ISSN: 2321-5690
IJOPT
INDIAN JOURNAL OF PHYSICAL THERAPY
AN INTERNATIONAL JOURNAL

INDIAN JOURNAL OF PHYSICAL THERAPY
AN INTERNATIONAL JOURNAL
editor.ijopt@gmail.com

A STUDY TO FIND OUT THE DIFFERENCE BETWEEN INTERNAL & EXTERNAL ROTATION ROM OF GLENOHUMERAL JOINT IN SPIN & FAST CRICKET BOWLERS-A CROSS-SECTIONAL STUDY

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DOI: https://doi.org/10.63299/ijopt.060463

ABSTRACT

Background: The shoulder is a highly mobile joint susceptible to sport-specific adaptations in overhead athletes. In cricket, repetitive bowling actions may alter glenohumeral internal and external rotation, potentially affecting performance and injury risk.
Objective: To compare internal and external rotation range of motion (ROM) of the glenohumeral joint between fast and spin bowlers.
Methods: A cross-sectional observational study was conducted on 44 cricket bowlers (22 fast, 22 spin) aged 20–26 years. Internal and external rotation ROM of dominant and non-dominant shoulders was measured using a universal goniometer. Data were analyzed using independent t-tests to compare ROM and side-to-side differences.
Results: Fast bowlers demonstrated significantly greater internal rotation (69.95° ± 4.49) than spin bowlers (61.32° ± 4.19; $p = 0.02$), while spin bowlers showed greater external rotation (90.64° ± 3.15 vs 84.18° ± 2.85; $p = 0.05$). External rotation difference (ERD) was significantly higher in fast bowlers (22.67° vs 16.34°; $p = 0.005$), whereas internal rotation difference (IRD) was slightly higher in spin bowlers (14.56° vs 13.90°; $p = 0.025$).
Conclusion: Fast bowlers have greater internal rotation, while spin bowlers exhibit higher external rotation. Fast bowlers also show larger side-to-side differences in external rotation. These sport-specific adaptations highlight the need for targeted shoulder conditioning and injury prevention programs in cricket.
Keywords: Glenohumeral Joint, Internal Rotation and External Rotation, Spin bowlers & Fast bowlers

INTRODUCTION

The shoulder complex is one of the most mobile and anatomically sophisticated structures in the human body, comprising five articulations: the glenohumeral, sternoclavicular, acromioclavicular, scapulothoracic, and coracoclavicular joints.

Among these, the glenohumeral joint is a ball-and-socket articulation formed between the humeral head and the glenoid cavity of the scapula, allowing motion in multiple planes, including flexion, extension, abduction, adduction, internal rotation, and external rotation [1]. This extensive mobility comes at the cost of inherent stability, as the glenohumeral joint has minimal bony congruence. Consequently, it relies heavily on dynamic stabilization provided by the rotator cuff muscles and static stabilization through the joint capsule and glenohumeral ligaments [2,3]. The capsule is reinforced by the superior, middle, and inferior glenohumeral ligaments, which, together with the tendinous insertions of the rotator cuff, allow controlled internal and external rotation while preventing excessive humeral translation [3]. The glenohumeral capsule also contains a synovial lining that facilitates smooth joint movement, while the rotator cuff tendons surround the capsule to enhance stability and absorb stress during high-velocity overhead movements [3].

Repetitive overhead activities, such as cricket bowling, impose considerable stress on the glenohumeral joint. These movements can produce adaptive changes in osseous and soft tissue structures, including humeral retroversion, anterior capsular stretching, and posterior-inferior capsular contracture. Such adaptations may shift the arc of rotational motion, potentially affecting shoulder function and increasing the risk of overuse injuries, such as internal impingement, rotator cuff pathology, or superior labrum anterior-to-posterior (SLAP) lesions [4,5]. Athletes performing repeated overhead movements often exhibit differences in internal and external rotation between their dominant and non-dominant shoulders. These variations can have significant biomechanical implications, influencing muscle recruitment patterns, joint loading, and the efficiency of force transmission during bowling [5,6].

During the overhead throwing motion, the shoulder complex functions as a regulator of the force generated by the legs and trunk. This regulating function, combined with the high velocities accompanying the throwing motion, places large forces and torques on the glenohumeral joint. The repetitive nature of the overhead action produces substantial stresses on the muscles, bones, and joints of the upper extremity. Overhead athletes often demonstrate a greater internal-to-external rotation strength ratio in their dominant arm compared to the non-dominant arm, reflecting sport-specific muscular adaptations. In cricket bowling, the internal rotators of the shoulder are primarily active during the acceleration phase through concentric contraction, while the external rotators control deceleration and stabilize the joint [5,7]. These phases are critical in maintaining shoulder integrity and optimizing performance, highlighting the importance of understanding rotational ROM differences in cricket bowlers.

In cricket, bowlers are generally classified as fast or spin bowlers based on their bowling technique and objectives. Fast bowlers generate high ball velocities through coordinated energy transfer from the lower limbs and trunk, culminating in rapid circumduction of the upper limb. Spin bowlers, by contrast, focus on imparting rotational spin to the ball using wrist and finger mechanics rather than maximal velocity, often with shorter run-ups and controlled shoulder motion [6,7]. The differences in bowling biomechanics suggest that internal and external rotation ROM may vary between fast and spin bowlers, reflecting sport-specific adaptations. Understanding these differences is essential for designing tailored training programs, monitoring shoulder health, preventing injuries, and optimizing performance [8].

Despite the widespread participation in cricket and the importance of shoulder function, limited research has quantitatively compared glenohumeral rotation between spin and fast bowlers. Most existing studies have focused on descriptive coaching observations or have combined all cricketers without distinguishing between bowling types. [5,8] Investigating the internal and external rotation ROM in these two groups can provide insight into how repetitive overhead movements influence shoulder biomechanics and may help identify potential risk factors for injury.

Aim of the Study

To investigate the differences in internal and external rotation range of motion (ROM) of the glenohumeral joint in spin and fast bowlers in cricket.

Objectives of the Study

- To assess and quantify the internal and external rotation ROM of the glenohumeral joint in spin and fast bowlers.
- To compare the differences in internal and external rotation ROM between spin and fast bowlers.

METHODOLOGY

Study Design: This was a cross-sectional observational study designed to evaluate the internal and external rotation range of motion (ROM) of the glenohumeral joint in spin and fast cricket bowlers.

Study Setting: The study was conducted at the Universal Cricket Academy, Ahmedabad, where trained cricket bowlers practice regularly.

Sampling Method: Participants were selected using a convenience sampling method. All eligible fast and spin bowlers practicing at the academy during the study period were considered until the required sample size was reached.

Sample Size: A total of 44 participants were enrolled in the study, comprising 22 fast bowlers and 22 spin bowlers.

Inclusion Criteria:

- Age between 20 and 26 years.
- Both male and female cricket players.
- Actively practicing as fast or spin bowlers for at least 1 year.
- Willingness to participate and provide written informed consent.

Exclusion Criteria:

- History of any shoulder injury in the past 6 months.
- Any current injury affecting the kinematic chain that could impair bowling ability.

Materials Used:

- Pen and paper for recording measurements
- Universal goniometer
- Plinth
- Towel

Procedure:

Participants were screened according to inclusion and exclusion criteria. Written informed consent was obtained after explaining the purpose and procedure of the study. Participants were positioned supine with the shoulder abducted to 90° and the elbow flexed to 90°, with the scapula stabilized against the plinth. A folded towel was placed under the elbow to maintain proper alignment. Internal and external rotation ROM of both the dominant and non-dominant glenohumeral joint was measured using a universal goniometer. Measurements were recorded for all participants, and mean values were calculated for comparison between spin and fast bowlers.

Outcome Measures:

- Internal Rotation ROM (IR): Maximal internal rotation achievable with the shoulder at 90° abduction and elbow at 90° flexion, recorded in degrees.
- External Rotation ROM (ER): Maximal external rotation under the same conditions, recorded in degrees.

Figure 1: Measurement of external rotation ROM and internal rotation ROM of the dominant shoulder using a universal goniometer in fast bowler

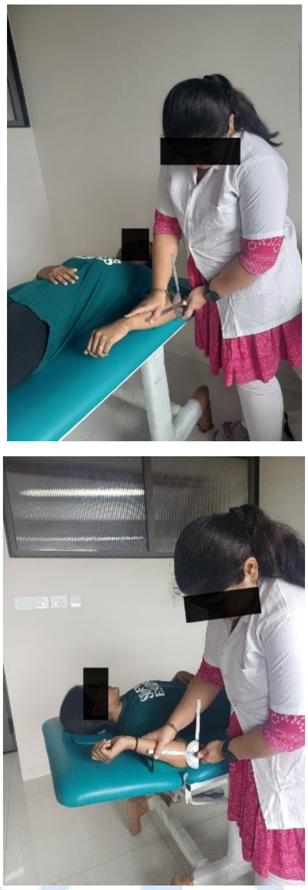


Figure 1: Measurement of external rotation ROM and internal rotation ROM of the dominant shoulder using a universal goniometer in spin bowler

Statistical Analysis: Data were analyzed using SPSS version 25.0. Descriptive statistics, including mean and standard deviation (SD), were calculated for internal rotation (IR) and external rotation (ER) of both dominant and non-dominant shoulders. Independent t-tests were used to compare ROM values and side-to-side differences (internal rotation difference [IRD] and external rotation difference [ERD]) between spin and fast bowlers. A p-value of <0.05 was considered statistically significant.

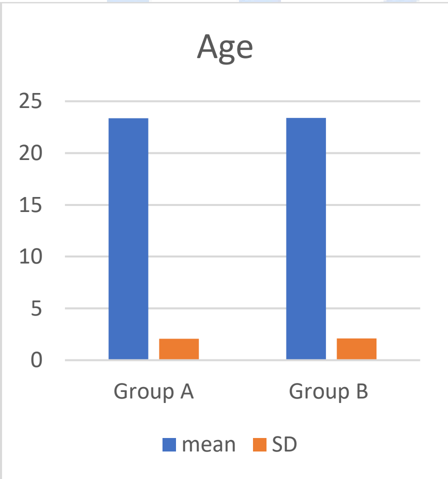
RESULTS

Table 1. Demographic Characteristics of Participants

Variable	Group A (Spin Bowlers)	Group B (Fast Bowlers)
Age (years)	23.36 ± 2.08	23.40 ± 2.10
Gender (n)		
Male	16	15
Female	6	7

Both groups were comparable in age, with mean ages of 23.36 ± 2.08 years in spin bowlers and 23.40 ± 2.10 years in fast bowlers. The gender distribution was also similar across groups, indicating that the two groups were demographically homogeneous.

Chart 1: Age and Gender Distribution



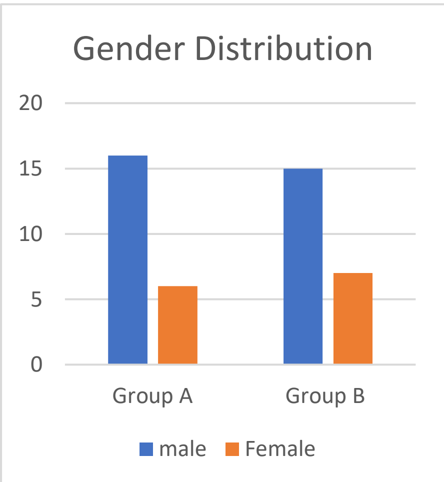


Table 2. mean and SD of Internal Rotation (IR) and External Rotation (ER) in spin and fast bowlers.

	Spin bowlers	Fast bowlers	*p* value	Result
Internal rotation	61.32± 4.19	69.95± 4.49	0.02	SIGNIFICANT
External rotation	90.64± 3.15	84.18± 2.85	0.05	

The results show a statistically significant difference in shoulder rotation between spin and fast bowlers. Fast bowlers demonstrated higher internal rotation ($p = 0.02$), while spin bowlers exhibited greater external rotation ($p = 0.05$). This indicates sport-specific adaptations in shoulder mobility due to repetitive bowling mechanics.

Chart 2. Comparison of Mean Shoulder Internal and External Rotation Range of Motion Between Spin and Fast Bowlers

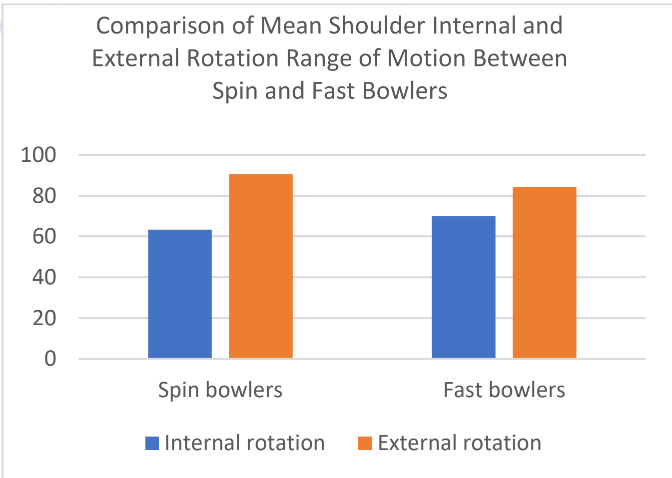


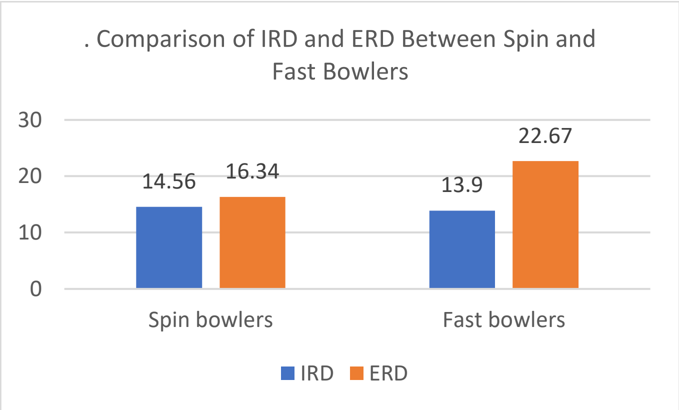
Table 3. Internal and external rotation difference in spin and fast bowlers.

	Spin bowlers	Fast bowlers	T value	*p* value
IRD	14.56	13.90	0.56	0.025

ERD	16.34	22.67	2.81	0.005

Table 3 indicates a significant difference in rotational deficits between spin and fast bowlers. The internal rotation difference (IRD) showed mild variation (p = 0.025), while the external rotation difference (ERD) was significantly higher in fast bowlers (p = 0.005), suggesting distinct adaptive patterns in shoulder mechanics associated with different bowling styles.

Chart 3. Comparison of IRD and ERD Between Spin and Fast Bowlers



DISCUSSION

The statistical analysis indicates a significant difference in internal and external rotation range of motion (ROM) between spin and fast bowlers. Fast bowlers demonstrated greater internal rotation (69.95 ± 4.49°) compared to spin bowlers (61.32 ± 4.19°), which was statistically significant (p = 0.02). Conversely, spin bowlers exhibited greater external rotation (90.64 ± 3.15°) than fast bowlers (84.18 ± 2.85°), showing a borderline significant difference (p = 0.05). Furthermore, the internal rotation difference (IRD) between dominant and non-dominant shoulders was slightly higher in spin bowlers (14.56°) compared to fast bowlers (13.90°), with a significant p-value (0.025). The external rotation difference (ERD) was greater in fast bowlers (22.67°) than in spin bowlers (16.34°), which was highly significant (p = 0.005). Overall, the findings suggest that fast bowlers have increased internal rotation but decreased external rotation compared to spin bowlers, likely due to repetitive overhead actions and sport-specific shoulder adaptations.

Our results align with previous studies on cricket-related shoulder adaptations. Giles and Musa (2016) reported similar patterns of glenohumeral rotation asymmetry, with fast bowlers showing increased internal rotation and spin bowlers demonstrating enhanced external rotation, supporting the concept of sport-specific adaptations induced by repetitive overhead movements. [9]

Brown et al. (2018) [10] observed significant differences in shoulder ROM between dominant and non-dominant arms in elite cricketers, emphasizing that repetitive loading can lead to structural and neuromuscular adaptations in the shoulder complex. Furthermore, studies by Laudner et al. (2010) [11] in baseball pitchers and Elliott et al. (2006) [12] in throwing athletes demonstrated that repetitive high-velocity overhead actions contribute to increased external rotation and decreased internal rotation, highlighting similar biomechanical principles across overhead sports. These comparisons reinforce the notion that the observed patterns in fast and spin bowlers are consistent with general overhead athletic adaptations, though specific to bowling technique. [13]

The observed differences in shoulder rotation may be attributed to the specific biomechanics of fast and spin bowling. Fast bowlers generate high linear and angular velocities during the delivery stride, producing large torques across the shoulder joint. The acceleration phase involves rapid concentric contraction of the internal rotators (subscapularis, pectoralis major, and latissimus dorsi) to propel the arm forward, leading to adaptive increases in internal rotation over time. [14,15] Additionally, the deceleration phase requires eccentric control of the posterior shoulder muscles (infraspinatus and teres minor) to dissipate forces safely, which may limit external rotation in fast bowlers. [14]

Conversely, spin bowlers rely on fine motor control and precise release mechanics, which place repetitive demand on the posterior cuff muscles and allow greater external rotation to generate spin while maintaining shoulder stability. [16] These biomechanical demands create specific adaptations in glenohumeral kinematics, including altered capsular laxity, muscle length-tension relationships, and rotational asymmetries. [17] The glenohumeral joint thus functions as a dynamic stabilizer, transferring forces generated by the legs and trunk to the arm while minimizing injury risk through coordinated muscular activation and joint positioning.

The practical implications of these biomechanical adaptations are significant for injury prevention and performance optimization in cricket. By understanding the bowling-specific shoulder rotation profiles, physiotherapists and trainers can design targeted mobility, flexibility, and strengthening programs to address internal-external rotation imbalances, enhance force transmission efficiency, and reduce overuse injuries. Our study contributes to the literature by directly comparing spin and fast bowlers in a single cohort, highlighting how distinct biomechanical demands of bowling types shape shoulder ROM adaptations and bilateral asymmetry, which is essential for developing individualized training and rehabilitation strategies.

CONCLUSION

The study demonstrates that fast and spin bowlers exhibit distinct glenohumeral rotation adaptations. Fast bowlers have significantly greater internal rotation, while spin bowlers show higher external rotation. Additionally, fast bowlers display larger side-to-side differences in external rotation, reflecting sport-specific adaptations to repetitive overhead bowling mechanics. These findings highlight the importance of understanding bowling-specific shoulder mechanics to guide targeted training, strengthening, and injury prevention programs. Tailoring conditioning strategies according to bowling type can optimize performance and reduce the risk of overuse injuries in cricketers.

This study had a relatively small sample size and included participants only between 20 and 26 years of age, which may limit the generalizability of the findings. Future research should consider larger and more diverse populations, including elite-level players, to better represent high-performance cricketers. Incorporating additional outcome measures, such as strength testing or muscle activation patterns, could provide a more comprehensive understanding of shoulder adaptations. Longitudinal studies tracking players across pre- and post-season periods would further help to examine the effects of training load, seasonal variations, and long-term bowling mechanics on glenohumeral rotation and injury risk.

ACKNOWLEDGEMENT:

I am deeply grateful to Almighty God for His blessings throughout this research. I sincerely thank my parents, Shetalben and Bhavesh Upadhyay, for their constant support, motivation, and guidance. I am thankful to Dr. Manisha Rathi, Principal of Venus Institute of Physiotherapy, for allowing me to conduct this study and providing invaluable support. My heartfelt gratitude goes to my guide, Dr. Tanuja Pandya, for her mentorship, encouragement, and guidance throughout the research. I also thank all the staff members and participants whose cooperation made this study possible. Finally, I express my gratitude to everyone who contributed, directly or indirectly, to the successful completion of this work.

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