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Evaluation of early functional outcome of arthroscopic decompression in chronic primary sub-acromial impingement syndrome

Pritam Samanta, Rajesh Kumar Chopra, Jatin Prakash, Ashish Jaiman

Department of Orthopaedics, Central Institute of Orthopaedics, Vardhman Mahavir Medical College & Safdarjung Hospital, New Delhi, India

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Corresponding author:
Ashish Jaiman.
E-mail address: drashishjaiman@gmail.com;
ORCID: 0000-0002-4625-0107

Abstract

Background: Sub-Acromial Impingement Syndrome (SAIS) spectrum ranges from acute inflammation to chronic degeneration of the bursa and of rotator cuff tendons in sub-acromial space. It may lead to a full-thickness tear of rotator cuff tendons and degenerative joint disease of the shoulder girdle leading to functional loss and disability if not treated early and adequately. This study aimed to determine the early functional outcome of arthroscopic sub-acromial decompression in chronic SAIS due to mechanical causes.

Material and methods: This was a prospective cohort study. Patients were operated on arthroscopically for sub-acromial decompression between September 2018 and March 2020. Thirty-five patients with a range of 20 to 65 years of age diagnosed clinically with primary chronic sub-acromial impingement syndrome meeting the inclusion criteria were included in this study. All the patients under study were initially kept for at least four weeks of a course of conservative treatment and persisted in having symptoms were treated surgically with arthroscopic sub-acromial decompression. The UCLA (The University of California at Los Angeles) shoulder rating scale was used to assess shoulder function. The assessment was done in the pre-operative period, four weeks, 12 weeks, and 16 weeks post arthroscopic sub-acromial decompression surgery.

Results: Compared to pre-operative UCLA shoulder function score at the end of non-operative conservative treatment, the patients under study showed a statistically significant improvement at the end of the 16th week of post-arthroscopic subacromial decompression ($p<0.0001$).

Conclusion: This study concludes that arthroscopic sub-acromial decompression provides a good functional outcome in patients having primary shoulder impingement due to extrinsic mechanical causes such as shape and slope of the acromion in the absence of significant (total or near total) rotator cuff tear after 16 weeks of follow-up.

Key words: sub-acromial impingement syndrome, shoulder arthroscopy, sub-acromial decompression

Introduction

Shoulder pain is complicated and causes include subacromial impingement syndrome (SAIS), glenohumeral problems, acromioclavicular illness, and referred pain [1, 2]. Soft tissue encroachment into the sub-acromial space narrows the sub-acromial space, which contains the supraspinatus tendon, subacromial bursa, and long head of biceps tendon and capsule of the shoulder joint [3,4]. Depending on the location of causative variables, two hypotheses have been proposed for SAIS: the extrinsic theory and the intrinsic theory. Neer et al. popularised the idea of extrinsic impingement by defining it as the impingement of the anterior acromion, coracoacromial arch and acromion-clavicular joint on the sub-acromial bursa, rotator cuff, and biceps tendon [4]. Furthermore, he concluded that impingement of the rotator cuff against the undersurface of the acromion was primarily anterior and not lateral; therefore, anterior decompression rather than total or lateral acromionectomy (which results in deltoid injury followed by abduction weakness) is the appropriate operative approach for SAIS associated with rotator cuff degeneration. Codman et al. were among the first to introduce the idea of secondary or intrinsic impingement

[5]. They hypothesised that an inherent degenerative degeneration of the rotator cuff tendon was crucial for the development of SAIS. Several microvascular procedures have provided support for this theory [6–9]. The resultant discomfort and weakening of the supraspinatus weakens its function as a humeral head depressor and permits upward humeral migration, which is amplified by the deltoid's upward abduction force. This divergence from normal shoulder biomechanics is pathogenic for shoulder impingement [10, 11]. During the time of clinical examination, Neer's SAIS stages are essential for identifying the chronic stage of SAIS. Stage 1 is characterised by joint swelling, tendinitis-like symptoms, and a locally elevated temperature in patients younger than 25 years old. There is no indication of a tear in the Rotator Cuff tendon, however. Individuals may have moderate pain during exercise, although there is no decrease of Rotator cuff muscular strength. There is evidence of permanent scarring and tendinitis of the rotator cuff tendons, but there is no sign of a torn rotator cuff or loss of mobility. Stage 2 is typically diagnosed in individuals aged 25 to 40 years. Stage 3 is frequently observed in patients older than 40 with a partial Rotator Cuff tear, whereas stage 4 is associated with a complete or near-complete Rotator Cuff rupture. The initial treatment consists of conservative measures (NSAIDs, physiotherapy, steroid injections) that modify inflammation, muscular dyskinesia, and altered shoulder biomechanics without removing the primary underlying pathology. Patients who do not respond satisfactorily to conservative treatment should be considered for surgical intervention. Ellmann et al. [12] were among the first surgeons to employ arthroscopes. The majority of subsequent research has detailed the inconsistent functional outcome of Arthroscopic sub acromion decompression (ASAD) in long-term follow-up, with few studies reporting good outcomes and others demonstrating no superiority over conservative therapy [13-18].

The purpose of this study was to evaluate the functional result of ASAD in patients with chronic primary SAIS of Neer type 2 without considerable rotator cuff pathology in order to demonstrate the efficacy of this common therapy. The primary objective was to determine the improvement in The University of California at Los Angeles (UCLA) score at 16 weeks postoperatively. The secondary objectives were to estimate the duration of the surgery and any complications that may arise.

Material and methods

This was a prospective cohort study at a tertiary care centre. This research was approved by an institutional review board (2018-225). From September 2018 through March 2020 patients with significant subacromial pain for more than one month without relief from non-operative means (physiotherapy, NSAIDs, corticosteroid injections & rest) and symptoms and signs indicating primary impingement syndrome due to extrinsic mechanical causes (clinically diagnosed by pain provoked by abduction, positive painful arc sign and Positive impingement test - Neers test, Hawkins Kennedy test) were included in the study. These patients were scanned with an MRI. Exclusion criteria included complete thickness/High-grade partial thickness tears of the Rotator Cuff tendon, concomitant secondary impingement signals, glenohumeral and/or acromioclavicular joint osteoarthritis, and extensive calcific deposits in the Rotator Cuff tendon.

Additional exclusion criteria included a history of previous surgical procedures on the afflicted shoulder and signs of shoulder instability (positive apprehension/positive sulcus sign). Only patients with primary impingement as indicated on MRI were included in the research. Patients were informed of their rights and provided with information about the treatment procedure. All patients gave their informed consent in writing. Patients ranging in age from 20 to 65 years old and clinically diagnosed with chronic SAIS (Neer's stage 2) were included in the study.

Patient satisfaction
0 Patient feels procedure was not successful
5 Patient feels procedure was a success
Active forward flexion range of motion
0 Less than 30°
1 30°-45°
2 45°-90°
3 90°-120°
4 120°-150°
5 Greater than 150°
Strength of forward flexion
0 No active contraction
1 Evidence of slight muscle contraction, no active elevation
2 Complete active forward flexion with gravity eliminated
3 Complete active forward flexion against gravity
4 Complete active forward flexion against gravity with some resistance
5 Complete active forward flexion against gravity with full resistance
Pain
1 Present always and unbearable, strong medication frequently
2 Present always but bearable, strong medication occasionally
4 None or little at rest, present during light activities; salicylates frequently
6 Present during heavy or particular activities only, salicylates occasionally
8 Occasional and slight
10 None
Function
1 Unable to use limb
2 Only light activities possible
3 Able to do light housework or most activities of daily living
6 Most housework, shopping, and driving possible; able to do hair and to dress and undress, including fastening brassiere
8 Slight restriction only, able to work above shoulder level
10 Normal activities
Total
Excellent: 34-35
Good: 28-33
Fair: 21-27
Poor: 0-20

Figure 1 - Detailed University of Los Angeles (UCLA) Shoulder Score.

The University of California and Los Angeles (UCLA) shoulder rating scale was utilised to evaluate shoulder function, and the pain score was determined from a preoperative history [12] (Figure 1). According to this scale, a score greater than or equal to 27 indicates a satisfying outcome, whereas a score less than or equal to 27 indicates a fair or bad performance (unsatisfactory result). The maximum score is 35 points. The UCLA score total outcome has been rated as poor (0-20), acceptable (21-27), good (28-33), and exceptional (34-35), with the outcome steadily improving. The UCLA scoring system questionnaire incorporates both objective criteria evaluated by professionals and subjective characteristics reported by patients. Active forward elevation and strength (physician-reported), discomfort, contentment, and function make up these five sub-scales (patient-reported). All elements of the UCLA score may not improve at the same time; for instance, the patient may report a reduction in pain prior to an increase in joint range of motion. Seldom have other research indicated this sub-categorical improvement in numerous metrics; instead, they have typically described the sum of all parameters. Knowing which parameters improve and which do not improve after subacromial decompression can help surgeons select patients more carefully. In our study, we evaluated the early functional result (each parameter of the UCLA score) of arthroscopic sub-acromial decompression in patients with primary chronic sub-acromial impingement syndrome.

General anaesthesia was administered during the operation. All surgeries were done by single senior surgeon trained in arthroscopy. With the patient in the lateral decubitus position, the surgical arm was placed in a Chinese finger trap sleeve and attached to the traction device. According to Gross and Fitzgibbons [19], it was in 45 degrees of abduction and 15 degrees

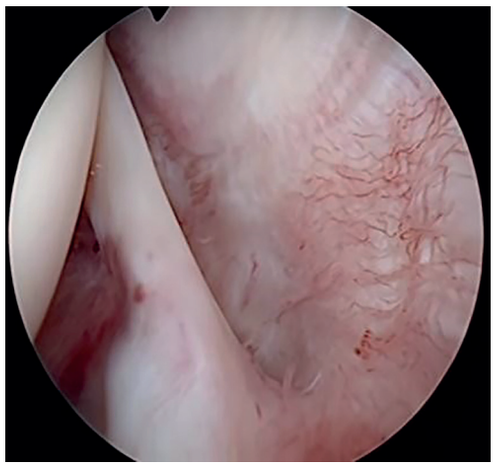

Figure 2 - 30 degree arthroscopic view showing rotator interval.

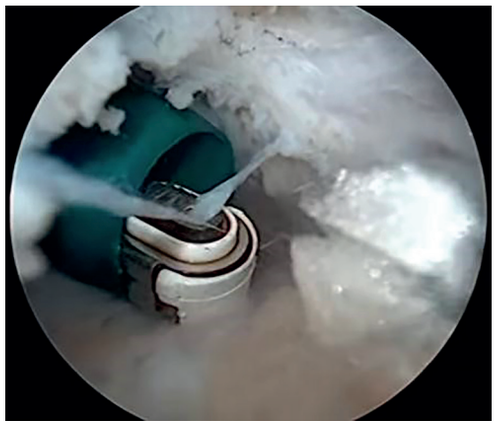

Figure 3 - Arthroscopic view showing subacromial space during process of debridement.

of forward flexion. Using a pulley, around five to six kg of weight were used to distract the arm. During diagnostic arthroscopy, the fluid pressure within the glenohumeral joint was kept close to 30 mm Hg, but it was occasionally elevated to between 40 and 70 mm Hg in the sub-acromial area to facilitate appropriate vision of structures and facilitate intervention. For diagnostic arthroscopy and ASAD, a three-portal method (posterior, anterosuperior, and lateral) was utilised. The posterior portal was created initially, 2 centimetres inferior and 1 centimetres medial to the posterolateral corner of the acromion soft spot, in order to facilitate the placement of the remaining portals and provide adequate visual acuity. The anterosuperior portal was created under the guidance of arthroscopic illumination via the posterior portal, which was positioned approximately 1 cm inferior and medial to the anterolateral corner of the acromion and lateral to the coracoid process (Figure 2) for improved visualisation of the anteroinferior and posterior portions of the glenohumeral joint. For end-on instrumentation and visibility of the subacromial area, a lateral portal 2 to 3 cm distal and parallel to the acromion's anterior margin was required [20]. A motorised shaver or radiofrequency ablation device was introduced by the lateral portal at the sub-acromial space to perform resection and decompression of hypertrophied synovial tissue of the sub-acromial bursa, and any loose body was removed (Figure 3). Via the posterior portal, the bur was used to remove 5 to 8 mm of the inferior surface of the acromion, including osteophytes extending from the ceiling of the sub-acromial area from the anterolateral corner to medially up to the lateral end of the clavicle [21]. For acromioplasty decision-making, preoperative X-ray shoulder outlet view [to rule out Bigliani [22] type 2-curved and type 3-hooked acromion] and intraoperative arthroscopic image of the acromion's undersurface were necessary. Using the cutting block technique, acromion resection was performed. In 1991, Sampson et al. [23] introduced a method, the "cutting block" approach (Figure 4), to shorten the procedure's steep learning curve and reduce the risk of insufficient decompression. Once the patient is positioned, it is necessary to sketch bone landmarks such as the clavicle, AC joint, acromion, and scapular spine as a requirement for this procedure. According to this technique, the scope was positioned laterally to view the acromial arch, and shaving and burring instruments were introduced through a posterior portal on the undersurface of the posterior half of the acromion; using this as a cutting block, the bur was advanced anteriorly and swept from medial to lateral. Both the lateral and posterior portals were used to examine the anterior hook and undersurface of the acromion. With an arthroscopic rasp, the surface was smoothened.

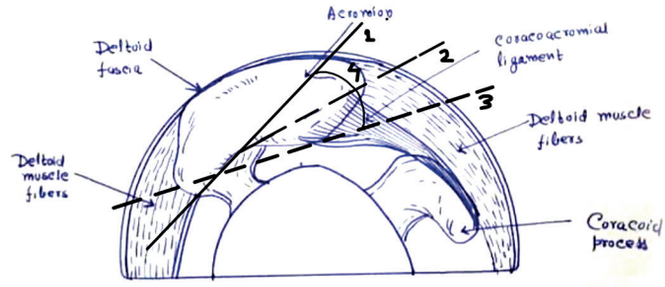

Figure 4 - End on view of subacromial space showing cutting block technique. Line 1 showing original cutting block line which is inappropriate for this curved acromion. Line 2 showing modified anterior hook resection per Ellman technique [12], preserving deltoid fascia and not producing a type 1 flat acromion. Line 3 showing the two extreme point of acromion. Curved line showing approximate amount of resection.

The day after surgery, patients were sent home with their arms immobilised in arm pouches. patients were evaluated at four, twelve, and sixteen weeks after arthroscopic sub-acromial decompression. Throughout the postoperative phase, physical therapy was performed in accordance with South Shore Hospital's [24] shoulder exercise guidelines.

Statistical evaluation

A qualified statistician calculated the sample size with following variables. Effect size expressed as a standardized mean difference (Cohen's d) with a value of 0.5. This means that the mean improvement in the UCLA score in the treatment group is expected to be 0.5 standard deviations higher than the control group. Significance level (α): It was set at 0.05, representing a 5% chance of incorrectly rejecting the null hypothesis. Power (1 - β): It was assumed to be a power of 0.80, indicating an 80% chance of detecting a significant difference if it truly exists. Dropout rate: Assume a dropout rate of 10%, meaning that 10% of participants may drop out or be lost to follow-up during the study. Plugging these values into the formula: $n = [(Z\alpha/2 + Z\beta) * \sigma / \Delta]^2$ a sample size of 35 was regarded adequate in comparison to previously published research [14]. Categorical variables were reported as numbers and percentages, whereas continuous variables were provided as means standard deviations (SD) and medians. The Kolmogorov-Smirnov test was used to examine the data's normality. The non-parametric test was employed when the assumption of normality was rejected. Quantitative variables were compared across follow-up using paired t-tests/ Wilcoxon tests (where data sets were not normally distributed). A p-value of less than 0.05 was deemed statistically significant. The data were entered into an MS EXCEL spreadsheet, and SPSS version 21.0 was used to conduct analysis.

Results

During the study period, 35 individuals were operated on. Thirty patients were male (85.71%) and five were female (14.29%). The range of ages was between 23 and 50 years, with a mean age of 36.1 years. In this study, the UCLA shoulder scale was used to evaluate shoulder function. We compared both the total Scores and the scores of each component. Table 1-5 displays the specific component-by-component variations in the UCLA scores during the evaluation period. After surgery, all components improved dramatically.

The pre-operative mean total UCLA score was 12.66±3.01. In the fourth week following surgery. At the 12th postoperative week mean UCLA was 24.80±3.96 and at the 16th week it was 29.14±3.05. The improvement in mean total UCLA scores at fourth, twelfth, and sixteenth weeks after surgery were statistically significant (p=0.0001) when compared to the pre-operative status.

According to this scale, a score greater than or equal to 27 indicates a satisfying outcome, whereas a score less than or equal to 27 indicates a fair or bad performance (unsatisfactory result).

Table 1 Comparison of pain component of UCLA score between pre-operative and follow up.

Pain	Pre-operative (n=35)	4th week (n=35)	12th week (n=35)	16th week (n=35)	P value	Test performed
Mean ± Stdev	2.86 ± 1.09	3.83 ± 1.22	5.66 ± 1.14	7.83 ± 1.12	Pre-operative vs 4th week:0.0001 Pre-operative vs 12th week:<.0001 Pre-operative vs 16th week:<.0001	Wilcoxon Signed Ranks Test
Median(IQR)	2 (2-4)	4 (4-4)	6 (5-6)	8 (8-8)		
Range	1-4	2-6	4-8	6-10		

Table 2 Comparison of function component of UCLA score between pre-operative and follow up.

Function	Pre-operative (n=35)	4th week (n=35)	12th week (n=35)	16th week (n=35)	P value	Test performed
Mean ± Stdev	3.03 ± 1.1	5.03 ± 1.01	6.74 ± 1.2	8.06 ± 1.24	Pre-operative vs 4th week:<.0001 Pre-operative vs 12th week:<.0001 Pre-operative vs 16th week:<.0001	Wilcoxon Signed Ranks Test
Median(IQR)	4 (2-4)	6 (4-6)	6 (6-8)	8 (8-8)		
Range	1-4	4-6	4-8	6-10		

Table 3 Comparison of active forward flexion component of UCLA score between pre-operative and follow up.

Active forward flexion	Pre-operative (n=35)	4th week (n=35)	12th week (n=35)	16th week (n=35)	P value	Test performed
Mean ± Stdev	2.89 ± 1.08	3.51 ± 0.78	4.2 ± 0.58	4.54 ± 0.61	Pre-operative vs 4th week:0.0001 Pre-operative vs 12th week:<.0001 Pre-operative vs 16th week:<.0001	Wilcoxon Signed Ranks Test
Median(IQR)	3 (2-4)	4 (3-4)	4 (4-5)	5 (4-5)		
Range	0-4	2-5	3-5	3-5		

Table 4 Comparison of strength of forward flexion between pre-operative and follow up.

Strength of forward flexion	Pre-operative (n=35)	4th week (n=35)	12th week (n=35)	16th week (n=35)	P value	Test performed
Mean ± Stdev	3.89 ± 0.58	3.89 ± 0.58	3.97 ± 0.62	4.14 ± 0.55	Pre-operative vs 4th week:1.00 Pre-operative vs 12th week:0.257 Pre-operative vs 16th week:0.007	Wilcoxon Signed Ranks Test
Median(IQR)	4 (4-4)	4 (4-4)	4 (4-4)	4 (4-4)		
Range	3-5	3-5	3-5	3-5		

Table 5 Comparison of satisfaction component of UCLA score of the patient between pre-operative and follow up.

Satisfaction of the patient	Pre-operative (n=35)	4th week (n=35)	12th week (n=35)	16th week (n=35)	P value	Test performed
Mean ± Stdev	0 ± 0	2.71 ± 2.53	4.29 ± 1.78	4.57 ± 1.42	Pre-operative vs 4th week:<.0001 Pre-operative vs 12th week:<.0001 Pre-operative vs 16th week:<.0001	Wilcoxon Signed Ranks Test
Median(IQR)	0 (0-0)	5 (0-5)	5 (5-5)	5 (5-5)		
Range	0-0	0-5	0-5	0-5		

The maximum score is 35 points. The UCLA score total outcome has been rated as poor (0-20), acceptable (21-27), good (28-33), and exceptional (34-35), with the outcome steadily improving. In the pre-operative phase, all evaluated patients (35, 100%) were graded as bad. After the fourth week of postoperative follow-up, the majority of patients (23, 65.71%) were still rated as poor. In addition, in the 12th week of postoperative follow-up, the majority of patients were graded as fair (23, 65.71%), and in the 16th week, the majority of patients were graded as good (27, 77.14%). The difference in total UCLA score between the preoperative stage and the fourth week of postoperative follow-up was extremely significant ($p<0.0001$), as was the difference between the preoperative UCLA score and that at the 12th and 16th weeks after surgery ($p<0.0001$). From the pre-operative period through the 16th week of postoperative follow-up, the total UCLA score showed a significant and ongoing trend of improvement.

The average duration of surgery was 49 minutes (range: 38-69 minutes), and no notable complications were seen during the course of the trial.

Discussion

The study demonstrates that arthroscopic sub-acromial decompression is an effective and reliable procedure for improving short-term functional outcomes in carefully selected patients with primary sub-acromial impingement (chronic type 2 primary impingement) who have failed to respond to conservative treatment. Aside from the tight patient selection criteria and prospective nature, another strength of the present study is that it describes changes in each of the five components of the UCLA shoulder score, which has seldom been done previously.

The results of subacromial decompression are inconsistent in the medical literature, likely due to improper diagnosis, failure to treat the associated rotator cuff pathology adequately, performing surgery in Neer's type 3 impingement, and technical errors such as under resection of the acromion [13-18]. Checroun et al. examined 34 studies (1,935 patients) between 1970-1996. Arthroscopic Sub-Acromial Decompression (ASAD) was indicated as the initial treatment of choice, with open surgery reserved for arthroscopic failure [13]. Although technically more rigorous, ASAD allowed for faster recovery. In recent literature, however, ASAD's efficacy has been called into question. Health Economists in Denmark have documented a poor and delayed rate of return to work for SAIS patients treated with ASAD [14]. They say that because to the low incidence of return to employment, there are no financial benefits for the government. Surgeons assert that patients who undergo ASAD obtain excellent pain alleviation and a high level of activities of daily living (ADLs). Owing to the aforementioned disparities, the current study was designed to include only individuals with type 2 main impingement. About fifty percent of acromioplasty failures have been ascribed by several researchers to a wrong or missed diagnosis. Unrecognized shoulder instability with secondary rotator cuff symptoms, glenohumeral arthritis, periarthritis of the shoulder, suprascapular neuropathy, and glenohumeral internal rotation deficiency are the most common causes of failure. Under these conditions, arthroscopic subacromial decompression and debridement exacerbate an already weakened shoulder, leading in many cases to recurrent dislocation and a positive postoperative apprehension test [25-29]. Arthroscopic subacromial decompression is the preferred treatment for patients with chronic type 2 primary impingement syndromes who have not responded to conservative treatment [30]. Dom et al. published a five-year follow-up analysis of 52 patients with advanced (stage 2) rotator cuff illness who underwent arthroscopic sub-acromial decompression. From six months to five years postoperatively, a total of 45 (out of 52) patients demonstrated progressive improvement and symptom alleviation [25]. Ellman et al. performed subacromial decompression on 65 patients who were assessed two to five years after surgery. According to the UCLA shoulder assessment scale, 89% of the cases in the research had an acceptable outcome [12]. Esch et al. assessed the outcomes of arthroscopic subacromial decompression based on the degree of rotator cuff tear in 71 patients with at least one year of follow-up (average 19 months). 82% of patients with stage 2 illness were pleased, regardless of whether they had a rotator cuff tear (9 of 11) or not (28 of 34). Eighty-eight percent (23 of 26) of patients with stage 3 illnesses (rotator cuff tears) were happy. 82% (9 of 11) of the patients without a rotator cuff tear, 76% (26 of 34) of those with a partial tear, and 77% (20 of 26) of those with a total tear had an acceptable objective UCLA shoulder rating > 28. Four patients with full tears less than one centimetre in length achieved excellent outcomes. The objective success rate of 77% and the total patient satisfaction rate of 85% are comparable to those of open rotator cuff repair [30]. Ravikiran et al. found that a total of 20 patients diagnosed with primary shoulder impingement due to secondary mechanical reasons and undergoing decompression surgery had a mean UCLA shoulder rating scale score greater than or equal to 27, indicating a good/excellent (satisfied) outcome [31]. Consistent with the aforementioned findings, the current investigation demonstrates similar outcomes. The study also indicates that arthroscopic sub acromion decompression is effective for a carefully selected group of patients with Neer's type 2 primary impingement with rotator cuff scarring/tendinitis and no signs of rotator cuff tear.

The present study has several limitations. The study participants were mostly males, and the sample size is small. Second, the period of follow-up is brief, and long-term outcomes are being tracked. In addition, no control group was included in the study. Despite these limitations, the study has major clinical implications for patients with mechanical sub-acromion impingement, demonstrating that surgical decompression is associated with a considerable improvement.

Conclusion

This study suggests that arthroscopic sub-acromial decompression produces a favourable functional outcome in patients with primary shoulder impingement due to extrinsic mechanical factors, such as the shape and slope of the acromion, in the absence of rotator cuff tear, after 16 weeks of follow-up.

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