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ORIGINAL ARTICLE

Does magnetic resonance imaging appearance of supraspinatus muscle atrophy change after repairing rotator cuff tears?

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Background: This study was conducted to determine whether supraspinatus muscle atrophy appearance changes after arthroscopic rotator cuff repair and to quantify the change in appearance on magnetic resonance imaging (MRI), if any, based on age and tendon retraction.

Methods: We retrospectively reviewed patients who underwent arthroscopic rotator cuff repair and considered only 209 patients who had both preoperative and immediate postoperative MRI. Patients were grouped by age <60 years and >60 years. They were further subdivided into stage 1 (mild), stage 2 (moderate), and stage 3 (severe), depending on preoperative supraspinatus tendon retraction on the coronal view of MRI according to Patte classification. The postoperative occupancy ratio was compared with the preoperative occupancy ratio within the subgroups, and change in the occupancy ratio was used for comparison between the subgroups.

Results: There was a significant increase in the occupancy ratio in the mild (P =.001) and moderate-severe (P =.003) subgroup from their preoperative values. In the mild subgroup, the occupancy ratio was significantly greater in the group aged <60 years compared with the group aged >60 years (P =.010). But in the moderate subgroup there was no significant difference between the 2 age groups (P =.710).

Conclusions: A significant change in supraspinatus muscle atrophy occurs in every patient, provided the patient has some tendon retraction preoperatively. The amount of change in supraspinatus muscle atrophy after surgery depends on the age to some extent, but tendon retraction is the most important thing that decides how much change in atrophy can occur postoperatively.

Level of evidence: Level II; Retrospective Design; Prognosis Study

Keywords: rotator cuff tear; arthroscopy; supraspinatus retraction; muscle atrophy; occupancy ratio; improvement

Rotator cuff repair is one of the most common orthopedic procedures and perhaps the most common of all shoulder operations. It is also well known that after full-thickness rotator cuff tendon tears, retraction, atrophy, fibrosis, and fatty degeneration develop within the rotator cuff muscles.

Atrophy of rotator cuff muscles can lead to a decrease in strength and failure of cuff healing after surgical repair and thus to a loss of shoulder function.[1] The degree of the atrophy depends on several factors, such as the size of the tear, aging, and disuse. The precise cause of this degeneration is unknown. However, it has been proposed that degeneration results from the lack of neurogenic feedback, an imbalance in the muscle

The Institutional Review Board South Korea approved this study

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tendon stress, or physiologic changes in the muscles themselves resulting from tendon bone discontinuity.[6]

After rotator cuff repair, one of the most important factors determining clinical results and anatomic cuff integrity is the amount of initial atrophy.[7] Accurate measurement of initial atrophy is essential to quantify the postoperative atrophy after 1 to 2 years of successful repair. Some authors claim that an improvement occurs, but others argue that atrophy is an irreversible process. Further, the effect of tendon repair on postoperative atrophy is also controversial.[3,5,17,18]

Shin et al[8] showed that repairing the rotator cuff changes the appearance of both fatty infiltration and muscle atrophy of the supraspinatus and infraspinatus in the immediate postoperative magnetic resonance image (MRI) and they believed that one of the most important reasons for the controversy on the effect of tendon repair on postoperative atrophy is the incorrect baseline measure of atrophy for comparison. Although they showed a significant change in tangent sign and occupancy ratio after surgery, they did not comment on whether this change would happen in each and every patient irrespective of the size of tendon retraction and how much approximate change one can expect depending on the tendon retraction and the age of the patient.

Our hypothesis is that significant change in supraspinatus muscle atrophy occurs only in patients who have large muscle retraction preoperatively. Secondly, younger patients will show more change in muscle atrophy than their older counterparts because they will have a healthier tissue to withstand lateral excursion during repair.

Materials and methods

Patient selection

A retrospective review was performed of 209 patients with a degenerative rotator cuff tear who underwent single–row arthroscopic rotator cuff repair between March 2012 and April 2015 in our hospital. Only patients who underwent both preoperative MRI and postoperative MRI within 1 week of surgery in our hospital and had minimum grade 1 atrophy on the preoperative MRI were included in this study. We excluded patients whose preoperative MRI was from another hospital, patients with isolated subscapularis tear, previous operation on the same shoulder joint, and those with MRI images that were not usable because of poor quality or absence of a proper Y view.

Data collection

All of the clinical and radiologic imaging files, including shoulder MRI, clinical records, medical records, operation notes, and notes taken during the follow-up visits, which were stored in a picture archiving and communication system, were obtained from the institutional patient database.

Supraspinatus muscle atrophy was measured and evaluated according to the Thomazeau classification: stage 1, slight atrophy occupancy ratio (1.00-0.60); stage 2, moderate atrophy occupancy ratio (0.60–0.40); and stage 3, severe atrophy occupancy ratio (<0.40).[17]

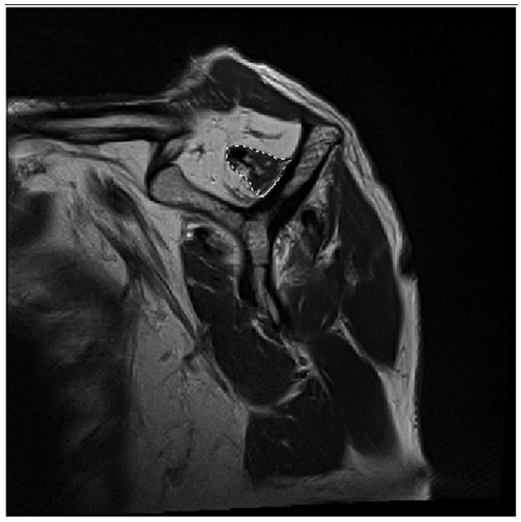

Figure 1 Supraspinatus muscle atrophy in the severe subgroup with a preoperative area of 1560 pixels.

Occupancy ratio = S1/S2

With *S1* representing the surface area the supraspinatus muscle and *S2* the surface area of the entire supraspinatus fossa. The number of tendons involved in the tear and the size of the tear were identified at the time of arthroscopic surgery and classified according to DeOrio Classification of Rotator Cuff Tears[4] (<1 cm = small, 1-3 cm = medium, 3-5 cm = large, >5 cm = massive).

Both MRI examinations were performed on a Magnetom Essenza 1.5-T MRI unit (Siemens, Munich, Germany), and T1-weighted MRIs were used.

Atrophy of the supraspinatus muscle was measured at the most lateral section of the oblique sagittal image at the point where the scapular spine was still in continuity with the body of the scapula forming a Y shape (Y view).[17] To evaluate the cross-sectional area of the supraspinatus muscle and supraspinatus fossa, we used the magic selection tool and the measurement tool in Photoshop CS3 (Adobe, San Jose, CA, USA; Figs. 1-7). This tool automatically selects the area that has similar brightness and measures the number of pixels in the selected area. This method has been described by Tae et al[15] for measurement of the occupancy ratio. The preoperative and postoperative occupancy ratios of the supraspinatus muscle were measured, and from this the change in occupancy ratio was calculated for each and every patient.

To assess interobserver reliability, 2 independent orthopedic surgeons measured the occupancy ratio using the same images. The raters were unaware of the each other's rating, and the mean value of their measurements was used for calculation. For intraobserver reliability, each rater performed the second measurement with the same images 12 week after the first measurement without knowing the first rating.

The degree of tendon retraction was assessed by the position of the retracted torn tendon in the coronal view of MRI by an orthopedic surgeon who was not aware of the patient's occupancy ratio readings, and patients were grouped according to Patte classification.[13] Simultaneously, patients were also given grades according to our