“ROLE OF SCAPULA ON UPPER LIMB KINETICS & KINEMATICS DURING BARBELL BENCH PRESS-AN OBSERVATIONAL STUDY”

Dissertation Submitted to the UTKAL

UNIVERSITY Bhubaneswar, Odisha

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In Partial fulfilment of the requirements for the degree of

MASTER OF PHYSIOTHERAPY (M.P.T)

In

ORTHOPAEDIC PHYSIOTHERAPY

Under the guidance of

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ABSMARI

ABHINAV BINDRA SPORTS MEDICINE & RESEARCH INSTITUTE

Bhubaneswar, Odisha

2022-2024

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I hereby declare that this dissertation entitled entitled **ROLE OF SCAPULA ON UPPER LIMB KINETICS AND KINEMATICS DURING BARBELL BENCH PRESS- AN OBSERVATIONAL STUDY**is a bonafide and genuine research work carried out by me under the guidance of Dr. Deepak Kumar Pradhan, H.O.D, Abhinav Bindra Sports Medicine and Research Institute, Odisha

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ACKNOWLEDGEMENT

I am thankful to God who has bestowed their blessings on me throughout this journey. At the very outset, I would like to extend my gratitude towards our respected chairman of ABSMARI **Dr. Apjit Singh Bindra.** Many thanks to the founder of ABSMARI, Bhubaneshwar Padma Bhushan Mr. **Abhinav Bindra.** I'm grateful to our Executive Director of ABSMARI **Dr. Digpal Singh Ranawat.** A special acknowledgement and heartfelt gratitude to our **Faculty, ABSMARI,** my guide **Dr. Deepak Kumar Pradhan,** for allowing me to conduct study and for hisguidance, encouragement and support. Your unwavering support, expert guidance, and insightful feedback have been instrumental in shaping this research.

I express my sincere thanks to **Dr. Joesph Oliver Raj (Dean) and Dr. Chinmaya Kumar Patra (Principal)**, and other teaching and non-teaching staff for their support and help to make this dissertation successful.

I want to express my deepest gratitude to my family. Their unwavering love, encouragement, and belief in me have been the driving force behind my achievements.

My sincere appreciation goes out to my friends and colleagues who have been a pillar of support, providing encouragement and understanding during challenging times. Their camaraderie made this journey more enjoyable and memorable. A Special thanks to all my batchmates**,** participants who volunteered their time and cooperation, making the data collection process possible for this research.

Thanks to everyone who has been a part of this endeavor, whether mentioned here or not, please accept my sincere thanks. Your support has been indispensable, and this dissertation would not have been possible without your contribution.

Date: Signature of the Candidate

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LIST OF ABBREVIATIONS

1. **ABSMARI –** Abhinav Bindra Sports Medicine and Research Institute
2. **ANOVA-** Analysis Of Variance
3. **EMG-** Electromyography
4. **GH**- Glenohumeral Joint
5. **LT**- Lower trapezius
6. **SA**- Serratus anterior
7. **SDT-** Scapula Dyskinesis Test
8. **ST**- Scapulothoracic Joint
9. **SD-** Scapula Dyskinesis
10. **SPSS –** Statistical package for social science
11. **SW-** Scapula winging
12. **UT-** Upper trapezius

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ABSTRACT

ROLE OF SCAPULA ON UPPER LIMB KINETICS & KINEMATICS DURING BARBELL BENCH PRESS-AN OBSERVATIONAL STUDY

Background- The shoulder blade, or scapula, is an important component of the upper limb's biomechanics and provides a strong foundation for motor activity. Scapular movement patterns are evaluated using 3D motion analysis to assess scapular, which indirectly relates to understanding dyskinesis and winging. No such study has yet been conducted to compare the effects of 3D motion analysis on barbell bench press and scapular dyskinesis/winging. The purpose of the study was to assess, through 3D motion analysis, how different scapular locations affect the upper limb's kinematics and kinetics (EMG) during the barbell bench press exercise.

Methods- Thirty healthy asymptomatic university students aged between (23±5,height 1.6±0.4m,weight 55kg±10kg) were allocated into three groups based on their scapular condition: Normal scapula group (n=10), winging of scapula group (n=10), dyskinesis of scapula group (n=10). The participants performed three repetitions lasting three seconds of the barbell bench press exercises of one-repetition maximum (1RM) on a bench. The kinetics and kinematics were done using the EMG & motion capture system respectively.

Results – The kinetics differences were seen in Serratus Anterior($p<0.05$) during barbell bench press task. The kinematics differences were seen in only wrist and elbow components ($p<0.05$) in sagittal plane barbell bench press task.

Conclusion- This study concluded that, the kinetics and kinematics parameters can be altered in subjects with different scapular positions, despite of having scapular stability. So, individuals should consider the present findings when selecting specific exercises aiming to improve upper limb strength in different scapular positions. Also provides new insights about scapular positions and activation of the deeper muscle during barbell bench press exercise.

Keywords- Biomechanics, Dyskinesis, Electromyographic activity, Upper extremity, Winging

INTRODUCTION

ROLE OF SCAPULA ON UPPER LIMB KINETICS & KINEMATICS DURING BARBELL BENCH PRESS-AN OBSERVATIONAL STUDY

INTRODUCTION

The scapula serves as a stable foundation for the motor function of the upper limb, and the scapular muscles are responsible for maintaining the stability and mobility of the shoulder joint [1]. In addition, the scapula acts as a connection between the trunk and the upper limbs, ensuring the necessary synergy for movement and force transmission [1,2]. Scapulohumeral rhythm, which involves a 2:1 movement ratio between the humerus and scapula, is the movement of the scapula together with the humerus during arm motions. The rotation of the scapula upward occurs when the humerus rises, allowing for an increased range of motion [1, 3]. variations in scapular postures or movements, which are indicative of scapular instability brought on by a weakening or imbalance in the periscapular muscles. Scapulothoracic muscular imbalance, repetitive motions that deviate from normal scapulohumeral rhythm, and repeatedly abnormal posture are musculoskeletal factors associated with scapular dysfunction [5,6]. Two common causes of altered scapular postures, namely dyskinesis and winging of the scapula, are as follows: The first is long thoracic nerve denervation, which makes it difficult to actively flex the shoulder past 120 degrees, second is weakness of the serratus anterior muscle [4]. The Winged scapula refers to the prominent of the scapula’s medial margin. And the term "scapular dyskinesis" refers to abnormal alterations in the scapula's position or movement as well as weakness in the Serratus anterior and Trapezius muscles [7]. Numerous conditions, including poor posture (thoracic kyphosis or cervical hyper lordosis) and abnormalities in the activation and synchronization of the scapular stabilizing muscles, can result in scapular dyskinesia [5]. One of the most crucial components in preventing anterior tilt and winging of the scapula is the SA, which preserves portions of normal three-dimensional scapular motions [8,9].

The muscles that mainly contribute to the scapula's upward rotation are the lower trapezius and the serratus anterior [10].

The instability of the scapulothoracic muscles, which results in abnormal scapular posture and affects the scapulohumeral rhythm, is one of the potential causes of scapular dyskinesia [20].

Bench press is a popular exercise utilized to induce muscular adaptations of the upper body, such as strength, hypertrophy, and power [11]. The Bench press is an open kinematic chain movement. It's a complex exercise that works a variety of joints and muscle groups, such as the muscles in the shoulders and chest. Since the elbow and shoulder are the main joints used in the bench press, keeping the shoulder blades retracted helps to reduce stress on these joints and improves their ability to lift weight. Scapular mobility must be done correctly in order to maximize joint alignment and stability and reduce the risk of injury [12,13]. This includes protraction during the concentric phase and retraction during the eccentric phase.

Electromyography is a dependable research method that is frequently used to examine the physiological characteristics of muscle activity during exercise [17]. Through the use of small wire electrodes inserted directly into a muscle's belly or electrodes attached to the skin, electromyography is a technique for electrically detecting muscle activity [14]. During bench press exercises, the muscles surrounding the scapula and upper limb can be studied using electromyography. 4 leads EMG placement upper and lower trapezius, anterior deltoid, pectoralis major/ serratus anterior to see changes in muscle activity during this barbell bench-press task.

Movements were captured using a sophisticated 3D motion analysis system. MVN Awinda (Xsens) is a wireless motion capture system that is user-friendly, quick, and dependable. It can be used to evaluate entire body kinematics data, including joint angles, centre of mass, segment orientations, and accelerations during more complex, functional and multiplanar movements [15,16]. In this study, Kinematic data from the GH, elbow joint and wrist joint were obtained from the affected arm subjects with normal and altered scapular positions to check the compensatory pattern movement during barbell bench press activity.

Need of the Study

- As bench press is an important upper limb functional task, there is a need for analyzing its biomechanics.
- As the scapula is closely related to upper limb tasks and upper limb functions there is a need to analyze upper functional tasks with both normal and altered scapular positions.
- No research has been done yet on analyzing in the context of bench press and individuals with altered scapular positions using 3D motion analysis.

Aim of the Study

To evaluate the biomechanical difference of upper limb during bench press on individuals with normal and altered scapular positions.

OBJECTIVES OF THE STUDY

- To analysis the kinematics changes during bench press task using 3D motion analysis.
- To analysis the kinetics changes during bench press task using EMG.

Hypotheses

- **Null Hypothesis**

- There will be no significance difference between the joint kinematics and the muscle activation of upper extremity in subjects with scapular dyskinesis.
- There will be no significance difference between the joint kinematics and the muscle activation of upper extremity in subjects with scapular winging.

- **Alternative Hypothesis:**

- There will be significance difference between the joint kinematics and muscle activation of upper extremity in subjects with scapular dyskinesis.
- There will be significance difference between the joint kinematics and muscle activation of upper extremity in subjects with scapular winging.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

1. Juliana Pereira Silva and Rodrigo Cappato, de Araújo (2014)

Conducted a study on Electromyographic analysis of the serratus anterior and trapezius muscles during push-ups on stable and unstable bases in subjects with scapular dyskinesis concluded that in individuals with scapular dyskinesis, there is increased EMG activity of the trapezius and decreased EMG activity of the serratus anterior in response to an unstable surface and the performance of the push up exercise on an unstable surface favorable to produce higher levels of trapezius activation and on stable surface it is favourable for serratus anterior strengthening.

2. KYUNG-MI PARK and JI-HYUN LEE (2014)

Conducted a study on Comparison of pectoralis major and serratus anterior muscle activities during different push up plus exercise in subjects with and without scapular winging concluded that greater PM activity and lesser SA activity was found in subjects with scapular winging.

3. Tsun-Shun Huang and Chien-Ying Huang (2015)

Conducted a study on Specific kinematics and associated muscle activation in individuals with scapular dyskinesis concluded that scapular dyskinesis is more prominent in lowering phase of arm elevation.

4. Rodrigo Cappatode, André Luiz Torres (2017)

Conducted a study on “Activity of periscapular muscles and its correlation with external oblique during push-up: Does scapular dyskinesis change the electromyographic response" concluded that- use of unstable surfaces in the push-up does not seem to be a good rehabilitation strategy for individuals with scapular dyskinesis.

5. Shahab Alizadeh and Machel Rayner (2020)

Conducted a study on Push-Ups vs. Bench Press Differences in Repetitions and Muscle Activation between Sexes concluded that the sex disparity in repetitions and muscle activation during push-up & bench press exercises indicates that push-ups may provide a greater training stress to women than men.

6. Stian Larsen and Olav Gomo (2021)

Conducted a study on A Biomechanical Analysis of Wide, Medium, and Narrow Grip Width Effects on Kinematics, Horizontal Kinetics, and Muscle Activity on the Sticking Region in Recreationally Trained Males During 1-RM Bench Pressing concluded that bench pressing with a wide or medium grip width is more beneficial.

7. Jang-hun Jung and Sung-Hoon Jung (2022)

Conducted a study on Comparison of the Scapular Muscles Activity Between Individuals with and Without Scapular Winging During Shoulder Flexion with Load concluded that the SA activity was lesser in the group with SW than in the group without SW with 25% load of the maximal shoulder flexion force, but there was no significant compensatory muscle activity of the UT and LT.

METHODOLOGY AND PROCEDURE

METHODOLOGY

- Study Design – Observational Study
- Study Population – Healthy Asymptomatic Adults (without any shoulder pain)
- Sample Size – 30(The sample size was calculated by using the G Power)
- Sampling Technique – Purposive Sampling
- Study Setting – ABSMARI
- Study Duration – 6 months

Selection Criteria

- **Inclusion Criteria:**

1. Healthy asymptomatic adults with no muscular disorders
2. Age:18-28 years
3. Both male and female are included
4. No recent history of shoulder dislocation, any injury, fracture or surgery
5. Subject those who are given consents

- **Exclusion Criteria:**

1. Age >28
2. Persons with mental retardation, co-morbidities, metabolic, cardiopulmonary disorders
3. Individuals having any musculoskeletal pain or discomfort or neurological disorders
4. Subjects who are not willing to participate in this study

➢ MATETRIALS AND TOOLS USED

- Dumbbell -(weight of 2.5kg)
- Barbell – (weight of 10kg)
- EMG- 4 channels of clarity EMG octopus machine
- Inch tape
- Body marker
- Xsens motion analyser

Fig-1.1-(Clarity EMG Octopus)

Fig-1.2- (Xsens motion analyser)

Fig-1.3- (Dumbbell)

Fig-1.4- (Barbell)

➢ Outcome Measures:

1. Scapular Dyskinesis Test:

SDT was used to assess the presence and absence of scapula Dyskinesis. To perform the test, male subjects were asked to remove their shirt and female participants to wear the sports inner in order to better observe the scapular kinematics. Participants were instructed to perform five repetitions of bilateral flexion followed by 5 repetitions of bilateral abduction in frontal plane at a cadence of 3 seconds with straight elbows and holding 2 dumbbells[2.5kg].

Fig-1.5- (SDT-Bilateral Flexion)

Fig-1.6- (SDT-Bilateral Abduction)

2. **Wall Press Test:**

   WPT was used to assess the presence or absence of medial or lateral border of scapula prominence. Participants were instructed to perform five repetitions of wall press test with elbow straight in frontal plane.

Fig-1.7- (Wall Press Test)

3. **EMG Test:**

   4 channel of Clarity EMG Octopus 8 amplifiers 5.03 version machine used to evaluate and record the electrical activity of upper limb muscles (Anterior deltoid, upper trapezius, lower trapezius, serratus anterior) during Barbell Bench Press tasks.

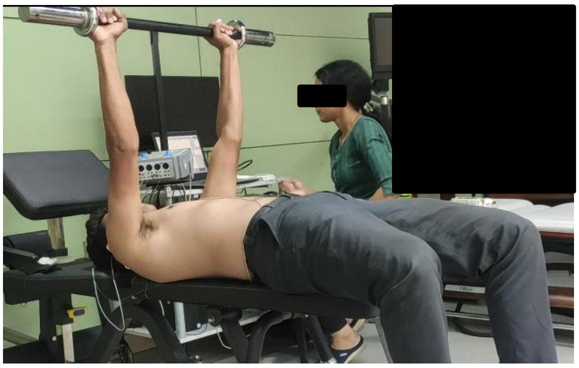


Fig-1.8- (EMG Test during bench press)

4. Xsens Motion Capture:

Kinematic data from the Glenohumeral, elbow, wrist joint were collected from the affected arm of each person from three scapular groups, using the available inertial sensor system ‘MVN Awinda motion capture system (version 2024.2.0). Data collection was done via wireless 17 inertial motion sensors connected to the mentioned body part.

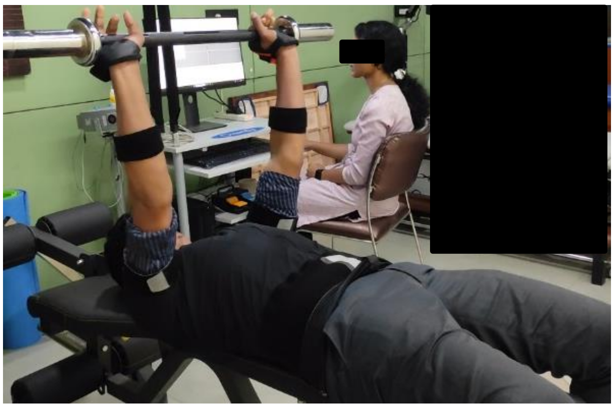


Fig-1.9- (Bench press kinematics motion capture)

Sample selection:

The institutional Ethical Committee evaluated and approved the current study. A total 90 samples were screened by using purposive sampling. 30 participants were selected based on inclusion and exclusion criteria and 60 subjects were excluded. Participants were explained about the study in their comfortable language. Everyone who participated in this study was informed about the procedure and their informed consent were taken. Each subject completed a short form regarding their current injury, history, demographic information along with information about the sports they played. Each participant's weight was measured in kilograms and height in centimeters.

The participants performed two tests (scapular dyskinesis test- bilateral shoulder abduction, bilateral shoulder flexion and scapular winging test) with two dumbbells for 5 times. Each time the participant performed these two tests observe any abnormality in scapula movement present during this movement in the frontal plane. According to that group allocation was done.

10 subjects were placed in Group A (healthy individuals)

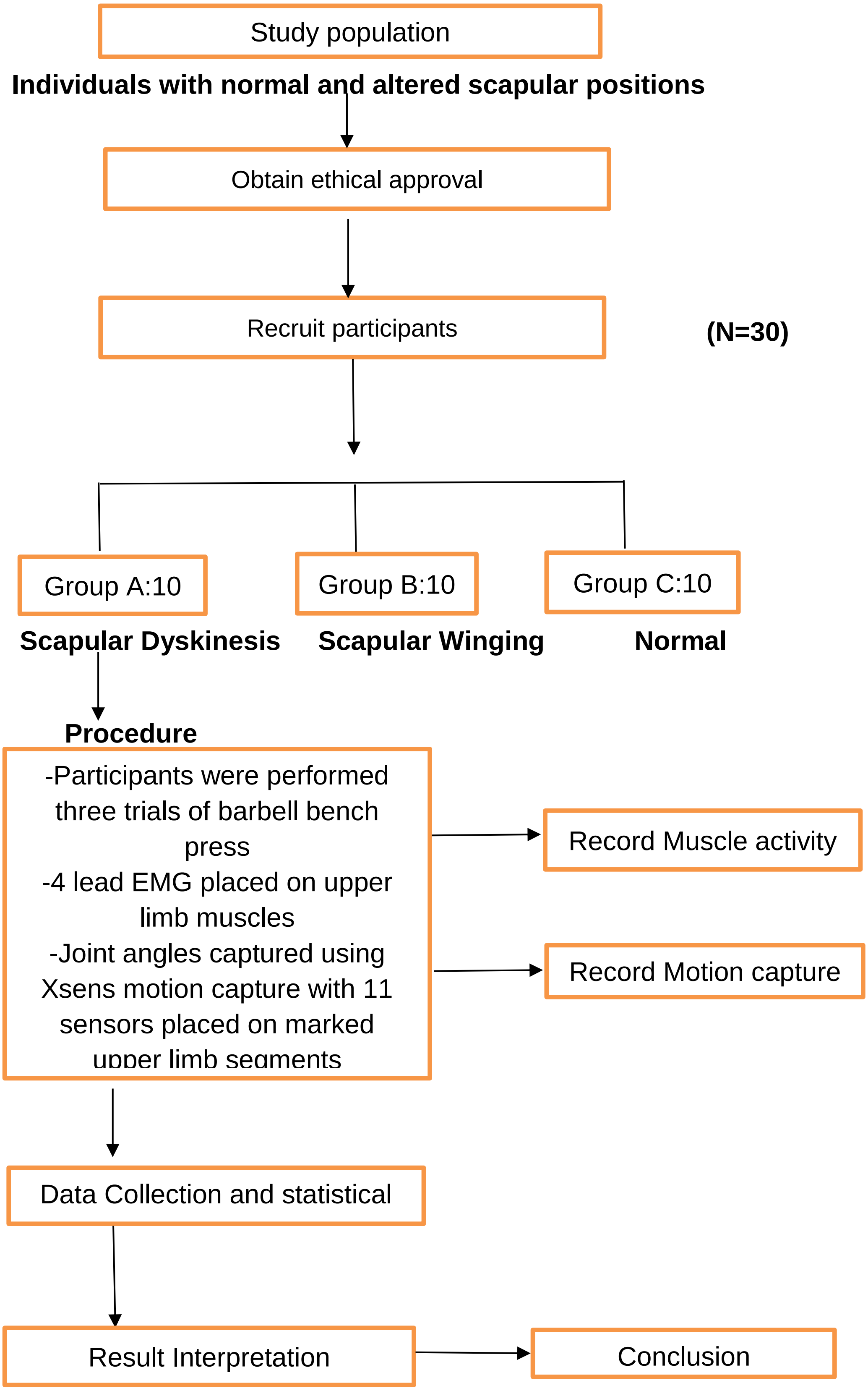
10 subjects were placed in Group B (Dyskinesis scapula)

10 subjects were placed in Group C (winging of scapula)

Procedure:

Barbell Bench press procedure was explained to each group participants. Participants performed bench press activity for 3 times with 4 lead EMG attached to upper limb (Anterior deltoid, upper and lower trapezius, serratus anterior) muscle. Muscle activity recorded during this activity.

For kinematics Xsens motion captured was used. 11 sensors attached to mentioned upper limb body part. Participants did a warm up that comprised processing of calibration. Participants performed bench press activity and motion capture was recorded.



2.2- Methodology Flowchart

SAMPLE SIZE ESTIMATION

The sample size was calculated using the G*power software with,

Effect size d **=** 0.67

α err prob **=** 0.05

Power (1-β err prob) **=** 0.90

Allocation ratio N2/N1 = 1

The total sample size was calculated was 30 i.e, 10 in each group

RESULTS

RESULTS

Statistical Analysis

Data was analyzed using statistical package **SPSS 22 software program** and level of significance was set **at p ≤ 0.05 Descriptive statistics** was performed to assess the mean and standard deviation of three groups. Normality of the data was assessed using **Shapiro-Wilk test.** A one-way ANOVA measures between group (group x muscles) with a **post hoc Tukey test** was used to determine the effect of the group, compare inter-muscle EMG activity for barbell bench press exercise and evaluate the interaction of factors. For all analyses the level of significance was **p ≤ 0.05**.

Between group analysis-

	Groups			
Joints	**SD**	**SW**	**Normal**	**P Value**
Wrist	**144.74 ± 16.06**	**114.24 ± 18.21**	**148.37 ± 41.52**	**0.001**
Elbow	**146.76 ± 21.71**	**136.00 ± 16.46**	**159.36 ± 35.55**	**0.001**
Shoulder	**162.44 ± 35.72**	**143.09 ± 11.26**	**160.52 ± 41.66**	**0.654**

(Fig-3.1-analysis of kinematic differences across the three groups during bench press task)

Between group analysis-

	Groups			
Muscles	**SD**	**SW**	**Normal**	**P Value**
Deltoid	**442 ± 69.81**	**479.75 ± 51.19**	**439.75 ± 61.28**	**0.277**
UT	**446.55 ± 127.00**	**476.12 ± 85.83**	**476.12 ± 85.83**	**0.756**
LT	**499.75 ± 63.15**	**471.2 ± 105.68**	**451.2 ± 95.36**	**0.488**
SA	**437.38 ± 1**07.29	**577.34 ± 170.56**	**444.22 ± 95.62**	**0.036**

(Fig-3.2-analysis of kinetics differences across the three groups during bench press task)

POST-HOC TEST: -

Pair (groups)-	Mean Difference	P value
ELBOW		
SD - SW	21.76275	0.012
SW - Normal	7.0847	0.574
Normal - SD	28.84745	0.001
SHOULDER		
SD - SW	10.9857	0.811
SW - Normal	1.16379	0.998
Normal - SD	12.14949	0.774
WRIST		
SD - SW	2.018	0.183
SW - Normal	15.681	0.037
Normal - SD	17.699	0.001

(Fig-3.3- pair wise analysis of kinematics variables)

POST-HOC TEST-

Pair(groups)-	Mean Difference	P value
DELTOID		
SD - SW	37.75	0.366
SW - Normal	40	0.325
Normal - SD	2.25	0.996
UT		
SD - SW	29.57	0.793
SW - Normal	0	1
Normal - SD	29.57	0.793
LT		
SD - SW	28.55	0.76
SW - Normal	20	0.873
Normal - SD	48.55	0.459
SA		
SD - SW	139.96	0.050
SW - Normal	133.12	0.071
Normal - SD	6.84	0.992

(Fig-3.4- pair wise analysis of kinetics variables)

DISCUSSION AND CONCLUSION

DISCUSSION

The aim of the study was to investigate and to compare the biomechanical difference of upper limb during bench press on individuals with normal and altered scapular positions (three groups with 10 each individual). As we know that during barbell bench press training scapula serves as a stable base for shoulder movement, allowing efficient force transfer, muscle activation and proper alignment of the upper limb, enhancing strength and reducing the risk of injury. According to the result of present study, during barbell bench press task there is a significant difference was found in Serratus Anterior group of muscle (P=0.032) and there is no such significant in other three muscles that is upper trapezius, lower trapezius, and anterior deltoid. Also, there is a significant difference found in kinematics except shoulder component which is done by using XSENSE 3D motion analysis where both wrist and elbow components (p=0.001, 0.001) is significant.

STRENGTH-

Focus on Scapular Position: By comparing the biomechanical variations in people with normal and altered scapular postures during the bench press, the study addresses a relevant matter. The reason for this focus is because upper limb mechanics and the risk of injury during weight training can be greatly impacted by scapular posture.

Objective Measurement Tools: A precise and objective method of analyzing joint movements is provided by using XSENSE 3D motion analysis to analyze kinematics, which increases the quality of the results.

Contribution to Scapular Strength: The research improves knowledge about the significance of scapular strength in upper limb mechanics.

This can help develop training plans and techniques for preventing injuries while preserving scapular stability and function.

Practical Implications for Patients and Athletes: The results have practical implications for patients and athletes undergoing physical therapy. Practitioners can reduce the chance of injury and improve performance when performing overhead exercises like bench presses by optimizing scapular posture.

Kinetics-Serratus anterior-The activation patterns of the serratus anterior are frequently changed in people with scapular dyskinesis. When performing the bench press task, a weak scapula may cause compensatory movement patterns because it may not stabilize against the thoracic wall effectively. Comparing this to people with normal scapular function may lead to different muscle activation. When the medial border of the scapula protrudes outward, especially during shoulder motions such as a bench press task, an individual with scapular winging fails to have this muscle maintain the scapula flat against the ribs. Due to this, there are noticeable changes in kinetics as well as unique movement patterns and muscle activation. [20]

Upper trapezius- The bench press mainly requires horizontal pushing movements, hence there are no significant variations in the upper trapezius muscle throughout the task between the scapular dyskinesis, winging, and normal scapula groups.[21] That is not its primary function as a stabilizer. Compensation in scapular dyskinesis and winging usually involves muscles more directly related to the abnormal action, such as the serratus anterior. The bench press does not require the primary tasks of elevation and upward rotation, hence the upper trapezius does not become more active.[22,23]

Lower trapezius- Improper timing and coordination of the scapular stabilizers is a common cause of abnormal scapular motion in scapular dyskinesis. The movement of the bench press, however, is primarily focused on elbow extension and horizontal shoulder adduction, therefore the lower trapezius is not the main muscle recruited during this exercise. When performing a bench press, the lower trapezius, which aids in scapular retraction and stabilization, does not take lead role in winging scapula. Because the bench press does not impair the muscle's essential functioning, the activation level of the muscle is constant between groups. There was likely less of a need for stabilization because of the scapula's support on the bench, which developed a stable condition.[22]

Anterior deltoid- The activation of the anterior deltoid muscle, which is predominantly responsible for shoulder flexion and horizontal adduction in the bench press, is mostly unaffected by the altered scapular kinematics in patients with scapula dyskinesis. The main cause of scapular winging is dysfunction in the serratus anterior. However, during the bench press, the anterior deltoid muscle, which moves the humerus instead of stabilizing the scapula, keeps its function intact, with no noticeable difference in activity between the groups. [22,23]

Kinematics-Wrist kinematics during the bench press exercise differed significantly, indicating that scapular conditions have a major impact on wrist movement and posture.

Any deviation in wrist alignment can change the mechanical force and load distribution throughout the forearm and upper arm. The wrist serves as an essential point for force transfer between the barbell and the upper limb. Variations in the placement of the scapula impact the stability and alignment of the shoulder, necessitating compensatory alterations at the wrist to preserve grip and control.[24]

The elbow serves as a main joint in the movement, which explains the notable difference in elbow kinematics during the bench press task.[23]

Changes in scapular positions can affect the stability of the shoulder and the patterns of muscle activation, which can change the dynamics of movement at the elbow.

In order to maintain proper bar path and load distribution, this may lead to compensating variations in elbow flexion and extension.

Scapular control is crucial for maintaining ideal elbow mechanics during the bench press.

Variations in scapular position may not have a major impact on shoulder movement in this exercise, as lack of significant change in shoulder kinematics during the bench press task. During the bench press, the shoulder joint primarily serves as a stabilizer, with the majority of movement taking place at the elbow and wrist to press the barbell. Because of this, the shoulder's function is more static, remaining in place to offer a firm platform, which could compensate for the mild kinematic differences seen in various scapular conditions.[24]

WEAKNESS-

Muscle Analysis: A more thorough understanding of scapular mechanics might be obtained by include more categories of muscles, such as the pectoralis minor and rhomboids.

Measurement-Scapular movements that are complicated, especially in multi-plane tasks, may not be correctly captured by XSENSE 3D motion analysis. This may have an impact on movement pattern interpretation and kinematic assessments.

Regarding bench press Diego et al [18] confirmed that, there is no difference in upper limb muscle EMG activity between subjects with and without scapular dyskinesis on a stable and unstable surfaces.

Limitations: -

Sample Size: The results may not be more widely applicable as they could be due to the limited sample size.

Populations: The results of the study are restricted to the particular group of university students that were examined; they may not be applicable to other groups, such as athletes, people with varying degrees of fitness, or people with scapular disorders.

Future Scopes: -

Future studies should include a larger and more various sample size to improve the applicability of the findings across different populations, including athletes, non-athletes, and those with varying degrees of physical fitness and scapular problems.

Technology Improvement: - To capture complex scapular movements and increase the accuracy and validity of kinematic and kinetic measures, future research may investigate the application of enhanced motion analysis technologies and procedures. Comparing the benefits of several versions of the bench press, such as (incline and decline, and dumbbell versus barbell) on scapular biomechanics could help identify optimal exercises for enhancing performance and reducing injury risk.

Functional Outcomes: Examining the relationship between scapular biomechanics and functional outcomes, such as strength, endurance, and injury incidence, could provide valuable insights for training and rehabilitation programs.

CONCLUSION

This study concluded that, the kinetics and kinematics parameters can be altered in subjects with different scapular positions, despite of having scapular stability. So, individuals should consider the present findings when selecting specific exercises aiming to improve upper limb strength in different scapular positions. Also provides new insights about scapular positions and activation of the deeper muscle during barbell bench press task.

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ANNEXURES.1

CONSENT FORM

Consent Form

Title of the study-

ROLE OF SCAPULA ON UPPER LIMB KINETICS & KINEMATICS DURING BARBELL BENCH PRESS-AN OBSERVATIONAL STUDY

I have been informed by Miss. Saswati Biswal. Pursuing MPT (Ortho) conducting the above-mentioned study under theguidance of Dr. Deepak Kumar Pradhan, H.O.D, Abhinav Bindra Sports Medicine and Research Institute (ABSMARI), BHUBANESWAR.

I have no objection and will be a part of that group. I also understand that the study does not have any negative implication on my health. I understand that the information procedure by the study will become a part of institute's record and will be utilized, as per confidentiality regulations of the institute. I am also aware that the data might be used for medical literature and teaching purposes, but all my personal details will be kept confidential.

I am well informed to ask as many questions as I can to Miss. Saswati Biswal either during the study or later.

I understand that my assent is voluntary and I reserve the right to withdraw or discontinue the participation from the study at any point of time during the study.

I have explained to MR/MISS/MRS   the purpose of the research, the procedure required in the language he/she could understand to the best of my ability.

(Investigator)   (Date)

I confirm that Miss. Saswati Biswal (Investigator) has explained to me in the language I can understand, the purpose of the study and the procedure. Therefore, I agree to give my assent for the participation as a subject in this study and I will be accountable for the decisions.

(Signature)   (Date)

ANNEXURES.2

ETHICAL COMMITTEE CLEARANCE CERTIFICATE

ABSMARI ETHICS COMMITTEE

ABHINAV BINDRA SPORTS MEDICINE AND RESEARCH INSTITUTE,
BHUBANESWAR, ODISHA

ABSMARI

Prof. (Dr.) E. Venkata Rao
Chairperson

Mr. Chinmaya Kumar Patra
Member Secretary

Ref. No. ABSMARI/IEC/2023/054

Date: 02/09/2023

APPROVAL LETTER

APPENDIX- VIII

To,

Saswati Biswal
ABSMARI
273, PAHAL, BHUBANEWAR-752101

Protocol Title: Role of Scapula on Upper Limb Kinetics & Kinematics During Barbell Bench Press-An Observational Study

Protocol ID.: ABS-IEC-2023-PHY-013

Subject: Approval for the conduct of the above referenced study

Dear Mr./Ms./Dr **Saswati Biswal**

With reference to your Submission letter dated 12/08/2023 the ABSMARI IEC has of the Ethics reviewed and discussed your application for conduct of clinical trial on dated 02/09/2023 (Sat Day).

The following documents were reviewed and discussed

S.N.	Documents	Document (Version/Date)
1	IEC Application Form	08-08-2023
2	Informed Consent Form	08-08-2023
3	Undertaking form PI	08-08-2023
4	CRF	08-08-2023
5	COI from the Investigators	08-08-2023

The following members were present at meeting held on 02-09-2023

S.N.	Name of the Member	Designation & Qualification	Representation as per NDCT 2019	Gender (M/F)	Affiliation with the Institution (Y/N)
1	Prof. Dr. E. Venkata Rao	Professor (MBBS, MD, Dept. of Community Med.) IMS & Sum Hospital, BBSR	Chair Person	M	N
2	Dr. Satyajit Mohanty	Director-Medcare Hospital, BBSR	Basic Medical Scientist	M	N
3	Dr. Ashok Singh Chouhan	PhD. Pharmacology, Assoc. Prof. Dept. of Pharmacology, Hi-Tech Medical College & Hospital, BBSR	Basic Medical Scientist	M	N

1

Utkal Signature, Plot No.-273, Ground Floor, Pahal, Bhubaneswar-752101 +91-63707-03654 iec@absmari.com

ANNEXURES.3

ETHICAL COMMITTEE CLEARANCE CERTIFICATE

ABSMARI ETHICS COMMITTEE

ABHINAV BINDRA SPORTS MEDICINE AND RESEARCH INSTITUTE, BHUBANESWAR, ODISHA

Prof. (Dr.) E. Venkata Rao
Chairperson

Mr. Chinmaya Kumar Patra
Member Secretary

Ref. No. ABSMARI/IEC/2023/054

Date 02/09/2023

MEMBERS

Dr. Smaraki Mohanty, Clinician

Dr. Satyajit Mohanty, Basic Medical Scientist

Dr. Ashok Singh Chouhan Basic Medical Scientist

Mr. Shib Shankar Mohanty Legal Expert

Ms. Annie Hans, Social Scientist

Ms. Subhashree Samal, Lay Person

Mr. Deepak Ku. Pradhan, Scientific Member

IEC-SECRETARIAT

Mr. Gouranga Ku. Padhy
Mr. Susant Ku. Raychudamani

S.N.	Name of the Member	Designation & Qualification	Representation as per NDCT 2019	Gender (M/F)	Affiliation with the Institution (Y/N)
4	Dr. Smaraki Mohanty	Asst. Prof-IMS & Sum Hospital/MBBS, MD (Community Med)	Clinician	F	N
5	Mr. Chinmaya Kumar Patra	Principal-ABSMARI, MPT	Member Secretary	M	Y
6	Mr. Shiba Sankar Mohanty	Junior Counsel-Lt. Ramachandra Sarangi's Chamber / BA LLB	Legal Expert	M	N
7	Ms. Annie Hans	Disability Inclusive Development Co-Ordinator in Humanity and Inclusion (India/Nepal/Srilanka). /MA in Social Work	Social Scientist	F	N
8	Ms. Subhashree Samal	Ret. Reader-Pol Sc.	Lay Person	F	N
9	Mr. Deepak Kumar Pradhan	Asst. Prof-ABSMARI, MPT	Scientific Member	M	Y

This is to confirm that only members who are independent of the Investigator and the Sponsor of the trial have voted/ provided opinion on the trial.

This Committee approves the documents and the conduct for the trial in the presented form with necessary recommendation.

The ABSMARI IEC must be informed about the progress of the study, any SAE occurring in the course of the study, any changes in the protocol and patient information/informed consent and requests to be provided a copy of the final report.

The ABSMARI IEC follows procedures that are in compliance with the requirements of ICH (International Conference on Harmonization) guidance related to GCP (Good Clinical Practice) and applicable Indian regulations.

ABSMARI ETHICS COMMITTEE
Dt..................
BHUBANESWAR

Yours sincerely

2/9/23

Mr. Chinmaya Kumar Patra
Member Secretary

Member Secretary
ABSMARI ETHICS COMMITTEE
ABSMARI Ethics Committee
Pahal, Bhubaneswar

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Utkal Signature, Plot No.-273, Ground Floor, Pahal, Bhubaneswar-752101 +91-63707-03654 iec@absmari.com

ANNEXURES.4

MASTER CHART

				DYSKINESIS GROUP					
SL NO.	AGE	WEIGHT	Ht.(meters)	BMI	DEL	UT	LT	SA	
1	21	42	1.53	17.9	425.6	530	544	479.6	
2	25	68	1.65	25	501	726.6	591.3	576.3	
3	25	63	1.62	24	437	367	488	493.5	
4	26	55	1.63	20.7	492	312.6	612	359	
5	27	62	1.51	27.2	478.2	412.8	537	368	
6	23	119	1.95	31.3	415	525	417.5	478	
7	24	56	1.59	22.2	423	372.5	552.3	442.1	
8	24	89	1.83	26.6	481.2	310	422.4	592.3	
9	22	45	1.55	18.7	357	410	528	312	
10	24	69	1.61	26.6	510	499	505	273	
MD	24.1	66.8	1.647	24.02	**452**	**446.5**	**519.75**	**447.38**	
SD	1.791957	22.62643	0.138568	4.182981	**454.324**	**462.516**	**523.278**	**456.203**	**RMS VALUE**
				WINGING GROUP					
SL NO.	AGE	WEIGHT	Ht. (Meters)	BMI	DEL	UT	LT	SA	
1	23	71	1.78	22.4	538.6	494	383.6	587	
2	24	65	1.71	22.2	631	464.3	674.6	842	
3	25	49	1.52	21.2	411.6	245	654.6	586.3	
4	26	48	1.52	20.8	497	559	417	888.3	
5	25	70	1.72	23.7	414.6	427	385	385.6	
6	25	54	1.61	20.8	480	415.6	512	538	
7	18	45	1.61	17.4	507	424.6	686.6	605.3	
8	21	48	1.54	20.2	400.6	378	371	444.6	
9	19	70	1.69	24.5	356.3	488.3	450.6	497.3	
10	26	47	1.65	17.3	340	451.3	435	399	
MD	23.2	56.7	1.635	21.05	**457.67**	**434.71**	**497**	**587.34**	
SD	2.898275	10.93465	0.090585	2.364671	**465.515**	**441.865**	**511.5**	**507.03**	**RMS VALUE**
				NORMAL GROUP					
SL NO.	AGE	WEIGHT	Ht.	BMI	DEL	UT	LT	SA	
1	24	62	1.78	19.6	499	528.3	421.6	390	
2	26	68	1.5	30.2	491.3	489.6	589.6	369.3	
3	19	55	1.66	30.2	480	479	512	363	
4	19	71	1.79	22.2	458.3	410	503.6	348	
5	21	79	1.52	34.2	495	423.6	598	375	
6	24	71	1.78	22.4	417.6	598.6	559.3	484	
7	25	65	1.81	19.8	411.6	314.3	447.6	431.6	
8	23	69	1.67	24.7	457	592.3	438.3	483.3	
9	19	53	1.46	24.9	512	487.5	312	630	
10	26	73	1.68	25.9	475.7	438	530	568	
MD	22.6	66.6	1.665	25.41	**469.75**	**476.12**	**491.2**	**464.22**	
SD	2.875181	8.058122	0.130661	4.81605	**470.843**	**483.033**	**498.222**	**481.956**	**RMS VALUE**