

The Evaluation of Supraspinatus Muscle of Patients with Rotator Cuff Tear on Magnetic Resonance Imaging

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We examined the intensity of the supraspinatus muscles of patients with a rotator cuff tear in Magnetic Resonance Imaging (MRI) findings. 109 shoulders in patients with rotator cuff tears were preoperatively scanned by MRIs. Using MRIs, the linear bands of the supraspinatus muscle were classified into three grades. Between each grade the following were examined; the age, the disease contraction period, the distribution of large tears and reruptures, and those chosen for patch graft method, as well as the postoperative JOA scores.

There were 46 cases in grade 1(G-1), 28 in grade 2(G-2), and 35 in grade 3(G-3). The mean ages of patients in the three grades were 53.4 years old, 56.7 years old, 61.3 years old respectively. The age of G-3 was significantly higher than the other grades. The period from onset of the G-3 was shorter than the other grades, but there was no statistic significance. The ratio of massive tears were 2.2%, 27.0% and 46.2% respectively. Reruptures were observed only in grade 3 and there were none in G-2 and G-3. The patch graft method was performed on one shoulder in G-2 and three shoulders in G-3. The average JOA scores were 89.5 in G-1, 88.4 in G-2 and 85.0 in G-3. The JOA score of G-3 was significantly lower than G-1. Especially function of JOA score was lower than the other grades.

The results of the present study suggest that high intensity on MRI is associated with poor clinical results in operative treatment. Some authors reports that these findings of MRI demonstrate a fatty degeneration of muscles. So we should select the best operation and carefully rehabilitate patients with a high intensity of the supraspinatus muscle belly on MRI.

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Introduction

Magnetic Resonance Imaging (MRI) examination for rotator cuff tear is very useful not only to determine its presence but also to determine the size of the tear.^{1) 6)} However, if MRI can be used for functional evaluation of supraspinatus muscle, it would be useful in determining the operative method, postoperative treatment, and prognosis presumption. Our study focused on the high signal intensity of the supraspinatus muscle by MRI before surgery, and classified it into three grades. We also examined the age, the period of the disease contraction and the treatment results between each grade.

Objects and Methods

We examined 109 patients who underwent rotator cuff tear enforcement operation, and who also had MRI before surgery, in our hospital between January 1990 and April 2000. The average age was 56.8 years old (37-78 years old) in 96 men and 13 women. The sizes of tears were 26 large, 55 medium, 11 small, and 17 partial according to the Lundberg's classification.³⁾

The high signal intensity of the supraspinatus muscle was classified into three grades according to Nakagaki's classification.⁵⁾ MR T1 weighted images taken before surgery were examined for the luminosity of the supraspinatus muscle as compared with that of trapezius muscle. According to the quality of the linear band of the high signal intensity which appeared in the supraspinatus muscle, it was classified into grade 1: no linear band (fig.1-a), grade 2: 1 or 2 thin linear bands (fig.1-b), grade 3: three or more linear bands or 1 or 2 thick linear bands (fig.1-c). The independent doctor and I evaluated the MRI findings.

MRI was performed with a 1.5 Tesla superconductive system in 4-5mm slices using circular surface coil (interval : 1 mm, TR/TE : 400/14, FOV : 15×15 cm, matrix : 256×224, NEX : 2). MRI was performed at the scapular plane with the arms at the side of the body in neutral rotation. The evaluation of intensity of the

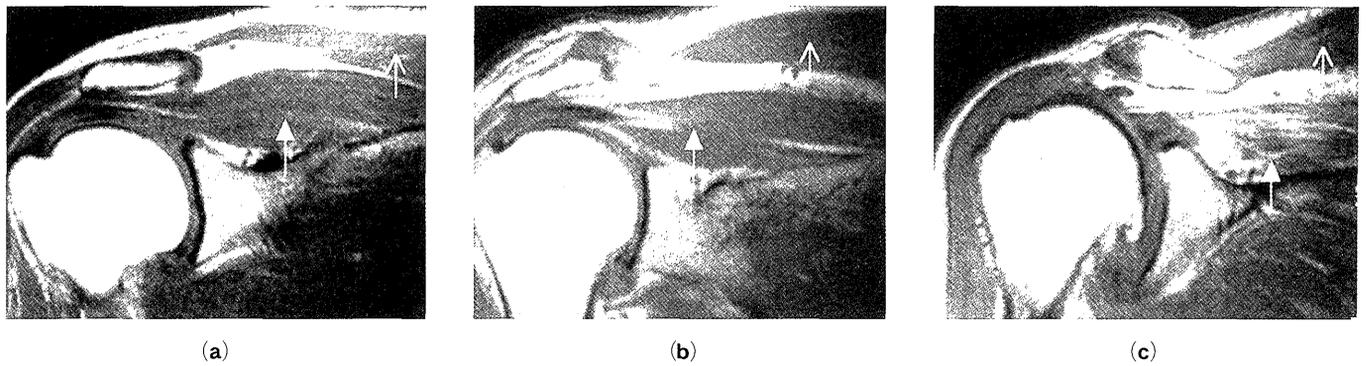


Figure 1. Classification of the high intensity in the supraspinatus muscle by MRI
(— : Trapezius, — : Supraspinatus)

- (a) grade 1 : no linear band
- (b) grade 2 : 1 or 2 thin linear bands
- (c) grade 3 : 3 or more linear bands or 1 or 2 thick linear bands

supraspinatus muscle on MRI was performed in all slices. When MRI findings showed two or three different grades in any slice, we classified the finding into the highest grade.

Between each grade the following were examined; the age, the disease contraction period, the distribution of large tears and reruptures, and those chosen for patch graft method, as well as the postoperative Japanese Orthopaedic Association shoulder score (JOA score). The results were evaluated with Welch's t-test for statistical significance.

In cases where the adhesion of the circumference of the rotator cuff is fully exfoliated and an insersion of the rotater cuff is achieved as much as possible to the medial side, yet the rotator cuf can not be sutured in a 30° abduction position, the patch graft method was adopted.

Results

There were 46 cases in grade 1, 28 in grade 2, and 35 in grade 3. The average age of grade 3 was significantly higher than that of the other grades. The disease period tended to decline as the grade progressed, but a significant difference was not observed. Half of the grade 3 patients had a large tear, and all the cases of rerupture were in grade 3. Moreover, all of the patients who underwent the patch graft method were in grade 3 except one case in grade 2 (Table 1).

The average postoperative JOA scores for grade 1, 2 and 3 were 89.5±7.6, 88.4 ±9.4and 85.0 ±6.8 points respectively, showing grade 3 was significantly inferior than grade 1. Furthermore, grade 3 results were the poorest in each individual JOA category, and significant differences were especially apparent in the functional items (Table 2). These results suggest a fall

in the power and the durability of the shoulder abductor muscles, and suggest that the supraspinatus muscle is somewhat brittle.

Table 1 The age, the disease contraction period, the distribution of large tears and reruptures, and those chosen for patch graft method between each grade

	average age (y.o)	average affection period (mon.)	rate of large tear (%)	rate of rerupture (%)	rate of patch graft (%)
Grade 1 (n = 46)	53.4 (37~67)	14.2 (1~180)	2.2	0	0
Grade 2 (n = 128)	56.7 (41~78)*	8.8 (1~60)	27.0	0	3.6
Grade 3 (n = 35)	61.3 (44~75)*	6.9 (1~84)	46.2	14.3	8.6

(* : P<0.05)

Table 2 Postoperative JOA scores

	JOA score	Pain	Function	ROM
Grade 1 (n = 26)	89.5 ± 9.4	25.2 ± 1.0	19.2 ± 1.0	26.5 ± 0.6
Grade 2 (n = 19)	88.4 ± 6.8	24.2 ± 1.1	18.3 ± 2.4	25.2 ± 1.0
Grade 3 (n = 21)	85.0 ± 7.6	22.8 ± 1.1	18.3 ± 2.0	25.2 ± 0.7

(* : P<0.05)

Discussion

It has been reported that massive rotator cuff tear lasting for a long time causes atrophy of the rotator cuff muscles characterized by a signal belt of high intensity in the muscle belly indicated by MRI. Also, fat denaturation was seen in the atrophied muscles 2)6). Similar analysis which used MRI before surgery has already been reported by Nakagaki 5) and Morisawa 4). Nakagaki reported fat denaturation in the circumference of the tendon fiber in atrophied supraspinatus muscle accompanied with cuff tear

according to his study of cadaver shoulders. The high signal intensity seen by the MR T1 weighted image might express the fat denaturation of the circumference of the tendon fiber in the muscle belly. In addition, his electrophysical examination showed that the supraspinatus muscle, whose amplitude of motor potential unit was less than 300 μ V, had no residual function and was connected to the linear band of MRI. On the other hand, Morisawa stated that the microsections of supraspinatus muscle obtained from operations showed much fibrous connective tissue and fat cells between sparse muscular tissue, and this finding showed that the high signal intensity of supraspinatus muscle in MRI reflected fatty degeneration of the muscle. He recommend the tendon transfer of latissimus dorsi in repairing such cuff tears. In our study, patients who showed a high signal intensity of supraspinatus muscle seen in the MR T1 weighted image had a greater tendency to rerupture their cuff, and were also more likely to be chosen to undergo the patch graft method. In addition, the function of the shoulder joint (the strength and durability of abductor muscle power) was significantly inferior in postoperative results. We think all of this, along with the high signal intensity noted by the MR T1 weighted image, suggested the rotator cuff, and the supraspinatus in particular, was degrading along with fatty degeneration. Therefore, we think that high signal intensity of the spraspinatus muscle in rotator cuff tear patients is accompanied by muscle weakness, so it is necessary to carefully consider the choice of operative methods and the postoperative treatments in such patients.

Conclusions

- 1) 109 shoulders in patients with rotator cuff tear were preoperatively scanned by MRIs, and the linear bands of the supraspinatus muscles were classified into three grades.
- 2) The patients in grade 3, who showed high signal intensity with the whole supraspinatus muscle belly, had higher rates of return cuffs, and their postoperative results (especially functional items) were significantly inferior.
- 3) We think that preoperative MRI can prove to be useful in the evaluation of the high signal intensity of supraspinatus muscle and can contribute to a more informed selection of operative methods and postoperative treatments.

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