

# Physical Therapy Following Arthroscopic Rotator Cuff Repair with Graft Augmentation: A Case Report with Magnetic Resonance Imaging

Hyun-Joong Kim<sup>a</sup> and Seungwon Lee<sup>b,c</sup>

<sup>a</sup>Department of Physical Therapy, Graduate School of Sahmyook University, Seoul, Republic of Korea

<sup>b</sup>Department of Physical Therapy, College of Health Science and Social Welfare, Sahmyook University, Seoul, Republic of Korea

<sup>c</sup>Institute of SMART Rehabilitation, Sahmyook University, Seoul, Republic of Korea

**Objective:** If non-surgical treatment fails, arthroscopic rotator cuff repair (ARCR) is recommended, and ARCR considers graft augmentation in consideration of size, direction, and re-tear. It is reported to have potential benefits by improving the healing rate as it can fill the gaps that have been left behind. The purpose of this study is to investigate the effect of structural changes observed after ARCR on muscle action through magnetic resonance imaging and to investigate the effect of appropriate physical therapy required for graft augmentation in the general ARCR rehabilitation protocol.

**Case presentation:** A 47-year-old male hospitalized for postoperative rehabilitation following ARCR participated in a 5-week physical therapy intervention. The postoperative day was 6 months, but due to shooting pain and shoulder dysfunction, and the movement of the shoulder was compensatory motion, not normal motion. Physical agents, manual therapy, and supervised exercise for 110 minutes per session were performed 3 times a week, and pain intensity, range of motion, function, and strength were evaluated.

**Results:** As a result of the study, the patient showed positive improvement in pain intensity, range of motion, function, and strength. In addition, normal scapulohumeral rhythm movement was observed.

**Conclusions:** According to the results of this case, appropriate physical therapy according to the compensatory motion shown in the structural changes after ARCR can positively improve the pain intensity, range of motion, function, and strength of ARCR patients.

**Key Words:** Postoperative care, Arthroscopy, Rotator cuff injuries, Physical therapy

## Introduction

A typical rotator cuff injury in shoulder pain is reported to affect more than 40% of adults over 60 years of age[1]. Also, more than 60% of adults over 70 years of age showed abnormal findings on magnetic resonance imaging (MRI) of the rotator cuff[2]. In a systematic review of the guidelines for rotator cuff repair, it was reported that non-surgical treatment (physical therapy and non-steroidal anti-inflammatory

drugs) is more effective when the duration of symptoms in rotator cuff tear is 3 months to less than 1 year[3].

However, if non-surgical treatment fails, arthroscopic rotator cuff repair (ARCR) is recommended, and the number of rotator cuff repairs estimated in the United States is estimated at more than 200,000 each year[4]. Additionally, graft augmentation is considered in ARCR considering the size, direction, and re-tear, and it is reported that there is a potential benefit by improving the healing rate as it can fill the gap lost in the bone

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Corresponding author: Seungwon Lee (ORCID <https://orcid.org/0000-0002-0413-0510>)

Department of Physical Therapy, College of Health Science and Social Welfare, Sahmyook University

815 Hwarang-ro, Nowon-gu, Seoul 01795, Republic of Korea

Tel: +82-2-3399-1630 Fax: +82-2-3399-1639 E-mail: [swlee@syu.ac.kr](mailto:swlee@syu.ac.kr)

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attachment of the tendon[5].

In case of ARCR-induced damage to surrounding tissues and joint immobilization, the recovery period is longer when graft augmentation is added[5]. The functional impairment of the muscle associated with a torn tendon reduces the likelihood of generating normal force after repair, mainly due to atrophy and fat infiltration [6]. In this process, chronic fibrosis increases muscle stiffness, which increases the tension in the ARCR region and interferes with the recovery process[7]. In response to the compensatory motion in the surrounding muscles, the muscles continue to tense and enlarge[8].

Therefore, in this study, through a single case of ARCR patient who additionally had graft augmentation, we would like to emphasize not only general problems after surgery, but also structural problems that appear in MRI images after augmentation, and physical therapy rehabilitation according to functional status.

## Methods

Ethical standards according to the Declaration of Helsinki were complied with after obtaining informed consent from the patients who participated in this study before the start of the study. This study is a prospective case report, and the procedure is shown in Figure 1.

### Patient history and systems review

The patient is a 47-year-old male, a manual laborer working at a construction site. He is 171cm and 72kg, and what stands out in screening is his rounded shoulder posture. He first complained of right shoulder pain in August 2020, endured for about 4 months,

and then underwent ARCR with graft augmentation (supraspinatus repair using bilayer engineered skin replacement product, biceps tenodesis, subacromial decompression) at an orthopedic surgeon on December 14, 2020.

Sufficient non-surgical treatment was not performed before surgery. During the period of tolerating the pain, the pain increased further, so when the orthopedic hospital revisited, only an 1.5-T MRI unit (SIGNA™ Creator, GE Healthcare, USA) was performed, excluding the physical examination, and then surgery was performed. According to the recorded medical information at the hospital where he was rehabilitated after ARCR, the passive range of motion (ROM) in forward flexion was 180°, but it was actually 130°. Also, it was 87° in active ROM, and he said that he felt a shooting pain.

### Examination

When visiting the rehabilitation clinic on June 15, 2021 (around 6 months after ARCR), the patient's consent was given to view the test results before and after surgery. The MRI scan before (December 1, 2020) and after surgery (December 21, 2020) is shown in Figure 2.

The patient's pain intensity was measured using the numeric pain rating scale (NPRS). Usual pain and worst pain were measured from 0 points (no pain) to 10 points (the most severe pain)[9]. For the activeROM of the shoulder, forward flexion, scaption flexion, abduction, internal rotation, and external rotation were measured using a goniometer[10]. For the shoulder function, a simple shoulder test (SST) was used. It is evaluated as “yes” or “no” with 12 items related to daily life, and the higher the score, the lower the function[11]. Muscle strength was evaluated by grip

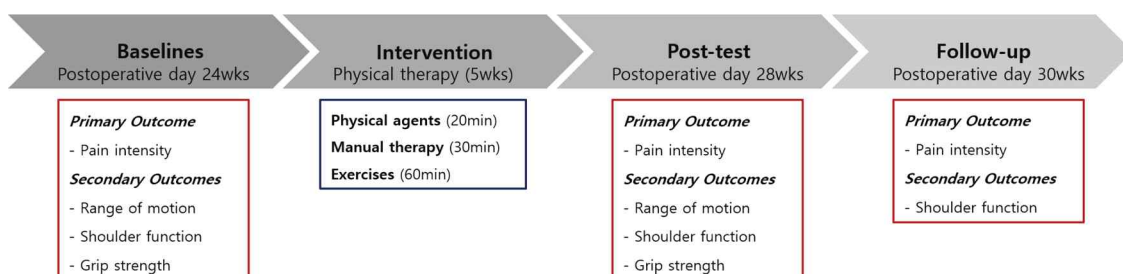


Figure 1. Sequencing flow plot



**Figure 2.** Magnetic resonance imaging before and after arthroscopic rotator cuff repair. (A) Imaging before surgery, (B) Imaging after surgery.

strength and was measured using a dynamometer (TKK-5401, Japan)[12]. It has an adjustable handle and was measured with the patient sitting and with the elbow fully extended.

#### Clinical impression

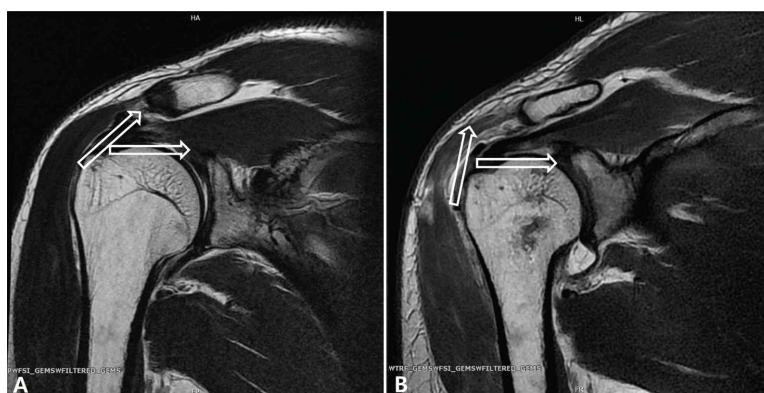
This patient appeared to be a good candidate for participation in this study for several reasons. In general, unlike ARCR patients who do not undergo augmentation, shoulder pain and function were not good. Considering the postoperative period, it was thought that there would be chronic fat infiltration and lack of neuromuscular control as a consolidation phase after 6 months in the tendon healing process[13]. In addition, compensatory motion, not normal motion, was remarkably clear, and rather severe pain was accompanied after ROM exercise. Based on these results, it is judged that normal movement was difficult

because the muscle vector was changed in MRI after ARCR (Figure 3)[14].

#### Intervention

Physical therapy in this study consists of physical agents (20 min), manual therapy (30 min), and supervised exercises (60 min). The physical therapy intensity is 110 minutes per session 3 times a week for a total of 5 weeks.

Physical agents consists of infrared (IR-2014, AJINMEDICAL, Jeonju, Republic of Korea), microwave (Hanil-TM, Seoul, Republic of Korea), and transdermal nerve electrical stimulation (TENS) (Hanil-TM, Seoul, Republic of Korea), and a total of 20 minutes. The patient applies TENS and infrared simultaneously for 15 minutes in a sitting position[15, 16]. After treatment, microwave is continued for 5 minutes. Infrared are applied to the patient's right shoulder at a distance of



**Figure 3.** Muscle vector as seen in magnetic resonance imaging. (A) Imaging before surgery, (B) Imaging after surgery.

50cm with moderate heat intensity. TENS was set at 100–300 Hz, and then microwave was applied at a distance of 20cm at 2,450 MHz and 100 W[17].

Manual therapy releases the upper back and posterior neck for the patient's relaxation. Soft tissue mobilization is used mainly for global muscles that become tight and weak (biceps brachii, deltoid, pectoralis major, pectoralis minor, subscapularis, rhomboid minor, latissimus dorsi)[18]. For joint mobilization, anterior to posterior glenohumeral joint mobilization is performed in the supine to prevent adhesion of the posterior aspect of the glenohumeral joint capsule[19]. Then, inferior gliding or superior gliding is performed depending on the angle to increase the range of flexion and abduction. For scapular dyskinesis, scapulothoracic joint mobilization makes movement so that downward rotation is smooth[20].

Supervised exercises consist of stretching, strengthening, and stabilization exercises. For stretching exercise, considering the chain reaction and postural characteristics, the muscles to be stretched are the pectoralis muscles, latissimus dorsi, upper trapezius, and levator scapulae[21]. Strengthening exercise and stabilization exercise aimed to make normal scapulohumeral rhythm by actively reflecting scapular dyskinesis and conscious correction of scapular orientation[22, 23].

## Results

During the 5 weeks of physical therapy intervention, no side effects occurred and overall positive improvement was observed. The results are summarized in Table 1.

The examination investigated pain intensity, ROM, function, and muscle strength as shown in figure 1. In follow-up, only pain intensity and shoulder function in the form of self-report questionnaires were examined. In the evaluated results, the pain intensity decreased from 4 to 1 point in the usual pain and decreased from 6 to 4 point in the worst pain. ROM was all increased, and the function also decreased from 8 to 4 point, indicating improved functions. The grip strength was also increased by 13kg after the intervention.

## Discussion

Although numerous rehabilitation protocols have been proposed after ARCR, the main trend of studies is underpinning the immobilization phase, which is the time to start active movement[24, 25]. However, in this case report, graft augmentation is added instead of general ARCR. In addition, the muscle vector changes according to the change in the muscle position after surgery, which has not been dealt with much until

**Table 1.** Pain intensity, range of motion, function, and grip strength of the patient's right shoulder.

Measurement	Baselines	Post-test	Follow-up
<b><i>Pain intensity (point)</i></b>			
Usual pain	4	2	1
Worst pain	6	6	4
<b><i>Range of motion (°)</i></b>			
Forward flexion	87	168	—
Scaption flexion	95	170	—
Abduction	67	144	—
Internal rotation	23	40	—
External rotation	0	27	—
<b><i>Shoulder function (point)</i></b>			
SST	8	6	4
<b><i>Muscle strength (kg)</i></b>			
Grip strength	28	41	—

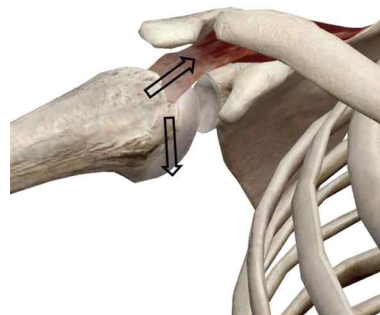
SST: simple shoulder test.

now. Therefore, it suggests that the composition and quality of rehabilitation should be considered.

As a result of the physical therapy performed in this case report, it can be a practical method in hospitals and exercise centers in the tendon recovery process, and there were no reported side effects during the implementation. The evaluated results are shown in Table 1. Positive improvement stood out in all results. The results of each are as follows. Considering that the reported minimal important difference (MCID) of pain intensity was 1.1 to 2.17 points[9, 26], it was found that the reduced result in this study was a clinically significant result. In shoulder ROM, even compared with other case report studies[27], the increase in baselines appears to be quite large. Considering that the reported MCID of SST was 2 points in the shoulder function[28], a reduction of 4 points in follow-up compared to baseline is a clinically meaningful result. The fact that grip strength was confirmed by muscle strength was highly correlated with rotator cuff strength[29]. Therefore, the 13kg increase in grip strength indirectly means the improvement of the rotator cuff strength.

Patients who participated in this study visited 6 months after ARCR. This period is the final phase of the tendon healing process, the consolidation and/or remodeling phase[13]. As collagen becomes more dense and organized, scar strength increases[30]. Therefore, in this phase, aggressive stretching or strong loading with compensatory motion rather than normal motion may cause re-tear[31]. The functions of supraspinatus are abduction and external rotation, and in a study comparing normal adults and patients with shoulder impingement syndrome, supraspinatus also plays a depressive role to prevent impingement from occurring in the subacromial space (Figure 4)[32]. However, a patient who received additional graft augmentation may suspect that the structurally modified muscle may have an altered vector as shown in Figure 3B. This was estimated through elevation of only compensatory motion due to severe scapular dyskinesis during forward flexion at 6 months.

Therefore, based on the improved results in this study, it is judged that release for the large moment arm[33] that makes compensatory motion in the intervention protocol was effective. Also, to normalize scapular dyskinesis, conscious correction for scapular



**Figure 4.** Depression of supraspinatus during shoulder abduction. Image from Muscles & Kinesiology (Muscle 8.0.76, Visible body, USA)

orientation is considered to have affected the muscle vector.

## Conclusion

This study is the first study to clinically suggest compensatory motion due to scapular dyskinesis, which can be overlooked in postoperative rehabilitation of ARCR. As a result, chronic pain and movement limitation in ARCR with graft augmentation patients can bring positive improvements in pain intensity, range of motion, function, and strength through physical therapy management.

## Conflicts of interest

The authors declare no conflict of interest.

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