J Shoulder Elbow Surg (2016) ■■, ■■–■■

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

ORIGINAL ARTICLE

Does successful rotator cuff repair improve muscle atrophy and fatty infiltration of the rotator cuff? A retrospective magnetic resonance imaging study performed shortly after surgery as a reference

Noritaka Hamano, MD[a,*], Atsushi Yamamoto, PhD[a], Hitoshi Shitara, PhD[a], Tsuyoshi Ichinose, PhD[a], Daisuke Shimoyama, MD[a], Tsuyoshi Sasaki, MD[a], Tsutomu Kobayashi, PhD[b], Yohei Kakuta, MD[c], Toshihisa Osawa, PhD[d], Kenji Takagishi, PhD[a]

[a]*Department of Orthopaedic Surgery, Gunma University Graduate School of Medicine, Maebashi, Gunma, Japan*
[b]*Department of Physical Therapy, Takasaki University of Health and Welfare, Takasaki, Japan*
[c]*Department of Orthopaedic Surgery, Maebashi Red Cross Hospital, Maebashi, Japan*
[d]*Department of Orthopaedic Surgery, National Hospital Organization Takasaki General Medical Center, Takasaki, Japan*

Background: Muscle atrophy and fatty infiltration in the rotator cuff muscles are often observed in patients with chronic rotator cuff tears. The recovery from these conditions has not been clarified.
Methods: Ninety-four patients were included in this study. The improvement in muscle atrophy and fatty infiltration in successfully repaired rotator cuff tears was evaluated by magnetic resonance imaging at 1 year and 2 years after surgery and was compared with muscle atrophy and fatty infiltration observed on magnetic resonance imaging at 2 weeks after surgery to discount any changes due to the medial retraction of the torn tendon. The patients' muscle strength was evaluated in abduction and external rotation.
Results: Muscle atrophy and fatty infiltration of the supraspinatus were significantly improved at 2 years after surgery in comparison to 2 weeks after surgery. The subjects' abduction and external rotation strength was also significantly improved at 2 years after surgery in comparison to the preoperative values. Patients whose occupation ratio was improved had a better abduction range of motion, stronger abduction strength, and higher Constant score. Patients whose fatty infiltration was improved had a better range of motion in flexion and abduction, whereas the improvements of muscle strength and the Constant score were similar in the group that showed an improvement of fatty infiltration and the group that did not.
Conclusion: Muscle atrophy and fatty infiltration can improve after rotator cuff repair. The strengths of abduction and external rotation were also improved at 2 years after surgery.
Level of evidence: Level IV; Case Series; Treatment Study

The Institutional Review Board of Gunma University Hospital approved this study: No. 1069 2013-09-04. All patients provided written informed consent.

*Reprint requests: Noritaka Hamano, MD, 3-39-22 Showa-machi, Maebashi, Gunma 371-8511, Japan.
E-mail address: m15702021@gunma-u.ac.jp (N. Hamano).

1058-2746/$ - see front matter © 2017 Journal of Shoulder and Elbow Surgery Board of Trustees. All rights reserved.
http://dx.doi.org/10.1016/j.jse.2016.10.016

Keywords: Rotator cuff tear; muscle atrophy; fatty infiltration; magnetic resonance imaging; arthroscopic rotator cuff repair; muscle strength

Muscle atrophy and fatty infiltration have several effects on muscle strength and the integrity of repaired tendons and may be useful for predicting the functional outcome after rotator cuff repair.[18,20] Although arthroscopic rotator cuff repair (ARCR) is the "gold standard" for the treatment of rotator cuff tears, muscle atrophy and fatty infiltration of the cuff muscles are risk factors for cuff retear, especially in patients with larger and older tears.[19,21] Because the degree of preoperative fatty infiltration is reported to be associated with the functional outcome after an operation,[10,13] it is important that it be evaluated when we consider postoperative functional outcomes and the use of ARCR. It is clear that muscle atrophy and fatty infiltration progress in patients who experience a retear after rotator cuff repair; however, it is unknown whether they improve after successful repair.[1,7,8,10,11,19,25]

In many cases, muscle atrophy and fatty infiltration are evaluated at a point that gives a Y-shaped view—on the most lateral image that shows the contact between the scapular spine and the scapular body.[13,23,25] However, when we repair the cuff, the muscles are pulled out from the lateral side, and the point of observation of the cuff muscles changes; thus, attention is needed when we evaluate the cuff muscles, particularly in patients with large and massive tears.[13] To the best of the authors' knowledge, no previous studies have evaluated the improvement of muscle atrophy and fatty infiltration in the cuff muscles after cuff repair using images taken shortly after surgery as a reference.

We hypothesized that muscle atrophy and fatty infiltration of the supraspinatus muscle would improve after successful cuff repair and that cases with improvement would show better functional outcomes. Thus, the purpose of this study was to retrospectively investigate whether successful rotator cuff repair improves muscle atrophy and fatty infiltration by use of magnetic resonance imaging (MRI) shortly after surgery as a baseline reference and whether better functional outcomes were achieved in patients who showed improved muscle atrophy and fatty infiltration.

Materials and methods

This retrospective study included 128 patients who underwent ARCR from April 2010 to March 2013. The a priori power analysis, which was performed using data that were previously published by Chung et al,[1] indicated that 15 subjects would provide a statistical power of 95% at an α level of .05 in a paired *t*-test. Fourteen shoulders from 128 patients were excluded because of retear within 1 year, 1 shoulder was excluded because MRI was not performed at the 1-year follow-up examination, 5 shoulders were excluded because the clinical data could not be evaluated at the 2-year follow-up examination, and 14 shoulders were excluded because MRI was not performed at the 2-year follow-up examination. Thus, a total of 94 patients (male, n = 67; female, n = 27) remained in the study group (Fig. 1). The mean age of the patients was 62.5 ± 7.6 years.

Surgical technique and rehabilitation

The patients were positioned in the beach chair position for arthroscopy. First, the arthroscope was inserted through a standard posterior portal into the glenohumeral joint. Then, the anterior portal was created through the rotator interval, and depending on the tear situation, an anterolateral portal, posterolateral portal, and anchor portal were created to visualize and to repair the rotator cuff from the bursal side. The tear size was measured before the repair of the rotator cuff under arthroscopic visualization using a measurement device. The rotator cuff footprint was then débrided with a shaver to expose the bleeding bone surface. Anchor holes were created for the selected repair techniques using a bone punch. For a small tear, single-row repair was chosen; and for a medium-size or larger tear, double-row repair or suture bridge repair was chosen. HEALIX ADVANCE (Mitek Sports Medicine, DePuy Synthes, Raynham, MA, USA) and VERSALOK (Mitek Sports) anchors were used for the medial and lateral anchors, respectively.

Immobilization was maintained with an abduction brace immediately after surgery.

Pendulum exercise of the shoulder and active range of motion exercises of the forearm were also performed immediately after surgery. The next step in the rehabilitation program was determined according to the tear size. For medium-size or smaller tears, active range of motion exercises were added at 4 weeks after surgery. For large or greater-sized tears, active range of motion exercises were added at 6 weeks after surgery. A return to all activities, including sporting activities, was permitted at 6 months after surgery.

Evaluation of the clinical outcome

All patients underwent clinical tests before and at 1 year and 2 years after surgery. Their range of motion, Constant score, shoulder pain, and shoulder muscle strength were recorded. Shoulder pain (rest pain, motion pain, and night pain) was evaluated using a visual analog scale (VAS). The active range of motion of the shoulder was assessed for 4 movements: flexion, abduction, external rotation with the elbow flexed to 90°, and internal rotation measured by determining the highest spinal segment that the patient could reach with the thumb. To facilitate the statistical analysis, the spinal segment that the patient could reach was converted into a number, with the segments at T1 through T12 designated 1 to 12, the segments at L1 through L5 designated 13 to 17, and the sacrum designated 18.[14,15] The shoulder abduction strength and external rotation strength were measured with a spring scale based on the technique described by Hislop.[12] The evaluations of abduction were performed with the subject sitting and abducting the shoulder to 90° with the elbow extended. In addition, the evaluations of external rotation were performed with the subject sitting with the arm in neutral rotation at the patient's side and the elbow flexed to 90°. The Constant score was calculated on the basis of the responses to questioning and the measured range of motion and muscle strength.[2,3]