Comparison of strength ratio of shoulder internal/external rotators in adolescent professional badminton players and non-athletes

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Objective: There is evidence of huge number of shoulder injuries in professional badminton players. The exact cause or aetiology of these shoulder injuries, in the badminton players is not very evident. The sporting shoulder has to work at extreme ranges, with very high forces, which predisposes the shoulder to injuries. Thus the purpose of this study was to observe if there exists any imbalance in the strength ratio of shoulder internal and external rotators in professional badminton players and compare it with the strength ratio of non-athletes.

Material and methods: Seventy-six participants consented to participate in the study out of which 38 were professional badminton players and 38 were non-athletes with mean age of 14.13 and 14.89 years respectively. Their isometric strength of dominant shoulder’s internal and external rotators was measured and the strength ratio of internal/external rotators of the two groups was compared.

Results: The isometric strength ratio of shoulder internal/external rotators in professional badminton players was 1.11±0.16 and that of non-athletes was 1.01±0.04 which was statistically significant with p=0.0003.

Conclusion: There exists a significant imbalance in the isometric strength of internal/external rotators in the professional badminton players as compared to non-athletes. This imbalance in the strength could be one of the causes which predispose the badminton players to higher risks of shoulder injuries. Thus during rehabilitation of the player the aim should be at gaining the optimum strength ratio of internal/external rotators of the shoulder.

Key Words: Strength imbalance, overhead sports, isometric assessment.
INTRODUCTION

In racquet sports like badminton, rapid internal and external rotation of the shoulder is seen. In these sports, the sporting shoulder has to deliver highly repetitive and very sport specific actions which include rapid internal and external rotation at high speed and force, it may also include working of the arm, shoulder girdle and the trunk at extreme ranges where the player has to reach for the shuttle which thereby increases the risk of shoulder injuries in racquet players. In such sports, wherein high forces are produced, the shoulder muscles are required to act in a synchronized and well-co-ordinated manner in order to provide maximum stabilization at the shoulder.¹

Couppe et al² conducted a questionnaire based study on 188 international level badminton players during World Mixed Team Championship showed that 52% of the players presented with shoulder pain out of which 37% were previous history of pain and 20% players had ongoing pain. Also Yung et al³ retrospectively reviewed 44 Hongkong professional badminton players in 2003 reported an overall incidence rate of 5.04 injuries per 1000 player hours and shoulder was one of the most commonly injured body sites (out of 80 injuries). This shows that, the rate of shoulder injuries is quite high. At the same time the exact cause or mechanism of injury at the shoulder is not known, thus it is important to deduce the causes of shoulder injuries in the professional badminton players.

Scoville et al⁴ studied the end range eccentric antagonist/concentric agonist strength ratios in overhead athletes playing at college level where the end range (60-90 degrees) ratio for the eccentrically working medial rotators and concentrically working lateral rotators was 2.39:1 and 2.15:1 for dominant and non-dominant shoulder respectively, and the ratio obtained at 10 degrees of lateral rotation and 20 degrees of medial rotation for eccentrically working lateral rotators and concentrically working medial rotators was 1.08:1 and 1.05:1 for dominant and non-dominant shoulders, respectively. The above study shows that there exists some imbalance in the strength ratio of internal and external rotators when compared between the dominant and non-dominant shoulders in the overhead athletes, but there needs to be adequate evidence for the prevalence of this kind of imbalance in the strength ratios in badminton players.

As mentioned above the sporting shoulder has to deliver shots at extreme ranges, so if there is any imbalance in the strength ratio of internal and external rotators, the sporting shoulder is prone to injuries. Thus the aim of this study was to compare strength ratio of shoulder internal and external rotators in adolescent professional badminton players and non-players.

METHOD

Seventy-six participants (46 males, 54 females) consented to participate in the study out of which 38 were professional badminton players in the age group of 13-18 years with mean age of 14.13±1.43 years and another 38 were normal healthy individuals with a mean age of 14.89±1.6 years. The players playing for more than 3 years and 6 hours of regular badminton training per week were included in the study. All the participants, with a history of shoulder pathology, shoulder injury or shoulder surgery or playing any sport other than badminton were excluded from the study.

The study was approved by the Institutional Review Board and a written informed consent was taken from all the participants before testing them. Before testing, the study and the procedure were briefly explained to the participants prior to the assessment. A hand-held dynamometer was used for assessment of strength as there is highest torque produced during isometric strength testing, also the reliability and validity of this instrument is well established⁵,⁶,⁷. Before the assessment each participant was made to do a warm up of 5-10 minutes which included stretching.
and light active shoulder movements and at the end of assessment, again stretching was given to
the assessed group of muscles.

Each participant was positioned supine lying with the testing arm placed in 90 degrees
abduction and the elbow in 90 degrees of flexion and stabilized in this position. The break test
strength of internal and external rotators was measured in the same position in both players and
non-athletes. First strength of internal rotators was measured followed by the external rotators,
three readings of each were taken and best of the three values were taken into consideration for
analysis.

During the assessment, participants were given verbal encouragement by the examiner. After
obtaining the internal and external rotators strength values, the ratio of these groups of muscles
was found for all individuals.

The data were analyzed using SPSS version 12. The level of significance was set at p ≤ 0.05.
The data was analysed using an unpaired t test between the groups.

RESULTS

Please refer to Table 1.

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<tr>
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<th>Athletes</th>
<th>Non-athletes</th>
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<tbody>
<tr>
<td>Internal rotation</td>
<td>7.96±1.96</td>
<td>8.09±2.03</td>
</tr>
<tr>
<td>External rotation</td>
<td>7.28±1.83</td>
<td>8.07±1.99</td>
</tr>
<tr>
<td>Ratio</td>
<td>1.11±0.16</td>
<td>1.01±0.04</td>
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<td>p value</td>
<td>0.0003</td>
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DISCUSSION

The objective of this study was to find out the strength ratio of internal and external rotators in
professional badminton players and non-athletes on the dominant shoulder, and compare the
strength ratio of players and non-athletes, and see if there exists any difference in their strength
ratio. The results revealed that the strength ratio of non-athletes was 1.01 and that of badminton
players was 1.11 which indicates that there is significant imbalance in the strength ratio in
professional badminton players with p=0.0003.

Hurd et al9 studied a profile of glenohumeral internal and external rotation motion in the
uninjured high school baseball pitchers: strength where they found the isometric strength ratio of
external rotators: internal rotators were lower in dominant limb by 9% than the non-dominant
limb.

Edouard et al 10 studied the shoulder strength imbalances, as one of the risk factors for injuries
in youth female Handball players. They found the isokinetic strength of internal rotators was
higher for the dominant shoulder than that of the non-dominant shoulder; also there was a
significant decrease in the external rotators/internal strength ratio on the dominant side as
compared to that of the non-dominant side. Ng et al11 studied Antagonist/Agonist isokinetic work
ratios of shoulder rotators in male badminton players and found the work ratio of eccentric
antagonist/concentric agonist are different in dominant 1.9:1 and non-dominant 1.3:1 shoulders.
during late cocking phase and work ratio during deceleration phase is 1.1:1 in dominant and 1.3:1 in non-dominant shoulder. Choi did a study where they checked the isokinetic strength ratios of eccentric antagonist/concentric agonist muscles in the late cocking and deceleration phases in 25 professional badminton players where they found the ratio at late cocking phase was 2.16:1 on the dominant side and 1.68:1 on non-dominant side. While that for deceleration phase the ratios were 0.73:1 and 0.89:1 respectively.

In overhead sports the action is divided into 4 phases: winding up, cocking, acceleration, and deceleration. The cocking phase is further divided in early and late phases. In the late cocking phase of such overhead sports there is full external rotation of shoulder and the shoulder is subjected to maximum anterior and superior forces. The external rotators have shown maximum electromyographic activities in the late cocking phase. The internal rotators are also known to work excessively during this phase to prevent excess of external rotation of the humerus. Thus during this eccentric control of the internal rotators in an attempt to prevent excessive external rotation of the humerus, there is eccentric loading causing intramuscular connective tissue tearing which further can lead to muscular weakness and chronic inflammatory changes. Also in a study done by Torres and Gomes it was seen that abduction and external rotation of the shoulder overloads the static and dynamic stabilisers of the shoulder joint, thus increasing the risk of injury to shoulder rotators.

Overhead athletes may also encounter overuse injury which can be caused in the deceleration phase of the overhead action. This happens because after a high angular velocity the arm is suddenly brought to stop in a very short period, high eccentric force is produced which predisposes the muscles to tensile failure. Gowitzke et al. have also reported that, during the forehand smash in badminton the impact and the power during impact comes mainly on the shoulder as the elbow extension ends earlier, this could cause repetitive trauma and injury to the shoulder. Thus the players are most likely to get injured in these two phases of the overhead activity.

The limitations of the study are: comparison between dominant and non-dominant shoulder was not seen, also muscle imbalance with respect to gender was not taken into consideration.

CONCLUSION

Significant differences are seen in the strength ratio of shoulder internal and external rotators of the badminton players and non-athletes. This indicates that there is more work of internal rotators than the external rotators while playing.

Clinical implication

As there is imbalance seen within the shoulder internal and external strength ratio, more importance should be given to strength parameters during the rehabilitation and training of the players to avoid injuries.

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REFERENCES


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