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RESEARCH

MASSIVE RETRACTED IRREPARABLE ROTATOR CUFF TEARS: WHAT IS THE EFFECT OF CONSERVATIVE THERAPY?

ABSTRACT

Introduction: Massive, irreparable, retracted cuff tears, without surgical intervention need to be treated with conservative therapy. In this study we aimed to determine the efficacy of conservative treatment in such tears.

Material and Methods: We retrospectively reviewed 33 patients with massive rotator cuff tears treated nonoperatively. Data were obtained from direct examination, medical records, plain radiographs, and magnetic resonance imaging (MRI). Radiographic classification has been made by plain AP views. The fatty muscle degeneration and the stage of retraction of the cuff were evaluated with MRI. Rehabilitation program was given to all patients.

Results: The mean age at the initial examination was 71 (range, 50–84) years. The mean follow-up time was 5.5 (range, 2-10) years. Patients with Grade 3-5 tears and Stage III retractions had a higher incidence of fatty muscle degeneration of the subscapularis muscle. Deltoid muscle strength was found to be increased significantly at the latest follow-up.

Conclusion: Exercise therapy should be kept in mind as a kind of rehabilitation method in patients with a symptomatic massive rotator cuff tear. It's essential that more randomised clinical investigations have to be conducted to find out the best management practice for this condition.

Key Words: Rotator Cuff; Physical Therapy Modalities; Treatment Outcome.

ARAŞTIRMA

MASİF RETRAKTE ONARILAMAZ ROTATOR KILIF YIRTIKLARINDA KONSERVATİF TEDAVİNİN ETKİNLİĞİ NEDİR?

ÖZ

Giriş: Cerrahi girişim yapılmamış masif, retrakte, onarılamaz rotator manşet yırtıkları konservatif yöntemlerle tedavi edilir. Bu çalışmada bu yırtık tiplerinde konservatif tedavinin etkinliğinin değerlendirilmesi amaçlanmıştır.

Gereç ve Yöntemler: Masif rotator manşet yırtığı nedeniyle cerrahi dışı yöntemlerle tedavi ettiğimiz 33 hasta geriye dönük olarak incelendi. Hastaların verileri, direk muayene bulguları, tıbbi kayıtları, radyografileri ve manyetik rezonans görüntülerinden (MRG) elde edildi. Radyolojik sınıflandırma ön-arka direk grafilerine göre yapıldı. Retraksiyon evresi ve yağlı dejenerasyonları MRG ile incelendi. Tüm hastalara rehabilitasyon programı uygulandı.

Bulgular: İlk muayenede hastaların ortalama yaşları 71 (dağılım, 50-84) yıldı. Ortalama takip süresi 5,5 (dağılım, 2-10) yıldı. Grade 3-5 yırtıklar ve Evre III retraksiyonları olan hastaların subskapuler kaslarında daha fazla yağlı dejenerasyon saptandı. Son kontrolde deltoid kas güçlerinin anlamlı düzeyde artmış olduğu saptandı.

Sonuç: Semptomatik masif rotator manşet yırtığı olan hastalarda egzersiz tedavisinin bir rehabilitasyon yöntemi olduğu unutulmamalıdır. İleriye dönük, randomize klinik çalışmaların tasarlanmasıyla bu durumun en iyi tedavi yöntemi ortaya konabilir.

Anahtar Sözcükler: Rotator Kaf; Fizik Tedavi; Tedavi Sonucu.

Introduction

Degenerative rotator cuff tendinopathies are the most common disabling shoulder problems faced by the older population (1). Milgrom et al. (2) in 1995 reported that a marked increase in cuff tears was found in those over age 50 in their 90 asymptomatic adult series. Studies also emphasized that 8-10% of all asymptomatic cuff tears are massive and more than two rotator cuff tendons are totally impaired (2). In these cases, in the presence of a balance between the muscles in transverse and coronal planes, the shoulder may function normally (3).

Although many patients with irreparable cuff tears function well, the American Academy of Orthopaedic Surgeons (AAOS) prefers surgery in these cases, apart from rehabilitation (4-5). It has been shown that surgical rotator cuff repair produces much less successful results in the elderly, especially in those with retraction (6-7). Rockwood et al. used surgery in 57 patients with an average age of sixty years. They reported that an unfavorable outcome was observed in shoulders in which the anterior part of the deltoid muscle was weak or absent, or in which a previous acromioplasty and attempted repair of the rotator cuff had been performed. They also reported that as a part of surgery, orthopaedic rehabilitation was also important in patients' clinical recovery, especially in those with unfavorable outcomes (5).

There are several studies examining the outcomes of surgical treatment modalities in the literature; however, the role of rehabilitation in patients with massive, irreparable, retracted cuff tears is still debatable (8-9). In 2007 Ainsworth and Lewis (10) reviewed the evidence for the effectiveness of therapeutic exercise for the treatment of full thickness tears of the rotator cuff. Based on the observational studies of lower scientific merit, they concluded that the findings suggest that some evidence exists to support the use of exercise in the management of full thickness rotator cuff tears (10).

In this study we evaluated the role of rehabilitation in adult patients with massive, irreparable and retracted cuff tears; we aimed to compare the results with literature and to examine the role of conservative treatment in clinical follow-up.

Materials and Methods

Records of patients with a diagnosis of rotator cuff tears were screened from a hospital electronic database. 44 patients were diagnosed and treated by our PMR center between March 2010and January 2012. All patients were contacted by phone; 40 patients were reexamined. Patients with neurological deficit, inappropriate laboratory data, no follow-up records, those who were operated, and those not willing to participate were excluded from the study. This exclusion left 33 patients suitable for further evaluation. The strength of the anterior, posterior and lateral deltoids was determined as the mean of the values gained by a horizontal hand scale fixed to the wall. Four investigators (MUO, ABS, TB, MA) reviewed the cases in order to diagnose a massive tear. Advanced and inspectable weakness and wasting of the supraspinatus and infraspinatus, infraspinatus lag, rupture of the long head of the biceps tendon, more than two tendon tears confirmed by MRI, and refusal of any surgical intervention were the inclusion criteria of this study sample. 33 patients (19 male, 14 female) were included in the study, which was conducted according to the Helsinki Declaration 2008. An informed consent was obtained from each patient.

Demographic data (age, gender), history (operation, chronic diseases, trauma), clinical examination records (locomotor), follow-up records (before and after rehabilitation programme), and laboratory (ESR, CRP and full blood count) and radiological [plain radiographs, magnetic resonance imagings (MRI)] data of 33 patients were evaluated retrospectively.

Clinical Examination and Follow-up

Initial and follow-up range of motion degrees were measured with the same goniometer, and muscle strength by manual examination by the same authors (MT, AYG). The physical examination and functional evaluation were carried out according to the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES) and the

Table 1— Radiographic Classification of Massive Rotator Cuff Tears (18).

Grade	AHI (mm)	Acetabulization
1	≥6	-
2	≤5	-
3	≤5	+
4 in the presence of glenohumeral narrowing		
4a	<7	-
4b	<7	+
5 Humeral head collapse is present		

AHI= Acromiohumeral interval.

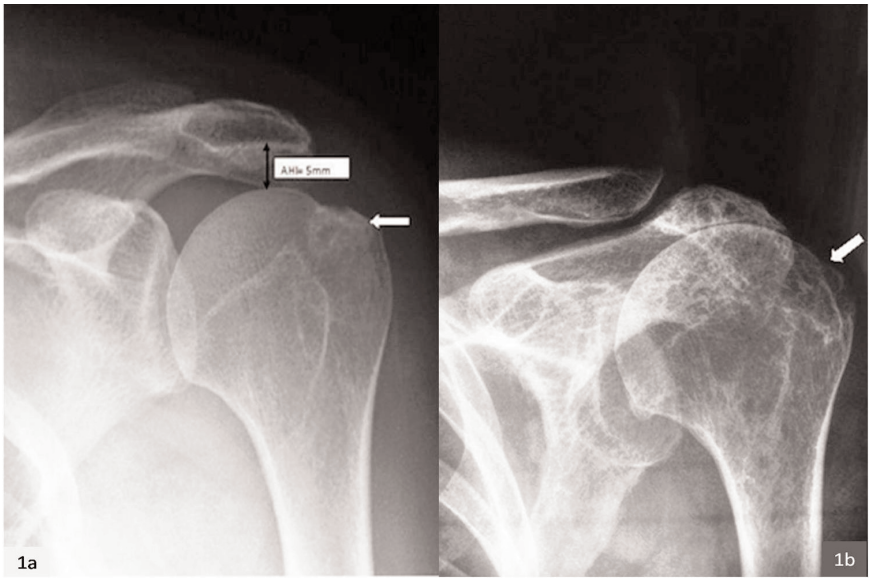

Figure 1— AP roentgenogram of the same patient at the initial presentation **(a)**, and at the latest follow-up **(b)**. The Grade 2 (AHI=5mm) rotator cuff tear progressed to Grade 4 (arthritic changes; glenohumeral narrowing) and the cyst (white arrow) at the greater tuberosity has enlarged after a 45 months followup.

University of California at Los Angeles (UCLA) scale (11-12). Pre- and post-rehabilitation recorded ASES scores (max 100 points), UCLA scale scores (max 35 points) and visual analogue scores (VAS) were evaluated.

Radiology

Radiographic classification of massive rotator cuff tears by plain anterior-posterior (AP) views were made according to Hamada et al. (13) by the same radiologist (KAG). To grade the severity of disease, we used the modified classification of Hamada et al. (13) (Table 1). We have further summarized this classification as grade 1 (no arthritic changes), grade 2 (prearthritic changes) and grades 3-5 (arthritic changes) for easy understanding (13-14) (Table 1) (Figure 1).

Tendon tears were diagnosed by MRI (1.5-T system, Signa Horizon LX; GE Healthcare, Milwaukee, WI) and by the same radiologist (KAG). T1-weighted images were used to determine the degree of fatty muscle degeneration. The tear was defined as massive when detachment of two or more entire tendons and typically at least the supraspinatus and infraspinatus tendon were observed (2). The criterion for a massive rotator cuff tear was a fluid-filled gap and retraction in the tendon noted on the T2-weighted coronal oblique or transverse images (15). The rates of the fatty degeneration to the whole muscle mass on scapula Y planes on MRI were calculated using standard millimetric papers (16) (Figure 2). The fatty muscle degeneration in each cuff component was further evaluated according to the five-stage classification of Fuchs et al. (17) (Figure 3). Further, the stage of retraction of the cuff was evaluated by the staging system proposed by Patte (18). According to this staging system, stage I is identified when the tendon stump is not or a little retracted, leaning near the original tendon insertion. When the tendon stump is retracted, but does not pass the glenoid rim, it is called as stage II. In stage III, the stump is retracted back passed the glenoid rim (Figure 4). The strength of the anterior, posterior and lateral deltoids was determined as the mean of the values gained by a horizontal hand scale fixed to the wall. Four investigators (MUO, ABS, TB, MA) reviewed the cases and diagnosed a massive tear when at least two tendons were not visible around the tuberosity. If the diagnoses differed between observers, a final diagnosis was determined by consensus. The tears were stated as irreparable when: (1) at least two tendons were not visible around the tuberosity, (2) the fatty degeneration was phase 3 and above, and (3) the retraction was staged at II and above. The positive predictive value (ratio of massive cuff tears in positive tests) was found to be 0.95 by MRI.

All the patients graded as Grade 1 or 2 at the initial MRI examination were re-examined for any grading changes at follow-up. The first MRI staging (done at the first attendance of

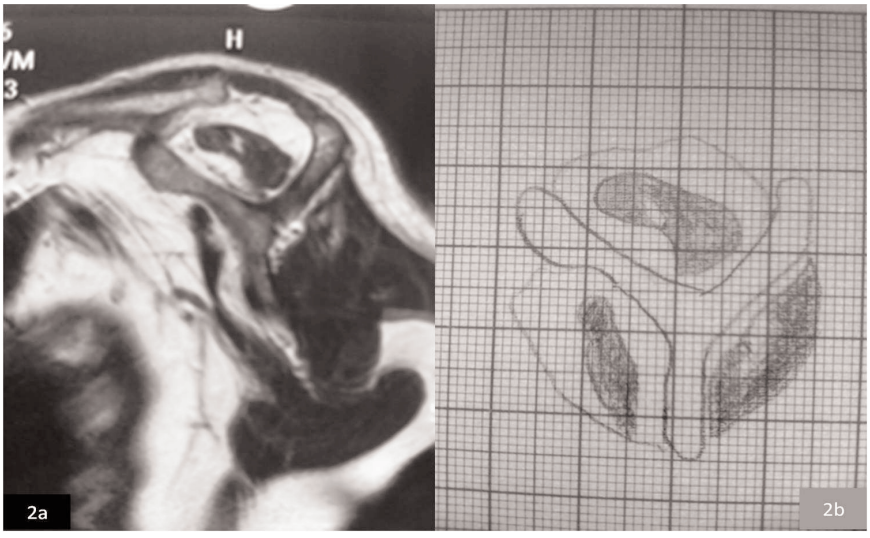

Figure 2— Calculation method of the rate of the fatty degeneration to the whole muscle mass on scapula Y planes on MRI **(a)** by using standard millimetric papers **(b)**.

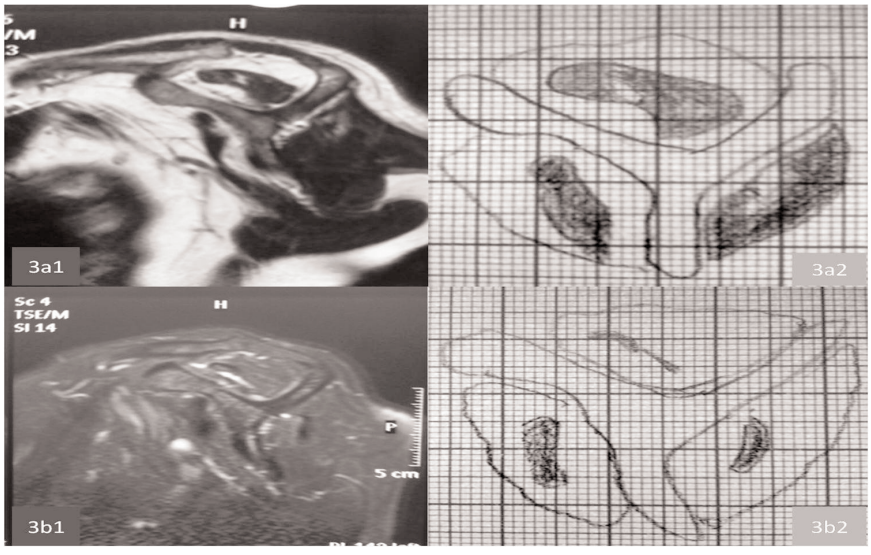

Figure 3— T1-weighted scapular-Y MRI of the same patient at the initial presentation **(a)**, and T2-weighted scapular-Y MRI at the final examination **(b)**. Note that phase 3 fatty degeneration of supraspinatus and subscapularis muscles and phase 2 fatty degeneration of infraspinatus progressed to phase 4.

the patient to PTR outpatient clinic) was recorded as initial MRI staging and the second MRI staging (done on follow-up examination) was recorded as follow-up MRI staging. These patients were divided into two groups: those who remained at Grade 1 or 2 at final follow-up and those who progressed to upper grades at final follow-up (Table 2). Patients were also divided into two groups according to the alterations of retraction stages (Table 2).

Therapy and Follow-up

All 33 patients were treated nonoperatively by physiotherapy and nonsteroidal anti-inflammatory drugs (NSAIDs).

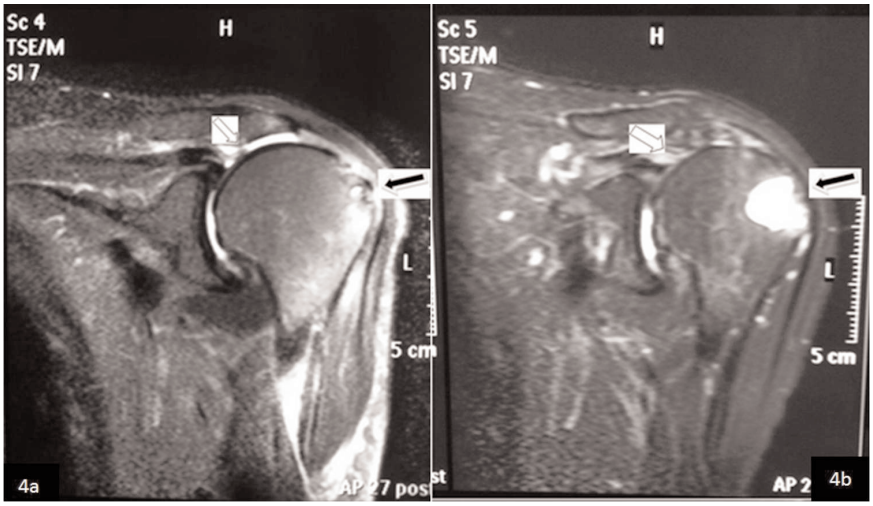

Figure 4— T2-weighted coronal oblique MRI of the same patient at the initial presentation **(a)** and at the final examination **(b)**. Note that the Stage II retraction (white arrow) remained and the cyst at the greater tuberosity (black arrow) has enlarged.

Table 2— Summary of The Rehabilitation Program

Phase	Intervention	Duration
Phase I	Pain control	1-2 weeks
Phase II	Stretching exercises	4-8 weeks
Phase III	Strengthening exercises	2-3 weeks
Phase IV	Maintenance exercises	3-4 months

Patients used medication with a mean of 10 days (min-max: 5-15 days), and close monitorization was made for systemic adverse effects. This treatment was conducted according to nonsurgical protocol, which was defined and introduced by Rockwood et al. (19) and supervised by two physiatrists (AYG, ABS). This rehabilitation programme consisted of four phases (Table 3).

Table 3— Number of Torn Tendons and Progression of Grades (G) and Stages (S).

	Mean Age (years)	Gender (M/F)	Side (D/nD)	RC Torn Tendons (SSp + ISp / more than SSp + ISp)	LHB Tendon (T/nT)
Grade					
G 1 or 2 to G 2 (n = 17; Group 1)	70	8/9	10/7	6/11	3/26
G 1 or 2 to G 3, 4, or 5 (n = 9; Group 2)	68	6/3	5/4	1/8	1/7
p	0.522	0.440	0.389	0.089	0.134
Stage					
S 1 or 2 to S 2 (n = 2; Group 1)	74	1/1	2/0	1/1	0/2
S 1 or 2 to S 3 (n = 6; Group 2)	70	2/4	4/2	2/4	3/3
p	0.613	0.395	0.325	0.094	0.165

G= Grade; S= Stage; n= number of patients; M=Male; F=Female; D= dominant; nD= non-dominant; RC = rotator cuff; SSp = supraspinatus; ISp = infraspinatus; LHB = long head of the biceps tendon; T=torn; nT= not torn (Mann-Whitney U test).

Differences in the aforementioned parameters (range of shoulder motion, muscle testing, radiological data and ASES-UCLA scoring) after the acute phase and at final follow-up were determined using the Mann-Whitney U test and the Student's t-test. Alterations between the grades and retractions during the follow-up were further evaluated by the chi-square test. Differences in patient characteristics, incidence of concomitant tendon tear, and degree of fatty muscle degeneration of rotator cuff components among grades and stages were further determined using multiple analysis of variance. All analyses were performed using SPSS II Version 17.0 (SPSS Inc., Chicago, IL).

In this retrospectively designed study, we sought the answers for: (1) do the patient characteristics and MRI findings at initial examination and final follow-up differ between the radiographic grades and retraction stages?; and (2) what factors affect the progression to a higher grade?

RESULTS

33 patients were included in the study. The mean age was 71 (range, 50–84) years. Mean duration of the disease was five years and six months (range, 2 to 10 years).

According to the stages of Patte, 15 patients were identified as grade I, 11 patients were identified as grade II, and seven patients were graded as stage III-IV by their initial MRI.

The mean active forward flexion and external rotation increased from 105º to 160º (p=0.0272) and from 41º to 44º (p>0.05), respectively, after rehabilitation. The mean strength of the supraspinatus and infraspinatus muscles did not differ significantly. However, the increase in the mean muscle strength of the deltoid was found to be statistically significant (p=0.0412). The mean ASES and UCLA scores increased significantly (p=0.0218 and p=0.0314, respectively). The improvement in VAS scores was also significant (p=0.0378) (Table 4).

Radiological grades and retraction stages of the patients recorded at the initial examination and at follow-up are presented in Table 5. Radiological grades and stages of retractions did not differ significantly, either at the first examination, or at the follow-up (McNemar's x^2=3.60 and x^2=1.77, p>0.05, respectively). In other words, grades of plain radiological changes and stages of retraction were strongly correlated with each other (r=0.818).

Further evaluation according to the plain radiological grading of the massive rotator cuff tears was conducted. Overall results showed that patients with Grade 1 or 2 tears were younger than those with Grade 3 to 5 massive cuff rotator tears, whereas concomitant rotator cuff tears and biceps ruptures, and fatty degeneration were more frequent. Similar relationships between Stage III retractions compared to Stage I or II retractions have been obtained.

Table 4— Overall Functional and Statistical Results Pre and Postrehabilitation (n=33).

	Pre-Rehabilitation	Post-Rehabilitation	p
Range of Motion			
Forward flexion	105° (40-150°)	160° (120-170°) 0.0272	
Adduction-Ext rot.	41° (20-75°)	44° (20-75°)	>0.05
Muscle strength			
Infraspinatus	3 (2-4)	3 (2-4+)	>0.05
Supraspinatus	3 (2-4)	3 (2-4+)	>0.05
Deltoid	3 (2-4)	4 (3-5) 0.0412	
ASES scores	25.4 (10-45)	86.7 (63.3-100)	0.0218
UCLA score	10.6 (8-16)	25.6 (17-35) 0.0314	
VAS	8.5 (7.5-10)	3.5 (3-5.5)	0.0378
Fatty degeneration			
Supraspinatus	42.8% (4-60%)	43.8% (24-100%)	>0.05
Infraspinatus	18.6% (2-42%)	22.5% (7-63%)>0.05	
Subscapularis	37.6% (8-53%)	39.2% (10-55%)	>0.05
Teres Minor	16.3% (4-28%)	18.6% (9-58%)>0.05	

ASES= the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form; UCLA= the University of California at Los Angeles Scale; VAS= visual analogue scores.

Five of 15 patients (33%) with Grade 1 tears and four of 11 patients (36%) with Grade 2 tears progressed to a higher grade in 68 and 74 months on average, respectively (Table 5). Of the 26 patients with Grade 1 or 2 tears at initial examination, 17 (Group 1) remained at Grade 1 or 2 and nine (Group 2) progressed to Grade 3–5 at final follow-up. Initially there were 11stage I, 16 stage II and six stage III retracted tears. At the follow-up, 3 of the stage I retractions (27%) progressed to a higher stage (Table 5).

Discussion

The best management and treatment for a patient with a symptomatic massive rotator cuff tear is still under debate. Although Ellman et al. (12) proposed better outcomes in case of early surgery for any kind of tear, Bartolozzi et al. have reported a patient series treated with conservative management with favorable outcomes (20). Yamada et al. followed up 12 patients with a mean age of 70 and for a mean duration of 48 months (21). They confirmed the diagnosis by arthrogram and treated their patients with intraarticular corticosteroid injection, heat, rotator cuff strengthening exercises and passive range of motion for flexion and external rotation. A mean of 22% improvement in Japanese Orthopedic Association Scores was reported. Ainsworth et al. (22) followed up 10 patients with a mean age of 76, for a mean duration of 3 months. They confirmed the diagnosis by ultrasonography and treated their patients with active anterior deltoid strengthening and patient education. A mean of 10 points of improvement in the Oxford Shoulder Score was noted.

In the present study, we hypothesized that nonsurgical rehabilitation of patients with massive, irreparable and retracted cuff tears can lead to clinical improvement, attracting attention to the option of conservative treatment of such tears. We found that patients with Grade 3-5 tears and Stage III retractions were older. They had concomitant rupture of the long head of the biceps, subscapularis and teres minor tendons and had more fatty degeneration of subscapularis than those with Grade 1 or 2 tears and Stage I or II retractions. In the literature, the shoulder joint is thought to age more by its tendons than by its cartilages, and the incidence of rotator cuff tears has been considered to increase with age. Nove-Josserand et al., (23) in their series, reported that their results confirm that the frequency of rotator cuff tears increases with age. One out of five patients aged 70-90 presented with subacromial impingement, versus one out of three among patients aged over 90 years. In the present study we chose a patient population with massive, irreparable, retracted cuff tears. As the open-surgery techniques are complex and followed by a troublesome postoperative period, they are perhaps most suitable for young and active patients. In older or more sedentary patients, less aggressive approaches such as rehabilitation may be preferable.

In the present study, and possibly as a result of compensation, no decrease was found in the average of active flexion despite the grade and/or retraction progression (24). Walch et al. reported that fatty infiltration of the infraspinatus and subscapularis muscles may lead to teres minor atrophy (25). We found that a longer follow-up period negatively influenced grade progression from Grade 1 or 2 to Grade 3-5, and these results were similar to those of Walch et al. (25). Different from that study, we have also noticed that a longer follow-up period may influence retraction staging.

We have followed up 33 patients, with a mean age of 71 and for a mean duration of 66 months. We have confirmed the diagnosis by MRI and treated the patients with a 4-phase rehabilitation programme. A mean of 60% in ASES and 15% of UCLA scores has been obtained. However, this study is retrospective; randomised clinical investigations may help clinicians to make appropriate decisions during management of such tears.

In summary, patients younger than 65 years, with no more than Grade 2 tears, Stage II retractions and Phase 2 fatty degenerations gained very favorable results from physiotherapy. This may be because younger patients with less damage and more compliance obey the rules of the rehabilitation programme much more, and they also have more tissues to be recycled. However, although fatty degeneration progresses independently, this progression is statistically non-significant. This fact may be explained by a probable misuse of the extremity caused by fear, during the rehabilitative process.

There are several major limitations in our study. First, we lost 25% of our patients to follow-up. Second, our follow-up period was short for observing radiographic degenerative changes. Third, there is no control group, such as an operatively treated sample. In order not to confuse the reader we did not evaluate the alterations of the scoring systems according to grading and staging systems separately. This may be the fourth limitation of this study.

This improvement in VAS was thought to be the result of the physiotherapy, rather than the short-term NSAIDs medication.

Conclusion

The findings of this study suggest that exercise therapy is an option for patients with symptomatic massive rotator cuff tears. When to initiate and what kind of programme to use, and when to refer to a surgeon, are still under debate. Prospectively designed randomised clinical investigations are essential to ensure definitive guidance. Moreover, in order to discover the best management protocol, these investigations have to be conducted using appropriate validated outcome measurements. For successful results to be gained with conservative treatment, adequate patient selection and education of the patients are crucial.

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Conflict of Interest Statement

The Authors declare that there is no conflict of interest.

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