INTRODUCTION

Multidirectional instability can result due to multiple factors like the increased retroversion, a hypoplastic posteroinferior rim, and decreased scapular abduction during arm elevation [1]. Biomechanical studies are often used to understand the changes in the shoulder biomechanics [1-4]. During a biomechanical study setup misalignment of the scapula can occur leading to anterior or posterior tilt, which is rotation around the glenoid height (superior-inferior axis) as shown in Figure 1. In past only one study has investigated the effect of scapular inclination [1-4]. However, to our knowledge there is no other study that has evaluated the influence of scapular misalignment/tilt. This study aimed to understand the relationship between glenoid tilt/misalignment and glenohumeral joint stability. We hypothesized that the shoulder stability would not change with variation in very small variations of glenoid tilt.

METHODS

Eight fresh-frozen cadaveric specimens were tested using a custom dislocation simulator. The specimens were thawed overnight and dissected before experimentation. All experiments were performed at glenohumeral abduction angle of 60° and 0° external rotation. After potting the scapula in a rectangular box, a line was drawn on glenoid from superior to inferior aspect of the glenoid. This line represented the height of the glenoid and was determined by using circumcircles. After the glenoid superior-inferior aspect was aligned parallel to the Y-axis of the simulator, it was then verified using a microscribe digitizer. However, the accuracy of a microscribe is 0.3mm, so we chose a 3° tilt for both anterior (red) and posterior (blue), because it represented three standard deviation of the error (“d”) that can occur as shown in Figure 1.

![Figure 1: Different orientations of the glenoid fossa tilt, black shows the normal tilt at 0°, red glenoid shows the 3° anterior tilt, and the blue glenoid is the 3° posterior tilt evaluated in this study, d represents the two st.dev of error that occurred on each side.](image)
static load of soft tissue that was removed for this study. Translational distance of the glenoid and medial-lateral displacement of the humeral head, along with horizontal reaction force were recorded for every trial. Repeated measures analysis of variance (ANOVA) was performed with statistical significance set at p <0.05.

RESULTS AND DISCUSSION

The distance to dislocation for each specimen was determined as the point at which the tangential reaction force was zero. The distance to dislocation was similar at all three orientations. The results from ANOVA showed no effect on distance to dislocation for change in glenoid orientation (Table I). Similarly, the results for reaction force and stability ratio had same mean values. The stability ratio for normal, 3° anterior, and 3° posterior tilt were 0.25 ± 0.07, 0.24 ± 0.07, and 0.25 ± 0.07, respectively. Change in tilt or glenoid orientation mismatch did not affect any measured variable.

To our knowledge no study has evaluated the effect of glenoid tilt. The present study demonstrated that the small mismatch in the glenoid alignment (tilt) did not affect the shoulder stability in terms of both translation and stability ratio. These findings were in agreement with our hypothesis. This study examined the sensitivity of the scapula alignment during potting process for a biomechanical experiment. In conclusion, a digitizer device like microscribe can be used to verify the scapula potting.

CONCLUSIONS

This study demonstrated that very small variation in glenoid tilt does not affect the stability of shoulder.

REFERENCES


ACKNOWLEDGEMENTS

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Table 1: Changes in distance to dislocation, reaction force, and stability ratio for different glenoid orientations (mean and standard deviation).

<table>
<thead>
<tr>
<th>Tilt Orientation</th>
<th>Distance to Dislocation (mm)</th>
<th>Force (N)</th>
<th>Stability Ratio (Force/50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3° Anterior</td>
<td>10.98 ± 2.12</td>
<td>11.89 ± 3.44</td>
<td>0.24 ± 0.07</td>
</tr>
<tr>
<td>0° Normal</td>
<td>11.36 ± 2.16</td>
<td>12.47 ± 3.45</td>
<td>0.25 ± 0.07</td>
</tr>
<tr>
<td>3° Posterior</td>
<td>11.09 ± 2.20</td>
<td>12.42 ± 3.73</td>
<td>0.25 ± 0.07</td>
</tr>
<tr>
<td>p-value</td>
<td>0.937</td>
<td>0.936</td>
<td>0.937</td>
</tr>
</tbody>
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