



Rehabilitation in arthroscopic subacromial decompression: six-year follow-up

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Research Report

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Purpose: The purpose of this study was to investigate long-term effects of physiotherapy program in patients with arthroscopic subacromial decompression (ASD). **Material and methods:** In a clinical prospective study, 33 consecutive patients who had undergone ASD and were resistant to conservative therapy and without full-thickness rotator cuff tears were regularly evaluated up to six years. Postoperative follow-up was performed by an independent observer after the 6th week, 12th month and 6th year. Patients were assessed by Neer Shoulder Scoring system, the University of California at Los Angeles (UCLA) Shoulder Rating Scale, Visual Analogue Scale (VAS), isokinetic strength and goniometric measurements. **Results:** We found no differences in the clinical tests after six years ($p>0.05$). No differences were found between the three evaluation years in duration of sick leave and daily intake of analgesics ($p>0.05$). Six weeks after adjustment for ASD, the difference in improvement in overall Neer Score was 4.0 (95% confidence interval -2 to 11). The condition of patients with ASD who were given active treatments showed a significant incremental improvement in the sixth week, 12th month, and sixth year ($p<0.05$). **Conclusion:** All patients in this study improved with physiotherapy and rehabilitation. Physiotherapy and rehabilitation should be thought of as a first-line management method for patients with subacromial decompression.

Key words: Shoulder impingement syndrome, Rehabilitation, Muscle strength, Quality of life.

Artroskopik subakromial dekompresyonda rehabilitasyon: altı yıllık takip

Amaç: Bu çalışmanın amacı artroskopik subakromial dekompresyon (ASD) yapılan hastalarda fizyoterapi programının uzun dönem sonuçlarını göstermektir. **Gereç ve yöntem:** Klinik prospektif bu çalışmada, ASD yapılan, konservatif tedavide başarısız olan ve tam kat rotator kılıf yırtığı olmayan ve sırasıyla gelen 33 hasta 6 yıla kadar düzenli olarak değerlendirildi. Post-operatif takip 6. hafta, 12. ay ve 6. yılda bağımsız bir gözlemci tarafından yapıldı. Değerlendirmede; Neer Omuz Skorlama Sistemi, Los Angeles Kaliforniya Üniversitesi (UCLA) Omuz Değerlendirme Skalası, Görsel Analog Skalası, izokinetik kuvvet testi ve gonyometrik ölçümler kullanıldı. **Sonuçlar:** Altı yıl sonra klinik testlerde fark bulunmadı. Hastalık nedeni ile işe gidememe süresinde ve analjeziklerin günlük kullanımında üç değerlendirme yılı arasında anlamlı fark bulunmadı ($p>0.05$). ASD'den 6 hafta sonra tüm Neer Omuz skorundaki gelişmede fark 4 (% 95 güven aralığı-2 ile 11) idi. ASD'li hastalar aktif tedavi ile 6. hafta, 12. ay, ve 6. yılda artan anlamlı bir gelişme gösterdiler ($p<0.05$). **Tartışma:** Bu çalışmada tüm hastalar fizyoterapi ve rehabilitasyon ile iyileşti. Fizyoterapi ve rehabilitasyon ASD'li hastalar için birinci sıradaki tedavi olarak düşünülmelidir.

Anahtar kelimeler: Omuz impingement sendromu, Rehabilitasyon, Kas kuvveti, Yaşam kalitesi.

Although shoulder arthroscopy was initially performed solely for subacromial decompression, at present it is widely used for rotator cuff repairs and reconstruction.¹ All arthroscopic rotator cuff repairs have been performed increasingly over the past decade and favorable long-term results have been reported in the literature.²⁻⁴

Subacromial impingement syndrome refers to encroachment of the coracoacromial arch on the underlying mechanism of the rotator cuff.⁵ The impingement syndrome was popularized by Neer in 1972.³ Arthroscopic subacromial decompression (ASD) is a state-of-the-art surgical procedure for the chronic subacromial impingement.^{6,7} It has been used sparingly, however, in patients whose impingement pathology has progressed to the point at which the affected rotator cuff has developed a full-thickness tear.⁸ The arthroscopic technique has proven to be comparable to the open method and has been found to be less traumatic with good results.^{9,10} Ellman described arthroscopic subacromial decompression for stages II and III impingement lesions with an overall satisfactory rate of 88%.¹¹

Physiotherapy is the gold standard for many centers for the treatment of patients after this type of surgery. A postoperative rehabilitation program is started immediately.¹² Robinson et al. reported good results with use of this technique, with relief of pain and marked improvement in function.¹³ Good results have also been reported with arthroscopic decompression and debridement. Although there has been recent interest in the use of arthroscopy for diagnosis and treatment of impingement syndrome of the shoulder, no research documenting the effect of this specific type of resource-demanding rehabilitation is available.

Few studies have been performed to investigate the efficacy of physical therapy programs after arthroscopic subacromial decompression.¹⁴⁻¹⁷ The majority of these are either retrospective or fail to isolate a single treatment modality. A recent Cochrane report has reviewed the evidence for physiotherapy intervention in shoulder pain and concluded that there is little evidence to either support or refute the efficacy of many of the modalities used.⁵ It also comments

that the interpretation of the results of the studies was difficult because the shoulder disorders are often poorly defined. Therefore, the goal of this clinical prospective study was to show early and late results after postoperative rehabilitation program applied in clinic after ASD in patients who had subacromial impingement without full-thickness rotator cuff tears.

Materials and methods

Between 1998 and 1999, 33 consecutive patients with subacromial shoulder impingement were included in this study. All patients gave a written informed consent before being included. Thirty-three patients were available for follow-up during 6 years long. There were 15 men and 18 women with a mean age of 41 years (range 18 to 75 years). The dominant shoulder was involved in 25 (76%) of the 33 patients. The average duration of symptoms before treatment was six months, ranging from two to eight months. All patients complained of pain and decreased active motion. After six years, we performed follow-up examinations on 33 patients and their results were reported.

Inclusion criteria were persistent impingement pain for more than 6 months without evidence of full-thickness rotator cuff tears and no or disappointing results after at least six months of conservative treatment including physiotherapy, nonsteroid and steroid anti-inflammatory medication, dysfunction or painful arc on abduction, normal glenohumeral range of movement, and positive impingement sign and test.

Exclusion criteria were arthritis of the acromioclavicular joint, cervical root syndromes, rotator cuff rupture, glenohumeral instability, bilateral muscular pain with tenderness and severely decreased ability to relax the shoulder, neck, and temporomandibular joints on examination, reluctance to accept one or more of the treatment regimens of the study. Glenohumeral instability was diagnosed if the patient had a history of traumatic luxation or performed overhead sports and had a positive apprehension or

relocation test on examination after a positive impingement test was confirmed.

All patients underwent nonoperative treatment for a period of not less than 6 months before operative intervention. The average duration of conservative therapy was 3.2 months (range, 1 to 5.2 months). This consisted of non-steroidal and steroidal anti-inflammatory medications, a supervised stretching and strengthening program, and activity modifications. It was always done by the same independent observer. All patients underwent a standard physiotherapy and rehabilitation regimen.

All patients received some or all of the following treatment modalities: acromioclavicular joint, thoracic, cervical spine and glenohumeral joint mobilization, exercise therapy including attention to muscle imbalance, postural advice, and strapping and, very occasionally, electrotherapy. Physiotherapy and rehabilitation began at the first postoperative week. All subjects received an individualized rehabilitation program based on the findings from the initial assessment. This consisted of a combination of supervised therapy at the hospital and a home exercise program. Daily passive pendulum exercises and range of motion exercises started on day 4. Patients were instructed at day 1 after surgery and provided with a written instruction booklet regarding shoulder exercises.¹⁸

The exercise program was progressed to involve strengthening of infraspinatus, subscapularis and teres minor relative to the supraspinatus and deltoid, aiming to restore the necessary depressor effect of the rotator cuff on the humeral head during arm elevation, resulting in less impingement. A sling was used for comfort during this period for 6 weeks. Active training was started by the end of the 2nd postoperative week and the passive pendulum exercise was continued only if needed. Unrestricted activities were allowed by the end of the 4th week. Strengthening consisted of concentric and eccentric with use of rubber tubing was initiated at 6th week and it was concentrated on the remaining intact portions of the rotator cuff muscles, the three parts of deltoid, the scapular rotators, and the biceps. These exercises focused on strengthening the internal and external rotator muscles of the shoulder and started

in neutral positions with isometric contractions and were progressed to inner range, through range, outer range and into functional positions. The resistance and speed of these exercises were altered and progressed. Aggressive, progressive, resistance exercises were avoided except in the younger patient.¹⁸

Post-rehabilitation, there were no limitations regarding physical activity and all patients were taught by a physical therapist a home training program before leaving the clinic. The aim of physiotherapy and rehabilitation program was to reduce inflammation and pain after surgery, directly using electrotherapy modalities and indirectly by altering the movement patterns (exercise and strapping).

The patients were evaluated at the 6th week, 12th month, and 6th years postoperatively.

Functional Rating Scales:

Subjective results (patient perception) were rated as satisfactory or unsatisfactory. A satisfactory result demonstrated significant improvement with either no pain or occasional pain and with improvement in functional level.

The UCLA Shoulder Rating Scale: It was applied to the postoperative 6th weeks and one year after the operation and yearly thereafter. Under this system, a numerical value assigned to the level of pain, strength, range of motion, function, and patient satisfaction with the procedure. The maximum score is 35 points. Results were subdivided into excellent (34 to 35 points), good (28 to 33), fair (21 to 27), and poor (0 to 20 points). An excellent or good score was considered satisfactory and a fair or poor score was considered unsatisfactory. An objective satisfactory result was a score 33 ± 2.7 points.^{4,11,12}

Neer Shoulder Scale: Secondary outcome criteria was the Neer shoulder score. This consisted of 4 parts: patient scoring his or her pain during the previous week (verbal rating scale) (35 points), clinical testing of function (muscle strength, reaching and stability) (30 points), active range of motion (25 points), and a radiological evaluation (10 points). All radiographs were assessed as normal according to the Neer criteria, so the overall scale ranged from 10 to 100 points.^{4,11,12}

Isokinetic measurement:

To evaluate and compare the musculature strength of shoulder both dominant and non-dominant sides we did isokinetic test of shoulders in the movement of external rotation (ER) and internal rotation (IR) at speeds of 90°/sec and 120°/sec. An explanation of the isokinetic testing procedure and equipment was given to each subject prior to beginning the test. Concentric and eccentric measures on the dominant and non-dominant shoulder were performed on a Cybex 6000 isokinetic dynamometer (Cybex, Inc., Ronkonkoma, NY) with the upper body exercise and testing table.¹⁹ Each subject performed three submaximal and then five maximal consecutive contractions of both shoulders in the movement of external rotation (ER) and internal rotation (IR). The dominant arm was tested first. The mean value of the five repetitions of total work (TW) was the isokinetic parameter used to evaluate muscle strength. During the ER test, the subjects were supine with stabilization straps secured at the pelvis and midthoracic levels. Subjects were given a 10 second and 30 second rest between each trial and two speeds, respectively, and performed at least three maximal contractions in each test to obtain a consistent result. An offset handle was provided for the non-testing extremity to grip during the testing procedure. Gravity correction was not utilized for this testing position, consistent with the manufacturer's recommendation. The test was initiated with the arm on across pelvis for external rotation, consistent with the manufacturer's recommendation.²⁰ Testing was performed at 90°/sec and 120°/sec. The 90°/sec testing speed was performed first for each extremity followed by the 120°/sec without randomization. Subjects were given a 30-second rest between each trial and two speeds respectively, and performed three submaximal and one maximal trial repetitions in each test to obtain a consistent result. Standardized verbal instructions and encouragement were given, with the subjects unable to receive visual feedback during the testing procedure.^{19,20}

Pain intensity level:

The last outcome measure in this study was Visual Analog Scale (VAS) described by

O'Connor et al.²¹ and Morrison et al.²² with the patient's assessments of pain at rest and during activity, were recorded at the 6th week, 12th month and 6th year.

All patients finished six years follow-up period and came to the controls routinely.

Statistical analysis:

Statistical analysis was performed using SPSS (SPSS, Inc., Chicago, IL) software. Averages are expressed as arithmetic means and as SD or range. Student *t* test was used for comparison. The level of significance was $p < 0.05$.

Results

Injury history: Thirty-three patients identified a history of injuries of which 22 were work related, and 11 were athletic (Table 1). Patients were hospitalized an average of three days.

Pain scores: Pain decreased markedly in the first one month postoperatively, but additional improvement took place until the 12 month follow-up. The average UCLA pain score indicated a significant level of improvement as follows: from 6.5 (constant pain) at three day postoperatively to 4.5 (pain with activity) at one month postoperatively; decrease to 3.2 (occasional pain) at 6 month postoperatively; additional decrease to 2.5 at 12 months postoperatively and 1 at six years postoperatively (Table 2). There was a significant improvement after surgery and six years after surgery ($p < 0.01$).

Patient satisfaction: Out of 33 patients, 24 (96%) were satisfied with the results of their surgery.

Function scores: The average score of the UCLA Shoulder Rating Scale changed from 5.8 (moderate work) post-rehabilitation to 8.9 (slight restriction only; able to work above shoulder level) at six years. Neer Shoulder Scale result was given in Figure 1.

Strength of forward flexion scores: The average strength of forward flexion score changed from 2.2 (poor) postoperatively to 4.7 (good+) six years postoperatively.

Complications: We had no post-operative

Table 1. Characteristics of the patients (N=33).

	n (%)
Female/male	18/15 (55/45)
Affected shoulder (right/left)	27/6 (82/18)
Dominant/nondominant side	25/8 (76/24)
Manual work/sedentary	22/11 (67/33)
	X±SD
Age at operation (years)	41±7.4
Duration of symptoms (months)	36±4.2
Duration of rehabilitation (weeks)	6±0
Neer Shoulder Scale (point)	
Overall (10-100)	53.6±22.1
Pain (max: 35)	23.8±11.7
Function (max: 30)	19.5±6.9
Range of motion (max: 25)	10.3±4.2

Table 2. Pre- and post-operative recordings of the patients.

	X±SD
UCLA Shoulder Rating Scale (0-35 point)	
Post-op 1 day	18±3.1
6 weeks	30±5.2
12 months	33±7.2
6 years	34±5.8
Pain at rest (VAS, 0-100 mm)	
Post-op 1 day	48±21
6 weeks	14±9
12 months	10±5.3
6 years	0±0
Pain during activity (VAS, 0-100 mm)	
Post-op 1 day	86±14
6 weeks	44±21
12 months	21±12
6 years	6±15
Overall satisfaction (VAS, 0-100 mm)	
Post-op 1 day	61±21
6 weeks	86±26
12 months	89±11
6 years	96±15

complications. Postoperative sick-leave was similar in the groups.

Apart from external rotation 60°/sec between 12 months and six years ($p<0.05$), no statistically significant differences were detected among the UCLA Shoulder Ratings, the VAS scales, and the Cybex recordings for total work (Joule) at 60°/sec and 180°/sec external and internal rotations ($p>0.05$). The average UCLA Scores improved most significantly from 12 months after surgery, and then gradually improved towards 6 year after the operation (Table 2). The differences in isokinetic dynamometer recordings showed the greatest improvement in six years after surgery, as compared to the 12 months, and muscle function continued to improve until one year after surgery (Fig. 2).

Discussion

In this study, we investigated the effect of a physiotherapy and rehabilitation program on patients with arthroscopic subacromial impingement after six years follow-up. The patients included in this trial were recruited following failed conservative treatment consisting of traditional physiotherapy and rehabilitation. At this stage, they were placed on the waiting list for surgery when it was felt that operative intervention was indicated, according to an existing protocol. This has been shown to be a very successful form of treatment for the patients after six years. In this study the patients has been monitored at very short intervals, providing first time a detailed picture of the postoperative program.

No control group was taken to the program because the aims of this study were to investigate the efficacy of physical therapy program after arthroscopic subacromial decompression and to show early and late results after postoperative rehabilitation program applied in clinic after ASD in patients who had subacromial impingement without full-thickness rotator cuff tears.

ASD has been shown to be an effective procedure in the treatment of Stage II and early stage III impingement syndrome.^{23,24} It, a well-evaluated procedure, is advocated by several

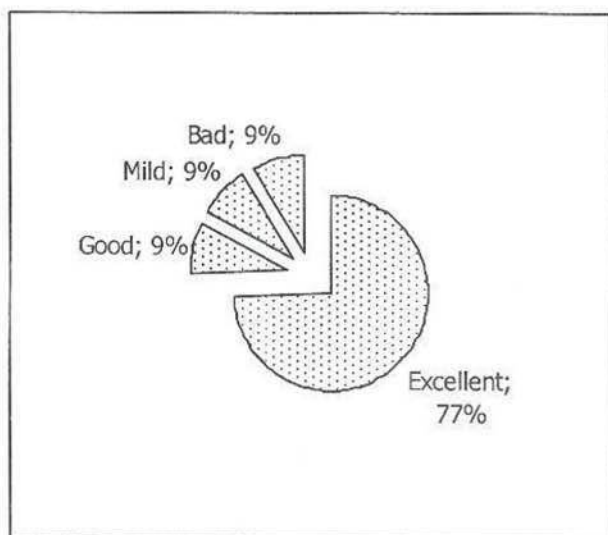


Figure 1. Results of the Neer Shoulder Scale with percentage of the patients at 6-year follow-up.

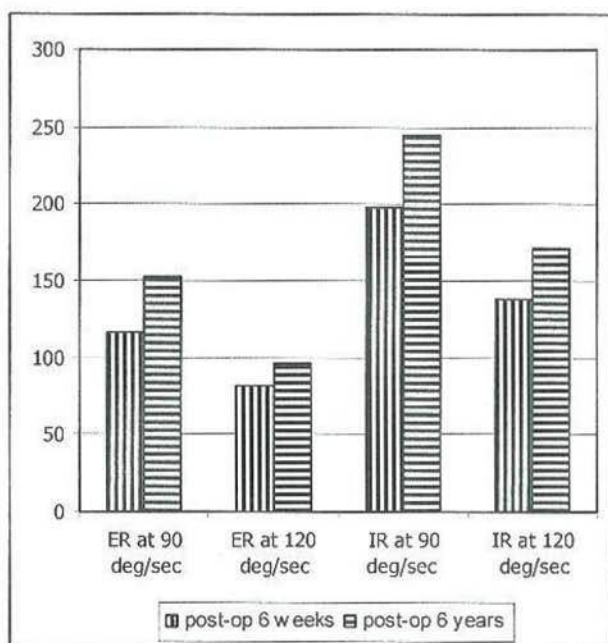


Figure 2. Comparison of isokinetic muscle strength values (Joule) of the patients at post-operative 6th week and 6th year (ER: External rotation, IR: Internal rotation).

authors,²⁵⁻²⁷ but only a few long-term studies on ASD have been done.^{10,11,16,28} All of them have concluded that it is a good alternative to UCLA Shoulder Rating Scale.

The UCLA shoulder rating scale accounts for

pain, function, motion, strength, and patient satisfaction. Ellman et al. reported on 40 patients who treated by arthroscopic subacromial impingement for full thickness rotator cuff tears.¹¹ Of these patients, 84% were rated as excellent or good. Esch et al reported a 77% satisfactory rating with 1-2 year follow-up in patients with complete tears treated by ASD.²⁹ Ellman and Kay reported a 2.5 year follow-up for subacromial decompression; only nine out of 20 patients with full-thickness tears were rated as satisfactory.³ Of these patients, seven later underwent open rotator cuff repair, with six satisfactory results. Cofield noted return of shoulder motion and strength after repair of a massive rotator cuff tear requiring extensive soft-tissue transposition is rarely achieved despite prolonged postoperative rehabilitation.⁹ Certainly, pain relief should be regarded as the primary goal for these patients, whose outcomes should most probably be considered in Neer's "limited goals" category. We have presented the results according to disease-specific and health-related quality of life outcome measures and isokinetic tests of 33 patients who underwent ASD. A total of 96% received a satisfactory rating with significant improvement in pain, function, motion and strength for ASD even up to 5 years.

Lindh and Norlin found that the rehabilitation and range of motion were better in the ASD group 3 months after surgery, and they concluded that ASD was better than open acromioplasty. At the 2-year follow-up, they found that the active range of motion was similar in the groups, and the median UCLA score was 29 points in both groups.⁸

In our present study, the patients attained the same clinical result as the literature after 1 and 6 years. Unlike previous studies, we found that the average UCLA scores, VAS recordings of pain and overall satisfaction were similar in the patients at short- and long-term follow-ups. All patients took same physiotherapy and rehabilitation program after surgery. Like Neer,³⁰ we do not believe that ASD patients need immobilization postoperatively.

We have also used isokinetic dynamometer recordings in our patients.¹⁹ Isokinetic muscle scores decreased after six years, as compared to those at one month. During the same period all patients showed some further improvement in

muscle function. We found a great individual variation in all measured isokinetic parameters, which may be due to the small number of patients in that range in age. The oldest patients may have had a reduction in muscle strength because of normal aging during the observation period. When compared with the unaffected extremity, we still find significantly lower results in the operated shoulder after 12 months. On the other hand, UCLA score, considered the main evaluation tool in this study, showed a consistently acceptable individual variation.

Pain is an important symptom in patients with impingement syndrome, and in prospective studies, it is essential to select methods of evaluation that the patients can tolerate both before and after treatment. In a previous study on isokinetic data's, Holm et al. found that external/internal rotation was the preferable movement pattern for evaluating muscle strength per second in patients with rotator tendinosis.²⁰ This movement pattern was weakly correlated to pain and most patients could perform the test both before and after treatment. The use of isokinetic muscle testing strengthens the validity of our study and supports the assumption that slight deltoid loosening does not affect the rehabilitation negatively.

In our study, the ASD patients returned to work at an average of six weeks postoperatively. We conclude that the choice of physiotherapy and rehabilitation program after ASD and six years follow-up after surgery is important to return to work and/or sport activity. Most physical therapists who master in shoulder rehabilitation prefer this type of program.

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