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Effects of Preoperative Evaluation of Rotator Cuff Injuries on the Prediction of the Convalescence Period

Makoto Goto[1)], Kenji Yamamoto[2)], Yasuhiro Morisaki[2)], Wataru Sakuragi[2)], Hideki Koeda[1)], Susumu Naruse[1)], Masayuki Uesugi[1)], Yuri Inoue[1)], Masahito Murakami[1)], Seiichi Takemasa[1)]

[1)] *Kobe International University: 9-1-6 Koyouchou, Higasinadaku, Kobe City, Hyogo, 658-0032 Japan. TEL: +81 78-940-4115, E-mail: gotou@kobe-kiu.ac.jp*
[2)] *Suzuki Orthopaedic Hospital*

Abstract. [Purpose] The purpose of this study was to assess the effectiveness of preoperative evaluation results of rotator cuff injuries. [Subjects and Methods] On the day of surgery, data were collected from 19 patients (12 males and 7 females; mean age 62.7 ± 6.6 years) diagnosed with rotator cuff injuries. The evaluation included assessment of range of motion, muscle strength, and rotator cuff function with regard to the postoperative period until active elevation of the shoulder joint, and the pain threshold. [Results] In patients who had a longer postoperative period until active elevation and in those complaining of severe pain, the preoperative evaluation results for muscle strength were more useful than the results for range of motion and examination tests of rotator cuff function. [Conclusion] The results of this study suggest that the preoperative evaluation of patients with rotator cuff injuries should include muscle strength measurements in order to predict postoperative function. To understand functional restoration of the shoulder joint after rotator cuff repair, we suggest preoperative evaluation of muscular function and kinematic assessments.

Key words: Rotator cuff injuries, Preoperative evaluation, Effectiveness

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INTRODUCTION

Severe rotator cuff injuries cause shoulder pain and impairment of shoulder elevation, which are indications for surgery to improve shoulder function. Diagnosis of shoulder cuff lesions is usually carried out using techniques such as magnetic resonance imaging (MRI) and arthrography. However, few studies have examined the usefulness of preoperative evaluation of rotator cuff injuries performed on the day of surgery for predicting prognosis[1, 2)]. Although some studies have examined preoperative assessment of rotator cuff injuries, there are few comparative studies of whether such assessments are equally effective within a limited time frame[3)].

Therefore, we investigated the effectiveness of preoperative evaluation, including evaluation of pain, shoulder range of motion, muscle strength, and functional testing of the rotator cuff, for patients with rotator cuff injuries.

We also aimed to determine which preoperative assessment items are most helpful for indicating the need for further detailed assessment of patients with rotator cuff injuries.

SUBJECTS AND METHODS

Nineteen patients {12 men and 7 women, aged 62.7 ± 6.6 [mean ± standard deviation (SD)] years} who underwent rotator cuff surgery after preoperative evaluation were selected for this study. All patients gave their informed written consent to their inclusion in the study. Written consent included the agreement that participation was free, and treatment costs were not discussed. The patients were also assessed regarding their understanding of the study on the basis of their verbal responses to questions concerning the purpose of the study. In addition, it was made clear to the patients that the study results would be used for scientific research only and that their privacy would be respected.

The preoperative evaluation was performed on the day of surgery by three physical therapists. Range of motion (passive and active) was measured for five shoulder movements in the sitting position: (i) flexion, (ii) extension, (iii) abduction, (iv) external rotation at 90° abduction, and (v) internal rotation at 90° abduction.

Strength was measured using a hand-held dynamometer (HHD) for these same five movements. Flexion and abduction were evaluated in the sitting position. Internal rotation, external rotation, and extension were evaluated in the prone position. Each measurement was performed twice and the higher value was used[4, 5)].

Pain was self-assessed on a visual analog scale (VAS) with “0” indicating no pain and “10” indicating severe pain.

To verify supraspinatus muscle function, the empty can

Table 1. Results of preoperative evaluation of rotator cuff tears (n=19)

	Postoperative recovery		
	short (under 5 weeks)	long (over 5 weeks)	
	n=12	n=7	P value
ROM (degree)			
Active			
flex	133.7 ± 38.1	109.3 ± 52.5	
abd	112.9 ± 37.9	92.14 ± 51.6	
ext-rot	63.6 ± 21.4	58.7 ± 19.8	
int-rot	52.8 ± 13.8	50.0 ± 16.9	
ext	32.1 ± 8.1	27.5 ± 11.2	
Passive			
flex	160.8 ± 30.7	151.4 ± 32.5	
abd	137.1 ± 32.6	127.1 ± 39.5	
ext-rot	81.4 ± 20.4	73.8 ± 20.6	
int-rot	66.4 ± 12.5	60.8 ± 15.2	
ext	39.3 ± 36.9	39.6 ± 10.1	
HHD (n)			
flex	83.5 ± 15.1	71.6 ± 18.9	
abd	69.7 ± 17.8	47.3 ± 19.9	*
ext-rot	80.4 ± 12.2	55.4 ± 7.1	**
int-rot	78.3 ± 23.5	71.4 ± 10.1	
ext	97.9 ± 29.1	80.0 ± 24.1	
VAS (cm)	4.4 ± 2.4	6.9 ± 2.7	
Functional test, n (%)			
Empty can test			
positive	9 (75%)	6 (85.7%)	
negative	3 (25%)	1 (14.3%)	
Belly press test			
positive	2 (16.7%)	6 (85.7%)	
negative	10 (83.3%)	1 (14.3%)	

NOTE: Values are mean ± SD or n (%).*: p<0.05, **: p<0.01. Abbreviations: ROM, range of motion; HHD, hand-held dynamometer; VAS, visual analog scale; flex, flexion; abd, abduction; ext-rot, external-rotation; int-rot, internal-rotation; ext, extension.

test was performed with the forearm in pronation, with the thumb directed toward the floor, and with the shoulder joint in abduction of about 30°–45° relative to the scapular plane. If the scapula was not stable in abduction of the shoulder, it suggests a decrease in supraspinatus muscle function.

To verify subscapularis muscle function, the belly press test was performed by pressing the abdomen with the palm of the hand. If this action cannot be performed stably, it indicates a decrease in subscapularis muscle function. Because infraspinatus muscle power was evaluated using a HHD after asking the patient to externally rotate the shoulder, this test was not considered as a test of rotator cuff function. According to the time taken after rotator cuff surgery to achieve abduction or flexion of the shoulder >90°, the patients were divided into short- and long-term groups. Patients receiving long-term physical therapy before surgery were not included in this study.

The χ^2 test, the Mann–Whitney U-test, and Student's t-test were used to compare the two patient groups. The level of statistical significance was chosen as $p < 0.05$.

RESULTS

The average postoperative period until active elevation of the shoulder joint was 5.1 ± 1.1 (mean ± SD) weeks.

Table 1 shows the results of the two groups over this period.

There were no significant differences in the period until active elevation of the shoulder joint between active and passive range of motion. Significant differences were observed for external rotation ($p<0.01$) and abduction ($p<0.05$) between the two groups, but no significant differences were observed in extension, flexion, or internal rotation. Shoulder joint pain at rest according to VAS in the short- and long-term groups was 4.4 ± 2.4 and 6.9 ± 2.7, respectively (without significant difference). The empty can test was positive in 75.0% and 85.7% of the patients in the short- and long-term groups, respectively. The belly press test was positive in 16.7% and 85.7% patients in the short- and long-term groups, respectively.

DISCUSSION

Preoperative evaluation of rotator cuff injuries is useful for predicting the prognosis of patients with these injuries. It includes evaluation of pain, motor function, muscle strength, and range of motion[3]. In patients who had a longer postoperative period until active elevation and in those complaining of severe pain, the preoperative evaluation results for muscle strength were more useful than the results for range of motion and rotator cuff examination tests. However, they were not enough to predict the prognosis.

Itoi et al. showed that the level of accuracy of MRI findings for patients with shoulder cuff tears was similar to that of physical examination findings; hence, muscle strength evaluation should be used in the diagnosis of shoulder cuff tears[6]. Murrell et al. showed that patients more than 60 years of age who showed two or more of the three signs—impingement, supraspinatus muscle weakness, and decreased external rotational power—had a 98% chance of having rotator cuff injuries[7].

In this study, we focused on five aspects of shoulder movement. However, true workings of the rotator cuff can affect the various movements of the gleno-humeral joint. Therefore, evaluation of other muscle groups, including the shoulder girdle, along with the rotator cuff is necessary. The motion tests included evaluation of the passive range of motion to determine contracture and pain, and evaluation of the active range of motion to determine muscle weakness.

Our study results did not reveal a difference in ranges of motion between active and passive movements. This could be because rotator cuff injuries were common to all patients, and this result is probably very useful when discussing postoperative patient status. The data regarding preoperative assessment of pain using VAS at rest had no impact on predicting the usefulness of surgery. Therefore, the hypothesis that preoperative assessment of pain would be useful for predicting the results of postoperative function was not confirmed.

This study focused on the level of pain at rest; however, it is also necessary to evaluate the type of pain, history, and impairment of activities of daily living. Differences in the rates of positivity for the empty can test, used to determine the muscular strength of the supraspinatus muscle, were observed between the two groups. With a sensitivity of 32%–89% and specificity of 50%–82%, our results differ from those of previously published studies[8]. Furthermore, when the empty can test was negative, some reports predicted negative supraspinatus tendon rupture with an accuracy of 96%. The specificity of evaluation of the rotator cuff by tests such as the belly press and empty can tests is high, but their sensitivity is low[9].

Finally, while many patients with rotator cuff injuries showed good postoperative results, some showed poor results. Few studies on the relationship between functional recovery and the healing status of the repaired rotator cuff have been published, and further research is needed in this area[10–12]. In clinical practice, pain is not observed even on elevation of the shoulder in some patients despite a massive tear in the rotator cuff being evident on noninvasive imaging. In contrast, symptoms such as pain and limitation of shoulder elevation may be observed in some patients despite identification of a tear in rotator cuff imaging. With regard to postoperative predictors of recovery for patients undergoing rotator cuff repair, this study demonstrates the need for preoperative muscle strength assessment for physical therapy and postoperative function. Future research should involve detailed assessments of muscular strength, including that of the shoulder girdle as well as the rotator cuff, to enhance the reliability and validity of the preoperative evaluation.

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