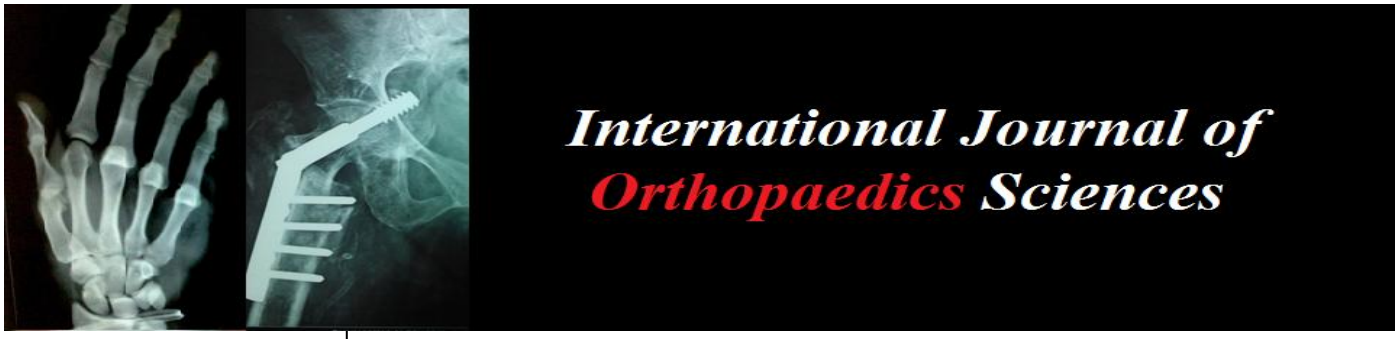

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Functional outcome of arthroscopic subacromial decompression in primary shoulder impingement syndrome due to extrinsic mechanical causes

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Abstract
Background: The purpose of this study was to determine the role of arthroscopic subacromial decompression in primary shoulder impingement due to secondary mechanical causes in terms of functional outcome.
Materials and Methods: Patients undergoing arthroscopic subacromial decompression at JSS Medical College, Mysore between September 2014 and May 2016 were studied prospectively. A total of 20 patients diagnosed with primary shoulder impingement meeting the required criteria were included in the study. The patients were put on a 6 week course of physiotherapy as initial trial with non-operative treatment. None of the patients responded to this treatment and persisted to have symptoms. These patients were treated surgically with arthroscopic subacromial decompression. The University of California Los Angeles (UCLA) shoulder rating scale was used to assess shoulder function. Assessment was done at pre-operative, 4 weeks, 8 weeks, 12 weeks, 6 months, 9 months and 12 months post arthroscopic subacromial decompression.
Results: Patients had statistically significant improvement in shoulder function after arthroscopic sub acromial decompression (p<0.001) compared to preoperative shoulder function at the end of non-operative treatment.
Conclusion: Arthroscopic subacromial decompression has a definitive role in primary shoulder impingement due to secondary mechanical causes as it produces well to excellent results while being minimally invasive.

Keywords: Acromion, Acromioplasty, Shoulder Impingement syndrome, Shoulder arthroscopy, Subacromial decompression

1. Introduction
Chronic shoulder impingement is a recognised cause of chronic shoulder. The principal underlying pathology is friction or impingement between the supraspinatus tendon and acromion process. The treatment of the condition is with initial trial of physiotherapy and analgesics (NSAIDS-Non Steroidal Anti-inflamatory Drugs) which may correct underlying dyskinesia and altered biomechanics at the shoulder which may be the underlying cause of impingement. Patients who don't obtain relief of symptoms with conservative non operative treatment must be considered for operative treatment.
Historically, the surgeries have all aimed at relieving impingement of the supraspinatus tendon against the acromion process, by excising a part of or the entire acromion process and gradually progressing to lateral acromionectomy. These surgeries had significant surgical morbidity as deltoid was detached during these surgeries. It was Neer in 1972, who first introduced the term "shoulder impingement syndrome" and attributed the anterior third of acromion to be responsible for impingement with supraspinatus tendon rather than acromion as a whole. He described open anterior acromioplasty in which only the anterior third of acromion is resected [1].
Arthroscopy which was being used as a minimally invasive surgical tool made its way in treatment of shoulder impingement in 1987, with Ellmann being the first to use it for this purpose.

This study was conducted to determine the role of arthroscopic subacromial decompression in primary shoulder impingement due to secondary mechanical causes in terms of functional outcome.

2. Materials and Methods

Patients undergoing arthroscopic subacromial decompression at JSS Medical College, Mysore between September 2014 and June 2016 were studied prospectively.

Patients aged between 20 to 65 years with confirmed diagnosis of stage I and stage II based on history, clinical examination and diagnostic imaging who are scheduled to undergo arthroscopic subacromial decompression for primary impingement syndrome due to extrinsic mechanical causes alone such as shape and slope of acromion, acromioclavicular joint arthritisand patients with positive impingement signs and tests were included in the study.

Patient beyond 65 years of age, with secondary impingement and intrinsic causes, patients not willing to co-operate for the post op rehabilitation and patients with associated pathology of rotator cuff tear were excluded from the study.

All patients gave written consent for inclusion in the study. The treatment process was explained to the patients and they were aware of his/her rights during the study. The written consent form was signed or fingerprinted by the patient. The institutional review board of JSS University approved the protocol of this study. The process of treatment did no harm to their health.

A total of 20 patients diagnosed with primary shoulder impingement meeting the required criteria were included in the study. The patients were put on a 6 week course of physiotherapy, an initial trial with non-operative treatment along with NSAIDS. None of the above 20 patients responded to this treatment and persisted to have symptoms. These patients were treated surgically with arthroscopic subacromial decompression. The UCLA shoulder rating scale was used to assess shoulder function. Assessment was done at pre-operative, 4 weeks, 12 weeks, 24 weeks, 9 months and 12 months post arthroscopic subacromial decompression. Pre-operative VAS, modified UCLA score were recorded.

The procedure was performed with the patient under general or regional anesthesia or a combination of both. The procedure was performed with the patient in the lateral decubitus position. With the lateral decubitus position, the arm was placed in a foam traction sleeve and connected to the traction device. It was positioned in 45 degrees of abduction and 15 degrees of forward flexion. This arm position was adequate for visualization of both the glenohumeral joint and the subacromial space, obviating the need for repositioning during the procedure. Ten pounds was placed for arm distraction, and 10 pounds was placed for abduction traction. Fluid pressure within the glenohumeral joint is kept close to 30 mm Hg; it increases to between 40 and 70 mm Hg in the subacromial space, allowing adequate visualization of the anatomy [2].

Three basic arthroscopic portals are used for this procedure. The posterior portal is located approximately 2 cm inferior and 1 cm medial to the posterolateral corner of the acromion. This portal allows adequate visualization of most of the glenohumeral joint and facilitates the placement of other portals. The anterosuperior portal is used mainly for instrumentation. It is also used for better visualization of the posterior and anteroinferior portions of the joint when this is necessary. It is located approximately 1 cm inferior and medial to the anterolateral corner of the acromion, lateral to the coracoid process. A lateral portal located 2 to 3 cm distal and parallel to the anterior margin of the acromion is used initially for instrumentation and then for visualization, as it provides an "outlet" view of the subacromial space [2].

The procedure begins with a thorough, systematic arthroscopic evaluation of the glenohumeral joint through a posterior portal. The articular surface of the rotator cuff is carefully inspected. Once the glenohumeral examination is completed and any associated intra-articular pathology has been addressed, attention is directed toward the subacromial space [2].

The subacromial space is distended, and the lateral portal is created. A self-sealing arthroscopic cannula is used through this portal, and a motorized shaver or radiofrequency soft tissue ablation device is introduced to perform a partial bursectomy and to remove periosteum from the under surface of the acromion. The medial and lateral extents of the acromion are identified, along with the coracoacromial ligament. Using either an electrocautery or a radiofrequency device, the ligament is released from the undersurface of the acromion until the subdeltoid fascia is seen, avoiding injury to the overlying muscle. If the acromial branch of the thoracoacromial artery, which is located along the superomedial aspect of the coracoacromial ligament, is encountered, it should be cauterized to avoid excessive bleeding [2].

The subacromial decompression is then performed using an arthroscopy bur. The anteroinferior acromion is approached first. While viewing from the posterior portal, the bur is used to remove 5 to 8 mm of the inferior surface of the acromion, beginning at the anterolateral corner and proceeding medially. Additionally, the acromial osteophyte projecting anterior to the leading edge of the clavicle is removed [2].

The arthroscope and bur are then interchanged to perform the posterior acromion resection. This is done using a cutting-block technique. While viewing from the lateral portal, the thickness and shape of the acromial arch are assessed. The spine of the scapula is used as a cutting block, and the bur is used to plane the undersurface of the acromion. Beginning at the low point of the acromion, the bur is swept from medial to lateral, proceeding to the anterior resection. This technique allows for the reproducible creation of a smooth, flat resection line. The resection should be assessed from both the lateral and posterior portals. Final smoothing can be performed with an arthroscopy rasp if desired [2].

The acromioclavicular joint is left undisturbed unless there is pathology that warrants correction. This includes symptomatic acromioclavicular joint arthritis and inferior-projecting osteophytes contributing to impingement. The acromioclavicular joint is exposed by resecting the inferior capsule. The bur is then used to resect osteophytes emanating from the distal clavicle and medial acromion [2].

The distal 7 to 10 mm of distal clavicle can be resected if clinically indicated i.e. – coplaning of clavicle can be done. This is best accomplished with the arthroscope placed laterally and the bur anteriorly through an ancillary portal created in line with the acromioclavicular joint [2].

The patient is sent home with the arm immobilized in a sling. The patient is allowed to remove the sling on the second postoperative day as long as there is no discomfort. The postoperative instruction packet includes instructions for the patient to perform pendulum exercises, elbow active range of motion (AROM), and hand squeezes four to six times per day. Most patients will be seen by a physical therapist for two to three visits after this type of surgery [3].

The patient returned at 7 to 10 days postoperatively for suture removal and further instructions. At this time, the patient was advised phase 1 Range of movement (ROM) exercises including supine passive forward elevation and external rotation. A majority of patients were discharged from therapy with this home exercise program to be performed four to six times per day. The next postoperative visit occurs 4 to 6 weeks after surgery. At this point, the patient was instructed in phase II ROM exercises (extension, internal rotation, cross-body adduction), phase I rotator cuff strengthening (external rotation, internal rotation, extension), and scapular retraction with resistance. At the 8- to 12-week postoperative visit the patient was progressed to phase II strengthening exercises and, possibly, phase II scapular strengthening exercises [3].

Beyond 12 to 16 weeks postoperatively, the patient who must return to work were gradually progressed to work-simulated activities. Patients were instructed in proper lifting techniques, tool use, and modification of activities. The overhead athlete were progressed to activities simulating his or her sport demands. Rotator cuff strengthening at 90 degrees abduction, polyometric exercise with weighted balls were included[3]. Postoperative VAS, objective (modified UCLA scores) were recorded periodically at 4 weeks interval for first 3 months followed by once in 3 months. Data from imaging studies and findings were documented as per proforma. All the patients underwent arthroscopy and findings were recorded.

Data were collected and entered in MS excel – 2010 and analysed using SPSS – version 22. Descriptive statistical analysis like mean, sd, percentages and other relevant inferential statistical tests were applied. Data were presented as tables and graphs as relevant.

3. Results

A total of 20 patients diagnosed to have primary shoulder impingement due to secondary mechanical causes who met the required criteria were included in the study. All subjects were available for follow up at the stipulated time periods. The following observations were made during pre-operative phase of conservative Management with physiotherapy and postoperatively at 4 weeks, 8 weeks, 12 weeks, 6 months, 9 months and 12 months using the UCLA shoulder scale to assess shoulder function.

Among the 20 patients, the mean age was 38 years with minimum age being 20 years and maximum age 65 years. 12 of the patients were males and 8 were females. Even though more number of males were diagnosed with chronic shoulder impingement, this was not statistically significant compared to females. There is no predilection for gender.

The patients had symptoms for a mean of 4.95 months, varying between 1 month and 6 months before seeking medical advice. These patients were treated initially with a trial of Physiotherapy for 6 weeks. None of the patients had relief of symptoms and subsequently all the patients were considered as failed non operative therapy patients due to persistence of shoulder impingement. These patients also had UCLA shoulder rating scale which indicated poor/ unsatisfactory outcome at the end of non-operative treatment. These patients were treated with Arthroscopic subacromial decompression.

The UCLA Shoulder rating scale was used to determine shoulder function. Scoring was done pre-operatively who had undergone physiotheraypy for 6 weeks. Following surgery the scoring was done at four weeks, eight weeks, twelve weeks, 6 months, 9 months and 12 months.

According to UCLA shoulder rating scale a Score > 27 is good/excellent (satisfactory result) and Score < 27 is Fair/poor (unsatisfactory result). The maximum score is 35 points. At end of non-operative treatment with physiotherapy for 6 weeks the mean score was 8.250 which indicated that the patients were not functionally satisfied and had fair/poor (unsatisfactory) outcome.

By 12 months after arthroscopic subacromial decompression patients had mean UCLA shoulder rating scale of > 27 which indicates good/excellent (satisfactory outcome) and a mean score of 29.0.

From 4 weeks post arthroscopic subacromial decompression with mean score 11.150 onwards up to final follow-up the p value is seen to be <0.001 with mean score 29.00 at 12 months, indicating significant difference in the UCLA shoulder rating scale compared to non-operative phase scores suggesting that arthroscopic subacromial decompression led to a good/satisfactory outcome in the study subjects.

4. Discussion

Subacromial impingement syndrome is the most common disorder of the shoulder in middle aged people, resulting in functional loss and disability [4].

Properly executed subacromial decompression is a rewarding surgery in properly indicated patients with main advantages of relief of pain and functional disability [5, 11]. Secondarily, it facilitates repair of rotator cuff and protects and enhances healing of repaired rotator cuff in selected patients.

Structures to be decompressed and extent of subacromial decompression varies according to different authors. Many authors have repeated that treatment of Subacromial impingement is not free of criticism. The reasons being:

- The identification of acromion type shows poor intra- and inter-observer reliability [6].
- A computerized three-dimensional study failed to support impingement by any portion of the acromion on the rotator cuff tendons in different shoulder positions [7].
- Most partial-thickness cuff tears do not occur on bursal surface, where mechanical abrasion from the acromion does occur [8].
- It has been suggested that bursal surface cuff tears could be responsible for subacromial spurs and not the opposite [9].
- There is growing evidence that routine acromioplasty may not be required for successful rotator cuff repair [10].

The results of subacromial decompression are mixed due to improper selection of cases like treating stage III impingement syndrome with isolated subacromial decompression. Several investigators have attributed nearly 50% of acromioplasty failures to an incorrect or missed diagnosis. The most common possibilities include unrecognized shoulder instability with secondary rotator cuff symptoms, glenohumeral arthritis, periarthritis shoulder, suprascapular neuropathy, glenohumeral internal rotation deficit. Arthroscopic subacromial decompression under these circumstances serves only to destabilize an already compromised shoulder, and in many cases, leads to worsening of symptoms.

Patients with stage II primary impingement syndrome who have failed to conservative treatment, the treatment of choice is arthroscopic subacromial decompression [12].

Due to improper diagnosis, failure to treat the associated rotator cuff pathology adequately and technical errors like under resection of acromion, arthroscopic subacromial decompression has led to poor results. Hence we have conducted a prospective study to analyse the functional

outcome of arthroscopic subacromial decompression in primary impingement syndrome due to extrinsic mechanical causes alone such as shape and slope of acromion, acromioclavicular joint arthritis.

The study was conducted prospectively at JSS Medical College, Mysore in patients undergoing arthroscopic subacromial decompression during September 2014 to May 2016.

Patients attending the outpatient department with shoulder pain were evaluated clinically for the various possible shoulder pathologies the patient may be presenting with. Patients with clinical findings of shoulder impingement were thus identified and evaluated further. The patients who had persistence of shoulder impingement symptoms beyond a period of 6 weeks were diagnosed to have chronic shoulder impingement and included in the study on meeting the inclusion criteria.

Dom K. *et al.* report a prospective five-year follow-up study of 52 patients who had arthroscopic subacromial decompression for advanced (stage II : type 1 and 2) rotator cuff disease. From six months until five years postoperatively, 45 (out of 52) patients showed a further progressing improvement and relief of symptoms [5]. However, in our study at 12 months post operatively, most of the cases achieved good to excellent results.

Ellman H. *et a1*.performed arthroscopic subacromial decompression on 65 patients who were evaluated for two to five years after surgery.On the UCLA shoulder rating scale, 89% of the cases in the study achieved a satisfactory result[12].However, in our study at 12 months post operatively, most of the cases achieved good to excellent results

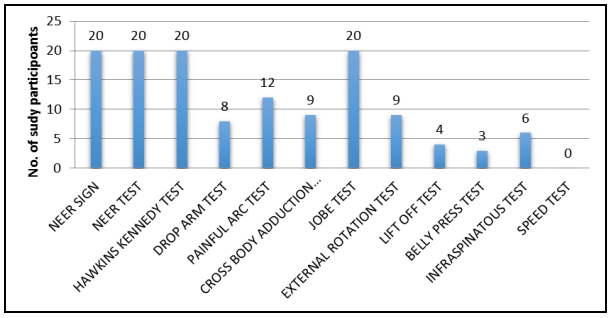
James C. Esch*et al.* evaluated the results of arthroscopic subacromial decompression according to the degree of rotator cuff tear in 71 patients, available for follow-up for at least 1 year (average 19 months). Of the patients with stage II disease, 82% were satisfied regardless of whether they had no rotator cuff tear (nine of 11) or had a partial tear (28 of 34) of the rotator cuff. Of patients with stage III disease (complete rotator cuff tear), 88% (23 of 26) were satisfied. An acceptable objective UCLA shoulder rating ~>28 points was seen in 82% (nine of 11) of the patients without a rotator cuff tear, 76% (26 of 34) with a partial tear, and 77% (20 of 26) with a complete tear. All four of the patients with complete tears < 1 cm obtained excellent results. The overall patient satisfaction rate of 85% and the objective success rate of 77% are within the range of that seen with open rotator cuff repair[13]. In our study, we have ruled out rotator cuff tear and isolated the cases of primary shoulder impingement due to extrinsic mechanical causes and most of the cases showed good to excellent results at 12 months postoperatively following arthroscopic subacromial decomopression.

Petre D. *et al.* reported a prospective study on 40 patients to investigate shoulder functions after arthroscopic subacromial decompression for advanced impingement syndrome (stage II) using a posterolateral and posteromedial portal. There were no intra-operative or post-operative complications related to the use of these portals. Patient satisfaction, reflected by the affirmation that they would have the same operation again, was 85%[14]. Similarly, in our study posterolateral, posteromedial and lateral portal was used and there were no intra- operative or post-operative complications related to the use of these portals.

However, our study concludes that arthroscopic subacromial decompression provides good functional outcome in patients having primary shoulder impingement due to extrinsic mechanical causes such as shape and slope of acromion, acromioclavicular joint arthritis with minimal invasion as from 4 weeks post arthroscopic subacromial decompression onwards up to final follow-up the p value is seen to be <0.001, indicating significant difference in the UCLA shoulder rating scale compared to non-operative phase scores suggesting that arthroscopic subacromial decompression led to a good/excellent outcome in the study subjects.

Table 1: Positivity of Various Clinical Test of Shoulder Joint among Study Subjects

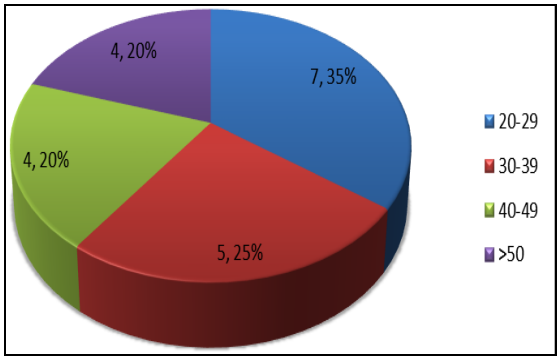
Clinical Tests	N	%
Neer Sign	20	100.0
Neer Test	20	100.0
Hawkins Kennedy Test	20	100.0
Drop Arm Test	8	40.0
Painful Arc Test	12	60.0
Cross Body Adduction Test	9	45.0
Jobe Test	20	100.0
External Rotation Test	9	45.0
Lift Off Test	4	20.0
Belly Press Test	3	15.0
Infraspinatous Test	6	30.0
Speed Test	0	.0



Graph 1: Positivity of Various Clinical Test of Shoulder Joint among Study Subjects

Table 2: Age Distribution of Study Subjects

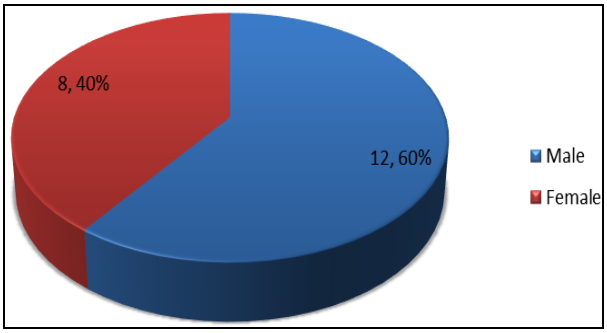
Age Yrs.	N	%
20-29	7	35.0
30-39	5	25.0
40-49	4	20.0
>50	4	20.0



Graph 2: Age Distribution of Study Subjects

Table 3: Gender Distribution of Study Subjects

Gender	N	%
`1y Male	12	60.0%
Female	8	40.0%



Graph 3: Gender Distribution of Study Subjects

Table 4: Duration of Symptoms

	Mean	Median	SD	Minimum	Maximum
Duration of Symptoms Months	4.95	5.00	.83	4.00	6.00

Table 5: Duration of Symptom Analysis Based On Sex of the Patients

Sex	No. Of Patients	Mean	Std. Deviation	Median
Males	12	4.92	.79	5.00
Females	8	5.00	.93	5.00
Total	20	4.95	.83	5

P=0.371, independent t test

Table 6: Ucla Shoulder Rating Scale Post Arthroscopic Subacromial Decompression

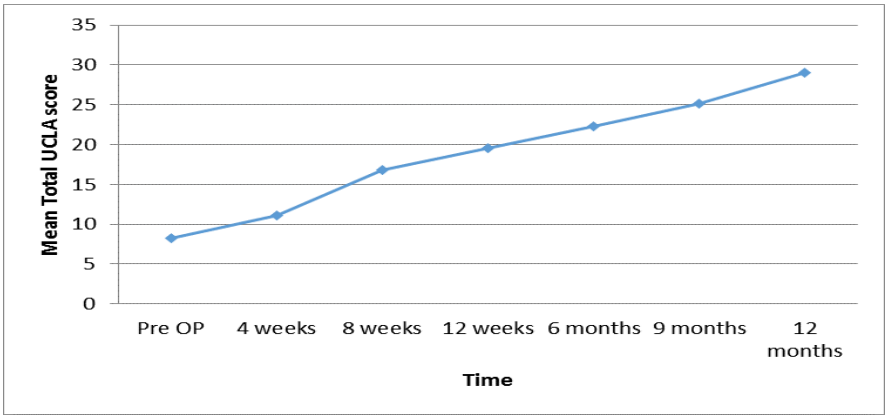
Total Ucla Score	Mean	95% Confidence Interval	
		Lower Bound	Upper Bound
PRE OP	8.250	6.637	9.863
4 WEEKS	11.150	9.506	12.794
8 WEEKS	16.800	15.658	17.942
12 WEEKS	19.550	18.146	20.954
6 MONTHS	22.250	21.233	23.267
9 MONTHS	25.150	23.923	26.377
12 MONTHS	29.000	27.650	30.350

P=0.0001, Repeated measure ANOVA

Table 7: Mean Change in Ucla Total Score from Pre Op Levels

Time (I)	Time (J)	Mean Difference From Pre Op	P
At Diagnosis	Pre-Operative		
	4 WEEKS POST SURGERY	-2.900*	<0.0001
	8 WEEKS POST SURGERY	-8.550*	<0.0001
	12 WEEKS POST SURGERY	-11.300*	<0.0001
	6 MONTHS POST SURGERY	-14.000*	<0.0001
	9 MONTHS POST SURGERY	-16.900*	<0.0001
	12 MONTHS POST SURGERY	-20.750*	<0.0001

Repeated measure ANOVA with post hoc test (bonferroni test)



Graph 4

Table 8: Pain Component of Ucla Score at Different Time Interval after Intervention

Pain	Mean	Median	SD	Minimum	Maximum
PRE OP	2.45	2.00	1.10	1.00	4.00
POSTOP 4WK	3.20	4.00	1.15	1.00	4.00
POSTOP 8WK	3.85	4.00	1.14	1.00	6.00
POSTOP 12WK	4.80	5.00	1.36	2.00	6.00
POSTOP 6MTHS	5.60	6.00	1.39	2.00	8.00
POSTOP 9MTHS	6.50	6.00	1.28	4.00	8.00
POSTOP 12MTHS	7.70	8.00	.98	6.00	10.00

P=0.001

Table 9: Function Component of Ucla Score at Different Time Interval after Intervention

Function	Mean	Median	Sd	Minimum	Maximum
PRE OP	2.00	1.50	1.26	1.00	4.00
POSTOP 4WK	2.55	2.00	1.00	1.00	4.00
POSTOP 8WK	3.10	2.00	1.37	2.00	6.00
POSTOP12WK	4.20	4.00	1.44	2.00	8.00
POSTOP 6MTHS	5.00	4.00	1.21	4.00	8.00
POSTOP 9MTHS	6.30	6.00	1.34	4.00	8.00
POSTOP12MTHS	7.60	8.00	1.54	4.00	10.00

P=0.001

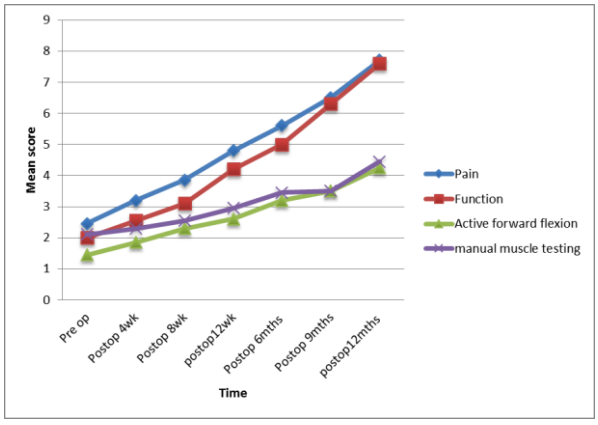
Table 10: Active Forward Flexion Component of Ucla Score at Different Time Interval after Intervention

Active Forward Flexion	Mean	Median	SD	Minimum	Maximum
PRE OP	1.45	1.00	.51	1.00	2.00
POSTOP 4WK	1.85	2.00	.49	1.00	3.00
POSTOP 8WK	2.30	2.00	.66	1.00	4.00
POSTOP12WK	2.60	3.00	.60	2.00	4.00
POSTOP 6MTHS	3.20	3.00	.62	2.00	5.00
POSTOP 9MTHS	3.50	3.50	.69	2.00	5.00
POSTOP12MTHS	4.25	4.00	.72	3.00	5.00

P=0.001

Table 11: Manual Muscle Testing Component of Ucla Score at Different Time Interval after Intervention

Strength of Forward Flexion (Manual Muscle Testing)	Mean	Median	Sd	Minimum	Maximum
PRE OP	2.10	2.00	.79	1.00	3.00
POSTOP 4WK	2.30	2.50	.80	1.00	3.00
POSTOP 8WK	2.55	3.00	.94	1.00	4.00
POSTOP 12WK	2.95	3.00	.83	1.00	4.00
POSTOP 6MTHS	3.45	4.00	.69	2.00	4.00
POSTOP 9MTHS	3.50	3.50	.69	2.00	5.00
POSTOP 12MTHS	4.45	5.00	.69	3.00	5.00



Graph 5

5. Conclusion

This study concludes that arthroscopic subacromial decompression provides good to excellent functional outcome in patients having primary shoulder impingement due to extrinsic mechanical causes such as shape and slope of acromion, acromioclavicular joint arthritis with minimal invasion in the absence of significant rotator cuff tear.

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