The Limited Subacromial Gliding of Supraspinatus Tendon during Dynamic Ultrasonography Can Predict Decrease in Capacity and MR Arthrographic Features of the Shoulder Joint

Poster No.: C-1244
Congress: ECR 2012
Type: Scientific Exhibit
Authors: H. Cheon¹, J. H. Yi¹, J. M. Lee¹, I. Kim²; ¹Daegu/KR, ²Daegu/KR
Keywords: Musculoskeletal joint, Ultrasound, MR, Comparative studies, Motility
DOI: 10.1594/ecr2012/C-1244

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Purpose

1. Adhesive capsulitis (AC), also known as a frozen shoulder, is a clinical syndrome characterized by the gradual worsening of pain and limitation of both active and passive shoulder joint motion.

2. It is reported that the limited supraspinatus tendon (SSP) movement during dynamic scanning was a sensitive and specific sign of AC [1].

3. The purpose of this prospective study is to compare the painful subacromial gliding limitation of the supraspinatus tendon during dynamic ultrasonography (SGLSdU), MR arthrographic features, and the maximum intra-articular injection volume to predict decreased joint capacity of the shoulder joint.
Methods and Materials

Patients:

we analyzed 67 patients with nonspecific pain and restricted motion of the shoulder with MR arthrography using ultrasonography-guided intra-articular injections of contrast media. They had no previous history of trauma or surgery around the shoulder area, and no patient refused passive abduction or contrast injection arbitrarily due to pain. We did not include patients who depicted any diseases other than adhesive capsulitis such as the superior impingement syndrome, subacromial-subdeltoid bursitis, rotator cuff tendinopathy such as tear or prominent tenosynovitis, joint capsular rupture, and bony or labral abnormalities indicating joint instability on either ultrasound or MR imaging. Age and sex of patients examined were as follows: age, 49.7 years; male/female, 48%/52%.

Protocols of ultrasonography and contrast media injection;

1. Every ultrasonography was performed 30 minutes prior to MR arthrography and contrast media was injected under real-time ultrasonographic guidance through the posterolateral approach using a 12 to 7 MHz linear-array transducer.

2. Patients were scanned in the supine and decubitus positions according to the standard protocol of our institute that includes the evaluation of the rotator cuff myotendinous structure, bursal space and rotator cuff interval including the coracohumeral ligament, acromioclavicular joint with the coracoacromial ligament, and a dynamic study of the subacromial gliding limitation of the supraspinatus tendon (SGLS).

3. Grading system of subacromial gliding of supraspinatus tendon during Dynamic Ultrasonography (SGLSdU);

The SSP was traced during full-range passive abduction, and the degree of SGLS was scored from 0 to 3. A score of 1 to 3 was defined as limited subacromial gliding, and a score 0 was regarded as normal (Table 1, Figure 1).

However, we just classified positive and negative groups in this study to reduce bias due to ambiguous criteria among the grades.

4. Injection of contrast media for the subsequent MR arthrography;
A syringe with 25 ml of diluted gadopentetate dimeglumine was prepared at a concentration of 2 mmol/l.

With the patient in the prone position, a 20-gauge needle was advanced into the glenohumeral joint through the infraspinatus muscle using ultrasound guidance and then an intra-articular injection was performed until the contrast passage to the joint was impeded by marked resistance or a maximum of 25 ml was injected if there was no resistance.

At this time, the volume of injected contrast media was measured from the line scale of the syringe, and we assumed the injected volume as the maximum joint capacity.

**MRI protocol;**

1. MR imaging was performed within 30 minutes after administration of the contrast agent. A 3.0-T scanner was used with a phased array surface coil.

2. Fat-suppressed T1-weighted sequences (TR range/TE range, 450-800/11-16) were performed in the axial, coronal oblique (parallel to the long axis of the supraspinatus tendon), and sagittal oblique (perpendicular to the long axis of the supraspinatus tendon) planes. Double-echo fast spin-echo pulse sequences were used to obtain coronal oblique intermediate-weighted MR images (3,000-4,500/14-21) and T2-weighted MR images (3,000-4,500/63-112) using an echo train length of 10.

3. MR imaging parameters for all sequences were the following;

   Field of view, 15-16 cm; 1-2 excitations; matrix size, 256 x 256; section thickness, 3 mm; intersection gap, 0.3 mm.

4. We defined the 'MR arthrographic positive group' of adhesive capsulitis as the following;

   i) thickening of the coracohumeral ligament (CHL) greater than 4 mm on sagittal oblique T1-weighted images

   ii) thickness of the joint capsule in the rotator cuff interval greater than 7 mm on sagittal oblique T1-weighted images

   iii) thickness of the capsule and synovium greater than 3 mm at the level of the axillary recess on oblique coronal T2-weighted images [2, 3]

**Data analysis;**
Pearson's correlation coefficients were calculated to evaluate relevance i) between SGLS and the mean injected volume and ii) between SGLS and MR arthrography, respectively. After analysis, Fisher's exact tests were used to evaluate the relationship. A statistically significant difference was defined as a $p < 0.05$. 
**TABLE 1 Subacromial Gliding of Supraspinatus Tendon during Dynamic Ultrasonography (SGLSdU)**

<table>
<thead>
<tr>
<th>Group</th>
<th>Grade</th>
<th>Ultrasonographic criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>0 (n=20)</td>
<td>Complete gliding of the supraspinatus tendon (SSP) beneath the acromion followed by distinct downward tilting of acromion</td>
</tr>
<tr>
<td>Positive</td>
<td>1 (n=14)</td>
<td>Complete gliding of the SSP without downward tilting of acromion</td>
</tr>
<tr>
<td></td>
<td>2 (n=24)</td>
<td>Incomplete gliding of the SSP (un-glidered SSP &lt;50% in length)</td>
</tr>
<tr>
<td></td>
<td>3 (n=9)</td>
<td>Severe gliding limitation of the SSP (un-glidered SSP &gt;50% in length)</td>
</tr>
</tbody>
</table>

Table 1

© Department of Radiology, Kyungpook National University Hospital - Daegu/KR

**Fig. 1:** Subacromial gliding limitation of the supraspinatus tendon on dynamic ultrasonography (SGLSdU). A and B. The shoulder ultrasonography of a 52-year-old patient showing negative features with a well-defined supraspinatus tendon (SSP) in the neutral position (A), and complete gliding of the SSP beneath the acromion followed by a distinct downward tilting of acromion during passive abduction of the shoulder (B). C. Dynamic ultrasonography of a 52-year-old patient showing a grade 1 limitation with complete gliding of the SSP without downward tilting of the acromion; note the localized joint fluid congestion between the acromion and the SSP tendon. D. Dynamic
ultrasonography of a 55-year-old patient showing a grade 2 limitation with incomplete subacromial gliding of the SSP tendon. E. Dynamic ultrasonography of a 53-year-old patient showing a continuously visualized SSP tendon with severe gliding limitation. (A: acromion, S: supraspinatus tendon, H: humeral head)

© Department of Radiology, Kyungpook National University Hospital - Daegu/KR
Results

Two divided group, SGLS-positive and SGLS-negative, depending on dynamic ultrasonography;

Among the 67 patients, 47 (70.1%; male 17; female 30; mean age 52.5) were revealed as SGLS-positive, and 20 (29.9%; male 15; female 5; mean age 43.2) were revealed as SGLS-negative during the dynamic ultrasonography. After the injections, no patient suffered a ruptured joint capsule.

Comparison of maximum intra-articular injection volume and MR arthrographic feature between two groups;(Table2, Figures2 and3)

1. Pearson's correlation coefficient between SGLS and the maximum intra-articular injection volume was -0.764 (p < 0.001). This results suggested SGLS to be inversely proportional to the maximum injection volume. The difference of the mean injected volume between the SGLS-positive (22.0 ml; range 9 to 25 ml) and negative group (10.7 ml; range 3.5 to 15 ml) was significant (p = 0.000) (Figure 4).

2. Pearson's correlation coefficient between SGLS and MR arthrographic features was 0.711 (p < 0.001). This suggested SGLS to be directly proportional to the MR arthrographic features with a strong linear relationship.

3. 9 patients (13.4%; male 3; female 6; mean age 54.1) showed discordant results between MR arthrography and dynamic ultrasonography. 2 patients showed SGLS-negative and positive features on MR arthrography, and the other 7 patients showed SGLS-positive and negative features on MR arthrography.
TABLE 2 The Maximum Intra-Articular Injection Volumes and MR Arthrographic Features of SGLS-Positive and Negative Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>SGLS positive (n=47)</th>
<th>SGLS negative (n=20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MR positive* (n=42)</td>
<td>40</td>
<td>2</td>
</tr>
<tr>
<td>MR negative* (n=25)</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td>Mean injection volume(ml)</td>
<td>10.7 (range 9-25)</td>
<td>22.0 (range 3.5-15)</td>
</tr>
<tr>
<td>Standard deviation of injection volume</td>
<td>3.31</td>
<td>6.29</td>
</tr>
</tbody>
</table>

Note: SGLS (subacromial gliding limitation of the supraspinatus tendon).

*Numbers of study subjects

Table 2

© Department of Radiology, Kyungpook National University Hospital - Daegu/KR

Fig. 2: The dynamic ultrasonography and MR arthrography of a 63-year-old woman showing complete gliding of the supraspinatus tendon (SSP) where the downward tilting of the acromion was not demonstrated and subacromial gliding limitation of the supraspinatus tendon (SGLS) was grade 1 (A), thickened coracohumeral ligament (CHL) in rotator interval (arrow), synovitis-like abnormality around the axillary recess (arrowheads) on sagittal oblique T1-weighted image (B), and discrete capsular thickening of axillary recess (white arrow) measuring 7.2 mm on the humeral aspect on an oblique coronal T2-weighted image (C). The measured maximum injection volume of contrast media was decreased to 6 ml.

© Department of Radiology, Kyungpook National University Hospital - Daegu/KR
**Fig. 3:** The dynamic ultrasonography and MR arthrography of a 52-year-old woman showing incomplete gliding of the SSP, SGLS grade 3 (A), thickened CHL (white arrow) on a sagittal oblique T1-weighted image (B), and thickened capsule of axillary recess (white arrow) measuring 7.5 mm on the humeral aspect on an oblique coronal T2-weighted image (C). The injection volume was 5 ml.

© Department of Radiology, Kyungpook National University Hospital - Daegu/KR
Fig. 4: A box plot of intra-articular contrast injection volume and subacromial gliding limitation of the supraspinatus tendon (SGLS). The rectangle contains the values of the injection volume of the two central quartiles (50% of the values) being the first and the fourth quartiles represented by the upper and lower limit of vertical line and the median is the horizontal line in the rectangles.

© Department of Radiology, Kyungpook National University Hospital - Daegu/KR
Conclusion

SGLS during dynamic ultrasonography is well correlated with MR arthrographic features and the maximum intra-articular injection volume. This sign could predict the decreased capacity of the shoulder joint, which is an important feature of adhesive capsulitis, and dynamic ultrasonography could be a useful diagnostic modality.
References


Personal Information

Hyejin Cheon MD.

Department of Radiology, Kyungpook National University Hospital,
200 Dongduk-Ro, Jung-Gu, Daegu, Republic of Korea.

E-mail: sugerin@hanmail.net