A DESCRIPTIVE STUDY ON GLENOHUMERAL ROTATIONS AND HORIZONTAL ADDUCTION OF SHOULDER JOINT IN MALE GOLFERS

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BACKGROUND

Shoulder injuries are more common in golf, account for 17% of all musculoskeletal injuries in golfer. The main reason for this could be the repetitive stresses or over use of the lead shoulder while performing the backswing and follow-through phases. Thus it is predisposed that golfer can develop injuries in shoulder due to adaptation that take place in glenohumeral joint.

Objective- To evaluate and compare bilateral glenohumeral rotations and horizontal adduction with posterior shoulder tightness in male golfers using bubble inclinometer procedures.

Methods- 65 subjects were included, group A(22-38yr) is having 22 subjects and group B (39-57yr) is having 43 subjects, where Group A has Mean of age, height, weight and BMI as (mean ± standard deviation ) 30 ± 8, 166.35 ± 7, 63 ± 10 and 23.5 ± 1.5 respectively while group B has Mean of age, height, weight and BMI as (mean ± standard deviation ) as 48± 9, 168.71 ± 7, 63 ± 10 and 26.5 ± 1.5 respectively. In order to get a statistical value a paired t test was applied to compare the internal and external rotational range of motion patterns and horizontal adduction with posterior shoulder tightness between the lead and the trailing shoulder.

Results- Statistical result suggests that there was a difference between ER and HA measures and no statistical differences existed between IR and PST. The result of this study confirms our experimental hypothesis that there is significant change in external rotations and horizontal adduction of shoulder in leading and trailing arm in both group of the golfers and also confirms our null hypothesis that there is no significant changes in internal rotation and posterior shoulder tightness in both leading and trailing arm in two group of golfers.

Discussion and Conclusion- Results indicates that group A is having more ER of the shoulder in both leading arm and trailing arm in the right hand dominant golfers while group B is having more HA of the shoulder in both leading arm and trailing arm in the right hand dominant golfers Thus the alternate hypothesis is accepted. No significant change has been found in IR and PST in both groups of the golfers in both extremities. Thus the null hypothesis is accepted. Factors such as subject’s age may confounded the findings of this study therefore further studies need to be done on additional number of amateur golfers in group A.

Key Words: Golf, Shoulder range of motion, glenohumeral joint, internal rotation, external rotation, horizontal adduction, posterior shoulder tightness and shoulder injuries.

INTRODUCTION:

Worldwide Golf is played in different skill and by people ranging from young to old age [1] In order to improves his game to the level of an professional player, a golfer had to focus on natural athletic ability and on daily routine practice for hours [2, [3]

In routine practice session for a week a golfers can perform 2000 swings in each week. [4] Therefore, golfers are at highrisk of developing overuse injuries [5] among which shoulder account for8% to 17.6% of all golf injuries. [6] Overuse is one of the main reasons of shoulder stress pathology that’s results in micro traumain shoulder musculature with an inflammatory response. Changes in the soft tissue in shoulder after inflammatory conditions such as bursitis, synovitis or tendinitis results in a reduced active shoulder motion, muscle weakness and leading to a pain-weakness atrophy sequence and if untreated can lead to tears in rotator cuff muscles. [7, 8]

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Golf swing is divided into five phases: the takeaway, the backswing, the downswing, acceleration, and follow-through.[8] Golf related overuse injuries generally occur due to the repetitive stresses applied during the golf swing especially in backswing and follow-through phases. Injuries like Impingement, rotator cuff disease, acromioclavicular joint pain, acromioclavicular osteoarthritis, and distal clavicular osteolysis[12] are more common in the lead shoulder (the left shoulder for the right hand dominant golfer) then the trailing shoulder[7].

Golfers has chances to develop, posterior glenohumeral instability [18] because during the golf swing especially in the back swing, shoulder goes through a large degree of left shoulder horizontal adduction and right shoulder external rotation. Thus it has been postulated that main reason for shoulder dysfunction is restricted mobility of the posterior shoulder structures. [8, 16, 21]

Among all glenohumeral instability cases, Posterior shoulder instability accounts for 2 to 12 percent only. In the literature traumatic and repetitive overuse mechanisms is found to a major reason that leads to posterior shoulder instability. [23] While in contact sports, the force directed towards the flexed, adducted and internally rotated arm accounts for the reason for posterior shoulder instability, [26,27] or repetitive mechanism could also be one of the reason. [24]

Aim of this study was to compare and examine the passive rotational ROM patterns of the glenohumeral joint in the dominant (trailing) and (lead) non-dominant shoulders with horizontal adduction associated with posterior shoulder tightness in two group of golfers i.e. Group A 24-38 years and Group B 39-57 years of age.

METHODOLOGY
All 65 subjects that participated in the study were clearly explained about the procedure and the purposes of the study, then the signed consent form were obtained from the subject. A Single blind descriptive study of golfers were assessed age between 24-58yrs who are physically active and have been playing for at least past one year with more than 2000 swings per week were included in the study and those who were having any recent musculoskeletal injury of upper limb, previous history of a shoulder, elbow or wrist injury from last six months, Neck muscle disorders like any musculoskeletal disorders were excluded from the study. Subjects were divided into 2 groups; group A (22-38) and group B (39-57) years.

The subjects have been assessed first for the internal and external rotations and then horizontal adduction associated with posterior shoulder tightness. Mean of the three readings has been taken as final reading.

Rotations: In physiotherapy couch or table, subjects were asked to lie in supine position with shoulder abducted in 90 degree; elbow flexed to 90 degree and the forearm in a neutral position then to measure range of motion a Bubble Inclinometer is placed at the forearm. In order to minimized the tension in the anterior soft tissue passing over the joint, neutral horizontal positioning of the humerus was maintained and thus vertebral commands were given participants to bring their arm back to their maximum available ER motion without compromising form. Once the limit of ER motion is achieved, and the reading has been taken from the Bubble Inclinometer. Similarly stabilizing manually force was applied while performing Passive internal rotation with the tester internally rotating the extremity. Measurements have been recorded for both internal rotation and external rotation. Mean of the three readings has been taken as final reading.

Horizontal Adduction: In order to take horizontal adduction measurements subjects were positioned against a examining table with both shoulders flush against it and investigator stood at the head of the examination table towards head of the subject and positioned the shoulder in 90 degree of abduction and elbow in 90° of flexion with forearm in neutral position. The proximal portion of the subjects forearm was placed slightly distal to elbow and humerus is moved in to horizontal adduction thus at the end range of movement the amount of motion present was measured by aligning bubble inclinometer at the midline of the humerus in distal aspect. Mean of the three readings has been taken as final one.

Posterior shoulder tightness: Measurements of posterior shoulder tightness was measured by using bubble inclinometer with Participants lying on their non tested side ½ the length of their humerus from the edge of a standard plinth during horizontal adduction while non tested extremity placed under their head in order to support a neutral head position. The investigator facing towards the golfer, level of their shoulder and with one of his hands grasping the participants elbow thus shoulder abducted passively to ninety degrees while maintaining zero degrees of rotation at the shoulder joint and elbow flexed to ninety degrees and with other hand placed at the participants lateral scapular border in a fully retracted (adducted ) position. Prior to lowering the humerus passively, a verbal command to “relax your arm and allow me to lower it to the table”
was given and then passively lowered the humerus into Horizontal adduction toward the plinth in the transverse plane maintaining neutral humeral rotation and scapular stabilization in the retracted position thus measurements was recorded three times from the Bubble Inclinometer. Mean of the three readings has been taken as final reading to a data collection sheet.

**Result**

**Table 1: Mean and SD of ER at Leading Arm (LA) and Trailing Arm (TA) for Group A and Group B**

<table>
<thead>
<tr>
<th>External Rotation</th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>LA</td>
<td>90.22</td>
<td>0.66</td>
</tr>
<tr>
<td>TA</td>
<td>89.60</td>
<td>1.04</td>
</tr>
</tbody>
</table>

**Table 2: Comparison of mean value for ER at Leading Arm (LA) and Trailing Arm (TA) between Group A and Group B**

<table>
<thead>
<tr>
<th>External Rotation</th>
<th>Group A Vs Group B</th>
<th>t value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LA</td>
<td></td>
<td>3.494</td>
<td>P &lt; 0.05</td>
</tr>
<tr>
<td>TA</td>
<td></td>
<td>2.961</td>
<td>P &lt; 0.05</td>
</tr>
</tbody>
</table>

**Comparison of mean value for ER (LA and TA) between Group A and Group B**

**Table 3: Mean and SD of IR at Leading Arm (LA) and Trailing Arm (TA) for Group A and Group B**

<table>
<thead>
<tr>
<th>Internal Rotation</th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>LA</td>
<td>83.60</td>
<td>0.77</td>
</tr>
<tr>
<td>TA</td>
<td>83.10</td>
<td>0.66</td>
</tr>
</tbody>
</table>
Table 4: Comparison of mean value for IR at Leading Arm (LA) and Trailing Arm (TA) between Group A and Group B

<table>
<thead>
<tr>
<th>Internal Rotation</th>
<th>Group A Vs Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t value</td>
</tr>
<tr>
<td>LA</td>
<td>-1.644</td>
</tr>
<tr>
<td>TA</td>
<td>-1.663</td>
</tr>
</tbody>
</table>

Comparison of mean value for IR (LA and TA) between Group A and Group B

Table 5: Mean and SD of HA at Leading Arm (LA) and Trailing Arm (TA) for Group A and Group B

<table>
<thead>
<tr>
<th>Horizontal Adduction</th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>LA</td>
<td>134.27</td>
<td>0.56</td>
</tr>
<tr>
<td>TA</td>
<td>133.35</td>
<td>0.69</td>
</tr>
</tbody>
</table>

Table 6: Comparison of mean value for HA at Leading Arm (LA) and Trailing Arm (TA) between Group A and Group B

<table>
<thead>
<tr>
<th>Horizontal Adduction</th>
<th>Group A Vs Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t value</td>
</tr>
<tr>
<td>LA</td>
<td>-2.225</td>
</tr>
<tr>
<td>TA</td>
<td>-2.845</td>
</tr>
</tbody>
</table>

Comparison of mean value for HA (LA and TA) between Group A and Group B
Table 7: Mean and SD of PST at Leading Arm (LA) and Trailing Arm (TA) for Group A and

<table>
<thead>
<tr>
<th>Posterior Shoulder Tightness</th>
<th>Group A</th>
<th></th>
<th>Group B</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>LA</td>
<td>125.26</td>
<td>2.14</td>
<td>124.80</td>
<td>1.29</td>
</tr>
<tr>
<td>TA</td>
<td>124.69</td>
<td>2.35</td>
<td>123.90</td>
<td>1.26</td>
</tr>
</tbody>
</table>

Table 8: Comparison of mean value for PST at Leading Arm (LA) and Trailing Arm (TA) between Group A and Group B

<table>
<thead>
<tr>
<th>Posterior Shoulder Tightness</th>
<th>Group A Vs Group B</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t value</td>
<td>P value</td>
</tr>
<tr>
<td>LA</td>
<td>1.052</td>
<td>P &gt; 0.05</td>
</tr>
<tr>
<td>TA</td>
<td>1.739</td>
<td>P &gt; 0.05</td>
</tr>
</tbody>
</table>

DISCUSSION –
Statistical Analysis of this study conclude that there is significant change in external rotations ER and horizontal adduction HA of shoulder in leading and trailing arm in two group of the golfers and also confirms our null hypothesis that no significant changes were observed in internal rotation IR and tightness in the posterior shoulder in both leading and trailing arm in both the group of golfers i.e., group A is 22-38 years and group B is 39-57 years.

In our study we found that group A is having more external rotation than group B and group B is having more HA than group A. Golfers were recruited for this study from Royal Spring Golf Course (RSGC), Lake View Golf Course (LVGC) and Army Environmental Park Training and Academy (AEPTA).

In this study we have evaluate the passive shoulder ER, IR, and horizontal adduction and purpose was to find if there is any association with posterior shoulder tightness bilaterally.

Various researchers conclude that golf swing biomechanics plays a vital role in development of posterior shoulder instability firstly because of serratus anterior muscle fatigue and secondly due to repetitive subscapularis muscle activity. (8)

As per literature available it has been observed that acromioclavicular joint impingement or injuries are quite common in golfers due to the forces acting on the joint while playing or practice especially during of back swing and at the end of the follow through (25-29)

Greg Davidson et al in his study found that no statistical differences existed between each shoulder in Internal Rotation and External rotation measurement though it was found that in both extremities, external rotations measurements were greater than Internal rotation.
N Zheng et al in kinematic analysis of swing in golfers concluded that during peak of the swing, the largest magnitudes for left shoulder horizontal adduction varies between 125 ± 6 degrees.\(^{(33)}\)

Kao et al in his work conclude that in lead arm side, serratus anterior muscle is active throughout the entire swing; thus when serratus muscles get fatigue it could alter the scapula humeral rhythm, thus impair the ability of the external rotators of the shoulder to provide stability at the glenohumeral joint.\(^{(4)}\)

Hovis et al propose that in despite of muscular fatigue in scapular region, if a golfer continues to play the sport it will allow the subscapularis muscle to impart an internal rotation stress to the shoulder thus can leads to posterior shoulder tightness.\(^{(8)}\)

Due to tightness in the posterior capsule there would be an increase in the stress on the anterior capsule of the shoulder which could be because of the increase in external rotation generally adaptation is gradual and this could be the reason why we did not observe in our study. Although we have noted significant increase in ER and HA in golfer players which could play a significant role in especially diagnosing and treatment planning of injured golfers.

David Kim et al conclude in his work that shoulder rotation decreases with increasing age of the golfer especially in amateur.\(^{(40)}\) but Senior golfers showed decreased in ER by 23 degree and 38 degree as compared to middle aged and college group respectively\(^{(32)}\) but we observe increased in ER in group A golfers and increased value of HA in group B golfers in both lead arm and trailing arm in right hand dominant.

During impact phase of the swing motion, Down swing horizontal is achieved through repetitive eccentric contractions of the posterior portion of the rotator cuff. Several authors have an opinion that a swing repetition and chronic stress could be the reason for injury in shoulder girdle.

McCarroll and Mallon et al stated older players have more shoulder problem especially in the left target side because of impingement that occur during back swing, as in this swing arm is maximally elevated to maximum thus increase the eccentric load on the shoulder muscles.\(^{(46)}\)

PST is common traits found in golfers in both leading arm and the trailing arm in both groups of the golfers but ones with having internal impingement due to any pathology also have marked decreased in internal rotation and increased in PST of both shoulders.

In our study cross chest adduction method was used for assessing PST in 2 group of golfers in both leading and trailing arm for right hand dominant. We investigated that no significant changes found in PST in both lead arm and trailing arm (right hand dominant) shoulders in 2 group of golfers.

In this study we have used the bubble inclinometer method which was used by Lin and Yang for shoulder stiffness and with ICC=0.82 inter-rater reliability. Researchers have found significant relationships between decreased internal rotation ROM and PST in elite pitchers thus it is postulate that subsequently tightness in posterior structures of shoulder may lead to the development of posterior shoulder tightness. Although just by PST we cannot conclude what are the structure that are responsible for limiting internal rotation of shoulder only it can be confirmed that posterior aspects structure are the one that are responsible.\(^{(24)}\)

**FUTURE RESEARCH**

1. Future studies should be done with more subjects in group A (amateur) golfers.
2. Future studies can also be done in GH IR , ER, HA and PST in the female golfers or inboth gender.

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