Disuse and deconditioning in chronic low back pain:

- concepts and hypotheses on contributing mechanisms. *Eur J Pain* 2003; 7: 9–21.
21. Fritz JM, Piva SR. Physical impairment index: reliability, validity, and responsiveness in patients with acute low back pain. *Spine* 2003; Jun 1; 28: 1189–1194.
 22. Hurwitz EL, Morgenstern H, Yu F. Cross-sectional and longitudinal associations of low-back pain and related disability with psychological distress among patients enrolled in the UCLA Low-Back Pain Study. *J Clin Epidemiol* 2003; 56: 463–471.
 23. Moldofsky H. Sleep and pain. *Sleep Med Rev* 2001; 5: 385–396.
 24. Wessely S, Hotopf M, Sharpe M. *Chronic fatigue and its syndromes*. Oxford: Oxford University Press; 1998.
 25. Andersson GBJ. The epidemiology of spinal disorders. In: Frymoyer JW, ed. *The adult spine: principles and practice*, 2nd edn. Philadelphia: Lippincott-Raven; 1997, p. 93–141.
 26. Andersson GB. Epidemiological features of chronic low-back pain. *Lancet* 1999; 354: 581–585.
 27. Pincus T, Burton AK, Vogel S, Field AP. A systematic review of psychological factors as predictors of chronicity/disability in prospective cohorts of low back pain. *Spine* 2002; 27: E109–E120.
 28. Deyo RA, Weinstein JN. Low back pain. *N Engl J Med* 2001; 344: 363–370.
 29. Nordin M, Welser S, Campello MA, Pietrek M. Self-care techniques for acute episodes of low back pain. *Best Pract Res Clin Rheumatol* 2002, p. 89–104.
 30. Hoogendoorn WE, van Poppel MN, Bongers PM, Koes BW, Bouter LM. Systematic review of psychosocial factors at work and private life as risk factors for back pain. *Spine* 2000; 25: 2114–2125.
 31. Maetzel A, Li L. The economic burden of low back pain: a review of studies published between 1996 and 2001. *Best Pract Res Clin Rheumatol* 2002; 16: 23–30.
 32. Jones T, Kumar S. Physical ergonomics in low-back pain prevention. *J Occup Rehabil* 2001; 11: 309–319.
 33. Karjalainen K, Malmivaara A, van Tulder M, Roine R, Jauhiainen M, Hurri H, et al. Multidisciplinary biopsychosocial rehabilitation for subacute low back pain in working-age adults: a systematic review within the framework of the Cochrane Collaboration Back Review Group. *Spine* 2001; 26: 262–269.
 34. Atalay A, Arslan S, Dincer F. Psychosocial function, clinical status, and radiographic findings in a group of chronic low back pain patients. *Rheumatol Int* 2001; 21: 62–65.
 35. Picavet HS, Schouten JS. Physical load in daily life and low back problems in the general population-The MORGEN study. *Prev Med* 2000; 31: 506–512.

Trunk muscle recruitment patterns in specific chronic low back pain populations

Sheri P. Silfies^{a,*}, Dawn Squillante^b, Philip Maurer^b,
Sarah Westcott^c, Andrew R. Karduna^d

^a *Rehabilitation Sciences Biomechanics Laboratory, Drexel University, 245 North 15th Street, Philadelphia, PA 19102-1192, USA*

^b *Booth, Bartolozzi, Balderston Orthopaedics, Pennsylvania Hospital, Philadelphia, PA, USA*

^c *University of Puget Sound, Tacoma, WA and Lake Washington School District, Redmond, WA, USA*

^d *Department of Human Physiology, University of Oregon, Eugene, OR, USA*

Received 30 August 2004; accepted 26 January 2005

Abstract

Background. It is hypothesized that injury or degeneration of osteoligamentous spinal structures would require compensation by trunk musculature and alterations in motor control to maintain spine stability. While, biomechanical modeling has supported this hypothesis, studies of muscle recruitment patterns in chronic low back pain patients both with and without significant osteoligamentous damage have been limited. This study utilized a non-randomized case-control design to investigate trunk muscle recruitment patterns around the neutral spine position between subgroups of patients with chronic mechanical low back pain and asymptomatic controls.

Methods. Twenty subjects with chronic low back pain attributed to clinical lumbar instability were matched to 20 asymptomatic controls. In addition 12 patients with non-specific chronic low back pain were studied. Surface EMG from five trunk muscles was analyzed to determine activation levels and patterns of recruitment during a standing reach under two different loading conditions.

Findings. The chronic low back pain group with symptoms attributed to clinical instability demonstrated significantly higher activation levels of the external oblique and rectus abdominus muscles and lower abdominal synergist ratios than the control group. No significant differences were found between patient subgroups.

Interpretation. While these data demonstrate altered muscle recruitment patterns in patients with chronic low back pain, the changes are not consistent with Panjabi's theory suggesting that these alterations are driven by passive subsystem damage. However, the higher activation of global abdominal musculature and altered synergist patterns may represent a motor control pattern that has consequences for continued dysfunction and chronic pain.

© 2005 Elsevier Ltd. All rights reserved.

Keywords: Chronic low back pain; Electromyography; Trunk muscle coordination

1. Introduction

Differences in trunk muscle recruitment or neuromuscular control in patients with mechanical low back pain

have been reported by several investigators (Hodges and Richardson, 1999; O'Sullivan et al., 1997a; Radebold et al., 2000; Van Dieen et al., 2003). It has been hypothesized that these changes in muscle recruitment patterns are an adaptation to underlying spinal instability resulting from osteoligamentous laxity or damage, muscle dysfunction or reduced neuromuscular control (Panjabi, 1992; Paris, 1985). Panjabi (1992) proposed a model for

* Corresponding author.

E-mail address: silfies@drexel.edu (S.P. Silfies).

a spinal stabilization system which partitioned the responsibility for joint stability and movement into three subsystems: a passive subsystem (connective tissue, bones, and intervertebral discs), an active subsystem of muscles and tendons, and a neural (motor) control subsystem. Panjabi further hypothesized that spinal instability created by dysfunction of the passive support system, resulting in loss of control or excessive motion of a spinal segments neutral zone, would trigger compensation strategies by trunk musculature under the guidance of the neural control systems. The objective of the compensation would be to maintain spinal stability (Panjabi, 1992).

Biomechanical modeling and experimental studies have demonstrated that trunk muscle co-contraction is necessary for spinal stability particularly in neutral upright postures even in the healthy spine (Cholewicki et al., 1997; Granata et al., 2001). Moreover, reduction of a model's passive stiffness component predicts that muscle activation would increase to maintain stability of a spine (Cholewicki et al., 1997). Gardner-Morse and Stokes (2001) lend further support to this hypothesis, by demonstrating that a 10% reduction in segmental stiffness can compromise spine stability. They further suggest that this reduction in segmental stiffness, in conjunction with poor neuromuscular control and reduction in muscle stiffness could result in clinical instability. These modeling predictions are supported by data from animal models (Kaigle et al., 1995; Wilke et al., 1995) and through experiments using healthy individuals, who upon challenges to trunk stability responded by increasing muscle co-contraction (Granata and Orishimo, 2001). This co-contraction is particularly necessary around the neutral spine position and during low load conditions (Cholewicki and McGill, 1996).

While numerous investigators have reported activation pattern differences in patients with non-specific mechanical low back pain, the hypothesis that changes in trunk muscle recruitment patterns are an adaptation to underlying passive subsystem damage that results in an increased neutral zone, segmental hypermobility, and/or clinical spinal instability has not been systematically investigated (Lariviere et al., 2000; Newcomer et al., 2002; Van Dieen et al., 2003). The few investigators who studied patients with radiographic findings associated with clinical lumbar instability (i.e., spondylolisthesis) have found differences in muscle recruitment; however, these findings were demonstrated during the performance of a specific therapeutic exercise or non-functional activity (Lindgren et al., 1993; O'Sullivan et al., 1997a; Sihvonen et al., 1997). These investigators did not study muscle activation patterns of the trunk flexors and extensors simultaneously nor did they consistently address muscle co-contraction or synergist ratios (i.e., *trunk flexors/extensors*, *internal oblique/rectus abdominus*).

On the basis of the assumption that chronic mechanical low back pain (CLBP) patients with significant passive subsystem damage adapt muscle recruitment to compensate for the loss of spinal stability, we have formulated several hypotheses regarding muscle activation levels and patterns. Patients with chronic mechanical low back pain attributed to clinical lumbar instability (CLBP_I) from significant passive subsystem damage would demonstrate increased muscle activation and greater co-contraction of the trunk muscular than asymptomatic controls during a functional reaching task. In addition, work by Bergmark (1989) and Panjabi et al. (1989) suggests that muscle architecture plays a role in effective spine stability. They found through biomechanical modeling that activation of segmentally inserting muscles would be more effective at increasing stability than multi-segmental muscle inserting on the thorax and pelvis. Based upon this work, we also hypothesized that synergist muscle ratios represented by activation of segmental relative to multi-segmental muscles when acting synergistically (i.e., *internal oblique/rectus abdominus*) would be higher in the CLBP_I group as an attempted to increase stability. To further establish if passive subsystem damage associated with findings of clinical lumbar instability was the determinate of muscle pattern changes, a separate subset of patients with non-specific chronic mechanical low back pain (CLBP_N) was compared to the CLBP_I group. Pattern differences between CLBP_I and CLBP_N; would also lend support to the idea that unique impairments exist between these subgroups of the chronic low back pain population. These hypotheses were tested by recording activity of ten trunk muscles during functional reach under two loading conditions.

2. Methods

2.1. Participants

A total of 39 participants with recurrent or chronic low back pain were recruited from an orthopedic surgery practice and completed the testing protocol. Inclusion criteria were current pain episode greater than 3 months, primary complaint of back and not leg pain, and inability to work or perform essential activities of daily living secondary to pain. All of these individuals had failed to resolve their symptoms in a course of conservative care, which included medical management, as well as physical rehabilitation. Potential participants were excluded if they had prior spine surgery, structural deformities or neurological findings indicating radiculopathy. The data from seven subjects were eliminated from this analysis secondary to demonstration of a high degree of psychosocial involvement (three out of five positive findings on Waddell's signs (Waddell, 1987) or inconsistency in performance during the clinical examination or testing).

The data from the remaining 32 CLBP participants were separated into the two groups. Twenty CLBP patients met the criteria for significant passive subsystem damage with moderate to severe degenerative disc disease (DDD) on magnetic resonance imaging (MRI) and positive low pressure discography at one or more corresponding levels. Although not a criteria for admission to this group, three of these individuals had documented spondylolisthesis at a segmental level corresponding to their DDD and positive discography. The underlying assumption was that damage to the major stabilizing structure of the spinal segment (disc) resulted in an increased segmental neutral zone as described by Panjabi et al. (1988). Evidence supporting the relationship between DDD, positive discography and spinal segmental hypermobility is offered in several studies (Eisenstein et al., 1999; Mimura et al., 1994; Tanaka et al., 2001). These medical findings in conjunction with clinical examination results placed these individuals into the clinical lumbar instability (CLBP_I) group. The recommended medical management of these 20 individuals was spinal fusion. The remaining 12 patients were diagnosed with non-specific mechanical low back pain (CLBP_N). They demonstrated DDD consistent with age-related changes and no evidence of spondylolysis or spondylolisthesis on MRI. In addition, these subjects demonstrated either negative discography (10/12) or negative flexion–extension films (2/12) which decreased the suspicion of an increased neutral zone or segmental hypermobility.

Asymptomatic controls ($n = 20$) were matched by age, sex and body mass index to the CLBP_I group. The control subjects reported no history of low back pain that required medical assessment or limited function for more than 3 days. Standard anterior–posterior and lateral flexion–extension views were completed on the control subjects to rule out degenerative changes deemed abnormal for the subject's age or evidence of an asymptomatic segmental hypermobility. All participants were evaluated by the same physician (P.M.), with that physician reading all imaging studies, performing the discography procedures and ruling out other medical diagnoses. Descriptive information for the participants is outlined in Table 1. There were no significant differences between the three groups based upon age or body mass index. Pain (11-point numeric pain rating scale), self-report disability (Roland–Morris disability questionnaire) and clinical measures were not significantly different between the two CLBP subgroups (Table 1). This study was approved by the Institutional Review Board of Drexel University and all subjects signed an informed consent prior to participation.

2.2. Instrumentation

Bipolar, pre-amplified surface electromyography (sEMG) electrodes (CMMR >100 dB, bandwidth 6–

29 kHz, 300–380 gain, inter-electrode distance 35 mm; Motion Control, Inc., Salt Lake City, UT, USA) were applied over five trunk muscles bilaterally: internal oblique (IO) (midway between the anterior superior iliac spine and pubic tubercle above the inguinal ligament), external oblique (EO) (15 cm lateral to umbilicus), rectus abdominus (RA) (3 cm lateral to umbilicus), lumbar erector spinae (ES) (3 cm lateral to midline, centered at the level of the L2 spinous process), lumbar multifidus (LM) (2 cm lateral to midline, centered at the level of the L5 spinous process) and ground over right lateral malleolus. Light skin abrasion and cleansing with alcohol preceded application of electrodes with conduction gel and double-sided foam tape. Electrodes placement was consistent with previous studies (Cholewicki et al., 1997; Ng and Richardson, 1996). Muscle activity was recorded at 1248 Hz. Raw sEMG signals were band pass filtered (Bessel high pass at 10 Hz and a Butterworth low pass at 750 Hz) and differentially amplified with a gain of 1500–3800 to achieve 3–5 V peak to peak activity during the reference contractions.

Kinematic data related to the spine position were collected (40 Hz) using a 3 Space Fastrak (Polhemus Incorporated, Colchester, VT, USA) with a lightweight magnetic receiver directly mounted to the skin over the L1 spinous process with double-sided adhesive tape. The Polhemus transmitter defined the global reference frame. Kinematic data representing trunk position were defined relative to the subject's neutral standing posture. Raw sEMG and kinematic data were simultaneously collected through a custom LabVIEW program (National Instrument, Austin, TX, USA) and digitally stored.

2.3. Testing procedures

Normalization of trunk flexor and extensor muscle activity was completed using submaximal isometric contractions. Each abdominal group was normalized to the highest activation level produced during the isometric hold (5 s) of either a gravity resisted abdominal crunch or crunch with rotation. Extensor muscles were normalized to the highest activation level achieved during submaximal isometric contraction in a modified standing position (20% of subject's lumbar flexion) with hip and pelvic motion restrained. The Kin-Com (Chattecx Corp., Chattanooga, TN, USA) back testing unit was modified for this purpose. The target submaximal force was calculated using 40% of the subject's body weight. This calculation was modified from research by Mayer et al. (1985) and pilot work with similar chronic low back pain subjects.

The functional task, a forward reaching activity, was performed for three continuous trials starting in a position of trunk extension (Fig. 1). The reaching task was completed holding the upper extremities at 90° of

Table 1

Descriptive statistics (mean (SD)) and clinical characteristics of the chronic low back pain and control subjects

	Control (<i>n</i> = 20)	Clinical instability (<i>n</i> = 20)	Non-specific (<i>n</i> = 12)	Significance ^a (<i>P</i> -value)
Sex	4F, 16M	4F, 16M	7F, 5M	–
Age (years)	40.6 (8.9)	42.9 (8.7)	44.3 (5.9)	NS/NS
Body mass index (kg/m ²)	25.2 (2.8)	26.8 (5.4)	29.5 (7.5)	NS/NS
Positive discography (# segments)	NA	2.4 (1.0)	NA	–
Pain location (% back pain only)	NA	60%	75%	NS
Current symptoms onset (years)	NA	2.8 (3.7)	3.8 (3.1)	NS
NPRS ^b pre-test (0–10)	NA	4.7 (2.3)	4.3 (2.3)	NS
NPRS post-test (0–10)	NA	5.4 (2.7)	5.1 (2.7)	NS
Lumbar flexion (cm)	6.4 (2.6)	6.4 (3.8)	5.9 (2.4)	NS
Functional reach (cm)	38.1 (11.7)	32.6 (7.5)	29.7 (9.9)	0.022/NS
Trunk extensor strength (N)	342.2 (148.7)	250.8 (112.3)	202.2 (75.8)	0.002/NS
Trunk flexion (% painful)	NA	29%	10%	NS
Return to standing from flexion (% painful)	NA	48%	40%	NS
Return to standing (% aberrant motion)	9%	48%	30%	0.005/NS
Lumbo-pelvic rhythm (% reversal)	5%	38%	10%	0.013/NS
Extension hinge (%)	23%	57%	70%	0.005/NS
RMQ ^c (0–24)	0.5 (0.21)	11.1 (4.4)	11.5 (4.6)	0.000/NS
SF-36 ^d (physical component score)	55.9 (5.9)	34.7 (7.3)	36.5 (10.8)	0.000/NS
SF-36 (mental component score)	51.2 (9.6)	43.6 (14.0)	45.5 (11.7)	0.035/NS

^a Comparison of combined chronic low back pain to control subjects/comparison of two chronic low back pain groups; NS indicating not significant.

^b Numeric pain rating scale (higher score indicates more painful condition).

^c Roland–Morris disability questionnaire (higher score indicates greater disability).

^d Medical Outcomes Study Short Form (SF-36) Health Status Profile (norm based to general US population mean 50, SD 10; lower score indicates reduced health status).

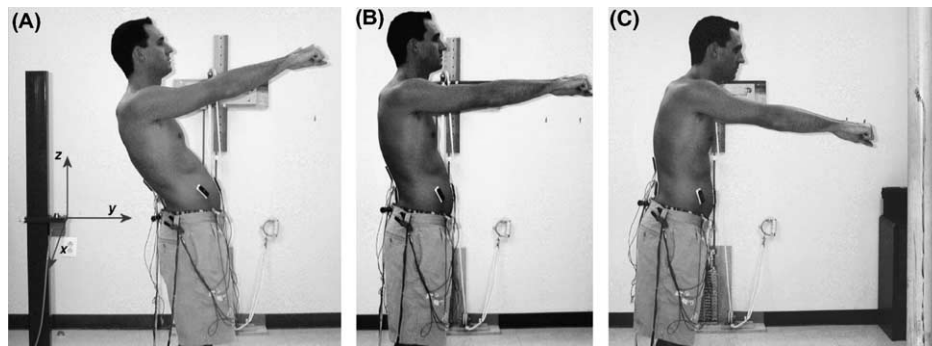


Fig. 1. This series depicts the no load condition of the functional reaching task. Panel A: the start position. Panel B: midrange or neutral position. Panel C: the maximum forward position at target. Subjects moved through a range of approx. 15° of trunk extension to 15° of flexion with respect to the global reference frame of the transmitter. Subjects were given a visual target to mark standardized reaching distance (pole, (C)).

shoulder flexion. Subjects selected a comfortable stance within foot prints shoulder width apart. The hips and pelvis were free to move. The excursion of the reach was standardized at 50% of the participant's forward reaching distance, determined by Functional Reach (Nakamura et al., 1988). Speed of movement was standardized (6 s cadence; approximately 10°/s) to control for its effects on muscle activation levels (Luoto et al., 1996). This movement was relatively slow as it amounted to taking 2 s to reach forward approximately 6–8 in. to a target. Data were collected throughout the reaching motion.

The task was completed under two conditions with a minimum of 1 minute of rest between no load (Fig. 1)

and holding a 5 lb sandbag with both hands. This protocol was developed based upon work by Cholewicki and McGill (1996) indicating that in upright tasks with little muscle demands, such as standing with no load, the spine functions close to the threshold of buckling. The no load condition provided a suitable model for testing the motor control system's ability to provide general trunk stability, while the additional load increased the stability challenge.

2.4. Data management and analysis

To determine sEMG signal amplitude, the raw sEMG data from a baseline resting signal, the reference

contractions and reaching activity was first filtered using an algorithm adapted from Aminian et al. (1988) to reduce heart rate artifact. The signal was further filtered using root-mean-square (RMS) processing with a time constant of 62 ms and then baseline resting levels were subtracted. The RMS sEMG signal for each muscle corresponding to the neutral spine position (0° of trunk flexion) was extracted from the reaching data and computed for each trial. The signal was then averaged over the three trials and between corresponding left and right trunk muscles. Normalized muscle activation was calculated using the submaximal isometric contraction for each muscle group creating a percent activation. Co-contraction (*flexors/extensors*) and abdominal (IO/RA, EO/RA) and extensor (LM/ES) synergist patterns were calculated using the RMS values to create synergist ratios.

The muscle recruitment patterns described in this paper represent trunk muscle activation and patterns of co-contraction at 0° of trunk flexion, during the forward phase of the reaching motion. Comparisons were made between groups and loading conditions. To address the hypotheses related to differences in muscle recruitment pattern between asymptomatic control and the CLBP_I group, a repeated measures ANOVA with between-subject factor of group (asymptomatic and CLBP_I) and within-subject/repeated factor of load (no load, 5 lb load) was used. This analysis was completed on 20 matched pairs of participants. Two planned comparisons using orthogonal contrasts were employed to test the specific hypotheses related to group difference. The first tested the hypothesis regarding differences between the subgroups of CLBP patients and the second tested differences between the asymptomatic control group and the combined CLBP groups. The purpose of the second comparison was to contrast our findings to previously published studies from other laboratories. Activation parameters for each muscle group were evaluated independently with significance level set at $P \leq 0.05$ for each analysis.

3. Results

3.1. Muscle activation levels

Fig. 2 provides group mean muscle activations with standard error for the no load and 5 lb load condition at 0° of trunk flexion. The rectus abdominus ($F_{1,36} = 5.226$, $P = 0.0001$) and external oblique ($F_{1,35} = 18.541$, $P = 0.028$) muscles had significantly higher activation levels in the CLBP_I group compared to matched asymptomatic controls. There was a significant main effect for load in all muscle groups except the external oblique (Table 2). A significant load x group interaction ($F_{1,38} = 6.406$, $P = 0.016$) for the lumbar

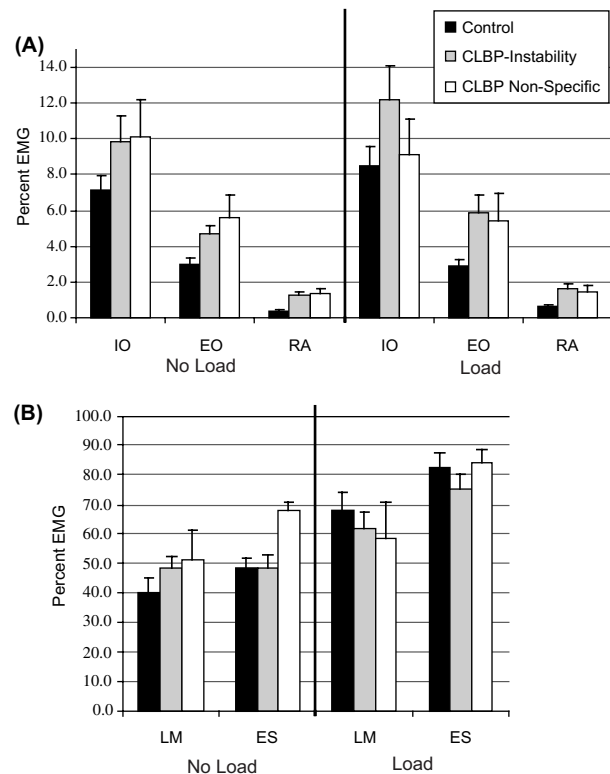


Fig. 2. Group mean and standard error of the normalized muscle activation levels in the no load and 5 lb load conditions. Panel A: abdominal muscle groups: internal oblique (IO), external oblique (EO) and rectus abdominus (RA). Panel B: extensor muscle groups: lumbar multifidus (LM) and erector spinae (ES).

Table 2

Results of the repeated measure ANOVA for muscle activation levels and ratios between the chronic mechanical low back pain instability subgroup ($n = 20$) and matched asymptomatic control group ($n = 20$)

ANOVA	Main effect (group)	Main effect (load)	Interaction
<i>Muscle groups</i>			
Internal oblique (IO)	0.217	0.012	0.633
External oblique (EO)	0.028	0.183	0.522
Rectus abdominus (RA)	0.0001	0.0008	0.172
Lumbar multifidus (LM)	0.962	0.0004	0.016
Erector spinae (ES)	0.748	0.0004	0.486
<i>Synergist ratios</i>			
IO/RA	0.059	0.033	0.609
EO/RA	0.006	0.318	0.964
LM/ES	0.986	0.005	0.782
Flexors/extensors	0.822	0.000	0.181

Data are presented as P -values.

multifidus was found due to a 28% increase in activation in the control group, but only a 14% increase in the CLBP_I group. Planned comparisons between the CLBP_I and CLBP_N groups demonstrated no significant differences (Table 3). The combined CLBP groups demonstrated significantly higher levels of normalized muscle activation than the asymptomatic control group for

Table 3

Results of planned contrast for muscle activation levels or ratios between the two chronic mechanical low back pain subgroups and combined chronic low back pain ($n = 32$) and control ($n = 20$) groups

Planned contrasts condition	CLBP vs. control		CLBP _I ^a vs. CLBP _N ^b	
	No load	Load	No load	Load
<i>Muscle groups</i>				
Internal oblique (IO)	0.321	0.721	0.579	0.520
External oblique (EO)	0.036	0.024	0.345	0.842
Rectus abdominus (RA)	0.0002	0.0003	0.357	0.628
Lumbar multifidus (LM)	0.083	0.325	0.976	0.879
Erector spinae (ES)	0.205	0.979	0.097	0.426
<i>Synergist ratios</i>				
IO/RA	0.025	0.139	0.632	0.266
EO/RA	0.028	0.041	0.860	0.406
LM/ES	0.435	0.997	0.425	0.809
Flexors/extensors	0.405	0.399	0.690	0.441

Data are presented as *P*-values.

^a Chronic low back pain subgroup defined as clinical instability.

^b Chronic low back pain subgroup defined as non-specific.

the rectus abdominus and external oblique in the both the no load and 5 lb conditions.

3.2. Muscle co-activation patterns

Fig. 3 provides group mean co-activation ratios with standard error for the no load and 5 lb load condition at 0° of trunk flexion. The EO/RA ratio ($F_{1,37} = 8.612$, $P = 0.006$) was significantly lower, with a trend toward a lower IO/RA ratio ($F_{1,34} = 3.813$, $P = 0.059$) for the CLBP_I group compared to the asymptomatic controls. There was a main effect for load with decreases in all ratios except the EO/RA. This includes a significant decrease in the co-contraction ratio (Table 2). Planned comparisons between the CLBP_I and CLBP_N groups demonstrated no significant differences (Table 3). The combined CLBP groups demonstrated a significantly

lower IO/RA ratio (no load) and EO/RA ratio (no load, 5 lb) than the asymptomatic control group (Table 3).

4. Discussion

4.1. Muscle activation levels and patterns

This study compared trunk muscle recruitment pattern between two subgroups of CLBP patients and asymptomatic control using both normalized muscle activation and RMS sEMG patterns of co-activation. The findings demonstrate differences in activation strategies of the CLBP_I subgroup and matched control subjects, but not between the CLBP subgroups themselves. Using both normalized muscle activity and RMS ratios of activation to describe muscle recruitment allowed us to address the limitations associated with EMG normalization and to also look at patterns of synergistic muscle activation (Edgerton et al., 1996; Van Dieen et al., 2003). We choose to normalize our EMG amplitude to standardized submaximal isometric contraction because of reported intolerance to maximal resistance and significant intrasubject variability for maximum voluntary isometric contractions in patients with low back pain (Yang and Winter, 1983). However, these methodological features limit direct comparison of activity levels with studies normalizing to maximal voluntary contractions or submaximal references using different activities or trunk positions. Within these limitations, and others, we believe our data add to the current knowledge of neuromuscular control patterns in specific subgroups of patients with CLBP during a standardized reaching task.

The data from this study supported portions of our hypotheses related to differences between our CLBP_I and matched control group. Muscle activation was generally higher in the CLBP_I group with significantly high-

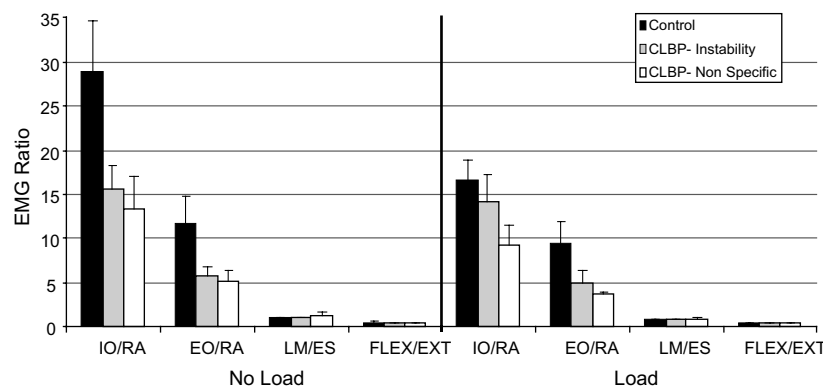


Fig. 3. Group mean and standard error of the synergist ratios in the no load and 5 lb load conditions. Synergist ratios: internal oblique/rectus abdominus (IO/RA), external oblique/rectus abdominus (EO/RA) and lumbar multifidus/erector spinae (LM/ES), and co-contraction ratio defined as abdominals/extensors (FLEX/EXT).

er activation of rectus abdominus and external oblique and a lower EO/RA synergist ratio. While, there appears to be increased muscle activity as either a compensation for or a precipitator of passive subsystem damage, the co-contraction ratio (*flexors/extensors*) was not significantly different between groups. The abdominal synergist ratios although significantly different, did not support our hypothesis that coordinated response from the segmental trunk muscles relative to the multi-segmental muscle would raise those synergist ratios. We found few studies where the investigators specifically assessed trunk muscle recruitment patterns in patients with a diagnosis of clinical lumbar instability. Our findings coincide with data from O'Sullivan et al. (1997a) who reported a significantly lower IO/RA ratio in CLBP patients with spondylolisthesis when performing specific abdominal isometric exercises. In our study, the lower abdominal synergist ratios resulted from greater activation of the rectus abdominus relative to external or internal oblique muscle recruitment. Although we did not find significant differences in our subjects extensor muscle patterns, Lindgren et al. (1993) reported differences in segmental extensor activation in stable vs unstable segments, and Sihvonen et al. (1991) reported a lower ratio of activity for the erector spinae muscles (activation averaged over the entire *flexion/extension* phase of motion) in their subjects with chronic low back pain. The extensor ratio was lowest in their subgroup of CLBP subjects (25/87) diagnosed with segmental hypermobility on flexion–extension radiographs.

Using the results of our planned comparison between the combined CLBP subgroups and asymptomatic control subjects we are able to further discuss our data relative to previously published studies. While our findings are generally supported by Chiou et al. (1998), who also found greater activation around neutral standing of the rectus abdominus and external oblique muscles in their low back pain subjects, additional comparisons are limited by methodological differences and the lack of description of their low back pain subjects. Sihvonen et al. (1991) also reported a decreased ratio of extensor activity in their non-specific CBLP subjects. While, Van Dieen et al. (2003) did not find a significant difference in the IO/RA ratio, between their group of non-specific CLBP subjects and controls; they did report a significantly higher co-contraction ratio (*flexors/extensors*) and ratio of lumbar to thoracic erector spinae activity. However, it should be noted that in addition to their blocking pelvic/hip motion during testing, their CLBP group was different from ours relative to pain intensity (lower), self-reported disability (less) and work status (working) at the time of their data collection.

To date, no optimal pattern of activation has been experimentally determined and results of biomechanical modeling studies do not indicate that one particular muscle group is the best stabilizer of the lumbar spine

(Cholewicki and VanVliet, 2002). Several studies do demonstrate that increased co-contraction (flexors/extensors) and higher synergists ratios (IO/RA, lumbar/thoracic ES) result in enhanced spine stability particularly in upright neutral postures (Cholewicki et al., 1997; Granata and Orishimo, 2001; Van Dieen et al., 2003). In addition, Gardner-Morse and Stokes (1998) demonstrated through modeling that the abdominal muscles may play a more important role than the extensors in providing trunk stability. Therefore, it is plausible that an altered abdominal recruitment pattern may lead to deficiencies in spine stability.

Several authors have suggested that lumbar stability is maintained by segmental muscles and/or a coordinated response of segmental and multi-segmental synergist muscle groups (Cholewicki and VanVliet, 2002; Crisco and Panjabi, 1991). In light of this work, we propose that the trunk muscle recruitment pattern demonstrated by our CLBP subjects reflects a muted response of segmental musculature (in our study the IO and LM) and reliance upon multi-segmental muscle activation. This pattern of recruitment may suggest muscle or motor control impairment and represent an inability to successfully meet the demand for maintaining spinal stability. These findings are consistent with recent research that indicated dysfunction of the segmental abdominal musculature (internal oblique and transverse abdominus) in CLBP patients during perturbation (Hodges and Richardson, 1998). Additionally, atrophy and altered function of the trunk extensors, particularly the lumbar multifidus, has been reported (Hides et al., 1996; Hides et al., 1994). We acknowledged that there is an ongoing debate related to the ability to accurately determine lumbar multifidus muscle function using surface electrodes (Stokes et al., 2003). Thus, our findings, relative to independent activation of the LM may be contaminated by crosstalk with the erector spinae.

The second hypothesis related to proposed differences between the two CLBP subgroups was not upheld by the data. The absence of this difference suggests that clinical lumbar instability, as defined in this study (moderate to severe DDD and positive discography), may not be the determinant of the alterations in muscle activation patterns. These pattern changes could be the result of other factors (altered mechanoreceptor information, muscle atrophy, reflex inhibition or pain) common to the two CLBP subgroups (Brumagne et al., 2000; Hides et al., 1996; Sterling et al., 2001). This is a reasonable alternative hypothesis given that our CLBP subgroups did not demonstrate differences in time since symptom onset, pain intensity or location, lumbar flexion ROM, clinically observed movement patterns or disability level. In addition, our operational definition of clinical lumbar instability, while suggestive of underlying neutral zone changes or segmental hypermobility, does not directly

measure these parameters. Thus it is possible that our CLBP groups were not significantly different in this attribute. Faced with these findings we also ran an additional comparison of CLBP subgroups, this time separating them based upon the number of lumbar segments demonstrating degenerative change (one level vs. greater than one level). The hypothesis being that those individuals with a greater amount of passive subsystem damage would demonstrate a different recruitment pattern. Again we found no differences between the subgroups.

4.2. Effects of load

The response of the musculature to an increased external load resulted in an expected significant increase in activation level for both the CLBP and control groups. The abdominal muscles on average increased activation by 1–3% while the extensors increased by 13–31%. The increase in activity due to increased load is consistent with previously reported findings in CLBP subjects and asymptomatic individuals (Huang et al., 2001; Ross et al., 1993). The greater increase by extensor muscle activity was expected due to the increased trunk flexion moment. The reason for the lack of significantly increased muscle activity of the external oblique or the lumbar multifidus interaction (control groups approximate twofold increase over CLBP_I group) cannot be directly explained and its effect on spinal stability are unclear. These findings may be associated with use of adaptive movement patterns to decrease the external flexion moment, an inability to further increase activation secondary to muscle inhibition, or an altered recruitment pattern in response to tissue injury, pain or avoidance behavior. It may be that the general increase in all trunk muscle activity satisfied the need for any additional stability through compression forces alone (Cholewicki et al., 2000). Future studies would benefit from the calculation of spinal stability or stiffness achieved by specific muscle recruitment patterns.

The synergist and co-contraction (*flexors/extensors*) ratios were affected by the load increase, with the exception of EO/RA. Thus, the additional 5 lb load in the hands significantly changed the recruitment, but did not assist in differentiation of groups with the exception of the lumbar multifidus response discussed previously. The decreased synergist and co-contraction ratios were primarily the result of a greater relative increase in the multi-segmental muscle response (RA, ES) and load sharing.

5. Conclusions

The data from our subjects does not support the theory that passive subsystem damage drives the muscle

recruitment patterns of patients with CLBP. While the altered abdominal recruitment patterns demonstrated by our CLBP patients suggest reliance on multi-segmental abdominal musculature, the 1–2% mean group difference in individual muscle activation, although statically significant, may have limited clinical implications. However, we believe the synergists ratios are a better and more meaningful indicator of trunk motor control, particularly given the issues surrounding normalization of EMG data. The model proposed by Panjabi (1992) would suggest that these pattern changes were driven by the need to provide increased spinal stiffness around the subject's neutral spine position. The CLBP subjects in our study increased trunk muscle activity overall which would serve to enhance trunk stability, however no difference in the co-contraction ratio and their synergist pattern of a lower IO/RA might suggest they were not successful at achieving the goal. Perhaps our CLBP subjects represent those individuals who are unable to adequately compensate for their spinal dysfunction “non-copers” and this has resulted in their chronic symptoms and prolonged functional limitations. This is supported by their history of long standing low back pain and moderate to severe functional limitations as per self-report disability scores. As such, interventions that address trunk muscle recruitment strategies, particularly relative activation levels of the abdominal musculature may be an important component of a therapeutic exercise program for these individuals. At this time clinicians and researchers are theorizing that improved activation of the segmental trunk muscles with a goal of achieving higher segmental to multi-segmental synergist ratios of activation is the most efficient means of attaining needed trunk stability (Van Dieen et al., 2003), reducing pain and improving function (Hides et al., 2001; O'Sullivan et al., 1997b; Rasmussen-Barr et al., 2003).

Acknowledgments

The authors would like to thank Dr. Susan Smith for her manuscript review and editorial suggestions. This study was supported in part by grants from the Orthopaedic Section of the American Physical Therapy Association and the US Department of Education, National Institute on Disability and Rehabilitation Research.

References

- Aminian, K., Ruffieux, C., et al., 1988. Filtering by adaptive sampling (FAS). *Med. Biol. Eng. Comput.* 26, 658–662.
- Bergmark, A., 1989. Stability of the lumbar spine. A study in mechanical engineering. *Acta Orthop. Scand. Suppl.* 230, 1–54.
- Brumagne, S., Cordo, P., et al., 2000. The role of paraspinal muscle spindles in lumbosacral position sense in individuals with and without low back pain. *Spine* 25, 989–994.

- Chiou, W.-K., Lee, Y.-H., et al., 1998. Use of the surface EMG coactivation pattern for functional evaluation of trunk muscles in subjects with and without low-back pain. *Int. J. Ind. Ergonom.* 23, 51–60.
- Cholewicki, J., McGill, S.M., 1996. Mechanical stability of the in vivo lumbar spine: implications for injury and chronic low back pain. *Clin. Biomech. (Bristol, Avon)* 11, 1–15.
- Cholewicki, J., Panjabi, M.M., et al., 1997. Stabilizing function of trunk flexor–extensor muscles around a neutral spine posture. *Spine* 22, 2207–2212.
- Cholewicki, J., Simons, A.P., et al., 2000. Effects of external trunk loads on lumbar spine stability. *J. Biomech.* 33, 1377–1385.
- Cholewicki, J., VanVliet, J.J.T., 2002. Relative contribution of trunk muscles to the stability of the lumbar spine during isometric exertions. *Clin. Biomech. (Bristol, Avon)* 17, 99–105.
- Crisco III, J.J., Panjabi, M.M., 1991. The intersegmental and multisegmental muscles of the lumbar spine. A biomechanical model comparing lateral stabilizing potential. *Spine* 16, 793–799.
- Edgerton, V.R., Wolf, S.L., et al., 1996. Theoretical basis for patterning EMG amplitudes to assess muscle dysfunction. *Med. Sci. Sports Exer.* 28, 744–751.
- Eisenstein, S., Summers, B., et al., 1999. Invasive provocation study. In: Szpalski, M., Gunzburg, R., Pope, M. (Eds.), *Lumbar Segmental Instability*. Lippincott Williams & Wilkins, Philadelphia, pp. 45–51.
- Gardner-Morse, M.G., Stokes, I.A., 1998. The effects of abdominal muscle coactivation on lumbar spine stability. *Spine* 23, 86–91, discussion 91–2.
- Gardner-Morse, M.G., Stokes, I.A., 2001. Trunk stiffness increases with steady-state effort. *J. Biomech.* 34, 457–463.
- Granata, K.P., Orishimo, K.F., 2001. Response of trunk muscle coactivation to changes in spinal stability. *J. Biomech.* 34, 1117–1123.
- Granata, K.P., Orishimo, K.F., et al., 2001. Trunk muscle coactivation in preparation for sudden load. *J. Electromyogr. Kinesiol.* 11, 247–254.
- Hides, J.A., Jull, G.A., et al., 2001. Long-term effects of specific stabilizing exercises for first-episode low back pain. *Spine* 26, E243–E248.
- Hides, J.A., Richardson, C.A., et al., 1996. Multifidus muscle recovery is not automatic after resolution of acute, first-episode low back pain. *Spine* 21, 2763–2769.
- Hides, J.A., Stokes, M.J., et al., 1994. Evidence of lumbar multifidus muscle wasting ipsilateral to symptoms in patients with acute/subacute low back pain. *Spine* 19, 165–172.
- Hodges, P.W., Richardson, C.A., 1998. Delayed postural contraction of transversus abdominus in low back pain associated with movement of the lower limb. *J. Spinal Disord.* 11, 46–56.
- Hodges, P.W., Richardson, C.A., 1999. Altered trunk muscle recruitment in people with low back pain with upper limb movement at different speeds. *Arch. Phys. Med. Rehab.* 80, 1005–1012.
- Huang, Q.M., Andersson, E., et al., 2001. Intramuscular myoelectric activity and selective coactivation of trunk muscles during lateral flexion with and without load. *Spine* 26, 1465–1472.
- Kaigle, A.M., Holm, S.H., et al., 1995. Experimental instability in the lumbar spine. *Spine* 20, 421–430.
- Lariviere, C., Gagnon, D., et al., 2000. The comparison of trunk muscles EMG activation between subjects with and without chronic low back pain during flexion–extension and lateral bending tasks. *J. Electromyogr. Kinesiol.* 10, 79–91.
- Lindgren, K.A., Sihvonen, T., et al., 1993. Exercise therapy effects on functional radiographic findings and segmental electromyographic activity in lumbar spine instability. *Arch. Phys. Med. Rehab.* 74, 933–939.
- Luoto, S., Huupli, M., et al., 1996. Isokinetic performance capacity of trunk muscles. Part II. Coefficient of variation in isokinetic measurement in maximal effort and in submaximal effort. *Scand. J. Rehab. Med.* 28, 207–210.
- Mayer, T.G., Smith, S.S., et al., 1985. Quantification of lumbar function. Part 2. Sagittal plane trunk strength in chronic low-back pain patients. *Spine* 10, 765–772.
- Mimura, M., Panjabi, M.M., et al., 1994. Disc degeneration affects the multidirectional flexibility of the lumbar spine. *Spine* 19, 1371–1380.
- Nakamura, D., Holm, M., et al., 1988. Measures of balance and fear of falling in the elderly: a review. *Phys. Occup. Ther. Geriatr.* 15, 17–32.
- Newcomer, K.L., Jacobson, T.D., et al., 2002. Muscle activation patterns in subjects with and without low back pain. *Arch. Phys. Med. Rehab.* 83, 816–821.
- Ng, J.K., Richardson, C.A., 1996. Reliability of electromyographic power spectral analysis of back muscle endurance in healthy subjects. *Arch. Phys. Med. Rehab.* 77, 259–264.
- O'Sullivan, P., Twomey, L., et al., 1997a. Altered patterns of abdominal muscle activation in patients with chronic low back pain. *Aust. J. Physiother.* 43, 91–98.
- O'Sullivan, P.B., Phytty, G.D., et al., 1997b. Evaluation of specific stabilizing exercise in the treatment of chronic low back pain with radiologic diagnosis of spondylolysis or spondylolisthesis. *Spine* 22, 2959–2967.
- Panjabi, M.M., 1992. The stabilizing system of the spine. Part I. Function, dysfunction, adaptation, and enhancement. *J. Spinal Disord.* 5, 383–389, discussion 397.
- Panjabi, M., Abumi, K., et al., 1989. Spinal stability and intersegmental muscle forces. A biomechanical model. *Spine* 14, 194–200.
- Panjabi, M., Brown, M., et al., 1988. Intrinsic disc pressure as a measure of integrity of the lumbar spine. *Spine* 13, 913–917.
- Paris, S.V., 1985. Physical signs of instability. *Spine* 10, 277–279.
- Radebold, A., Cholewicki, J., et al., 2000. Muscle response pattern to sudden trunk loading in healthy individuals and in patients with chronic low back pain. *Spine* 25, 947–954.
- Rasmussen-Barr, E., Nilsson-Wikmar, L., et al., 2003. Stabilizing training compared with manual treatment in sub-acute and chronic low-back pain. *Manual Ther.* 8, 233–241.
- Ross, E.C., Parnianpour, M., et al., 1993. The effects of resistance level on muscle coordination patterns and movement profile during trunk extension. *Spine* 18, 1829–1838.
- Sihvonen, T., Lindgren, K.A., et al., 1997. Movement disturbances of the lumbar spine and abnormal back muscle electromyographic findings in recurrent low back pain. *Spine* 22, 289–295.
- Sihvonen, T., Partanen, J., et al., 1991. Electric behavior of low back muscles during lumbar pelvic rhythm in low back pain patients and healthy controls. *Arch. Phys. Med. Rehab.* 72, 1080–1087.
- Sterling, M., Jull, G., et al., 2001. The effect of musculoskeletal pain on motor activity and control. 2, 135–145.
- Stokes, I.A., Henry, S.M., et al., 2003. Surface EMG electrodes do not accurately record from lumbar multifidus muscles. *Clin. Biomech. (Bristol, Avon)* 18, 9–13.
- Tanaka, N., An, H., et al., 2001. The relationship between disc degeneration and flexibility of the lumbar spine. *Spine J.* 1, 47–56.
- Van Dieen, J.H., Cholewicki, J., et al., 2003. Trunk muscle recruitment patterns in patients with low back pain enhance the stability of the lumbar spine. *Spine* 28, 834–841.
- Waddell, G., 1987. 1987 Volvo award in clinical sciences. A new clinical model for the treatment of low-back pain. *Spine* 12, 632–644.
- Wilke, H.J., Wolf, S., et al., 1995. Stability increase of the lumbar spine with different muscle groups. A biomechanical in vitro study. *Spine* 20, 192–198.
- Yang, J.F., Winter, D.A., 1983. Electromyography reliability in maximal and submaximal isometric contractions. *Arch. Phys. Med. Rehab.* 64, 417–420.

Please PRINT in black ink.

Claim Number

A. Patient & Employer Information

Last Name				First Name				Init.																				
Address (no. street, apt.)																												
City/Town						Prov.	Postal Code	Telephone No. ()																				
Date of Birth	dd	mm	yyyy	Date of Accident	dd	mm	yyyy	Sex	☐ F ☐ M																			
Employer Name				Supervisor/Contact Name				Telephone No. ()																				
Address (no. street, apt.)																												
City/Town						Prov.	Postal Code																					
Patient's Current Job Title/Occupation								Length of time in current job: months years																				
Patient's employment status at time of assessment:																												
<table border="0"> <tr> <td>A. ☐ Full time</td> <td>OR</td> <td>☐ Part time worker</td> <td colspan="7" rowspan="4"> Please ask the patient before assessment: If not working how long do you think you will be off work? _____ days </td> </tr> <tr> <td>B. ☐ Regular duties</td> <td>OR</td> <td>☐ Modified duties</td> </tr> <tr> <td>C. ☐ Regular hours</td> <td>OR</td> <td>☐ Modified hours</td> </tr> <tr> <td>D. ☐ Not working</td> <td></td> <td></td> </tr> </table>										A. ☐ Full time	OR	☐ Part time worker	Please ask the patient before assessment: If not working how long do you think you will be off work? _____ days							B. ☐ Regular duties	OR	☐ Modified duties	C. ☐ Regular hours	OR	☐ Modified hours	D. ☐ Not working		
A. ☐ Full time	OR	☐ Part time worker	Please ask the patient before assessment: If not working how long do you think you will be off work? _____ days																									
B. ☐ Regular duties	OR	☐ Modified duties																										
C. ☐ Regular hours	OR	☐ Modified hours																										
D. ☐ Not working																												

B. Health Professional Information

☐ Chiropractor ☐ Physiotherapist ☐ Other _____									
Health Professional Name (please print)								WSIB Provider ID.	
Facility Name									
Address (no. street, apt.)									
City/Town						Prov.	Postal Code	Telephone No. ()	

C. Clinical Information

1. Indicate the provider/facility who provided first treatment:							Date of First Treatment			dd	mm	yyyy
2. Name of referring health professional (if applicable):							Date of Referral			dd	mm	yyyy
3. Patient's history of injury:												
4. Describe patient's current symptoms:												
5. Describe relevant medical information (include medical history, medications, medical conditions, surgeries):												

**Program of Care for
Acute Low Back Injuries
Initial Assessment Report**

Patient's Last Name	First Name
Date of Birth	Date of Accident

Claim Number

C. Clinical Information (continued)

6. Summary of physical findings (including pertinent negative findings):

7. Are there any complicating factors that may delay recovery? ☐ Yes ☐ No

If **Yes**, please identify:

- ☐ Believes hurt equals harm ☐ Low mood/social withdrawal ☐ Home environment concerns ☐ Other: _____
☐ Fears/avoids activity ☐ Prefers passive treatments ☐ Work environment concerns _____

8. Working Diagnosis:

9. Administer and record patient's numeric pain rating at initial assessment: _____ /10

10. Indicate Range of Pain:

- ☐ No low back pain ☐ Low back pain without radiation ☐ Low back pain radiating no further than the knee ☐ Low back pain radiating below the knee, no neurological signs ☐ Low back pain radiating to a precise dermatome, with or without neurological signs

11. Administer and record patient's Roland - Morris Disability Questionnaire score at initial assessment: _____ /24

12. Describe patient's limitations in Activities of Daily Living and/or significant changes (self-care, sleep history, participation and leisure, sports, and hobbies):

D. Treatment Plan & Return To Work Recommendation

13. Specify anticipated treatment plan (include type of intervention, intensity, frequency, duration):

Anticipate treatment beyond 4 weeks (into sub-acute phase)? ☐ Yes ☐ No

14. Will referral(s) be made to other health professional(s)? ☐ Yes ☐ No

If **Yes**, provide name and contact information: _____

15. Considering your assessment findings, can patient remain/return to work? ☐ Yes ☐ No

If **Yes**, specify: ☐ Regular duties ☐ Modified duties
☐ Regular hours ☐ Modified hours

If **No**, indicate expected return to work:

dd	mm	yyyy
----	----	------

16. Describe the patient's functional limitations:

A. ☐ No Limitations

B. ☐ Limitations (please specify) ☐ Lifting ☐ Sitting ☐ Climbing stairs/ladders
☐ Kneeling ☐ Standing ☐ Use of upper extremities
☐ Bending/twisting ☐ Other: _____

Comments: _____

It is an offense to knowingly make a false or misleading statement or representation to the Workplace Safety and Insurance Board (WSIB). I hereby declare that the information being submitted is true and complete.

Health Professional's Signature

Date

Aberdeen Low Back Pain Scale

Overview:

Ruta et al all used a questionnaire to measure outcome in patients with low back pain. This can be used for initial evaluation of the patient and to monitor the effectiveness of any interventions. The authors are from the University of Aberdeen and the Aberdeen Royal Infirmary in Scotland.

Question	Response	Points
In the past 2 weeks how many days did you suffer pain in the back or leg(s)?	none at all	0
	between 1 and 5 days	1
	between 6 and 10 days	2
	for more than 10 days	3
On the worst day during the past 2 weeks how many painkilling tablets did you take?	none at all	0
	less than 4 tablets	1
	between 4 and 8 tablets	2
	between 9 and 12 tablets	3
	more than 12 tablets	4
Is the pain made worse by any of the following?	coughing	+1
	sneezing	+1
	sitting	+1
	standing	+1
	bending	+1
	walking	+1
Do any of the following movements ease the pain?	lying down	see below
	sitting down	see below
	standing	see below
	walking	see below
In your right leg do you have any pain in the following areas?	pain in the buttock	+1

	pain in the thigh	+1
	pain in the shin or calf	+1
	pain in the foot or ankle	+1
In your left leg do you have any pain in the following areas?	pain in the buttock	+1
	pain in the thigh	+1
	pain in the shin or calf	+1
	pain in the foot or ankle	+1
Do you have any loss of feeling in your legs?	no	0
	yes just one leg	1
	yes both legs	2
In your right leg do you have any weakness or loss of power in the following areas?	hip	+1
	knee	+1
	ankle	+1
	foot	+1
In your left leg do you have any weakness or loss of power in the following areas?	hip	+1
	knee	+1
	ankle	+1
	foot	+1
If you were to try and bend forward without bending your knees how far down do you think you could bend before the pain stopped you?	I could touch the floor.	0
	I could touch my ankles with the tips of my fingers.	1
	I could touch my knees with the tips of my fingers.	2
	I could touch my mid thighs with the tips of my fingers.	3
	I couldn't bend forward at all.	4

On the worst night during the last 2 weeks how badly was your sleep affected by the pain?	not affected at all	0
	I didn't lose any sleep but needed tablets	1
	it prevented me from sleeping but I slept for more than 4 hours	2
	I only had 2-4 hours of sleep	3
	I had less than 2 hours of sleep	4
On the worst day during the last 2 weeks did the pain interfere with your ability to sit down?	I was able to sit in any chair for as long as I liked	0
	I could only sit in my favorite chair as long as I liked	1
	pain prevented me from sitting more than 1 hour	2
	pain prevented me from sitting more than 30 minutes	3
	pain prevented me from sitting more than 15 minutes	4
	pain prevented me from sitting at all	5
On the worst day during the last 2 weeks did the pain interfere with your ability to stand?	I could stand as long as I wanted without extra pain	0
	I could stand as long as I wanted but it gave me extra pain	1
	pain prevented me from standing more than 1 hour	2
	pain prevented me from standing more than 30 minutes	3
	pain prevented me from standing more than 15 minutes	4
	pain prevented me from standing at all	5
On the worst day during the last 2 weeks did the pain interfere with your ability to walk?	pain did not prevent me walking any distance	0
	pain prevents me walking more than 1 mile	1

	pain prevents me walking more than 1/2 mile	2
	pain prevents me walking more than 1/4 mile	3
	I can walk but less than 1/4 mile	4
	I was unable to walk at all	5
In the last 2 weeks did the pain prevent you from carrying out your work housework and other daily activities?	no not at all	0
	I could continue with my work but my work suffered	1
	yes for one day	2
	yes for 2-6 days	3
	yes for 7 days or more	4
In the last 2 weeks for how many days have you had to stay in bed because of the pain?	none at all	0
	between 1 and 5 days	1
	between 6 and 10 days	2
	for more than 10 days	3
In the last 2 weeks has your sex life been affected by your pain?	not affected by the pain	0
	mildly affected by the pain	1
	moderately affected by the pain	2
	pain prevents any sex life at all	3
	does not apply	NA
In the last 2 weeks have your leisure activities been affected by your pain?	not affected by the pain	0
	mildly affected by the pain	1
	moderately affected by the pain	2
	severely affected by the pain	3
	pain prevents any social life at all	4
In the last 2 weeks has the pain	not at all	0

interfered with your ability to look after yourself (e.g. washing dressing etc.)		
	because of the pain I needed some help looking after myself	1
	because of the pain I needed a lot of help looking after myself	2
	because of the pain I could not look after myself at all	3

where:

- Point assignments is discussed on page 1889 first column.
- Some point assignments may need review. For example pain in the foot or ankle without pain higher up strikes me as unusual to be due to back pain.
- The point assignment for actions that relieve the pain is unclear to me. According to the text it could be scored as +1 for each activity. But it would seem that the pain is worse if no activity relieves the pain. So I scored it as $(4 - (\text{number of actions relieving the pain}))$.
- Many scores of pain relief distinguish between different types of "painkillers".

total number of points = SUM(points for all questions answered)

back pain severity score = $(\text{SUM}(\text{points for all questions answered}) / \text{SUM}(\text{maximum points for questions answered})) * 100$

Interpretation: • minimum back pain severity scale: 0

• maximum back pain severity scale: 100

• The higher the score the greater the severity of the back pain.

Performance:

- The authors found the instrument valid and reliable.
- It was compared to the Oswestry Waddell and Greenough indices.
- It correlated with the SF-36 as a general measure of health status. It was able to detect significant changes in patients and was more responsive than the SF-36.
- It shows good internal consistency and test-retest reliability.
- The instrument shows construct validity.

References:

Ruta DA Garratt AM et al. Developing a valid and reliable measure of health outcome for patients with low back pain. Spine. 1994; 19: 1887-1896.

Program of Care for Acute Low Back Injuries

The evaluation of the Program of Care for Acute Low Back Injuries relies on the collection of complete, consistent and accurate information. You will note that much of the requested information is standard demographic and clinical information commonly recorded in this population.

Included is a numeric rating scale for pain and the Roland-Morris Disability Questionnaire (RMDQ) (Roland et. al., 2000). Please have your patients complete these and record the results on the **Initial Assessment Report** and again on the **Care and Outcomes Summary**. Report the pain score out of 10 and report the RMDQ as a total score out of 24. **Please do not send copies of the actual scales to the WSIB, simply retain them for your records.**

You can use these as your originals and copy as needed (permission from the authors to use or reproduce the instrument is not required). References are also included for your review.

REFERENCES

Roland M., & Fairbank J. (2000). The Roland-Morris Disability Questionnaire and the Oswestry Disability Questionnaire. *Spine*, 25(24), 3115-3124.

PLEASE NOTE A CORRECTION TO THE ROLAND-MORRIS DISABILITY QUESTIONNAIRE

In the Roland–Morris Disability Questionnaire as referenced above, there was a typographical error cited in question 18 which read “I sleep less well on my back”. The error was corrected in 2001 as cited below.

Spine 2001 Apr 1; 26(7):847.

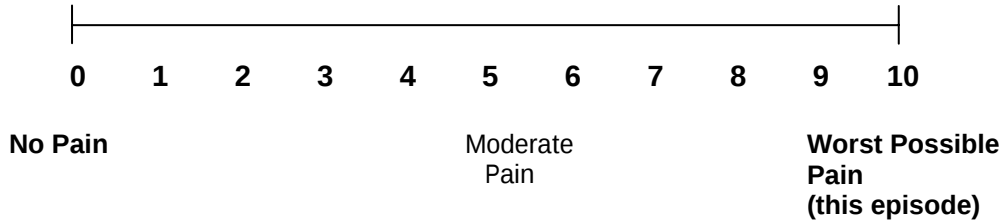
Erratum

RE: Roland M., Fairbank J. The Roland-Morris Disability Questionnaire and the Oswestry Disability Questionnaire. *Spine* 2000;25:3115–3124.

In Appendix 1, item 18 should read “I sleep less well because of my back.”

Pain Scale

Indicate your level of pain by choosing the appropriate number on the scale below.



The Roland-Morris Disability Questionnaire

When your back hurts, you may find it difficult to do some of the things you normally do. This list contains some sentences that people have used to describe themselves when they have back pain. When you read them, you may find that some stand out because they describe you *today*. As you read the following list, think of yourself *today*. When you read a sentence that describes you *today*, put a tick against it. If the sentence does not describe you then leave the space blank and go on to the next one. Remember, only tick the sentence if you are sure that it describes you today.

- ☐ 1. I stay at home most of the time because of my back.
- ☐ 2. I change position frequently to try and get my back comfortable.
- ☐ 3. I walk more slowly than usual because of my back.
- ☐ 4. Because of my back, I am not doing any of the jobs that I usually do around the house.
- ☐ 5. Because of my back, I use a handrail to get upstairs.
- ☐ 6. Because of my back, I lie down to rest more often.
- ☐ 7. Because of my back, I have to hold on to something to get out of an easy chair.
- ☐ 8. Because of my back, I try to get other people to do things for me.
- ☐ 9. I get dressed more slowly than usual because of my back.
- ☐ 10. I only stand for short periods of time because of my back.
- ☐ 11. Because of my back, I try not to bend or kneel down.
- ☐ 12. I find it difficult to get out of a chair because of my back.
- ☐ 13. My back is painful almost all the time.
- ☐ 14. I find it difficult to turn over in bed because of my back.
- ☐ 15. My appetite is not very good because of my back pain.
- ☐ 16. I have trouble putting on my socks (or stockings) because of the pain in my back.
- ☐ 17. I only walk short distances because of my back.
- ☐ 18. I sleep less well because of my back.
- ☐ 19. Because of my back pain, I get dressed with help from someone else.
- ☐ 20. I sit down for most of the day because of my back.
- ☐ 21. I avoid heavy jobs around the house because of my back.
- ☐ 22. Because of my back pain, I am more irritable and bad tempered with people than usual.
- ☐ 23. Because of my back, I go upstairs more slowly than usual.
- ☐ 24. I stay in bed most of the time because of my back.

Total = _____

The score is the total number of items checked and will range from 0 to 24.



Four-year follow-up of surgical versus non-surgical therapy for chronic low back pain.

Jens Ivar Brox, Øystein Nygaard, Inger Holm, et al.

Ann Rheum Dis published online July 26, 2009

doi: 10.1136/ard.2009.108902

Updated information and services can be found at:

<http://ard.bmj.com/content/early/2009/07/26/ard.2009.108902>

These include:

P<P

Published online July 26, 2009 in advance of the print journal.

**Email alerting
service**

Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Notes

Advance online articles have been peer reviewed and accepted for publication but have not yet appeared in the paper journal (edited, typeset versions may be posted when available prior to final publication). Advance online articles are citable and establish publication priority; they are indexed by PubMed from initial publication. Citations to Advance online articles must include the digital object identifier (DOIs) and date of initial publication.

To order reprints of this article go to:

<http://ard.bmj.com/cgi/reprintform>

To subscribe to *Annals of the Rheumatic Diseases* go to:

<http://ard.bmj.com/subscriptions>

Four-year follow-up of surgical versus non-surgical therapy for chronic low back pain.

Jens Ivar Brox, PhD*

Øystein P. Nygaard, PhD**

Inger Holm, PhD#

Anne Keller, PhD##

Tor Ingebrigtsen, PhD§

Olav Reikerås, PhD*

* Orthopaedic Department, Oslo University Hospital - Rikshospitalet, Norway.

** Neurosurgical Department, St. Olavs Hospital, Trondheim, Norway.

Clinic of Rehabilitation, Oslo University Hospital –Rikshospitalet.

Department of Physical Medicine and Rehabilitation, Oslo University Hospital – Ullevaal.

§ Neurosurgical Department, UNN, Tromsø, Norway.

§§ Hospital of Rehabilitation, Stavern, and Unifob Health, University of Bergen, Norway

Corresponding author: Jens Ivar Brox, Orthopaedic Department, Rikshospitalet University Hospital, Sognsvannsveien, 0027 Oslo, Norway.

E-mail: jens.ivar.brox@rikshospitalet.no

Key words: chronic low back pain, surgery, cognitive intervention, long-term, randomised

Abstract

Objectives: To compare long-term effectiveness of surgical with non surgical treatment in patients with chronic low back pain.

Methods: Two merged randomised clinical trials compared instrumented transpedicular fusion with cognitive intervention and exercises in 124 patients with disc degeneration and at least 1 year of symptoms after or without previous surgery for disc herniation. The main outcome measure was the Oswestry Disability Index.

Results: At 4 years 14 (24%) patients randomly assigned to cognitive intervention and exercises had also undergone surgery. Fifteen (23%) patients assigned fusion had undergone re-surgery. The mean treatment effect for the primary outcome was 1.1; 95% CI: -5.9 to 8.2, according to the intention-to-treat analysis, and -1.6; 95% CI: -8.9 to 5.6 in the as-treated analysis. There was no difference in return to work.

Conclusions: Long-term improvement was not better after instrumented transpedicular fusion compared with cognitive intervention and exercises.

Introduction

Lumbar spine fusion for chronic low back pain has increased rapidly during the past two decades.¹ Four randomised studies have compared lumbar fusion and conservative treatment in patients with disc degeneration and chronic low back pain.²⁻⁵ Results up to 2 years after treatment have been published. A recent meta-analysis concluded that cumulative evidence at the present time does not support routine fusion, while a recent systematic review concluded that surgery may be more efficacious than unstructured care, but may not be more efficacious than structured cognitive behavioural therapy.^{6,7} Methodological limitations of the randomised trials prevent firm conclusions. The Norwegian studies, published in three papers,^{4,5,8} were criticized for lack of power, short follow-up and a high number of withdrawals from fusion among patients with chronic low back pain after surgery for disc herniation.

Because results, interventions and outcome measures were similar we merged the two Norwegian trials for long-term follow-up using a questionnaire mailed to the patients. We report 4-year effectiveness of lumbar fusion versus cognitive intervention and exercises in patients with chronic low back pain with and without previous surgery for disc herniation.

PATIENTS AND METHODS

Study design

The Norwegian studies were investigator-initiated in 1999 and conducted at four university hospitals. They were designed as two separate randomised trials and results were reported after 1-year follow-up.^{4,5} The ethics committee for medical research in health region I of Norway approved the studies.

Patients

Patients aged 25-60 years with chronic low back pain for at least 1 year, Oswestry Disability Index > 30, and disc degeneration at L4/5 and/or L5/S1, were eligible to participate in the study. Exclusion criteria were: widespread myofascial pain, spinal stenosis with reduced walking distance and neurological signs, disc herniation or lateral recess stenosis with clinical signs of radiculopathy, inflammatory disease, previous spinal fracture, previous fusion surgery of the spine, pelvic pain, generalized disc degeneration on plain radiographic examination, ongoing serious somatic and psychiatric disease, registered medicine abuse, and reluctance to accept one of the

interventions. At least one spine surgeon and one specialist in physical medicine and rehabilitation examined each patient. A research physiotherapist coordinated the study and verified eligibility. All eligible patients were given oral and written information about the study and the two interventions.

Randomisation

Patients received treatment assignments from an independent randomisation central at the University of Bergen that was not involved in the treatment. Computer-generated randomly permuted blocks were used and allocation was concealed. The project coordinator telephoned the randomisation central and reported an identification number and was phoned back in order to inform the patient about the assigned intervention.⁴ Treatments were started within 3 months after the randomisation.

Study interventions

The protocol surgery was posterolateral fusion with transpedicular screws of the L4-L5 and/or L5-S1 segment. Autologous bone was used in all cases. Postoperative rehabilitation was at the choice of the surgeon. Surgery was performed at two neurosurgical and two orthopaedic departments.⁴

The cognitive intervention and exercises consisted of 1 week + 2 weeks in the outpatient clinic at the study centre interrupted by 2 weeks at home. Specialists in physical medicine and physiotherapists gave the intervention. In addition, patients met a peer for exchanging experiences. The main aim was to make the patients confident that they could not do any harm to the disc (back) by engaging in ordinary activities of daily life. Details of the program have been outlined previously.⁴

Outcome measures

A standardized questionnaire was sent by post to all patients. The primary outcome measure was the original (version 1.0) Oswestry Disability Index.⁹ This score has 10 questions about pain and disability and ranges from 0% (no pain and disability) to 100% (worst possible disability).

Secondary outcome measures included pain,³ General Function Score,¹⁰ Global Back Disability Question for assessment of patients overall rating,¹¹ work and medication,¹¹ emotional distress,¹² fear-avoidance beliefs,¹³ and life satisfaction (for details see online supplemental file).¹⁴ The questionnaire also included questions about treatment taken after the 1-year follow-up. Additional surgery was verified from medical records.

Statistical analysis

Estimation of sample sizes in the two trials merged for 4-year follow-up has been reported previously.^{4,5} Results are primarily analyzed with an intention-to-treat approach. Because of crossover and withdrawal, sensitivity analyzes were based on the treatment actually received. Baseline characteristics in those who attended 4-year follow-up were compared with crossover patients and withdrawals in the two treatment groups (Table 1). Means ($\pm$ SD) or numbers (percentages) were calculated for baseline and 4-year follow-up in those who attended, and reported separately for intention-to-treat and as-treated analyzes. The analyzes of treatment effects compared differences between interventions at 4 years using linear regression with adjustments for gender, age, previous surgery for disc herniation, and baseline scores. We conducted analyzes with and without the most recent observed non-missing value carried forward in those who did not attend 4-year follow-up. We used this simplistic

method, being aware that more comprehensive multiple imputation techniques are available.¹⁵ The estimated treatment effects are reported as mean adjusted differences between groups (95% confidence interval) based on analyses using the last observed value carried forward and including all patients randomised (Table 2 and 3). Categorical outcomes (patients overall rating, medication and work) were dichotomized and logistic regression was used to calculate adjusted odds ratios (95% confidence interval) with adjustments for gender, age, previous surgery for disc herniation, and baseline scores.⁴ Analyses were performed with the use of SPSS software, version 15.

RESULTS

Patients

A total of 124 patients were enrolled out of 234 who were eligible: 66 were assigned to the surgical group and 58 to the non-surgical group (fig 1). The 4-year follow-up rate was 92% and 86%, respectively. In the surgical group, 88% had undergone surgery at 1 year and 91% at 4 years. In the non-surgical group, 5% had undergone surgery at 1 year and 24% at 4 years.

In both groups patients had stronger beliefs in surgical compared with non-surgical treatment at baseline (table 1). Crossover patients and withdrawals from surgery were more often men and non-smokers, had higher occupational education and higher comorbidity, but took less often analgesics at baseline. Such patients from the non-surgical group took more often analgesics at baseline.

Health care utilization and return to work

Thirty (49%) and 29 (58%) allocated surgical or non-surgical treatment, respectively, reported visits to a physician for back pain the year before 4-year follow-up. Physiotherapy (20% vs. 22%) and other treatments (16% vs. 14%) were taken by a minority in both groups. More patients who had surgery (53% vs. 32%) were on disability pension (Adjusted OR 2.5; 95 % CI 1.1 to 5.9). For the intention-to-treat analysis this difference was no longer significant ($p = 0.21$). The number of patients working full time was not significantly different (tables 2 and 3).

Cross-over, complications, and reoperations

Non-adherence was registered in 17 (29%) patients randomised to cognitive intervention and exercises, 3 (5%) did not have the allocated treatment and 14 (24%) patients had later surgery (fig 1). Eleven (17%) patients randomised surgery were classified as non-adherence, 6 (9%) did not have lumbar fusion (Fig 1), 2 (3%) withdrew and three (5%) patients died. Deaths were not related to surgical procedures. Four cross-over patients operated (25%) in the non-surgical group and 15 (25%) in the surgical group had re-operation.

The reason was persistent complaints or deterioration of the condition. Complications are described previously.^{4, 5} No major complications occurred in patients operated after the 1-year follow-up.

Main treatment effects

In the intention-to-treat analysis there was no treatment effect for the Oswestry Disability Index. When adjusted for age, gender, baseline score, and previous disc surgery the treatment effect was 1.1; 95% CI: -5.9 to 8.2 (table 2). The mean adjusted treatment effect was -1.6; 95% CI: -8.9 to 5.6 (table 3) according to as-treated

analysis. Sensitivity analyses including only those who attended 4-year follow-up did not alter results.

Secondary outcome

The only treatment effect observed among secondary outcome was reduction of fear avoidance beliefs favouring cognitive intervention and exercises (table 2 and 3). The mean treatment effect for fear avoidance beliefs for physical activity was -3.5 ; 95% CI: -5.8 to -1.1 in the intention-to-treat analysis, and -2.8 ; 95% CI: -5.3 to -0.4 in the as-treated last analysis, and -4.3 ; 95% CI -8.3 to -0.2 , and -4.8 ; 95% CI: -8.9 to -0.7 for fear avoidance beliefs for work, respectively. Pain medication was taken daily or weekly by 58% treated with surgery vs. 35% not operated (Adjusted odds ratio 2.3; 95% CI: 1.0 to 5.2. For the intention-to-treat analysis the difference was no longer significant ($p = 0.14$).

Table 1. Baseline characteristics of the patients*

	Lumbar fusion		Cognitive intervention and exercises	
	All randomised (n = 66)	Crossover/withdrawals (n =11)#	All randomised (n = 58)	Crossover/withdrawals (n =17)#
Age (years)	42.7±8.0	43.9±7.3	42.4±8.0	42.1±7.7
Number of men (%)	27 (41)	7 (64)	29 (50)	8 (47)
Years from first pain episode	8.9±7.9	8.1±7.9	9.6±7.4	12.2±9.6
Married/living together no. (%)	57 (86)	10 (91)	49 (81)	15(88)
Occupational education < 3 years no. (%)	45 (68)	8 (27)	38 (66)	9 (53)
Work status no. (%)				
- working	9 (14)	2 (18)	9 (16)	1 (6)
- on sick leave	14 (21)	3 (27)	16 (28)	5 (29)
- on rehabilitation	29 (44)	3 (27)	22 (38)	7 (41)
- disability pension	10 (15)	3 (27)	10 (17)	4 (24)
- student, homemaker, unemployed	3 (5)			
- retirement pension	1 (2)		1 (2)	
Back pain (0-100)§	63.0±14.7	64.2±15.5	64.6±12.5	65.2±12.0
Oswestry Disability Index □	44.5±10.7	45.3±10.1	44.2±11.0	47.0±7.8
Emotional distress (1-4)**	1.9±0.5	1.9±0.7	1.9±0.5	1.9±0.5
Previous surgery for disc herniation no. (%)	29 (44)	4 (36)	31 (53)	8 (47)
Beliefs in surgery##	69.7±18.2	62.1±17.7	72.4±20.3	70.3±16.5
Beliefs in non-surgical treatment ##	40.1±25.4	42.1±24.5	44.5±25.1	44.0±24.7
Comorbidity no. (%)	24 (36)	6 (55)	18 (31)	6 (35)
Taking analgesics daily or weekly no. (%)	40 (61)	4 (36)	40 (69)	16 (94)
Smoking no. (%)	36 (55)	4 (36)	30 (52)	9 (53)

* Plus-minus values are means ± SD.

Three patients allocated lumbar fusion died, 4 did not have and 4 had cognitive intervention and exercises. 14 patients allocated cognitive intervention and exercises had surgery.

§ Back pain ranges from 0 to 100, with lower score indicating less severe symptoms.

□ The Oswestry Disability Index ranges from 0 to 100, with lower scores indicating less severe symptoms.

** Emotional stress ranges from 1 to 4, with lower scores indicating less severe symptoms.

Beliefs ranges from 0 to 100, with lower scores indicating not efficient.

Table 2. Intention-to-treat analysis*

Outcome	Lumbar fusion (N=61)§	Cognitive/ exercises (N=50)§	Adjusted treatment effect (95% CI)#
Primary			
Oswestry Disability Index §			
Base line	44.1±10.7	43.4±11.1	
4-year	29.7±20.5	27.0±19.4	1.1 (-5.9 to 8.2)
Secondary			
General Function Score §			
Base line	37.3±19.3	40.0±18.9	
4-year	25.8±24.7	21.4±21.5	-3.5 (-11.6 to 4.6)
Back pain §			
Base line	62.8±14.5	64.2±12.5	
4-year	42.2±23.9	44.7±22.8	2.3 (-6.4 to 10.9)
Lower limb pain §			
Base line	48.5±24.4	44.8± 23.5	
4-year	34.8±29.4	33.5± 24.7	1.3 (-8.3 to 10.8)
Emotional distress □			
Base line	1.9±0.5	1.9±0.5	
4-year	1.7±0.6	1.7±0.6	-0.1 (-0.1 to 0.3)
Life satisfaction **			
Base line	5.0±2.2	4.6±1.7	
4-year	6.2±2.5	6.4±2.3	-0.3 (-1.1 to 0.6)
Fear-avoidance beliefs physical activity ##			
Base line	13.0± 5.0	15.4±5.0	
4-years	9.1± 7.3	7.0±6.0	-3.5 (-5.8 to -1.1)
Fear- avoidance beliefs work ##			
Base line			
4-years	26.1±10.5 23.9±13.8	28.4±10.7 21.1±12.5	-4.3 (-8.3 to -0.2)
Patients overall rating - no. (%) success§§			
1-year	38 (62)	32 (64)	1.0 (0.8 to 1.5)
Work – no. (%)			
Base line	9 (15)	8 (16)	
1-year	16 (26)	17 (34)	0.8 (0.3 to 1.9)

* Mean values ± SD unless otherwise noted.

The treatment effect is the difference between patients randomised lumbar fusion and cognitive intervention and exercises at 4 years with adjustments for baseline score, age, gender, and previous disc surgery. All patients randomised (n = 124) are included with last observed value carried forward.

§ The Oswestry Disability Index, the General Function Score, back and lower limb pain ranges from 0 to 100, with lower scores indicating less symptoms.

□ Emotional stress ranges from 1 to 4, with lower scores indicating less severe symptoms.

** Life satisfaction ranges from 1-10, with higher scores indicating better life satisfaction.

Fear-avoidance beliefs for physical activity ranges from 0 to 24 and for work from 0 to 42, with lower scores indicating less strong beliefs for physical activity and work hurting the back.

§§ All who did not attend 4-year follow-up are classified as non-success.

Table 3. As-treated analyses.*

Outcome	Lumbar fusion (N=62)	Cognitive/ exercises (N=49)	Adjusted treatment effect (95% CI)#
Primary			
Oswestry Disability Index §			
Base line	44.4±10.6	43.0±11.1	
4-year	29.1±20.2	27.7±19.9	-1.6 (-8.9 to 5.6)
Secondary			
General Function Score §			
Base line	37.9±19.3	39.2±19.2	
4-year	24.8±24.7	22.5±22.9	-3.2 (-11.4 to 5.0)
Back pain §			
Base line	63.3±14.7	64.2±12.5	
4-year	40.5±23.0	46.8±23.4	4.1 (-4.7 to 12.8)
Lower limb pain §			
Base line	48.4±23.1	44.8± 24.9	
4-year	35.5±27.7	32.7± 26.8	- 2.9 (-12.6 to 6.7)
Emotional distress □			
Base line	1.8±0.5	1.9±0.5	
4-year	1.6±0.5	1.6±0.7	0.1 (-0.2 to 0.3)
Life satisfaction **			
Base line	5.0±2.3	4.7±1.7	
4-year	6.4±2.4	6.2±2.4	0.2 (-0.6 to 1.0)
Fear-avoidance physical activity ##			
Base line	13.1± 5.0	15.5±5.1	
4-years	8.8± 7.0	7.3±6.4	-2.8 (-5.3 to -0.4)
Fear- avoidance work ##			
Base line	26.4±10.1	28.1±12.4	
4-years	23.8±13.0	21.1±13.4	-4.8 (-8.9 to -0.7)
Patients overall rating - no. (%) success§§			
1-year	38 (61)	32 (65)	1.1 (0.8 to 1.8)
Work – no. (%)			
Base line	8 (13)	9 (18)	
1-year	15 (26)	16 (33)	0.8 (0.4 to 1.6)

* Mean values ± SD unless otherwise noted.

The treatment effect is the difference between the lumbar fusion group and the cognitive intervention and exercises group at 4 years with adjustments for baseline score, age, gender, and previous disc surgery. All patients randomised (n = 124) are included with last observed value carried forward.

§ The Oswestry Disability Index, the General Function Score, back and lower limb pain ranges from 0 to 100, with lower scores indicating less symptoms.

□ Emotional stress ranges from 1 to 4, with lower scores indicating less severe symptoms.

** Life satisfaction ranges from 1-10, with higher scores indicating better life satisfaction.

Fear-avoidance beliefs for physical activity ranges from 0 to 24 and for work from 0 to 42, with lower scores indicating less strong beliefs for physical activity and work hurting the back.

§§ All who did not attend 4-year follow-up are classified as non-success.

DISCUSSION

In patients with chronic low back pain with and without previous surgery for disc herniation, lumbar fusion was not superior to cognitive intervention and exercises at relieving symptoms, improving function, and return to work at 4-years. The results were consistent for intention-to-treat and as-treated analyzes. The number of re-operations in patients randomised surgery were similar to the number patients operated in the non-surgical group.

The confidence intervals for the treatment effects were within 10 points on Oswestry Disability Index that the trial was designed to detect. This indicates that lack of power is unlikely to explain the observed results.

Comparison with existing literature

The present study is the first to provide long-term results of a randomised study comparing lumbar fusion with non-surgical treatment in patients with chronic low back pain. Results are in agreement with previously reported results at 1- and 2 years.²⁻⁵ The reported long-term results do not exclude that fusion may be indicated in carefully selected patients with chronic low back pain, but widening indications have contributed to the rise in rates of fusion surgery.¹⁶ Despite much effort to improve selection criteria, there is no agreement in order to provide a valid tool to diagnose discogenic pain, and even procedures such as discography and MRI are not reliable for selecting patients.¹⁷ Hägg et al reported that a personality characterized by low neuroticism, and low disc height predicted functional improvement after surgery and that work resumption was predicted by low age and short-term sick leave.¹⁸

The re-operation rate was slightly higher than previously reported after spinal surgery.¹⁹ A higher rate is not unexpected after instrumented fusion compared with laminectomy and discectomy. Although device failure and postoperative infection did not explain the cases in the present study, outcome after surgery for back pain may be less predictable than after surgery for leg pain. Re-operation is an undesirable outcome, and the high rate observed in the present study, is an argument against surgery. Preventing repeat spinal surgery is an important goal for surgeons and patients.

We observed no treatment effects in secondary outcome except for fear-avoidance beliefs. Differences in favour of non-surgical treatment for the number taking pain medication regularly or on disability pension were observed in the as treated analysis only. The aim of the non-surgical intervention was to give the patients the understanding that they could not do any harm to the disc (back) by engaging in ordinary activities of daily life. To reduce fear and avoidance and achieve confidence patients were encouraged and confronted in physical activities that were previously not recommended. Results at 4-years suggest that the reduction in avoidant behaviour observed at 1-year was maintained.

We observed that more patients used pain medication after surgery. Alternative interpretations are that these patients either experience more pain or they are habituated to pain medication. A recent study reported that surgical patients used more opiates, but that both pain medication and pain intensity were reduced after participation in a multidisciplinary pain program.²⁰ The reduction was attributed a cognitive-behavioural approach to symptom management during the course of the rehabilitation program. The possible effect of multidisciplinary pain rehabilitation on withdrawal of pain medication warrants further studies.

Most patients included were out of work at baseline. The number, who had returned to work, was not significantly different at 4-years, but the odds-ratio for

disability pension was increased after surgery. Our interpretation is that the claim adjuster may consider that lumbar fusion represents the end stage of treatment, and consequently the claim for disability pension may be more easily accepted.

Possible confounders and weaknesses

A limitation of this study is the non-adherence to randomised treatment. Although patients consented to the protocol, some of them chose to change their consent as they are allowed to in clinical trials. The degree of non-adherence was lower than in the SPORT studies.^{21, 22} One possible interpretation is that we aimed to conduct the interventions within 3 months after enrolment as compared with 3 to 6 months in the SPORT studies. The consistency of results in intention-to-treat and as-treated analyzes of the present study indicates that non-adherence does not play a decisive role to explain our results. Although 89% answered the follow-up questionnaire, the use of last value carried forward and not multiple imputation technique for missing values, may bias results.

Another limitation is the lack of placebo group. Expectations are important for outcome. Sham surgery has previously shown that methods expected to be highly effective, was mediated by placebo.²³ We are unable to exclude that the observed improvements reflect the natural course, placebo or expectations and care.

Surgeons, patients, and stakeholders may consider new technical surgical solutions more powerful, implying fast improvement and simple technical solutions in the hands of a skilled spine surgeon, but postulated advantages for new procedures are more based on theories than knowledge.²⁴ Introduction of new technology in clinical practice should be based on sound evidence from randomised studies.²⁵ Patients allocated non-surgical treatment should be given the best evidence intervention and the same attention and care as the surgical patients.

In conclusion, patients did not have better long-term improvement after instrumented fusion compared with cognitive intervention and exercises.

ACKNOWLEDGEMENTS:

We thank the patients who participated in the trial, the nurses and the nurse aids at the hospital departments and outpatient clinics, and the referring medical doctors; A. Friis for coordinating inclusion, treatments, and 1-year follow-up; H. Ursin and H. Eriksen at Unifob Health, University of Bergen for their work with randomisation of patients and comments on study design, A.H. Pripp at Rikshospitalet University Hospital for statistical advice; physiotherapists A.K.Koller, M. Fosdahl, and T. Haakenstad for non-surgical treatments; R. Sørensen, J.E. Lange, R.Riise, and O.Grundnes for lumbar fusions; and the radiologists R.Gunderson and A.M. Finnanger for their assistance.

The Corresponding Author has the right to grant on behalf of all authors and does grant on behalf of all authors, and exclusive licence (or non exclusive for government employees) on a worldwide basis to the BMJ Publishing Group Ltd to permit this article to be published in ARD and any other BMJ PGL products to exploit all subsidiary rights, as set out in our licence
<http://ARD.bmjournals.com/ifora/licence.pdf>.

REFERENCES

- 1 **Cowan JA, Jr.**, Dimick JB, Wainess R, Upchurch GR, Jr., Chandler WF, La MF. Changes in the utilization of spinal fusion in the United States. *Neurosurgery* 2006; **59**:15-20.
- 2 **Fairbank J**, Frost H, Wilson-MacDonald J, Yu LM, Barker K, Collins R and for the Spine Stabilisation Trial Group. Randomised controlled trial to compare surgical stabilisation of the lumbar spine with an intensive rehabilitation programme for patients with chronic low back pain: the MRC spine stabilisation trial. *BMJ* 2005; **330**:1233-9.
- 3 **Fritzell P**, Hägg O, Wessberg P, Nordwall A. 2001 Volvo award winner in clinical studies: lumbar fusion versus nonsurgical treatment for chronic low back pain: a multicenter randomized controlled trial from the Swedish lumbar spine study group. *Spine* 2001; **26**:2521-2532.
- 4 **Brox JI**, Sørensen R, Friis A et al. Randomized clinical trial of lumbar instrumented fusion and cognitive intervention and exercises in patients with chronic low back pain and disc degeneration. *Spine* 2003; **28**:1913-1921.
- 5 **Brox JI**, Reikerås O, Nygaard Ø et al. Lumbar instrumented fusion compared with cognitive intervention and exercises in patients with chronic back pain after previous surgery for disc herniation: a prospective randomized controlled study. *Pain* 2006; **122**:145-155.
- 6 **Ibrahim T**, Tleyjeh IM, Gabbar O. Surgical versus non-surgical treatment of chronic low back pain: a meta-analysis of randomised trials. *Int Orthop* 2008; **32**:107-113.
- 7 **Mirza SK**, Deyo RA. Systematic review of randomized trials comparing lumbar fusion surgery to nonoperative care for treatment of chronic back pain. *Spine* 2007; **32**:816-823.
- 8 **Keller A**, Brox JI, Gunderson R, Holm I, Friis A, Reikerås O. Trunk muscle strength, cross-sectional area, and density in patients with chronic low back pain randomized to lumbar fusion or cognitive intervention and exercises. *Spine* 2004; **29**:3-8.
- 9 **Fairbank J**, Davis J, Couper J, O' Brian JP. Oswestry disability questionnaire. *Physiotherapy* 1980; **66**:271-273.
- 10 **Hägg O**, Fritzell P, Romberg K, Nordwall A. The General Function Score: a useful tool for measurement of physical disability. Validity and reliability. *Eur Spine J* 2001; **10**:203-210.

- 11 **Holm I**, Friis A, Storheim K, Brox JI. Measuring self-reported functional status and pain in patients with chronic low back pain by postal questionnaires. A reliability study. *Spine* 2003; **28**:828-833.
- 12 **Derogatis LR**, Lipman RS, Rickels K, Uhlenuth EH, Cori L. The Hopkins Symptom Checklist (HSCL): A self-report inventory. *Behav Sci* 1974; **19**:1-15.
- 13 **Waddell G**, Newton M, Henderson I, Somerville D, Main CJ. A fear-avoidance beliefs questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability. *Pain* 1993; **52**:157-168.
- 14 **Andrews FM**, Robinson JP. Measures of subjective well-being. In: Robinson JP, Shaver PR, Wrightsman LS, editors. *Measures of personality and social psychological attitudes*. San Diego: Academic Press; 1991.
- 15 **Carpenter JR, Kenward MG, Vansteelandt S**. A comparison of multiple imputation and doubly robust estimation for analysis with missing data. *J Roy Statist Soc (A)* 2006; **169**: 1-14.
- 16 **Deyo R**, Nachemson A, Mirza SK. Spinal fusion surgery - the case for restraint. *N Engl J Med* 2004; **350**:722-726.
- 17 **Carragee EJ**. Persistent low back pain. *N Engl J Med* 2005; **352**:1891-1898.
- 18 **Hägg O**, Fritzell P, Ekselius L, Nordwall A. Predictors of outcome in fusion surgery for chronic low back pain. A report from the Swedish Lumbar Spine Study. *European Spine Journal* 2003; **12**:22-33.
- 19 **Martin BI**, Mirza SK, Comstock BA, Gray DT, Kreuter W, Deyo RA. Are lumbar spine reoperation rates falling with greater use of fusion surgery and new surgical technology? *Spine* 2007; **32**:2119-2126.
- 20 **Crisostomo RA**, Schmidt JE, Hooten WM, Kerkvliet JL, Townsend CO, Bruce BK. Withdrawal of analgesic medication for chronic low-back pain patients: improvement in outcomes of multidisciplinary rehabilitation regardless of surgical history. *Am J Phys Med Rehabil* 2008; **87**:527-536.
- 21 **Weinstein JN**, Tosteson TD, Lurie JD et al. Surgical versus nonsurgical therapy for lumbar spinal stenosis. *N Engl J Med* 2008; **358**:794-810.
- 22 **Weinstein JN**, Lurie JD, Tosteson TD et al. Surgical versus nonsurgical treatment for lumbar degenerative spondylolisthesis. *N Engl J Med* 2007; **356**:2257-2270.
- 23 **Chalmers TC**. Randomization and coronary artery surgery. *Ann Thorac Surg* 1972; **14**:323-327.
- 24 **Gibson JN**, Waddell G. Surgery for degenerative lumbar spondylosis. *Cochrane Database Syst Rev* 2005;(4):CD001352.
- 25 **Weinstein JN**. The tortoise and the hare: is there a place in spine surgery for randomized trials? *Spine* 1999; **24**:2548-2549.

Outcome measures

A standardized questionnaire was sent by post to all patients. The primary outcome measure was the original (version 1.0) Oswestry Disability Index.¹ This score has 10 questions about pain and disability and ranges from 0% (no pain and disability) to 100% (worst possible disability).

Secondary outcome measures included pain,² General Function Score,³ Global Back Disability Question for assessment of patients overall rating,⁴ work and medication,⁴ emotional distress,⁵ fear-avoidance beliefs,⁶ and life satisfaction.⁷ The questionnaire also included questions about treatment taken after the 1-year follow-up. Additional surgery was verified from medical records.

Patients scored their back and lower limb pain intensity on vertical Visual Analogue Scales (VAS), ranging from 0-100, where 100 reflected the worst pain imaginable. Maximum pain, minimum pain and current pain were scored on three different scales. The mean of the three measurements provided the pain index for back and lower limb pain.

The General Function Score was used to measure back related disability in activities of daily living. Patients answered nine questions using one of the three alternatives: “can perform”, “can perform with difficulty due to back complaints” and “cannot perform due to back complaints”. The score is presented as a percentage where 100% represents maximum disability.

Patients rated their overall function by the Global Back Disability Question answered only at 1-year follow-up. There were five response alternatives, “excellent, no or unimportant complaints”, “good, occasionally bothered by back pain”, “fair, some back pain and limited function”, “poor, unchanged, considerable complaints and severe disability” and “miserable, worse, not self-reliant in activities of daily living”. We have previously found that the reliability and construct validity of this question is good in the target population.⁴

Evaluation of work status included questions about paid work (full time, part time, not working), and status if not working (sick leave, rehabilitation, disablement pension, unemployed, homemaker or student). Within the Norwegian Social Insurance system persons who are still incapable of work after one year on sick leave are entitled to rehabilitation benefit or disablement pension. The reliability and construct validity of this outcome measure was acceptable.⁴

Emotional distress was rated by the Hopkins Symptom Check List (HSCL-25). Patients rate 25 symptoms from 1 (not at all) to 4 (extremely). A score > 1.75 is a high predictor of current help seeking, but seems to reflect illness or unspecific distress more than psychiatric diagnoses.

Waddell’s Fear-Avoidance Belief Questionnaire was used to quantify fear-avoidance beliefs, each item scored from 0-6, higher numbers indicating increased levels of fear-avoidance beliefs. Two sub-scales were used measuring fear-avoidance beliefs about physical activity and work. In a recent methodological study we found considerably higher variance for this questionnaire than the results from Waddell’s study.⁴

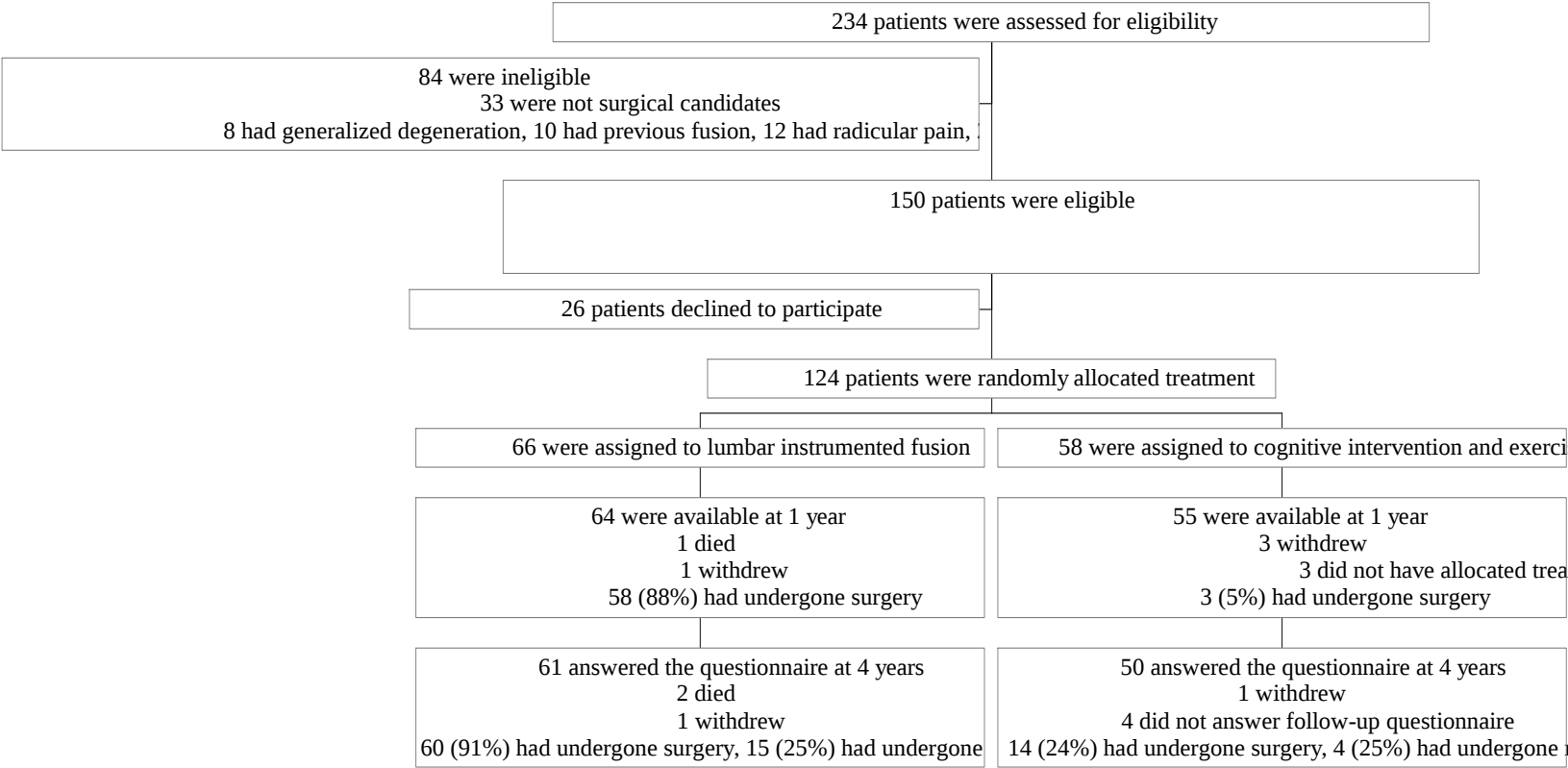
Life satisfaction was scored on a vertical Visual Analogue Scale from one (worst possible) to 10 (best possible). This score showed a considerable variation when measured twice within two weeks.⁴

References

- 1 **Fairbank JCT**, Davis J, Couper J, O’ Brian JP. Oswestry disability questionnaire. *Physiotherapy* 1980; **66**:271-273.

- 2 **Fritzell P**, Hägg O, Wessberg P, Nordwall A. 2001 volvo award winner in clinical studies: lumbar fusion versus nonsurgical treatment for chronic low back pain: a multicenter randomized controlled trial from the Swedish lumbar spine study group. *Spine* 2001; **26**:2521-2532.
- 3 **Hägg O**, Fritzell P, Romberg K, Nordwall A. The General Function Score: a useful tool for measurement of physical disability. Validity and reliability. *Eur Spine J* 2001; **10**:203-210.
- 4 **Holm I**, Friis A, Storheim K, Brox JI. Measuring self-reported functional status and pain in patients with chronic low back pain by postal questionnaires. A reliability study. *Spine* 2003; **28**:828-833.
- 5 **Derogatis LR**, Lipman RS, Rickels K, Uhlenuth EH, Cori L. The Hopkins Symptom Checklist (HSCL): A self-report inventory. *Behavioural Science* 1974; **19**:1-15.
- 6 **Waddell G**, Newton M, Henderson I, Somerville D, Main CJ. A fear-avoidance beliefs questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability. *Pain* 1993; **52**:157-168.
- 7 **Andrews FM**, Robinson JP. Measures of subjective well-being. In: Robinson JP, Shaver PR, Wrightsman LS, editors. *Measures of personality and social psychological attitudes*. San Diego: Academic Press; 1991.

Figure 1 Exclusion, enrollment, randomisation, and follow-up of participants.



Modification of the Pain Scales of Von Korff et al to Evaluate a Patient with Back Pain

Overview:

Underwood et al used a modification of the pain scales developed by von Korff et al to evaluate patients with back pain. The authors are from St. Bartholomew's and the Royal London School of Medicine in London.

Questions:

- (1) In the past 4 weeks how much has your back pain interfered with your daily activities?
- (2) In the past 4 weeks how much has back pain changed your ability to take part in recreational social and family activities?
- (3) In the past 4 weeks how much has back pain changed your ability to work (including housework)?
- (4) How would you rate your back pain today?
- (5) In the past 4 weeks how bad was your worst back pain?
- (6) In the past 4 weeks on average how bad was your back pain?

Responses are from a 11 point Likert scale from 0 to 10.

	Anchor 0	Anchor 10
impact on ADL	none	unable to do any at all
impact on social activities	none	extreme
impact on work	none	extreme
back pain today	none	as bad as could be
worst pain in last month	none	as bad as could be
average pain in last month	none	as bad as could be

disability score = (SUM points for first 3 questions) / 3 * 10

pain score = (SUM points for last 3 questions) / 3 * 10

Interpretation: • minimum score: 0 and maximum score: 100

- The higher the score the more severe the disability or the back pain.

References:

Underwood MR Barnett AG Vickers MR. Evaluation of two time-specific back pain outcome measures. Spine. 1999; 24: 1104-1112 (Appendix page 1112).

von Korff M Ormel J et al. Grading the severity of chronic pain. Pain. 1992; 50: 133-149.

The Back Pain Function Scale (BPFS) of Stratford et al

Overview:

Stratford et al developed the Back Pain Function Scale (BPFS) to evaluation functional ability in patients with back pain. The authors are from McMaster University Appalachian Physical Therapy (Georgia) and Virginia Commonwealth University.

Measures:

- (1) any of your usual work housework or school activities
- (2) your usual hobbies recreational or sporting activities
- (3) performing heavy activities around your home
- (4) bending or stooping
- (5) putting your shoes or socks (or stockings or pantyhose)
- (6) lifting a box of groceries from the floor
- (7) sleeping
- (8) standing for 1 hour
- (9) walking 1 mile
- (10) going up or down 2 flights of stairs (about 20 steps)
- (11) sitting for 1 hour
- (12) driving for 1 hour

Responses	Points
unable to perform activity	0
extreme difficulty	1
quite a bit of difficulty	2
moderate difficulty	3
a little bit of difficulty	4
no difficulty	5

total score = SUM(points for all 12 measures)

adjusted total score = (total score) / 60

Interpretation:

- minimum score: 0
- maximum score: 60
- maximum adjusted score: 1 (100%)
- The higher the score the greater the patient's functional ability.

Total Score (Adjusted)	Interpretation
0 (0%)	unable to perform any activity
60 (100%)	no difficulty in any activity

Performance (page 2098):

- Test-retest reliability: 0.88
- Internal consistency: 0.93
- The score strongly correlates with the Roland-Morris questionnaire.

References:

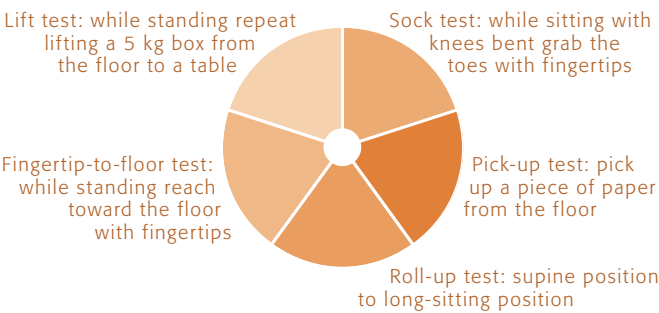
Stratford PW Binkley JM et al. Development and initial validation of the Back Pain Functional Scale. Spine. 2000; 25: 2095-2102 (Appendix A page 2101).

5 BACK PERFORMANCE SCALE (BPS)

Source: **Strand LI, Moe-Nilssen R, Ljunggren AE (2002)** Back Performance Scale for the assessment of mobility-related activities in people with back pain. *Phys Ther*; 82(12):1213–1223.

Type: Clinician-based outcome
Scale: 5 items relating to physical performance of compound activities.

Each item scored on a 0 to 3 point scale.



Interpretation:
Maximum score: 15
Minimum score: 0

The higher the score, the greater the disability.

OUTCOMES VALIDATED AGAINST

- [1]
 - Patients with back pain
 - Patients with neck or shoulder pain
 - Activity limitations
 - Return to work
- [2]
 - Roland-Morris disability questionnaire
 - Hannover functional ability questionnaire

Patient population tested in	Validity	Reliability	Responsiveness
Patients with back pain (N = 114) (44 years; 40% male) [1]	+	+	+
Patients with chronic low back pain (N = 32) (38 years; 34% male) [2]	+	+	NOT TESTED
Patients with acute low back pain (N = 9) (46 years; 89% male) [2]			

5 BACK PERFORMANCE SCALE (BPS)

VALIDATION STUDIES

- 1. **Strand LI, Moe-Nilssen R, Ljunggren AE (2002)** Back Performance Scale for the assessment of mobility-related activities in people with back pain. *Phys Ther*; 82(12):1213–1223.
- 2. **Magnussen L, Strand LI, Lygren H (2004)** Reliability and validity of the back performance scale: observing activity limitation in patients with back pain. *Spine*; 29(8):903–907.

METHODOLOGICAL EVALUATION

		NO SCORE	0 POINTS	1 POINT	POINTS
Validity	Content validity	NOT TESTED	NOT VALID	VALID	-
	Construct validity	NOT TESTED	NOT VALID	VALID	1
	Criterion validity	NOT TESTED	NOT VALID	VALID	1
Reliability	Internal consistency	NOT TESTED	NOT CONSISTENT	CONSISTENT	1
	Reproducibility	NOT TESTED	NOT REPRODUCIBLE	REPRODUCIBLE	1
	Responsiveness	NOT TESTED	NOT RESPONSIVE	RESPONSIVE	1
SUBTOTAL					5

CLINICAL UTILITY

	0 POINTS	1 POINT	2 POINTS	POINTS
Patient friendliness	LIMITED	MODERATE	STRONG	2
Clinician friendliness	LIMITED	MODERATE	STRONG	0
SUBTOTAL				2

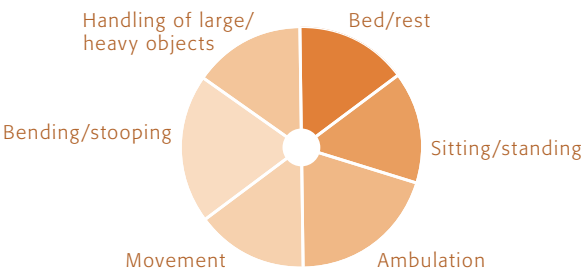
TOTAL				7
-------	--	--	--	---

22 QUEBEC BACK PAIN DISABILITY SCALE

Source: **Kopec JA, Esdaile JM, Abrahamowicz M, Abenhaim L, Wood-Dauphinee S, Lamping DL, Williams JI** (1995) The Quebec Back Pain Disability Scale. Measurement properties. *Spine*; 20(3):341–352.

Type: Patient-reported outcome
Scale: 6 categories (20 items)

Each item scored on a
0 to 5 point scale.



Interpretation:
Maximum score: 100
Minimum score: 0

The higher the score,
the greater the disability.

OUTCOMES VALIDATED AGAINST

- [1,2] • Other measures of functional disability
• Measures of pain
• Medical history variables
• Work related variables
• Socio-demographic variables
• Oswestry disability questionnaire
• Roland-Morris disability questionnaire
• Physical function subscale of SF-36
- [3] • Dallas pain scale
• Impact of pain
• Perceived health
• Impairment
• Psychological status
• Social status
• Nottingham health profile
- [4] • Roland-Morris disability questionnaire
• Pain severity

Patient population tested in	Validity	Reliability	Responsiveness
English and French speaking patients with back pain (N = 178) (>18 years; sex NR) [1, 2]	+	+	+
French speaking patients with chronic low back pain (N = 32) (42 years; 66% male) [3]	+	+	NOT TESTED
Dutch speaking patients with chronic low back pain (N = 120) (40 years; 60% male) [4]	+	+	NOT TESTED
Patients with low back pain (N = 106) (18-83 years; 31% male) [5]	+	+	+
Patients with acute or work-related low back pain (N = 67) (39 years; 57% male) [6]	NOT TESTED	-	-

22 QUEBEC BACK PAIN DISABILITY SCALE

Validated translations: French, Dutch; computerized version available

OUTCOMES VALIDATED AGAINST CONT

- [5]
- Oswestry disability questionnaire
 - Roland-Morris disability questionnaire
 - Waddell disability index
 - SF-36 physical functioning scale

VALIDATION STUDIES

1. **Kopec JA, Esdaile JM, Abrahamowicz M, et al** (1995) The Quebec Back Pain Disability Scale. Measurement properties. *Spine*; 20(3):341–352.

2. **Kopec JA, Esdaile JM, Abrahamowicz M, et al** (1996) The Quebec Back Pain Disability Scale: conceptualization and development. *J Clin Epidemiol*; 49(2):151–161.

3. **Yvanes-Thomas M, Calmels P, Bethoux F, et al** (2002) Validity of the French-language version of the Quebec back pain disability scale in low back pain patients in France. *Joint Bone Spine*; 69(4):397–405.

4. **Schoppink LE, van Tulder MW, Koes BW, et al** (1996) Reliability and validity of the Dutch adaptation of the Quebec Back Pain Disability Scale. *Phys Ther*; 76(3):268–275.

5. **Davidson M, Keating JL** (2002) A comparison of five low back disability questionnaires: reliability and responsiveness. *Phys Ther*; 82(1):8–24.

6. **Fritz JM, Irrgang JJ** (2001) A comparison of a modified Oswestry Low Back Pain Disability Questionnaire and the Quebec Back Pain Disability Scale. *Phys Ther*; 81(2):776–788.

METHODOLOGICAL EVALUATION

		NO SCORE	0 POINTS	1 POINT	POINTS
Validity	Content validity	NOT TESTED	NOT VALID	VALID	1
	Construct validity	NOT TESTED	NOT VALID	VALID	1
	Criterion validity	NOT TESTED	NOT VALID	VALID	-
Reliability	Internal consistency	NOT TESTED	NOT CONSISTENT	CONSISTENT	1
	Reproducibility	NOT TESTED	NOT REPRODUCIBLE	REPRODUCIBLE	1
	Responsiveness	NOT TESTED	NOT RESPONSIVE	RESPONSIVE	1
SUBTOTAL					5

CLINICAL UTILITY

		0 POINTS	1 POINT	2 POINTS	POINTS
Patient friendliness		LIMITED	MODERATE	STRONG	1
		LIMITED	MODERATE	STRONG	2
SUBTOTAL					3
TOTAL					8

The Revised Oswestry Disability Index (for low back pain/dysfunction)

Patient name: _____ File # _____ Date: _____

This questionnaire has been designed to give the doctor information as to how your back pain has affected your ability to manage everyday life. Please answer every section and mark in each section only the ONE box that applies to you. We realize that you may consider that two of the statements in any one section relate to you, but please just mark the box that most closely describes your problem.

SECTION 1-PAIN INTENSITY

- ☐ The pain comes and goes and is very mild.
- ☐ The pain is mild and does not vary much.
- ☐ The pain comes and goes and is moderate.
- ☐ The pain is moderate and does not vary much.
- ☐ The pain comes and goes and is very severe.
- ☐ The pain is severe and does not vary much.

SECTION 2-PERSONAL CARE

- ☐ I would not have to change my way of washing or dressing in order to avoid pain.
- ☐ I do not normally change my way of washing or dressing even though it causes some pain.
- ☐ Washing and dressing increases the pain, but I manage not to change my way of doing it.
- ☐ Washing and dressing increases the pain and I find it necessary to change my way of doing it.
- ☐ Because of the pain, I am unable to do some washing and dressing without help.
- ☐ Because of the pain, I am unable to do any washing and dressing without help.

SECTION 3-LIFTING

- ☐ I can lift heavy weights without extra pain.
- ☐ I can lift heavy weights, but it causes extra pain.
- ☐ Pain prevents me from lifting heavy weights off the floor, but I manage if they are conveniently positioned (e.g., on a table).
- ☐ Pain prevents me from lifting heavy weights off the floor.
- ☐ Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned.
- ☐ I can only lift very light weights at the most.

SECTION 4-WALKING

- ☐ I have no pain on walking.
- ☐ I have some pain on walking, but it does not increase with distance.
- ☐ I cannot walk more than one mile without increasing pain.
- ☐ I cannot walk more than 1/2 mile without increasing pain.
- ☐ I cannot walk more than 1/4 mile without increasing pain.
- ☐ I cannot walk at all without increasing pain.

SECTION 5-SITTING

- ☐ I can sit in any chair as long as I like.
- ☐ I can only sit in my favorite chair as long as I like.
- ☐ Pain prevents me from sitting more than one hour.
- ☐ Pain prevents me from sitting more than 1/2 hour.
- ☐ Pain prevents me from sitting more 10 minutes.
- ☐ I avoid sitting because it increases pain right away.

SECTION 6-STANDING

- ☐ I can stand as long as I want without pain.
- ☐ I have some pain on standing, but it does not increase with time.
- ☐ I cannot stand for longer than one hour without increasing pain.
- ☐ I cannot stand for longer than 1/2 hour without increasing pain.
- ☐ I cannot stand for longer than 10 minutes without increasing pain.
- ☐ I avoid standing because it increases the pain right away.

SECTION 7-SLEEPING

- ☐ I get no pain in bed.
- ☐ I get pain in bed, but it does not prevent me from sleeping well.
- ☐ Because of pain, my normal night's sleep is reduced by less than 1/4.
- ☐ Because of pain, my normal night's sleep is reduced by less than 1/2.
- ☐ Because of pain, my normal night's sleep is reduced by less than 3/4.
- ☐ Pain prevents me from sleeping at all.

SECTION 8-SOCIAL LIFE

- ☐ My social life is normal and gives me no pain.
- ☐ My social life is normal, but increases the degree of pain.
- ☐ Pain has no significant effect on my social life apart from limiting my more energetic interests, e.g., dancing, etc.
- ☐ Pain has restricted my social life and I do not go out very often.
- ☐ Pain has restricted my social life to my home.
- ☐ I have hardly any social life because of the pain.

SECTION 9-TRAVELLING

- ☐ I get no pain while travelling.
- ☐ I get some pain while travelling, but none of my usual forms of travel makes it any worse.
- ☐ I get extra pain while travelling, but it does not compel me to seek alternative forms of travel.
- ☐ I get extra pain while travelling, which compels me to seek alternative forms of travel.
- ☐ Pain restricts all forms of travel.
- ☐ Pain prevents all forms of travel except that done lying down.

SECTION 10-CHANGING DEGREE OF PAIN

- ☐ My pain is rapidly getting better.
- ☐ My pain fluctuates, but is definitively getting better.
- ☐ My pain seems to be getting better, but improvement is slow at present.
- ☐ My pain is neither getting better nor worse.
- ☐ My pain is gradually worsening.
- ☐ My pain is rapidly worsening.

Instructions:

1. This is a self-report questionnaire: the patient is instructed to fill it out.
2. The patient follows the general instructions given at the top of the questionnaire.
3. Each section must be completed. If the patient leaves one blank, instruct them to complete the form. It must be completed in one sitting.
4. Each section has 6 possible answers. Statement 1 is graded as 0 points; statement 6 is graded as 5 points. A total score of 50 is thus possible and would indicate 100% disability. So, for example, a total score of 10 of a possible 50 would constitute a 20% disability.
5. The following interpretation of disability scores is excerpted from the developers of the Oswestry system (457):

0%-20%: Minimal disability

This group can cope with most living activities. Usually no treatment is indicated, apart from advice on lifting, sitting posture, physical fitness, and diet. In this group some patients have particular difficulty with sitting, and this may be important if their occupation is sedentary, e.g., a typist or lorry [truck] driver.

20%-40% Moderate disability

This group experiences more pain and problems with sitting, lifting, and standing. Travel and social life are more difficult and they may well be off work. Personal care, sexual activity*, and sleeping are not grossly affected, and the back condition can usually be managed by conservative means.

40%-60%: Severe disability

Pain remains the main problem in this group of patients, but travel, personal care, social life, sexual activity*, and sleep are also affected. These patients require detailed investigation.

60%-80%: Crippled

Back pain impinges on all aspects of these patients' lives—both at home and at work—and positive intervention is required.

80%-100%

These patients are either bed-bound or exaggerating their symptoms. This can be evaluated by careful observation of the patient during medical examination.

6. It is recommended that clinicians focus their discussions of the results with patients in positive terms, rather than reporting disability scores. For example, point out the 10% improvement on a subsequent test.

* Note: in the revised Oswestry, sex life questions were replaced with recreation questions.

Back Pain Measures Group

PQRI Data Collection Sheet*

☐ Male ☐ Female

Patient's Name Practice Medical Record Number (MRN) Birth Date (mm/dd/yyyy)

National Provider Identifier (NPI) Date of Encounter

Step 1 Preliminary reporting requirements

You must identify your intent to report the Back Pain Measures Group by submitting the G-code specified for this measures group on the first patient claim (G8493: I intend to report the Back Pain Measures Group). You do not need to resubmit the measures group-specific G-code on more than one claim.

Step 2 Determine patient eligibility

(Codes determining a patient's eligibility must be reported on the **same claim** as the quality code(s) identified in Step 3 below.)

	Yes	No	
Patient is aged 18 through 79 on date of encounter.	☐	☐	Refer to date of birth listed above or on claim form.
If No is checked for the above, STOP. This patient is not eligible for reporting on this measures group. Do not report a CPT category II code or G-code.			
Patient has a line item diagnosis indicating back pain AND a CPT Code for an office visit or physical therapy evaluation.	☐	☐	721.3 721.41, 721.42, 721.90, 722.0, 722.10, 722.11, 722.2, 722.30, 722.31, 722.32, 722.39, 722.4, 722.51, 722.52, 722.6, 722.70, 722.71, 722.72, 722.73, 722.80, 722.81, 722.82, 722.83, 722.90, 722.91, 722.92, 722.93, 723.0, 724.00, 724.01, 724.02, 724.09, 724.2, 724.3, 724.4, 724.5, 724.6, 724.70, 724.71, 724.79, 738.4, 738.5, 739.3, 739.4, 756.12, 846.0, 846.1, 846.2, 846.3, 846.8, 846.9, 847.2 AND 97001, 97002, 99201, 99202, 99203, 99204, 99205, 99212, 99213, 99214, 99215
OR	OR		OR
There is a CPT Code for back surgery.	☐	☐	22210, 22214, 22220, 22222, 22224, 22226, 22532, 22533, 22534, 22548, 22554, 22556, 22558, 22585, 22590, 22595, 22600, 22612, 22614, 22630, 22632, 22818, 22819, 22830, 22840, 22841, 22842, 22843, 22844, 22845, 22846, 22847, 22848, 22849, 63001, 63003, 63005, 63011, 63012, 63015, 63016, 63017, 63020, 63030, 63035, 63040, 63042, 63043, 63044, 63045, 63046, 63047, 63048, 63055, 63056, 63057, 63064, 63066, 63075, 63076, 63077, 63078, 63081, 63082, 63085, 63086, 63087, 63088, 63090, 63091, 63101, 63102, 63103, 63170, 63172, 63173, 63180, 63182, 63185, 63190, 63191, 63194, 63195, 63196, 63197, 63198, 63199, 63200

If **No** is checked for both of the above, STOP. This patient is not eligible for reporting on this measures group.
Do not report a CPT category II code or G-code.

continued on next page

*For additional information on the PQRI program and reporting on measures groups, please visit the CMS Web site at <http://www.cms.hhs.gov/pqri>.

Back Pain Measures Group

continued from previous page

Determine if patient meets additional eligibility criteria			
	Yes	No	
Is this the first visit ¹ to the clinician for a new episode ² of back pain (ie, a new or recurrent episode of back pain that has not been seen or treated by this practitioner during the four preceding months)?	☐	☐	If No , report 0526F once for this patient AND STOP. If Yes, proceed to Step 3.

Step 3 Complete individual measures		
Comprehensive Initial Assessment <i>(including pain assessment, functional status, patient history, assessment of prior treatment and response, and employment status)</i>		Report one code for comprehensive assessment OR one code for NOT completed.
PQRI Measure #148 - reporting frequency: comprehensive assessment must be completed and reported at the initial visit - preferred standardized assessment tools for pain and functional assessment include: SF-36, Oswestry low back pain disability questionnaire, Roland-Morris disability questionnaire, Quebec pain disability scale, sickness impact profile, multidimensional pain inventory) - warning signs include: history of cancer or unexplained weight loss, current infection or immunosuppression, fracture or suspected fracture, cauda equina syndrome or progressive neurologic deficit - preferred standardized assessment tools for employment status assessment include: sickness impact profile, multidimensional pain inventory - variables of an employment assessment include: type of work; work status; length of time for work limitations, if applicable; workers' compensation or litigation involvement	Pain assessment completed using one of the preferred standardized tools or an acceptable alternative	☐ 1130F
	Functional assessment completed using one of the preferred standardized tool or assessment of activities of daily living	
	Patient history completed including notation of presence or absence of warning signs	
	Assessment of prior back pain episodes completed and if applicable, associated treatment and response	
	Employment status assessment completed using one of the preferred standardized tools or an assessment of specified variables	
		OR
		Comprehensive assessment NOT completed ☐ 1130F-8P
Physical Exam		Report the following code for physical exam OR one code for NOT performed.
PQRI Measure #149 - reporting frequency: physical exam must be performed and reported at the initial visit - for patients with radicular symptoms, physical exam must include: straight leg raise test AND notation of completion of neurovascular exam - for patients without radicular symptoms, physical exam must include: straight leg raise test AND either neurovascular exam or clear notation of absence or presence of neurologic deficits	Performed	☐ 2040F
	OR	
		Physical exam NOT performed ☐ 2040F-8P

continued on next page

¹Initial Visit — First visit to the clinician during an episode of back pain. There can only be one initial visit with each clinician, but there can be more than one initial visit for a patient, if multiple clinicians evaluate or treat the patient for the back pain episode. Report the appropriate Quality Data Codes on the claim for each initial visit. For each subsequent encounter after the initial visit with that clinician, or if the initial visit with that clinician occurred prior to the start of the reporting period, then report 0526F.

²Episode — Patient with back pain who has not been seen or treated for back pain by any practitioner during the four months prior to the first clinical encounter with a diagnosis of back pain. If a patient has a four-month period without treatment, and then sees both a primary care physician and a specialist, both visits are considered the initial visit with that clinician. A new episode can either be a recurrence for a patient with prior back pain or a patient with a new onset of back pain. The first clinical encounter after the four months without being seen or treated for back pain is considered the beginning of the new episode.

Back Pain Measures Group

continued from previous page

Advice for Normal Activities	Report the following code for advice for normal activities or one code for NOT provided.	
PQRI Measure #150 • <i>reporting frequency: advice for normal activities must be provided and reported at the initial visit</i>	Advice provided to maintain or resume normal activities	☐ 4245F
	OR	
	Advice NOT provided	☐ 4245F-8P
Advice Against Bed Rest	Report the following code for advice against bed rest or one code for NOT provided.	
PQRI Measure #151 • <i>reporting frequency: advice against bed rest must be provided and reported at the initial visit</i>	Advice provided against bed rest lasting four days or longer	☐ 4248F
	OR	
	Advice NOT provided	☐ 4248F-8P

Step 4 Reporting Instructions

This measure can be reported for each eligible patient in one of two ways:

1. Report the corresponding CPT category II code(s) as selected above for each of the four measures in the Back Pain Measures Group.

OR

2. If **all** quality actions for the patient have been performed for each of the four measures in the Back Pain Measures Group, **G8502** may be reported. *Note: G8502 is not appropriate for this patient if any CPT category II codes with the 8P modifier have been selected from Step 3.*

The Back Pain Function Scale (BPFS) of Stratford et al

Overview:

Stratford et al developed the Back Pain Function Scale (BPFS) to evaluation functional ability in patients with back pain. The authors are from McMaster University Appalachian Physical Therapy (Georgia) and Virginia Commonwealth University.

Measures:

- (1) any of your usual work housework or school activities
- (2) your usual hobbies recreational or sporting activities
- (3) performing heavy activities around your home
- (4) bending or stooping
- (5) putting your shoes or socks (or stockings or pantyhose)
- (6) lifting a box of groceries from the floor
- (7) sleeping
- (8) standing for 1 hour
- (9) walking 1 mile
- (10) going up or down 2 flights of stairs (about 20 steps)
- (11) sitting for 1 hour
- (12) driving for 1 hour

Responses	Points
unable to perform activity	0
extreme difficulty	1
quite a bit of difficulty	2
moderate difficulty	3
a little bit of difficulty	4
no difficulty	5

total score = SUM(points for all 12 measures)

adjusted total score = (total score) / 60

Interpretation:

- minimum score: 0
- maximum score: 60
- maximum adjusted score: 1 (100%)
- The higher the score the greater the patient's functional ability.

Total Score (Adjusted)	Interpretation
0 (0%)	unable to perform any activity
60 (100%)	no difficulty in any activity

Performance (page 2098):

- Test-retest reliability: 0.88
- Internal consistency: 0.93
- The score strongly correlates with the Roland-Morris questionnaire.

References:

Stratford PW Binkley JM et al. Development and initial validation of the Back Pain Functional Scale. Spine. 2000; 25: 2095-2102 (Appendix A page 2101).

The Back Pain Function Scale (BPFS) of Stratford et al

Overview:

Stratford et al developed the Back Pain Function Scale (BPFS) to evaluation functional ability in patients with back pain. The authors are from McMaster University Appalachian Physical Therapy (Georgia) and Virginia Commonwealth University.

Measures:

- (1) any of your usual work housework or school activities
- (2) your usual hobbies recreational or sporting activities
- (3) performing heavy activities around your home
- (4) bending or stooping
- (5) putting your shoes or socks (or stockings or pantyhose)
- (6) lifting a box of groceries from the floor
- (7) sleeping
- (8) standing for 1 hour
- (9) walking 1 mile
- (10) going up or down 2 flights of stairs (about 20 steps)
- (11) sitting for 1 hour
- (12) driving for 1 hour

Responses	Points
unable to perform activity	0
extreme difficulty	1
quite a bit of difficulty	2
moderate difficulty	3
a little bit of difficulty	4
no difficulty	5

total score = SUM(points for all 12 measures)

adjusted total score = (total score) / 60

Interpretation:

- minimum score: 0
- maximum score: 60
- maximum adjusted score: 1 (100%)
- The higher the score the greater the patient's functional ability.

Total Score (Adjusted)	Interpretation
0 (0%)	unable to perform any activity
60 (100%)	no difficulty in any activity

Performance (page 2098):

- Test-retest reliability: 0.88
- Internal consistency: 0.93
- The score strongly correlates with the Roland-Morris questionnaire.

References:

Stratford PW Binkley JM et al. Development and initial validation of the Back Pain Functional Scale. Spine. 2000; 25: 2095-2102 (Appendix A page 2101).

BACK PAIN: AN ASSESSMENT IN BREAST HYPERTROPHY PATIENTS

PAULO MAGALHÃES FERNANDES¹, MIGUEL SABINO NETO², DANIELA FRANCESCATO VEIGA³, LUIS EDUARDO FELIPE ABLA⁴,
CARLOS DELANO ARAÚJO MUNDIM⁵, YARA JULIANO⁶, LYDIA MASAKO FERREIRA⁷

SUMMARY

Objective – To evaluate the influence of breast hypertrophy on the incidence of back pain and how much they can interfere in patients' daily activities. **Methods** – This was a cross-sectional analytic study in patients examined at the Outpatient Orthopedics and Plastic Surgery Departments at Samuel Libânio University Hospital in Pouso Alegre, MG. 100 women were examined, 50 presenting breast hypertrophy (study group) and 50 with normal breast size (control group). Breasts were classified according to Sacchini's criteria. The Numerical Rating Scale (NRS) and the Roland-Morris questionnaire were

used in order to evaluate the magnitude of back pain and the limitations arising from these symptoms. **Results** – The mean age of the patients in the study group was 32.2 years and 32.7 for the control group. The scores in the NRS scale and Roland-Morris Questionnaire were higher in the study group when compared to the control group. **Conclusion** – The results achieved showed that back pain is more severe and determined more extensive limitations in the daily activities for patients presenting breast hypertrophy.

Keywords: *Back pain; Quality of life; Neck pain; Breast.*

Citation: Fernandes PM, Sabino Neto M, Veiga DF, Abila LEF, Mundim CDA, Juliano Y et al. Back pain: an assessment in breast hypertrophy patients. *Acta Ortop Bras. [serial on the Internet].* 2007; 15(4): 227-230. Available from URL: <http://www.scielo.br/aob>.

INTRODUCTION

Back pain is amongst the most frequent complaints of patients at orthopaedic examination, representing a common cause of work leaves⁽¹⁾. Spinal pain is sometimes difficult to evaluate, because many factors can be associated to it, and, sometimes, no correlation is found between clinical and X-ray findings and symptoms reported⁽²⁾.

Breast hypertrophy is described as an abnormal augmentation of the breasts, and it has been associated to the emergence of various symptoms related to musculoskeletal system, with spinal pain being the most frequent ones (Figure 1). This kind of pain may range from a simple discomfort to functional disability, with frequent indications to surgical treatment for reducing breasts volume⁽³⁻⁵⁾. The source of these symptoms may be postural changes resulting from gravity center changes, a consequence of breast augmentation, which causes exacerbation of the physiological curves of the cervical, thoracic and lumbar spine, additionally to keep cervical and thoracic muscles highly tensioned⁽⁶⁾.

Several methods have been used to measure painful symptoms as well as restraints resulting from these symptoms. The use of standardized questionnaires, of which measurement properties have already been tested, enables us to evaluate patients' profiles through their individual perspectives, being thus possible to assess discomfort and disability determined by a disease or treatment^(6,7).

This study intends to assess the influence of breast hypertrophy over painful spinal symptoms and also how much the usual daily activities of the patients can be compromised as a result of the presence of these symptoms.

METHODS

In the period of June 2005 to February 2006, 50 women with breast hypertrophy referred from Orthopaedics and Plastic Surgery outpatient services of Hospital das Clínicas Samuel Libânio, in Pouso Alegre (MG) were assessed. Other 50 women with normal sized breasts and similar sociodemographic characteristics, which were selected from the general population of the region, constituted the control group of the study. No restriction was made in terms of ethnicity, education level or social layer. Women aged between 18 and 59 years with body mass index (BMI) as low as 30 Kg/m², who had not been previously submitted to spinal or breast surgeries, were considered as candidates to the study. Women with BMI below 18.5 Kg/m², presenting with uncontrolled systemic diseases, who had delivered or were breastfeeding in the previous one-year period, with hypomastia or mammary asymmetry were excluded from the study. Selected women were enrolled only after signing the Free and Informed Consent Term. The study was approved by the committee on ethics in research of this institution.

Study conducted at the University of Vale do Sapucaí – Hospital das Clínicas Samuel Libânio - Pouso Alegre - MG.

Correspondences to: Rua Cássio Carvalho Coutinho, 26 - Bairro Santa Elisa. Pouso Alegre-MG. CEP: 37550000 - Email: paulomf@uai.com.br

1. Master in Health Sciences by Minter - Interinstitutional Mastery Course UNIFESP/UNIVÁS. Orthopaedic Doctor, Department of Orthopaedics and Traumatology, Hospital das Clínicas Samuel Libânio -University of Vale do Sapucaí- UNIVÁS
2. Associate Professor of the Discipline of Plastic Surgery - UNIFESP
3. Doctor, Plastic Surgery Division, Hospital Clínicas Samuel Libânio - University of Vale do Sapucaí- UNIVÁS
4. Associate Professor, Discipline of Plastic Surgery, UNIFESP
5. Orthopaedic Doctor, Department of Orthopaedics and Traumatology, Hospital das Clínicas Samuel Libânio -University of Vale do Sapucaí- UNIVÁS
6. Chairman, Department of Biostatistics, UNIVÁS
7. Chairman, Discipline of Plastic Surgery, UNIFESP

Received in: 10/09/06; Approved in: 11/10/06

Breasts were rated using the Sacchini's index. In this classification, a normal breasts are regarded as those presenting measurements between 9 and 11 cm, hypertrophic breasts as those with measurements above 11 cm, and hypomastia, those measurements below 9 cm, in which each breast is individually measured⁽⁹⁾ (Figure 2).



Figure 1 - Woman with breast hypertrophy: watch for cervical muscles' and shoulder tension in order to keep an upright posture.

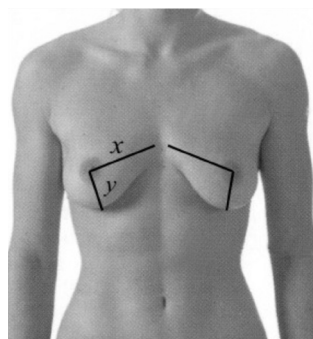


Figure 2 - Sacchini's index = average between X and Y distances.

The Numeric Scale (NRS) was employed to assess spinal pain severity⁽⁶⁾. The scale presents scores ranging from zero to ten, where the patient determines the level in which her pain is according to the scale (Figure 3). The scale was introduced to patients, which informed the number of the scale that best described the level of their pain severity. Reports of pain on cervical, thoracic and lumbar spine segments were taken into account.

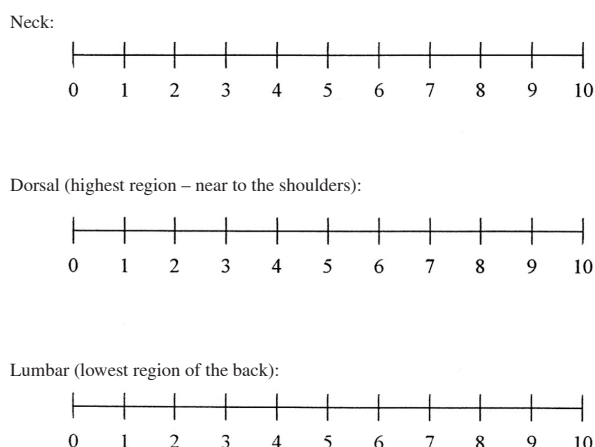


Figure 3 - Numeric scale for pain severity assessment (NRS)

The Roland-Morris Questionnaire^(9,10) enables to evaluate physical restraints resulting from reported pain on lumbar spine and has been used to evaluate restraints resulting from other spinal segments, as well. The questionnaire is composed of 24 yes/no questions, where each positive answer corresponds to a score. The final score is determined by the sum of the values obtained. Values closer to zero represent the best results, that is, fewer restraints, while val-

ues closer to 24 represent the worst results, that is, more restraints. The questionnaire was applied as an interview, performed by only one researcher⁽¹¹⁾.

For statistical analysis of the results, the Mann-Whitney's test was used⁽¹²⁾, in order to compare any potentially existent differences between data obtained for control and study groups. The test was applied alone in order to assess differences regarding age, NRS and Roland-Morris questionnaire scores. For comparing BMI values for both groups, the Student's t test was employed⁽¹²⁾. Null hypothesis rejection level was determined as 0.05 or 5%.

On the line below, please check where you believe your back pain represents today. Zero means absence of pain and ten means excruciating pain.

RESULTS

Among women with breast hypertrophy (study group), the average age was 32.2 years (± 8.2 years) and the average age for control group was 32.7 years (± 11.1 years). Mean BMI for study group was 25.8Kg/m² (± 2.59 Kg/m²) and for control group, 22.3 Kg/m² (± 2.87 Kg/m²). We noticed no statistically significant difference between assessed groups regarding age, while there was a statistically significant difference for BMI ($p < 0.001$), with the hypertrophy group presenting a higher BMI than control group (Table 1).

	GROUP	N	Average	Median	Standard	Minimum	Maximum	p-value
AGE	Control	50	32.72	30.00	11.10	20.00	56.00	0.790
	Hypertroph	50	32.20	31.50	8.17	19.00	50.00	
	Total	100	32.46	30.50	9.70	19.00	56.00	
WEIGHT	Control	50	59.48	58.50	8.31	44.00	80.00	< 0.001*
	Hypertroph	50	65.33	66.25	7.11	50.00	80.00	
	Total	100	62.41	63.25	8.24	44.00	80.00	
HEIGHT	Control	50	1.63	1.63	0.07	1.50	1.77	0.003*
	Hypertroph	50	1.59	1.61	0.07	1.41	1.70	
	Total	100	1.61	1.62	0.07	1.41	1.77	
BMI	Control	50	22.31	22.00	2.98	18.20	29.00	< 0.001*
	Hypertroph	50	25.88	26.07	2.59	20.55	30.00	
	Total	100	24.09	24.42	3.31	18.20	30.00	

Table 1 - Comparison of the groups regarding Age, Weight, Height, and BMI

When groups were compared for NRS scores, Roland-Morris Questionnaire and pain scale (NRS), a statistically significant difference was found for all scores. In the group of women with breast hypertrophy, only one patient reported absence of pain in all segments of the spine, while, in control group, 12 women (24%) reported none of these symptoms. For Roland-Morris Questionnaire, the score zero occurred in 8% of the women with breast hypertrophy, and in 50% of the women in control group.

The results of NRS pain assessment and the results of the analysis of Roland-Morris questionnaire are shown on Table 2.

DISCUSSION

Occasionally, orthopaedic doctors are requested to provide a legal opinion about the need of surgical treatment for breast reduction in patients with symptomatic breast hy-

	GROUP	N	Average	Median	Minimum	Maximum	p-value
CERVICAL PAIN	Normal mammary	50	1.74	0.00	0.00	10.00	
	Mammary hypertrophy	50	5.48	6.00	0.00	10.00	< 0.001*
	Total	100	3.61	3.00	0.00	10.00	
DORSAL PAIN	Normal mammary	50	1.74	0.50	0.00	10.00	
	Mammary hypertrophy	50	6.50	8.00	0.00	10.00	< 0.001*
	Total	100	4.12	3.00	0.00	10.00	
LUMBAR PAIN	Normal mammary	50	2.26	2.00	0.00	10.00	
	Mammary hypertrophy	50	6.18	7.00	0.00	10.00	< 0.001*
	Total	100	4.22	3.00	0.00	10.00	
ROLAND MORRIS	Normal mammary	50	1.24	0.50	0.00	6.00	
	Mammary hypertrophy	50	10.54	10.50	0.00	24.00	< 0.001*
	Total	100	5.89	3.00	0.00	24.00	

Table 2 - Comparisons of groups regarding variables of pain as evaluated by NRS, and restraints caused by these symptoms as evaluated by Roland-Morris Questionnaire

hypertrophy. Many times, this professional is unaware of the objective and subjective criteria for breast assessment, or even of the severity of breast hypertrophy effects on musculoskeletal system.

Breast hypertrophy has been known and disseminated due to the aesthetic changes it causes on women; however, in addition to aesthetic changes, this can determine serious physical problems, which can damage these patients' health and quality of life⁽⁵⁾. Physical changes caused by increased breast weight are due to the change of patients' gravity center, leading to sharper physiological curves of the spine, with increased shoulder and cervical spine muscles tension⁽⁴⁾.

Previous studies evidenced that breast hypertrophy patients' major complaints, in addition to the aesthetic aspect, are musculoskeletal system pain, with the most common ones being back pain, and these symptoms have been constituting factors for indicating breast size reduction in those patients⁽³⁻⁵⁾.

In recent years, great emphasis has been given to patient's opinion about symptoms and restraints in their lifestyles due to diseases or treatments. For evaluating changes resulting from diseases or treatments, a number of questionnaires were developed, which allow for analyzing such changes from the perspective of the very patient⁽¹²⁾.

Efforts have been made to quantify pain symptoms from a patient's point of view. Thus, scales and instruments have been developed and were shown to be effective for assessing those symptoms. Several studies addressing these symptoms related to breast hypertrophy have been performed with the use of non-validated instruments, and ultimately have

shown to be inconsistent for comparisons^(4,13,14). The evaluation of spinal pain and restraints resulting from these symptoms in patients with breast hypertrophy, assessed from a patient's point of view, and using instruments of which measurement properties have already been tested, lends higher reliability to the study. There are a scarce number of studies published in literature addressing spinal symptoms in patients with breast hypertrophy, and the restraints resulting from these symptoms, using previously validated scales and questionnaires^(3,5).

In this study, we applied a strict inclusion criterion, where reported symptoms were correlated to breast size. Objective breasts evaluations, using Sacchini's criteria, allow for standardizing measurements, with potential ability to reproduce and compare results. There was no significant difference between ages. The BMI for the group with breast hypertrophy was 25.8 kg/m², characterizing overweight, but this is a common data among breast hypertrophy patients, and tend to be higher in more significant hypertrophies. This can be due to the fact that breast size is already a factor for a heavier weight, and to these patients presenting physical and emotional discomfort, restraining physical activities^(4,5,15).

The Analogous Numeric Scale (NRS) is a simple and efficient method for assessing pain severity from a patient's perspective, and it is used in several medicine areas for assessing these symptoms in a disease or treatment responsiveness research. This scale was shown to be more reliable for assessing pain in our population when compared to other pain assessment scales⁽¹⁶⁾. These scales have been used for assessing pain severity in breast hypertrophy patients. It has been used for assessing spinal pain in patients with breast hypertrophy and the average pain score was six⁽⁵⁾. Freire⁽³⁾ assessed these symptoms on spine segments, and data were similar to those found in our study, where the average score was 5.4 for cervical spine, 6.5 for thoracic spine, and 6.1 for lumbar spine. They described a significant reduction of the NRS scores after surgery was performed for reducing breast size.

The Rolland - Morris questionnaire is one of the most indicated questionnaires for assessing restraints resulting from back pain^(17,18). This questionnaire was translated and validated for use in Brazil. It presents a single value for evaluation and a score 11 is determined as indicative of important disabling changes⁽¹⁰⁾. In this study, we noticed that patients with breast hypertrophy show more significant restraints, with an average value of 10.5 when compared to the group of patients with normal breasts, which showed an average of 1.2. In a study using this instrument to assess reductive mammoplasty results, a major restraints reduction was seen, as measured by this questionnaire, in which the mean index dropped from 5.9 to 1.2 after surgical treatment⁽³⁾.

This study shows the importance of physical symptoms associated to breast hypertrophy. Previous studies showed that reductive mammoplasty is the recommended treatment, and conservative therapies such as weight lose and physical therapy, additionally to other methods, are not efficient for symptoms relief^(3,14). Unfortunately, the healthcare sector, both public and private, do not recognize breast hypertrophy as deleterious for these patients' health, being recognized only as an aesthetic change, and reductive mammoplasty as a cosmetic procedure, only, many times requiring patients to seek legal help to prove their symp-

toms and thus be granted with authorization for surgery. Studies using a multidisciplinary approach, with the use of validated instruments, may generate a broader knowledge of various aspects in a pathology, which will be converted into useful conclusions to professionals and to healthcare system and into benefits for patients. It is important to recognize the criteria for breast hypertrophy definition and classification, as well as its implications on musculoskeletal sys-

tem, because, many times, this disease is seen just as for its aesthetic aspects for a major portion of doctors, health insurances and public healthcare system.

CONCLUSION

Patients with breast hypertrophy present with a more severe back pain, as well as an important restraint in their daily activities when compared to patients with normal breasts.

REFERENCES

1. Kelsey JL, Golden AL. Occupational and workplace factors associated with low back pain. *Occup Méd.* 1988; 3(1): 7-16.
2. Brazil AV, Ximenes AC, Radu AS, Fernandes AR, Appel C, Maçaneiro CH, et al. Diagnóstico e Tratamento das Lombalgias e Lombociatalgias. Associação Médica Brasileira e Conselho Federal de Medicina. Projeto Diretrizes, 2001. [citado em 2006 abr 3]. Disponível em: http://projetodiretrizes.org.br/projeto_diretrizes/072.pdf
3. Freire MAMS. Capacidade funcional e dor após a mamoplastia redutora [tese]. São Paulo:Universidade Federal de São Paulo, Escola Paulista de Medicina; 2004.
4. Gonzalez F, Walton RL, Shafer B, Matory Jr. WE, Borah GL. Reduction mammoplasty improves symptoms of macromastia. *Plast Reconstr Surg.* 1993; 91(7):1270-6.
5. Chao JD, Memmel HC, Redding JF, Egan L, Odom LC, Casas LA. Reduction mammoplasty is a functional operation, improving quality of life in symptomatic women: a prospective, single-center breast reduction outcome study. *Plast Reconstr Surg.* 2002; 110:1644-54.
6. Letterman G, Schurter M. The effects of mammary hypertrophy on skeletal system. *Ann Plast Surg.* 1980; 5(6):425-31.
7. Ferraz MB. Qualidade de vida Oliveira: conceito e um breve histórico. *Revista Jovem Médico*, 1988; 4:219-22.
8. Sacchini V, Luini A, Tana S, Lozza L, Galimberti V, Merson M et al. Quantitative and qualitative cosmetic evaluation after conservative treatment for breast cancer. *Eur J Cancer.* 1991; 27(11):1395-400.
9. Rolland M, Morris R. Study of the natural history of low back pain. Part II: development and guidelines for trials of treatment in primary care. *Spine* 1983; 8:145-50.
10. Nusbaum L, Natour J, Ferraz MB, Goldenberg J. Translation, adaptation and validation of the Roland Morris questionnaire – Brazil Roland-Morris. *Braz J Med Biol Res.* 2001; 34:203-10.
11. D'Amorim AB. Avaliação das formas auto-administradas dos questionários HAQ e SF-12 em pacientes com doenças reumáticas [dissertação]. São Paulo: Universidade Federal de São Paulo, Escola Paulista de Medicina; 2001.
12. Siegel S, Castellan NJ Jr. Non parametric statistics. 2nd Ed. New York: McGraw-Hill; 1988.
13. Chadbourne EB, Zang S, Gordon MJ, Ro EY, Ross SD, Schnur PL et al. Clinical outcomes in reduction mammoplasty: a systematic review and meta-analysis of published studies. *Mayo Clin Proc.* 2001; 76: 503-10.
14. Netscher DT, Meade RA, Goodman CM, Brehm BJ, Friedman JD, Thornby J. Physical and psychosocial symptoms among 88 volunteer subjects compared with patients seeking plastic surgery procedures to the breast. *Plast Reconstr Surg.* 2000; 105:2366-72.
15. Blomqvist L. Reduction mammoplasty: analysis of patients' weight, resection weights, and late complications. *Scand J Plast Reconstr Hand Surg.* 1996; 30: 207-10.
16. Ferraz MB, Quaresma MR, Aquino LR, Atrá E, Tugwell P, Goldsmith H. Reliability of pain scales in the assessment of literature and illiterate patients with rheumatoid arthritis. *J Rheumatol.* 1990; 17:1022-4.
17. Rocchi MBL, Sisti D, Benedetti P, Valentini M, Bellgamba S. Critical comparison of nine different self administered questionnaires for evaluation of disability caused by low back pain. *Eur Med Phys.* 2005; 41: 275-81
18. Grotle MPT, Brox JI, Vollestad NK. Concurrent comparison of responsiveness in pain and functional status measurements used for patients with low back pain. *Spine* 2004; 26:493-501.

Reliability and Validity of the Active Straight Leg Raise Test in Posterior Pelvic Pain Since Pregnancy

Jan M. A. Mens, MD ^{*†}; Andry Vleeming, PhD^{*}; Chris J. Snijders, PhD[‡]; Bart W. Koes, PhD[§]; Henk J. Stam, MD, PhD[†]

From the *Spine & Joint Centre, and the Departments of †Rehabilitation Medicine, ‡Biomedical Physics and Technology, and §General Practice Medicine, Faculty of Medicine and Health Sciences, Erasmus University Rotterdam, Rotterdam, The Netherlands.

SPINE 2001;26:1167-1171

[\[Click here for reference links. \(15 references linked.\)\]](#)

Study Design. A cross-sectional analysis was performed in a group of women meeting strict criteria for posterior pelvic pain since pregnancy (PPPP). The scores on the Active Straight Leg Raise Test (ASLR test) were compared with the scores of healthy controls.

Objectives. To develop a new diagnostic instrument for use in patients with PPPP. The objectives of the present study were to assess the validity and reliability of the ASLR test.

Summary of Background Data. Various diagnostic tools are used to diagnose PPPP, but there is still a need for simple tests with high reliability, sensitivity, and specificity.

Methods. Reliability of the ASLR test was assessed in a group of 50 women with lumbopelvic pain of various etiologies and various degrees of severity. Sensitivity was assessed in 200 patients with PPPP and specificity in 50 healthy women. Sensitivity and specificity of the ASLR test were compared with the posterior pelvic pain provocation test (PPPP test).

Results. The test-retest reliability measured with Pearson's correlation coefficient between the two ASLR scores 1 week apart was 0.87. The intraclass correlation coefficient (ICC) was 0.83. Pearson's correlation coefficient between the scores of the patient and the scores of a blinded assessor was 0.78; the ICC was 0.77. In the patient group, the ASLR score ranged from 0–10; in the control group it ranged from 0–2. The best balance between specificity and sensitivity was found when scores 1–10 are designated as positive and zero as negative. With this cut-off point sensitivity of the test was 0.87 and specificity was 0.94. The sensitivity of the ASLR test is higher than the sensitivity of the PPPP test; an advantage of the ASLR test is the simplicity of measuring the score.

Conclusion. The ASLR test is a suitable diagnostic instrument to discriminate between patients who are disabled by PPPP and healthy subjects. The test is easy to perform; reliability, sensitivity, and specificity are high. It seems that the integrity of the function to transfer loads between the lumbosacral spine and legs is tested by the ASLR test.

Key words: diagnostic tests; low back pain; sacroiliac joint; pregnancy

The use of diagnostic instruments in lumbopelvic pain is mainly to categorize patients in groups with different prognoses and to measure disease severity. The value of physical examination, and radiography is limited.^{9,16,19-21} A need exists for simple tests with high validity, sensitivity and specificity.⁹

Pregnancy is frequently complicated by the occurrence of lumbopelvic pain; the reported cumulative 9-month incidence ranges from 48%-56%.^{2,4,8,12} Posterior pelvic pain since pregnancy (PPPP) is often described as a distinct category.^{7,12,13,17} It remains questionable whether PPPP is a specific syndrome or just nonspecific lumbopelvic pain with an onset during pregnancy or delivery. Regardless of the answer, detailed study on the characteristics of PPPP could provide better understanding of lumbopelvic pain in general.

To discriminate patients with PPPP from healthy subjects, various instruments have been investigated. Mobility of the pelvic joints assessed by the Chamberlain method showed a range of motion between the pubic bones of 5.9 ± 3.3 mm in puerperal women with pelvic pain since pregnancy and 1.9 ± 2.2 mm in a group of puerperal women without pelvic pain.^{1,3} As far as is known, the specificity of this method was never studied in PPPP with a disease duration exceeding 6 months. In two studies in pregnant women the posterior pelvic pain provocation test (PPPP test) scored high both on sensitivity (0.69–0.81) and specificity (0.80–0.90).^{7,13} “Catching” of the leg (the phenomenon whereby a patient feels difficulty in moving one or both legs forward when walking) is described as a diagnostic sign in PPPP.¹⁷ The specificity of this sign was similar to that of the PPPP test, but its sensitivity was much lower; the reliability of this sign has, as far as we know, never been investigated.

The setting provides the opportunity to examine a large group of patients with PPPP. It was noticed that in most patients active raising of one or both legs in the supine position was weak. Many patients report pain during this action, even though most also describe feeling as though they were paralyzed. As early as 1839, the Swedish gynecologist Cederschjöld gave a description of a condition that he called “joint loosening” in pregnant and puerperal women.⁵ One of the described characteristics was the “difficulty or almost impossibility of even moving the lower limbs.” He assessed “... an instantaneous relief in the pains and the ability to move the limbs when the hips are pressed hard together with the hands.” In a previous study, a significant association was found between impaired active straight leg raising (ASLR) and radiographically measured mobility of the pelvic joints.¹¹

The aim of the present study is to investigate the usefulness of this phenomenon as a diagnostic instrument in women with PPPP. More specifically, the reliability and the validity of the Active Straight Leg Raising Test (ASLR test) to diagnose PPPP were investigated.

Materials and Methods

Subjects. Patients were selected from the outpatient clinic of a rehabilitation center, specialized in the treatment of pregnancy-related lumbopelvic pain.

Reliability. Test-retest reliability was performed in a group of 50 women with lumbopelvic pain of various etiologies and various degrees of severity. The test was scored two times with a 1-week period in between.

To be sure that the test-retest reliability of the two scores one week apart was not largely based on good

memory of the patient, the scores of the patient were compared with the scores of a blinded assessor. The assessor was an experienced examiner (I.R.) and scored the impairment to raise the leg by observing the velocity of leg raising, the appearance of any tremor in the leg, the amount of rotation of the trunk, and verbal and non-verbal expressions of the patient. The patients and the assessor were blinded for each others' scores and for the scores from the previous week. Moreover, the assessor was blinded for the results of all other measurements and the patients' medical history.

Sensitivity. Two hundred consecutive patients who fulfilled the criteria were included. Patients generally have two main reasons to consult the center: for treatment of (relatively severe) complaints or because they have (relatively minor) complaints and need information about the risks in case of a new pregnancy. To investigate the diagnostic properties of the ASLR test in patients with minor as well as severe disease intensity, patients were selected from the entire population. The sensitivity of the 50% of the patients with the highest disability and that of the 50% with the lowest disability were both computed. Disability was measured on the Québec Back Pain Disability Scale (QBPDS). This scale was developed to measure the grade of disability in non-specific low back pain;^{6,14} in a pilot study the scale appeared also suitable in patients with PPPP (unpublished data).

Inclusion Criteria. The inclusion criteria were:

1. Pain in the lumbopelvic region. Defined as pain experienced between the upper level of the iliac crests and the gluteal fold.
2. Pain beginning during pregnancy or within 3 weeks after delivery.
3. The patient was not pregnant and the last delivery was 6 months to 5 years previously.
4. Aged 20–40 years.

Exclusion Criteria. The exclusion criteria were:

1. A history of fracture, neoplasm or previous surgery of the lumbar spine, the pelvic girdle, the hip joint, or the femur.
2. Signs indicating radiculopathy: asymmetric Achilles tendon reflex and/or (passive) straight leg raising restricted by pain in the lower leg.
3. A systemic disease of the locomotor system.
4. Insufficient knowledge of the Dutch language to fill in forms, or any restriction to be tested.

Specificity. Control subjects were 50 nonpregnant women who consulted a primary care unit because of local problems of the locomotor system, *e.g.*, tennis elbow. Only those women were included who had at some time been pregnant and were without previous medical consultations or time lost from work because of lumbopelvic pain, and scored zero on the QBPDS at the moment of examination.

Measurements. The ASLR test was performed in a supine position with straight legs and feet 20 cm apart. The test was performed after the instruction: “Try to raise your legs, one after the other, above the couch for 20 cm without bending the knee.” The patient was asked to score impairment on a six-point scale: not difficult at all = 0; minimally difficult = 1; somewhat difficult = 2; fairly difficult = 3; very difficult = 4; unable to do = 5. The scores of both sides were added, so that the summed score ranged from 0-10.

Comparison With the PPPP Test. Because the PPPP test is a well-documented, reliable, sensitive and specific diagnostic instrument to assess PPPP,^{7,12,13} the ASLR test was compared with this test. The test was scored positive if pain was provoked on at least one side.

Statistical Analysis. SPSS statistical software was used for data analysis. Test-retest reliability and comparison of the score of the patient with the score of the assessor were determined by calculating Pearson's correlation coefficient and intraclass correlation coefficient (ICC). The estimates of variance for the ICC were obtained from a one-way random effect model. Sensitivity and specificity were calculated for different levels of the ASLR score. A χ^2 -test and Pearson's correlation coefficient were used to investigate the correlation between the ASLR test and the PPPP test. A P -value < 0.05 was considered significant.

Results

Mean age of the patients was 32.7 ± 3.5 years. Parity ranged from 1 to 6 with a median of 2. Postpartum period ranged from 0.5 to 4.8 years with a median of 1.7 years.

Mean age of the control subjects was 47.7 ± 8.1 years. Parity ranged from 1-9 with a median of 2. Postpartum period ranged from 0.27 to 40.4 years with a median of 18.5 years. Age, parity, and duration of the postpartum period of the control group were higher than those of the patient group (independent samples t -test $P < 0.001$).

Reliability In this group of 50 patients the score at the first examination ranged from 0-10 with a mean value of 4.6 ± 2.4 . The test-retest reliability measured with Pearson's correlation coefficient between the two ASLR scores 1 week apart was 0.87; the ICC was 0.83.

The test-retest reliability for the scores of the assessor measured with Pearson's correlation coefficient between the two ASLR scores 1 week apart was 0.82; the ICC was also 0.82. When the scores of the patient were compared with the scores of the assessor, Pearson's correlation coefficient was 0.78 and the ICC was 0.77.

Sensitivity and Specificity Figure 1 shows the ASLR scores of patients and controls; Figure 2 shows the sensitivity and specificity for various scores of the ASLR test. The sum of specificity and sensitivity was highest when a cut-off was made between ASLR score 0 and 1. Based on these figures it is proposed to indicate scores 1-10 as positive and zero as negative. At that level sensitivity was 0.87 and specificity was 0.94. The QBPDS score in the patient group ranged from 1 to 85. The mean score was 43.8 ± 18.7 . The ASLR score of the 100 patients with a QBPDS score 45 or higher was positive in all patients (sensitivity 1.00); the ASLR score of the 100 patients with a QBPDS score below 45 was positive in 73 patients (sensitivity 0.73).

Figure 1. ASLR scores of 200 patients with posterior pelvic pain since pregnancy (PPPP) and 50 healthy controls.

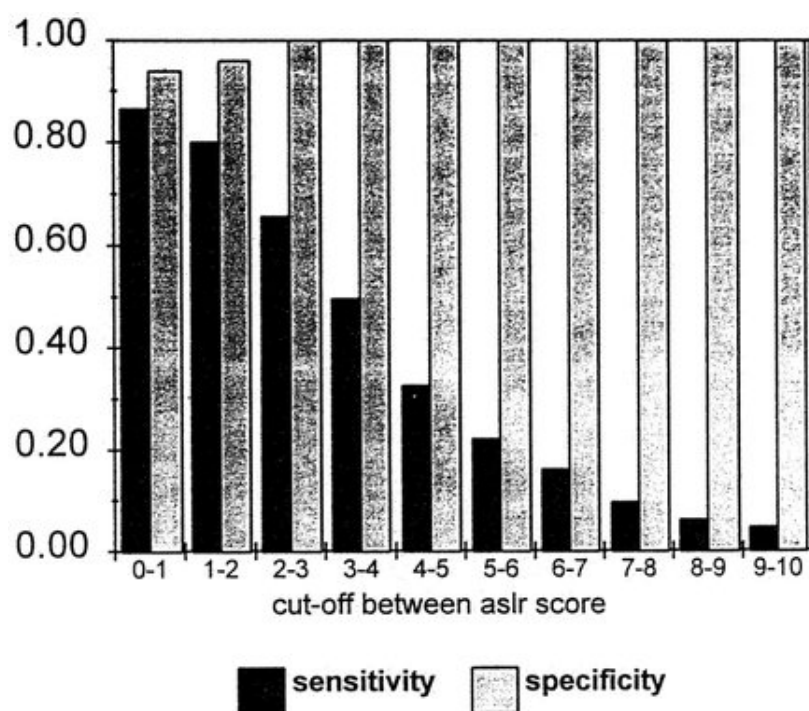
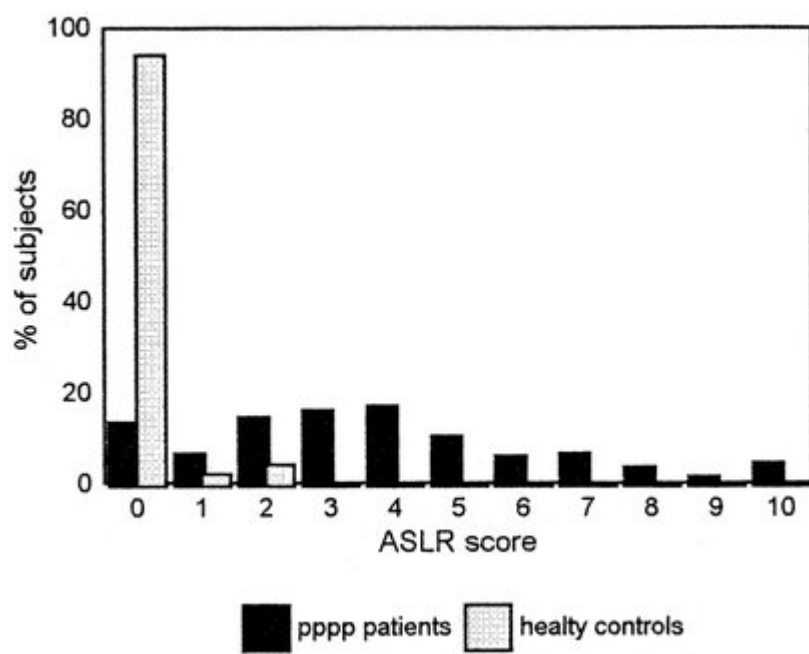


Figure 2. Sensitivity and specificity of the ASLR test in 200 patients with PPPP and in 50 healthy controls.

Comparison With the PPPP Test Sensitivity of the PPPP test in the patient group was 0.69 (Table 1). Pearson's correlation coefficient between the ASLR test and the PPPP test was 0.27 ($P < 0.001$; Pearson's χ^2 test, $P < 0.001$). In 17 of the 200 patients (8.5%) both tests were negative.

Table 1. Association Between PPPP Test and ASLR Test in Patients With PPPP

	PPPP Test Negative	PPPP Test Positive	Total
ASLR test negative	17	10	27
ASLR test positive	45	128	173
Total	62	138	200

Data are number of patients. Pearson's correlation coefficient = 0.27 ($P < 0.001$); Pearson's χ^2 , $P < 0.001$.
 PPPP = posterior pelvic pain since pregnancy; ASLR = Active Straight Leg Raise; PPPP Test = Posterior Pelvic Pain Provocation Test.

Table 1. Association Between PPPP Test and ASLR Test in Patients With PPPP

Discussion

In the present study the validity and reliability of the ASLR test were assessed to decide whether this instrument can be used to diagnose PPPP.

Reliability The results show that the test-retest reliability is high. The scores from the patient and from the experienced assessor showed a high correlation; this substantiates the reliability of the test. In case an objective verdict is needed the score of an experienced examiner would be preferred. In case the assessor is not experienced, or in situations where blinding is needed (*e.g.*, clinical trials) the score of the patient might be preferable. It would be interesting to investigate the cause of an occasional large discrepancy between the score of an individual patient and that of a skilled assessor. The discrepancy might give the investigator more insight into how the patient is facing her disability, especially in case of a large discrepancy between the severity measured with the self-assessment scales and assessed with the physical examination.

Sensitivity and Specificity The best balance between specificity and sensitivity was found when score 0 is negative and 1–10 is designated as positive. It is possible that in some clinical situations a higher cut-off point may be preferable. For example, between ASLR score 2 and 3 the sensitivity is 0.66 (not very high), but specificity is 100%. The results of this study show that the degree of disability influences the ASLR score. The sensitivity of 0.73 in cases with QBPDS score below 45 is still acceptable.

Comparison With the PPPP Test Sensitivity of the ASLR test is higher than the sensitivity of the PPPP test: 0.87 and 0.69, respectively. The correlation coefficient between both tests (0.27) is rather low. It seems that both tests measure different aspects of PPPP. An advantage of the ASLR test is that, when the score is given by the patient, it is not necessary to be skilled in examination of the locomotor system to measure the score.

Possible Explanation for the Phenomenon In previous studies it was hypothesized that symptoms in PPPP are caused by overloading of the ligaments of the pelvic ring and/or lumbopelvic junction during activities in which loads have to be transferred between legs and trunk.^{10,11,15} The ASLR test could be seen as a check for this system. Radiographic films taken during the ASLR test suggest that during active raising of the leg the pelvic bone at the tested side is forced to an anterior rotation about a horizontal axis near the sacroiliac joint. Secondary mobility of the lumbar spine and the contralateral sacroiliac joint are involved.¹¹ The hypothesis that joint laxity plays a role in PPPP and in the ASLR test is also supported by our experience that in the majority of patients with PPPP fastening of a pelvic belt and, in severe cases, fusion of the three joints of the pelvic ring are beneficial in the majority of cases. In

daily practice it became evident that the influence of a pelvic belt on the ASLR test predicts the usefulness of a pelvic belt during activities of daily living in individual patients. With this procedure the best position of the belt and the required tension are determined in a simple instant manner.

The suggested anterior rotation of the pelvic bone at the tested side during the ASLR test is probably the same as accomplished during the PPPP test. However, the rather low correlation between both tests suggests that the tests measure different aspects of this phenomenon. We hypothesize that the ASLR test measures the decreased function to transfer loads from legs to trunk and that the PPPP test shows whether the system has been overloaded or not during the preceding days or weeks.

Besides joint laxity as explanation it is suggested that problems in lumbopelvic pain are caused by a disturbed proprioception and decreased function of muscles because of pain and fatigue.^{17,18} Enlarged joint mobility as well as decreased muscle function may play a role. Especially patients with joint laxity may be vulnerable being trapped in a vicious circle with pain and fatigue, decreased proprioception, decreased muscle function, decreased muscular stability, decreased load transfer between spine and legs, pain and fatigue, etc. It seems that the ASLR test measures, in particular, the mechanical part of this vicious circle even in the absence of pain.

The “catching of the leg” phenomenon (whereby the patient feels difficulty in moving one or both legs forward when walking) seems to be based on the same mechanism as weakness during the ASLR test.¹⁷ Both phenomena are based on impaired ability to perform active hip flexion. Because of the difference of the lever arm it is obvious that moving the leg in flexion from a horizontal position is more difficult than from a vertical position. This could explain the difference in the sensitivity of both signs.

Waddell et al. described weakness of active raising of both legs together in supine position (bilateral active straight leg raising).²¹ The test was positive when the patient was not able to raise both legs six inches off the couch during 5 seconds. The test had a sensitivity of 0.40 in patients with chronic non-specific low back pain and a specificity of 1.00. It seems that this sign is related to the ASLR test.

The use of the ASLR test to discriminate between PPPP and healthy subjects is substantiated in the present study. Further studies are needed to evaluate the usefulness of the test to discriminate PPPP from other syndromes with pain in the lumbopelvic region. It would be interesting to score the ASLR test in a population of patients with lumbopelvic pain of various etiologies and to analyze whether the patients with a positive test are different with respect to other diagnostic tests, etiologies and prognoses. It might be that the effects of mechanical influences (*e.g.*, pelvic belt, improvement of muscle function, surgical joint fusion) are more marked in patients with lumbopelvic pain with a positive ASLR test than in those with a negative test.

Conclusion

The ASLR test is a suitable diagnostic instrument to discriminate between patients who are disabled by PPPP and healthy subjects and can be recommended as an instrument to diagnose PPPP. The test is easy to perform; reliability, sensitivity, and specificity are high. It seems that the integrity of the function to transfer loads between the lumbosacral spine and legs is tested by the ASLR test.

Key Points

- The active straight leg raise test is introduced as a reliable test.
- The active straight leg raise test can be recommended to diagnose posterior pelvic pain since

pregnancy.

Acknowledgments

The authors thank Inge Ronchetti, research assistant, for assessing the test–retest reliability, and Ronald TM van Kalmthout, MD, for examining a large number of control subjects.

References

[\[Click here for reference links. \(15 references linked.\)\]](#)

1. Berezin D. Pelvic insufficiency during pregnancy and after parturition. *Acta Obstet Gynecol Scand* 1954; 23 (3): 1–130.
2. Berg G, Hammar M, Möller-Nielsen J, et al. Low back pain during pregnancy. *Obstet Gynecol* 1988; 71: 71–5.
3. Chamberlain WE. The symphysis pubis in the roentgen examination of the sacroiliac joint. *Am J Roentgenol Rad Ther* 1930; 24: 621–5.
4. Fast A, Shapiro D, Ducommun EJ, et al. Low back pain in pregnancy. *Spine* 1987; 12: 368–71.
5. Genell S. Studies on insufficientia pelvis (gravidarum et puerpartum). *Acta Obstet Gynecol Scand* 1949; 28: 1–33.
6. Kopec JA, Esdaile JM, Abrahamowicz M, et al. The Québec back pain disability scale. *Spine* 1995; 20: 341–52.
7. Kristiansson P, Svärdsudd K. Discriminatory power of tests applied in back pain during pregnancy. *Spine* 1996; 21: 2337–44.
8. Mantle MJ, Greenwood RM, Currey HLF. Backache in pregnancy. *Rheumatol Rehabil* 1977; 16: 95–101.
9. McCombe PF, Fairbank JCT, Cockersole BC, et al. Reproducibility of physical signs in low back pain. *Spine* 1989; 14: 908–17.
10. Mens JMA, Vleeming A, Stoeckart R, Stam HJ, Snijders CJ. Understanding peripartum pelvic pain: Implications of a patient survey. *Spine* 1996; 21: 1363–70.
11. Mens JMA, Vleeming A, Snijders CJ, et al. The active straight leg raising test and mobility of the pelvic joints. *Eur Spine J* 1999; 8: 468–73.
12. Östgaard HC, Andersson GBJ, Karlsson K. Prevalence of back pain in pregnancy. *Spine* 1991; 16: 549–52.
13. Östgaard HC, Zetherström GBJ, Roos-Hansson E. The posterior pelvic pain provocation test in pregnant women. *Eur Spine J* 1994; 3: 258–60.
14. Schoppink LEM, Tulder MW van, Koes BW, et al. Reliability and validity of the Dutch adaptation of the Québec Back Pain Disability Scale. *Phys Ther* 1996; 76: 268–75.
15. Snijders CJ, Vleeming A, Stoeckart R. Transfer of lumbosacral load to iliac bones and legs. Part I: Biomechanics of self-bracing of the sacroiliac joints and its significance for treatment and exercise. *Clin Biomech* 1993; 8: 285–94.
16. Strender LE, Sjöblom A, Sundell K, et al. Interexaminer reliability in physical examination of patients with low back pain. *Spine* 1997; 15: 814–20.
17. Stureson B, Uden G, Uden A. Pain pattern in pregnancy and “catching” of the leg in pregnant women with posterior pelvic pain. *Spine* 1997; 22: 1880–3.
18. Taimela S, Kankaanpää M, Luoto S. The effect of lumbar fatigue on the ability to sense a change in lumbar position. *Spine* 1999; 24: 1322–7.
19. Thomas E, Silman AJ, Papageorgiou AC, et al. Association between measures of spinal mobility and low back pain. An analysis of new attenders in primary care. *Spine* 1998; 23: 343–7.
20. van Tulder MW, Assendelft WJ, Koes BW, et al. Spinal radiographic findings and nonspecific low back pain. A systematic review of observational studies. *Spine* 1997; 22: 427–34.
21. Waddell G, Somerville D, Henderson L, et al. Objective clinical evaluation of physical impairment in chronic low back pain. *Spine* 1992; 17: 617–28.

Acknowledgment date: April 21, 2000.

Address reprint requests to

J.M.A. Mens

Spine & Joint Centre

Westerlaan 10

3016 CK Rotterdam, The Netherlands

E-mail: sjceco@wxs.nl

The Low-Back Outcome Scale of Greenough and Fraser

Overview:

Greenough and Fraser developed the Back Outcome Score (LBOS) scale for measuring functional outcome in a patient with low back pain. The authors are from Middleborough General Hospital in England and Royal Adelaide Hospital in Australia.

Parameters:

- (1) current pain from a 10 cm (or 100 mm) visual analogue scale (VAS)
- (2) employment
- (3) domestic chores or "odd jobs"
- (4) sport or active social activities (like dancing)
- (5) resting
- (6) treatment or consultation with health care provider
- (7) analgesia
- (8) sex life
- (9) sleeping
- (10) walking
- (11) sitting
- (12) traveling
- (13) dressing

Parameter	Finding	Points
current pain	7 to 10 cm VAS	0
	5 to 6 cm VAS	3
	3 to 4 cm VAS	6
	0 to 2	9
employment	unemployed because of back pain	0
	part time	3
	full time lighter	6
	full time original	9
domestic chores or odd jobs	none	0
	a few but not many	3
	most or all but more slowly	6
	normally	9
sport or active social activities	none	0
	some but much less than before	3
	back to previous level	9
resting	resting more than half the day	0

	little rest needed occasional	4
	no need to rest	6
treatment or consultation	more than once per month	0
	about once per month	2
	rarely	4
	never	6
analgesia	several times each day	0
	almost every day	2
	occasionally	4
	never	6
sex life	severely affected impossible	0
	moderately affected difficult	2
	mildly affected	4
	unaffected	6
sleeping	severely affected impossible	0
	moderately affected difficult	1
	mildly affected	2
	unaffected	3
walking	severely affected impossible	0
	moderately affected difficult	1
	mildly affected	2
	unaffected	3
Sitting	severely affected impossible	0
	moderately affected difficult	1
	mildly affected	2
	unaffected	3
Travelling	severely affected impossible	0
	moderately affected difficult	1

	mildly affected	2
	unaffected	3
Dressing	severely affected impossible	0
	moderately affected difficult	1
	mildly affected	2
	unaffected	3

- where:
- The pain scale is a linear scale from 0 to 10 cm with 0 = no pain and 10 = worst possible pain imaginable.
 - The VAS score appears to have gaps (at 2-3 4 and 6-7 cm).
 - For employment status housewives are according to previous abilities.

total score = SUM(points for all 13 parameters)

- Interpretation:
- minimum score: 0
 - maximum score: 75
 - The higher the score the better the patient's status.

Score	Status
>= 65	excellent
50 – 64	good
30 – 49	fair
0 – 29	poor

References:

Greenough CG Fraser RD. Assessment of outcome in patients with low-back pain. Spine. 1992; 17: 36-41 (Table 1 page 37).

Greenough CG. Results of treatment of lumbar spine disorders. Acta Orthop Scand. 1993; Supplement 251: 126-129.

Woertgen C Holzschuh M et al. Does the choice of outcome scale influence prognostic factors for lumbar disc surgery? Eur Spine J. 1997; 6: 173-180.

Woertgen C Gliese M et al. Short term prognostic factors in lumbar disc surgery: The low back prognostic score is of predictive value. Zentralbl Neurochir. 1998; 30: 4-13.

Low Back Pain Disability Questionnaire of Roland and Morris

Overview: Roland and Morris developed a questionnaire for evaluating patients with low back pain. This can be used to determine the level of patient disability and can help measure outcome following therapeutic intervention. The authors are from St. Thomas' Hospital in London.

NOTE: The questionnaire is usually paired with a visual analogue scale (VAS) for pain rating ranging from no pain at all to unbearable pain.

Questions answered based on how they pertain to the patient today:

- (1) I stay at home most of the time because of my back.
- (2) I change position frequently to try and get my back comfortable.
- (3) I walk more slowly than usual because of my back.
- (4) Because of my back I am not doing any of the jobs that I usually do around the house.
- (5) Because of my back I use a handrail to get upstairs.
- (6) Because of my back I lie down to rest more often.
- (7) Because of my back I have to hold on to something to get out of an easy chair.
- (8) Because of my back I try to get other people to do things for me.
- (9) I get dressed more slowly than usual because of my back.
- (10) I only stand up for short periods of time because of my back.
- (11) Because of my back I try not to bend or kneel down.
- (12) I find it difficult to get out of a chair because of my back.
- (13) My back is painful almost all the time.
- (14) I find it difficult to turn over in bed because of my back.
- (15) My appetite is not very good because of my back pain.
- (16) I have trouble putting on my socks (or stockings) because of pain in my back.
- (17) I only walk short distances because of my back pain.
- (18) I sleep less well because of my back.
- (19) Because of my back pain I get dressed with help from someone else.
- (20) I sit down for most of the day because of my back.
- (21) I avoid heavy jobs around the house because of my back.
- (22) Because of my back pain I am more irritable and bed tempered with people than usual.
- (23) Because of my back I go upstairs more slowly than usual.
- (24) I stay in bed most of the time because of my back.

Response	Points
Yes	1
No	0

total score = SUM(points for all 24 statements)

Interpretation: • minimum score: 0

• maximum score: 24

• The higher the score the more severe the disability associated with the low back pain. A score of 0 indicates no disability and 24 severe disability.

• A score ≥ 14 indicates a patient in the poor outcome group.

References:

Roland M Morris R. A study of the natural history of low-back pain. Part I: Development of a reliable and sensitive measure of disability in low-back pain. Spine. 1983; 8: 141-144 (Appendices 1 and 2 pages 143-144).

Low Back Pain Impairment Score of Waddell and Main

Overview:

Waddell and Main developed a score for calculating impairment associated with low back pain. The authors are from the Western Infirmary in Glasgow Scotland.

Parameters:

- (1) major problem
- (2) time pattern
- (3) history of previous fracture
- (4) history of previous back surgery
- (5) root compression
- (6) lumbar flexion in cm using the technique described by Macrae and Wright or Moll and Wright
- (7) straight leg raising with distraction left leg
- (8) straight leg raising with distractaion right leg

Parameter	Finding	Points
major problem	none	0
	back pain	0
	back and referred pain	8
	root pain	-2
	spinal stenosis with neurogenic claudication	8
time pattern	acute	0
	recurring	4
	chronic	8
previous fracture	none	0
	transverse process	1
	wedge compression	2
	fracture dislocation	6
previous back surgery	none	0

	1	3
	> 1	6
root compression	none	0
	doubtful	1
	definite	2
lumbar flexion	distance in cm	(- 2) * cms
straight leg raising	angle for left leg	(-1) * (degrees) / 10
	angle for right leg	(-1) * (degrees) / 10

approximate total body impairment =

= 28 + SUM(parameters)

Impression:

- minimum score: around 0
- maximum score: around 58
- The higher the score the greater the degree of impairment.

References:

Macrae IF Wright V. Measurement of back movement. Ann Rheum Dis. 1969; 28: 584-589.

Moll JH Wright V. Normal range of spinal mobility. Ann Rheum Dis. 1971; 30: 381-386.

Waddell G Main CJ. Assessment of severity in low-back disorders. Spine. 1984; 9: 204-208 (Table 3 page 205).

Waddell G. Clinical assessment of lumbar impairment. Clin Orthopaedics and Related Research. 1987; 221: 110-120 (Table 2 page 114).

Low Back Pain Rating Scale of Manniche et al.

Overview:

Manniche et al developed rating scale to evaluate patients with low back pain. The scale covers the 4 manifest components of back pain and was designed for monitoring outcome following therapeutic interventions. The authors are from several hospitals in Denmark.

Measures in rating scale:

- (1) back and leg pain (60 points)
- (2) disability index (30 points)
- (3) physical impairment (40 points)

Back and Leg Pain

Visual analogue scales (VAS) ranging from 0 (no pain) to 10 (worst imaginable pain):

- (1) back pain at the time of the examination
- (2) leg pain at the time of the examination
- (3) the worst back pain within the last 2 weeks
- (4) the worst leg pain within the last 2 weeks
- (5) average level of back pain during the last 2 weeks
- (6) average level of leg pain during the past 2 weeks

pain index =

= SUM(points for all 6 visual analogue scales)

Disability Index

Questions (Table 1 page 319)

- (1) Can you sleep at night without low back pain interfering?
- (2) Can you do your daily work without low back pain reducing your activities?
- (3) Can you do the easy chores at home such as watering flowers or cleaning the table?
- (4) Can you put on shoes and stockings by yourself?
- (5) Can you carry two full shopping bags (10 kilograms total)?
- (6) Can you get up from a low armchair without difficulty?
- (7) Can you bend over the wash basin to brush your teeth?
- (8) Can you climb stairs from one floor to another without resting because of low back pain?

- (9) Can you walk 400 meters without resting because of low back pain?
- (10) Can you run 100 meters without resting because of low back pain?
- (11) Can you ride a bike or drive a car without feeling any low back pain?
- (12) Does low back pain influence your emotional relationship to your nearest family?
- (13) Did you have to give up contact with other people within the last 2 weeks because of low back pain?
- (14) If it was a present interest do you think that there are certain jobs which you would not be able to manage because of your back trouble?
- (15) Do you think that the low back pain will influence your future?

Responses	Points	Forward	Reverse
not a problem	0	yes	no
can be a problem	1	can be	can be
is a problem	2	no	yes

Forward questions: 1 2 3 4 5 6 7 8 9 10 11

Reverse questions: 12 13 14 15

NOTE: In the paper scoring is given as yes = 0; can be problem = 1; no = 2. However these responses for the last 4 questions reverse the general trend of the first 11 questions. It makes more sense to me to reverse the scoring for the last 4 questions.

disability index = SUM(points for all 15 questions)

Physical Impairment

Measures:

- (1) endurance of back muscles: length of time that the patient can lie horizontal above the floor with the legs strapped to a bench and the trunk unsupported from the level of the iliac crest
- (2) back mobility: modified Schober's test (see Calin 1998 (a) draw a line between the posterior iliac spines then (b) identify a point 10 cm above the midpoint of the line then (c) with the person bending forward measure the distance from that point to the midpoint of the line connecting the posterior iliac spines and (d) determine the distraction = increase in measurement while bending forward.
- (3) overall mobility: fastest time taken to go from (a) lying supine on a flat couch 80 cm above the floor to (b) standing beside the couch then (c) walking to the end of the couch where (d) a deep knee bend is done and then (e) return to the starting position.
- (4) use of analgesics: based on the frequency of use for non-narcotic and narcotic analgesics

Measure	Finding	Points
back muscle endurance	>= 270 seconds	0
	240 – 269 seconds	1
	210 – 239 seconds	2
	180 – 209 seconds	3
	150 – 179 seconds	4
	120 – 149 seconds	5
	90 – 119 seconds	6
	60 – 89 seconds	7
	30 – 59 seconds	8
	1 – 29 seconds	9
	0 seconds	10
back mobility (modified Schober's test)	>= 60 mm	0
	50 – 59 mm	2
	40 – 49 mm	4
	30 – 39 mm	6
	20 – 29 mm	8
	0 – 19 mm	10
overall mobility test	< 10 seconds	0
	10 – 19 seconds	2
	20 – 29 seconds	4
	30 – 39 seconds	6
	40 – 49 seconds	8
	>= 50 seconds	10
analgesic use	none during past week	0
	use NSAID or non-narcotic analgesic 1-4 times a week	2
	use of NSAID or non-narcotic analgesic 5+ times a week	4

	use of morphine or analogues 1-4 times a week	8
	use of morphine or analogues 5+ times a week	10

impairment index = SUM(points for all 4 measures)

Interpretation:

- minimum score for subscores and total: 0
- maximum pain index: 60
- maximum disability index: 30
- maximum physical impairment: 40
- maximum total points: 130
- The higher the score the greater the level of disability and impairment.

Performance:

- The scale was found to be reliable based on comparisons with the Global Assessments reported by an experienced clinician and the patient.
- Inter-rater agreement is high.

References:

Calin A. Chapter 5.5.5: Ankylosing spondylitis pages 1058-1070 (page 1065). IN: Maddison PJ Isenberg DA et al (editors). Oxford Textbook of Rheumatology Second Edition. Oxford Medical Publications. 1998.

Manniche C Asmussen K et al. Low back pain rating scale: Validation of a tool for assessment of low back pain. Pain. 1994; 57: 317-326.