Measurement of the glenoid track in vivo, investigated by the three-dimensional motion analysis using open MRI

INTRODUCTION:

Hill-Sachs lesion is a common injury associated with anterior glenohumeral instability. One factor thought to be related to recurrent instability is a significant bony defect of the humeral head that engages with the anterior glenoid rim (engaging Hill-Sachs lesion). To our knowledge, no anatomic or biomechanical studies to date have clarified which size of Hill-Sachs lesion is critical. Recently, Yamamoto et al. (JSES 2007) measured in a cadaveric study the contact between the glenoid and humeral head in abduction, external rotation, and horizontal extension. They proposed a new concept 'glenoid track' to evaluate the risk of engagement with the glenoid. The purpose of this study was to investigate the 'glenoid track' in vivo using non-invasive motion analysis system developed in our laboratory.

METHODS:

We examined 20 right shoulders of 20 healthy volunteers (14 males, 6 females, mean age of 25 yrs). None of them had shoulder pain or medical history of shoulder joint disorders. The subjects lied supine on the table of an open MRI machine. MRI was taken in seven static positions with the arm from 0° to maximum abduction keeping maximum external rotation and horizontal extension. The custom made device was used to keep the arm in each position without restricting the physiological movement of the scapula. We used 3D-flash method with a loop coil around the shoulder. Using our motion analysis system, three-dimensional models of the scapula and humerus were created from the MRI data by segmentation (Fig.1). Then, the movement was calculated by voxel-based registration of each model. After this motion visualization process, motion of the glenoid on the humeral head was analyzed. We measured the width of the glenoid track which was the distance from the medial margin of contact area to that of the footprint, and we calculated the percentage of the glenoid track width to the glenoid width at 60°, 90°, 120° and 150° of abduction (Fig.2). We used Fisher’s LSD method for statistical analyses and considered p-values less than 5% to be significant. The present study was approved by the ethics committee of our hospital and all participants gave informed consent to participate in this study.

RESULTS:

The images clearly demonstrated that the glenoid shifted from infero-medial to supero-lateral portion of the humeral head (Fig.3). The width of the glenoid track at 60° of abduction was 20.3 mm ± 3.3 mm (mean ± SD), which was equivalent to 85% ± 12% of the glenoid width (Table 1). The glenoid track width (% to the glenoid width) at 60° was significantly greater than those at 90°, 120° and 150°.

Table 1 The values of glenoid track at various degrees of abduction

<table>
<thead>
<tr>
<th>Glenoid track width</th>
<th>Abduction angle</th>
<th>(measured distance)</th>
<th>(% to the glenoid width)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>60°</td>
<td>22.1 mm ± 4.2 mm</td>
<td>93% ± 14%*</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>90°</td>
<td>20.3 mm ± 3.2 mm</td>
<td>85% ± 12%</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>120°</td>
<td>19.5 mm ± 2.8 mm</td>
<td>82% ± 10%</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>150°</td>
<td>19.4 mm ± 2.3 mm</td>
<td>82% ± 9%</td>
<td>19</td>
<td></td>
</tr>
</tbody>
</table>

(mean ± SD)

DISCUSSION:

In the present study, we measured the size of the 'glenoid track' in vivo. The in vivo width of the glenoid track was almost equal to the value measured in cadaver. With this concept, we are able to assess the risk of engaging Hill-Sachs lesion. The risk of engagement depends on the location of Hill-Sachs lesion as well as the existence of bony glenoid defect (Fig.4). The limitation of this study was that these measurements were done using MRI taken under sequential static conditions in supine positions, which may or may not be different from the ones during dynamic activities. In summary, we believe that this new concept is useful in evaluating the risk of Hill-Sachs lesions.

REFERENCES: