

Minimal invasive (Arthroscopic) versus mini open Acromioplasty as a treatment of shoulder impingement

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Abstract

Background: Chronic subacromial bursitis, impingement syndrome and rotator cuff tendinitis are synonymous terms describing a clinical condition affecting from 2% to 18% of the adult population with subacromial impingement syndrome in particular being the most common disorder, resulting in functional loss and disability, of the shoulder. The research set intended to compare the efficacy of open acromioplasty to that of arthroscopic acromioplasty in treating impingement in the shoulder. **Methods** Forty adult patients with a clinical and imaging diagnosis of shoulder impingement from the outpatient clinic of the orthopaedic department at Banha University Hospitals participated in this prospective randomised clinical study. The patients were randomly split into two groups: Group A: 20 patients who received arthroscopic acromioplasty surgery, Group B: 20 patient who underwent open acromioplasty surgery. **Results:** The mean age of our patients in Group A and Group B were (42.19 ± 4.4 ; 40.70 ± 3.8 correspondingly) with no significant difference. Group B had longer operative and recovery times and a longer mean hospital stay than group A ($p = 0.02, 0.028$). In the current research, the VAS scores of both groups A and B were significantly lower after surgery compared to before surgery ($P 0.001$). The difference between pre- and post-operative VAS scores was also substantially larger in group B than in group A ($p = 0.039$). Group A had a higher ASES score at two weeks, one month, and three months post-op than group B did ($p = 0.002, 0.001, \text{ and } = 0.029$). As far as problems go, this research found no discernible difference between the groups. In Group B, 20% of patients had post-op stiffness, and 15% experienced wound infection. **Conclusion:** the arthroscopic acromioplasty method was related with reduced pain, higher ASES score. A difference was identified between the 2 groups in main and secondary outcomes in the long term, no difference in the occurrence of complications. Besides, we feel that the arthroscopic acromioplasty surgery has greater recovery at short-term follow-ups.

Key words: Minimal invasive (Arthroscopic), Mini open Acromioplasty, Treatment, Shoulder impingement

1. Introduction

The efficacy of acromioplasty in relieving shoulder pain caused by impingement syndrome is well established. In 1983, a preliminary report documented the first arthroscopic subacromial decompression (ASD), and a short-term follow-up analysis of 50 patients indicated that ASD may be a viable alternative to open surgery. Arthroscopic surgery is a complex medical technique [1].

Hospital stays are short, patients may go back to their regular routines quickly, problems related to the deltoid muscle are rare, and the effects remain [2].

By injecting saline into the glenohumeral joint, an arthroscope may be inserted there for examination. The inflammatory subacromial bursa may be seen on the screen and excised during a bursectomy. To avoid impingement, the acromion's anterior inferior undersurface is trimmed using a high-speed burr. The goal is not to reduce the length of the acromion's underside but rather to smooth off any rough spots caused by bony spurs. The surgical burr may be used to remove any osteophytes and the distal 1cm of the clavicle if required. Scar tissue forms in the acromioclavicular joint (ACJ) over time, making the joint stronger and more stable [3].

This study set out to compare the effectiveness of two different approaches to treating shoulder impingement: open acromioplasty and arthroscopic acromioplasty.

2. Patients and Methods

This was a prospective case study was carried out on forty adult patients who were diagnosed clinically and radiologically as shoulder impingement after failure of all conservative modalities (medical treatment, physiotherapy, activity modification). They were selected from those attending the outpatient clinic of orthopedic department of Banha University Hospital.

They were subdivided to two groups:

- **Group (A)** 20 patient were chosen consequently and underwent arthroscopic acromioplasty surgery.
- **Group (B)** 20 patient were chosen randomly and underwent open acromioplasty surgery.

All patients were submitted for treatment in Banha University Hospital with mean period of follow up of three months.

Ethical consideration :

An informed consent was obtained from each individual before being enrolled in the

study and after full explanation of the procedure, risks and purpose of the study.

Inclusion criteria:

Patient at any age, both sexes with average body built. With shoulder impingement

Exclusion criteria :

Patients with traumatic impingement, Other associated shoulder pathology e.g rotator cuff tear and calcific tendonitis, arthritic changes of glenohumeral joint, infection, neurological deficits, adhesive capsulitis and prior surgery or infection on shoulder girdle were excluded

All patients were underwent full detailed history, physical examination, and radiological evaluation by plain X-ray and MRI and laboratory investigation and clinically by American shoulder and elbow surgeons scoring system (ASES).

Postoperative follow-up

All patients evaluated both clinically by scoring system and radiologically by x-ray AP view, axillary view and outlet view. The follow up was at 2 weeks, 1 month and 3 months postoperative. Passive upholding and movement of the influenced shoulder is provided by the other arm if needed. Pendulum exercises were began the next day. Range of motion exercises are utilized the first week at home. Physiotherapy may or may not be utilized depending on the patient's progress with the home program. Sports activities are individualized and variable.

Statistical Analysis

Analysis of data were performed using SPSS 18 (Statistical Package for Scientific Studies) for Windows.

3. Results

Table (1) Baseline characteristics of the studied groups

		Group A (n =20)	Group B (n =20)	P value
Age (years)	Mean ± SD	42.19 ± 4.4	40.70 ± 3.8	0.265
	Range	32 - 50	35 - 49	
Gender	Male	12 (60%)	9 (45%)	0.527
	Female	8 (40%)	11 (55%)	
Dominant Shoulder affection	Yes	11 (55%)	13 (65%)	0.748
	No	9 (45%)	7 (35%)	
Duration of symptoms (months)	Mean ± SD	35.5 ± 3.2	36.6 ± 2.5	0.173
	Range	29 - 45	33 - 42	

There was no significant difference in baseline characteristics (age, gender, dominant shoulder affection, and duration of symptoms) between the studied groups.

Table (2) Operation time and hospital stay the studied groups

Description of variables were presented as follows:

- Description of quantitative variables were in the form of mean, standard deviation (SD), minimum and maximum.
- Description of qualitative variables were in the form of numbers (No.) and percents (%).
- Data were explored for normality using Kolmogorov-Smirnov test of normality. The results of Kolmogorov-Smirnov test indicated that most of data were normally distributed (parametric data) so parametric tests were used for the comparisons.
- Comparison between quantitative variables were carried out by student T-test of two independent samples. Repeated measures Analysis of Variance (ANOVA) test was used instead of T- test when comparing between 4 groups of independent variables. Results were expressed in the form P-values.
- Comparison between qualitative variables were carried out by Chi-Square test (X²). Fisher exact test was used instead of Chi-square test when one expected cell or more were ≤ 5.
- The significance of the results was assessed in the form of P-value that was differentiated into:
 - Non-significant when P-value > 0.05.
 - Significant when P-value ≤ 0.05.
 - Highly significant when P-value ≤ 0.01.

		Group A (n =20)	Group B (n =20)	P value
Operation time (minutes)	Mean ± SD	73.4 ± 6.4	79.3 ± 7	0.02*
	Range	62 – 83	66 – 90	
Hospital stay (days)	Mean ± SD	1.05 ± 0.22	1.46 ± 0.5	0.028*
	Range	1 – 2	1 - 2	

*Statistically significant as $p \leq 0.05$.

Operation time and hospital stay were significantly higher in group B than group A ($p = 0.02$, 0.028 respectively).

Table (3) VAS score in the studied groups

		Group A (n =20)	Group B (n =20)	P value
VAS score preoperatively	Mean ± SD	7.4 ± 0.9	7.6 ± 0.4	0.142
	Range	5 – 8	7 – 8	
VAS score post operatively	Mean ± SD	4.1 ± 0.7	3.7 ± 0.4	0.372
	Range	2 – 5	3 – 4	
P value		<0.001*	<0.001*	
Change in VAS score Pre and post operatively	Mean ± SD	3.4 ± 0.6	3.9 ± 0.4	0.039*
	Range	3 - 4	3 - 5	

VAS: Visual analogue scale, *Statistically significant as $p \leq 0.05$

There was no significant difference in VAS score pre and post operatively between the studied groups.

There was a significant decrease in VAS score postoperatively than preoperatively in both group A and group B ($P < 0.001$).

The mean difference of VAS score pre and post operatively was significantly higher in group B than group A ($p = 0.039$).

Table (4) ASES score in the studied groups

		Group A (n =20)	Group B (n =20)	P value
Preoperative	Mean ± SD	39.3 ± 6.5	36 ± 6.4	0.121
	Range	25 – 50	20 – 45	
2 Weeks post operative	Mean ± SD	72.5 ± 8.4	64 ± 8.2	0.002*
	Range	55 – 80	45 -75	
1 month post operative	Mean ± SD	79.3 ± 8.2	71.3 ± 7.6	<0.001*
	Range	60 – 90	55 – 85	
3 months postoperative	Mean ± SD	82.5 ± 7.7	77.3 ± 7	0.029*
	Range	65 – 90	65 – 90	

ASES: American shoulder and elbow surgeons

There was no significant difference in ASES score preoperatively between the studied groups.

ASES score was significantly higher in 2 weeks, 1 month, and 3 months post operatively in group A than group B ($p = 0.002$, < 0.001 , and $= 0.029$).

Table (5) Complications in the studied groups

		Group A (n =20)	Group B (n =20)	P value
Complications	No complications	18 (90%)	13 (65%)	0.107
	Postoperative stiffness	2 (10%)	4 (20%)	
	Wound infection	0 (0%)	3 (15%)	

There was no significant difference in complications between the studied groups.

4. Discussion

There was no statistically significant difference in the ages of our patients in Group A (42.19 4.4) and Group B (40.70 3.8).

Researchers Ketola et al. [4] wanted to see whether arthroscopic acromioplasty for stage II shoulder impingement syndrome was helpful over a five-year period. According to what they said, in line with other research, participants had to be between the ages of 18 and 60 to be included [5]. Glenohumeral instability is the most common cause of shoulder pain in individuals less than 18 years old [6]. However, only four individuals younger than 30 were included in their research. Patients older than 60 were excluded because they had a larger risk of rotator cuff injuries than the younger participants.

Group B had longer operative and recovery times and a longer mean hospital stay than group A ($p = 0.02, 0.028$).

Churchill and Ghorai [7] found that the mini-open repair procedure is 10 minutes quicker than the arthroscopic one.

Davis et al. [8], who sought to conduct a systematic review and meta-analysis of clinical trials within the literature, found no significant differences in the results of arthroscopic and open procedures at the 1-year follow-up point. According to their findings, arthroscopic acromioplasty is linked to a nearly 2-day shorter hospital stay.

After arthroscopic subacromial decompression, the average recovery period for the 166 patients documented by Luyckx et al. [9] was 11.1 weeks (with a minimum of one week).

Cho et al. [10] found that, on average, all-arthroscopy procedures take longer than MO procedures, but they found no statistically significant difference between the two.

The open method of surgery was quicker to complete [11].

In the current research, the VAS scores of both groups A and B were significantly lower after surgery compared to before surgery ($P 0.001$).

The difference between pre- and post-operative VAS scores was also substantially larger in group B than in group A ($p = 0.039$).

Hefny et al. (1) set out to assess the efficacy of arthroscopic subacromial decompression (ASD) in 16 patients. Patients said their average level of discomfort went from 3 before surgery to 8.6 after. Shoulder discomfort was eliminated for fourteen of sixteen participants.

S. Ketola et al. [12] found that at 24 months, there was no difference between arthroscopic decompression with acromioplasty followed by exercise treatment

(combined treatment) and supervised exercise (exercise group) in mean self-reported pain on VAS, or in secondary results variables of disability, night pain, shoulder disability questionnaire score, number of painful days, and percentage of pain-free patients. Open procedures were shown to be superior than arthroscopic ones, as described by Spangehl et al [13].

In their review, Barfield et al. [14] found no statistically significant difference between open and arthroscopic acromioplasties in terms of pain alleviation.

When comparing the effects on the Disability and Activity Level Questionnaire (DASH) score, the VASdpain/impairment score, and the range of motion, the all-arthroscopic surgery had a shorter recovery time and more rapid therapeutic benefit (for example, after 6 weeks). This may be because in the MO group, the swelling and separation of muscle fibres from the acromion lead to a larger loss of deltoid muscle tissue [15].

Three authors with level II SE reported no significant differences in symptom relief between open surgery and the single portal endoscopic approach [16].

Compared to endoscopy with 2 portals, neither the standard, open approach nor the decreased mini-invasive procedure significantly improved patients' quality of life [17].

After six months, there were no statistically significant changes in VAS scale, according to a systematic review and meta-analysis by Shan et al. [18], which included 12 trials and 770 patients.

Several studies [19; 10] found that AA patients recovered from their injuries more quickly than those in the mini-open (MO) group in terms of function score, VAS discomfort, and range of motion.

Patients were randomly randomised to either arthroscopic subacromial decompression or diagnostic arthroscopy in sham-controlled studies conducted by Paavola et al. [20] and Beard et al. [21]. The placebo effect is mitigated because both groups of patients undergo surgical intervention, and Paavola et al. found that patients who received sham surgery were no more likely to correctly identify that they had been subjected to a placebo procedure than those who had received subacromial decompression. Clinically meaningful differences in pain relief or functional outcome improvement between individuals having surgical decompression and those undergoing placebo surgery were not seen in either experiment.

Group A had a higher ASES score at two weeks, one month, and three months post-op than group B did ($p = 0.002, 0.001, \text{ and } = 0.029$).

After treating 30 patients in group A arthroscopically and treating 30 patients in group B via open procedure, Morsy et al. [22] found that the total ASES score at 2 weeks, 1 month, and 3 months was statistically significant between group A and B, with better results in the arthroscopic group (A) because the score at 2 weeks was adequate (68.511.1) in group A and poor (54.110.7) in group B, and the score at 1 month was satisfactory (79.8). There was no statistically significant difference in the mean ASES score between the two groups at either the 6-month or 1-year follow-up points.

Also, Lindh and Norlin [23] concluded that ASD is superior than OSD because the rehabilitation and range of motion were better in the ASD group 3 months after surgery.

Clinical metrics were comparable across the ASD and OSD groups, however TJonck et al. [24] observed that the UCLA score was superior in the short term for the ASD group.

In a randomised comparison of ASD and OSD, Sachs et al. [25] found that the ASD group had higher rehabilitation results over the first three months. Some patients in the OSD group had simultaneous distal clavicle excision, which may have slowed their recovery in the early postoperative period.

In a research by Chui et al. [26], the authors used the University of California, Los Angeles (UCLA) shoulder scoring system to evaluate the success of 23 open acromioplasties done on 22 patients with shoulder impingement syndrome. According to their research, that method has a good chance of being both successful and safe. The most critical factors are a well-vetted patient pool and prompt physiotherapy recovery after surgery [26].

Pain, function, range of motion, strength, and patient satisfaction were all measured using the UCLA shoulder rating scale, as published by Hefny et al. [1]. [27]. Eighty-eight percent of the instances were deemed good, while 12 percent were deemed unsatisfactory. After a year, the outcomes for 6 patients were outstanding, 8 were good, 2 were fair, and none were bad, as measured by the UCLA score.

Arthroscopic acromioplasty has a high success rate of between 73% and 88%, with the majority of patients reporting a positive experience [2].

In their study, Davis et al. [8] found that arthroscopic acromioplasty and open

acromioplasty both lead to identical long-term clinical results; however, arthroscopic acromioplasty is linked to a decreased return to work of more than 2 weeks earlier than individuals treated by an open acromioplasty.

Open acromioplasty has been shown to have a generally positive subjective outcome, with excellent and good outcomes ranging from 43% to 94%, as reported by P. Hyvonen et al [28]. Subjective findings in this investigation were consistent with those from prior studies with shorter follow-up periods. The Constant functional score did not provide universally positive results when assessing objective outcomes.

Two to three years after the operation, Stefanos Farfaras et al [29] compared the outcomes of surgery and non-operative therapy. Patients diagnosed with SAIS were randomly assigned to have either open acromioplasty (OS), arthroscopic acromioplasty (AS), or physical therapy (PT). At the follow-up, there was no discernible difference between the groups on any of the clinical evaluations or health-related QoL measures.

Treatment options for shoulder impingement syndrome were compared in a randomised controlled trial conducted by Ketola et al. [30]. There were a total of 70 patients in each group, and 96% of them were followed up with. The change in pain visual analogue score (VAS) between pre-op and 24 months post-op was the major outcome measure considered. There were no significant variations in results across the various treatment groups. According to the authors, acromioplasty does not provide clinically significant improvements in comparison to an exercise programme in terms of subjective outcome or cost-effectiveness.

Even though both techniques significantly improved pain and function (main end variable), Mark et al. [31] found that the open technique was more effective than the arthroscopic technique after a year of follow-up. Given that all of the surgeons were seasoned arthroscopists, it's puzzling that this result contradicts previous results.

Moreover, van der Zwaal et al. [32] found that the postoperative range of motion in the all-arthroscopic (AA) therapy group was significantly better than in the open surgery group. The average degree of forward flexion and external rotation after surgery was [33] better [34]. The amount of the calculated difference may or may not have clinical significance.

After 6 weeks, van der Zwaal et al. [32] found that the DASH scores in the AA group

had improved much more than those in the mini-open (MO) group. As a result, although the AA group may experience some treatment benefits a little bit sooner than the MO group, these benefits do not grow with time and the treatment impact is similar to that seen in the MO group at the end of the follow-up period.

Although Lenters et al. [35] found that arthroscopic methods improved function, they also carried a greater chance of recurrence, redislocation, and reoperations, making them less beneficial in terms of reintegrating patients back into their employment and/or sporting activities.

Based on a comprehensive review and meta-analysis of 12 trials including 770 participants, Shan et al. [18] found no statistically significant differences in functional results.

Whether a shoulder is operated on with or without arthroscopy, Pearsall et al. [36] observed no significant differences in range of motion, discomfort, or functional result.

While the SST, UCLA, and Constant & Murley scores all improved significantly after surgery, Pearsall et al. [36], using the SF-36 outcome measures, found no significant change.

Open surgery was found to have no advantages over the single portal endoscopic technique in the postoperative period or in the recovery of muscle strength, hand function, grip strength, manual dexterity, or sensitivity, according to a meta-analysis of 3 works with level II SE [16].

With the endoscopic method, patients might return to work sooner [37].

A randomised controlled trial on the management of impingement syndrome in the absence of rotator cuff tears was reported by Henkus et al. [38]. 55 patients were split into two groups: those who would have arthroscopic bursectomy (26 patients) and those who would undergo bursectomy plus acromioplasty (30 patients). Both the bursectomy and acromioplasty groups had positive clinical outcomes at a mean follow-up of 2.5 years (range, 1-5 years), with no significant differences between the groups.

Coghlan et al. [39] found that after reviewing 14 research on rotator cuff surgery, they were unable to definitively state whether or not the treatment was safe and successful due to the inherent biases of the studies themselves. The outcomes of surgical or arthroscopic decompression and conservative therapy for impingement do not vary significantly, as shown by three studies with "Silver" level evidence. There is little evidence that arthroscopic or open decompression

produces different outcomes, however four studies have reported faster recovery with arthroscopic operation.

There were no significant differences between endoscopy with 2 portals and the standard, open approach or the reduced mini-invasive procedure in terms of outcomes or time to return to work activity in trials with level II SE. Patient satisfaction was greater (93%) with the open method than with endoscopy (85%). According to a research with level I SE, there were no discernible changes between the two operations 5 years following surgery [17].

The open acromioplasty group had their shoulders immobilised for three weeks by Norlin (40) and Lindh and Norlin (41). In the three months after their surgeries, the open group had less range of motion than the arthroscopic group. Two years after the initial study, this result had disappeared.

At 3 months following surgery, Norlin (age 40) observed a statistically and likely clinically significant difference in ROM loss in the open acromioplasty. These results are presumably the result of performance bias due to the fact that these patients were required to remain immobile for three months following surgery, but the arthroscopic control group was not.

While research by Norlin [40] and Lindh and Norlin [41] showed that patients might return to work sooner after arthroscopic treatment, the improvement was not statistically significant. These studies may not have been as powerful as they may have been because of the degree of variation in the types of jobs surveyed. Therefore, no inferences can be drawn about whether or not patients will be able to return to work more quickly after an arthroscopic technique.

The most convincing studies in the literature are nonetheless tainted by a number of serious forms of bias. Still, there are a few takeaways. The key end measure, pain, showed no statistically significant difference between arthroscopic and open acromioplasty [14].

As far as problems go, this research found no discernible difference between the groups. In Group B, 20% of patients had post-op stiffness, and 15% experienced wound infection.

Similarly, van der Zwaal et al. [32] found no statistically significant differences in functional result or problems between the AA and MO groups in the first year.

Neviaser and Neviaser [41] used Neer's 11 method to avoid postoperative deltoid complications. Due to the low number of

patients included in this series, the rare consequence predicted by Barfield et al. [14] was not confirmed.

The rate of complications was equivalent between the two options [11].

Significant complication rates were found to be minimal by Carr et al. [42]. The total infection rate was 0.7%, with 1.5% requiring further surgical intervention.

According to Davis et al. [8], there was no statistically significant difference between the groups in terms of problems. The clinical outcomes of arthroscopic and open acromioplasty are comparable, and the incidence of complications is lower with the former.

All surgeries were reportedly conducted by a single, highly skilled orthopaedic surgeon [4], and there were no major problems.

5. Conclusion

This research indicated that arthroscopic acromioplasty led to a greater reduction in pain and an improved ASES score. A difference was identified between the 2 groups in main and secondary outcomes in the long term, no difference in the occurrence of complications. To add, we think that the arthroscopic acromioplasty operation has greater recovery during short-term follow-ups.

References

- [1] A.A. Hefny, M.H. Nasef, Y.M. Khira, M. Abd Abdelsalam, arthroscopic acromioplasty for treatment of shoulder impingement syndrome. *Zagazig University Medical Journal*.vol.24(6),pp.478-485,2018.
- [2] X Li, W Xu, N Hu, X Liang, W Huang, D Jiang, H Chen. Relationship between acromial morphological variation and subacromial impingement: A three-dimensional analysis. *PLoS One*. 2017 Apr 25.vol.12(4),pp.e0176193.
- [3] DJ. Beard, JL. Rees, JA Cook, and on behalf of the CSAW study group. Arthroscopic subacromial decompression for subacromial shoulder pain (CSAW): a multicentre, pragmatic, parallel group, placebo-controlled, three-group, randomised surgical trial. (Published online Nov 16 *Lancet*,2017.
- [4] S. Ketola, J. Lehtinen, T. Rousi, M. Nissinen, H. Huhtala, YT. Konttinen, I. Arnala. No evidence of long-term benefits of arthroscopic acromioplasty in the treatment of shoulder impingement syndrome: Five-year results of a randomised controlled trial. *Bone Joint Res*. 2013 Jul .vol.1;2(7),pp.132-9.
- [5] JP. Haahr, JH Andersen. Exercises may be as efficient as subacromial decompression in patients with subacromial stage II impingement: 4-8-years' follow-up in a prospective, randomized study. *Scand J Rheumatol*.vol.35,pp.224–228,2006.
- [6] WK Chang. Shoulder impingement syndrome. *Phys Med Rehabil Clin N Am* 2004;15:493–510
- [7] RS. Churchill, JK. Ghorai. Total cost and operating room time comparison of rotator cuff repair techniques at low, intermediate, and high volume centers: mini-open versus allarthroscopic. *J Shoulder Elbow Surg*.vol.19,pp.716-21,2010.
- [8] A. D. Davis, S. Kakar, C. Moros, E. K. Kaye,; Schepsis, A. A.; Voloshin, I. Arthroscopic Versus Open Acromioplasty: A Meta-Analysis. *The American Journal of Sports Medicine*.vol.38(3),pp.613–618,2010.
- [9] L. Luyckx, T. Luyckx, P. Donceel, P. Debeer. Return to work after arthroscopic subacromial decompression. *Acta Orthop Belg*.vol.77,pp.737–742,2011.
- [10] CH. Cho, KS Song, GH Jung, et al. Early postoperative outcomes between arthroscopic and mini-open repair for rotator cuff tears. *Orthopedics*.vol.35,pp.e1347–52,2012.
- [11] RD. Ferdinand, JG. MacLean. Endoscopic versus open carpal tunnel release in bilateral carpal tunnel syndrome. A prospective, randomised, blinded assessment. *J Bone Joint Surg Br*.vol.84,pp.375-9,2002.
- [12] S. Ketola, J. Lehtinen, I. Arnala et al. Does arthroscopic acromioplasty provide any additional value in the treatment of shoulder impingement syndrome? September 2009.
- [13] MJ. Spangehl, et al, *Journal of Shoulder and Elbow Surgeons*.vol.11,pp.101-107,2002.
- [14] L. Barfield, BS. Cole; Kuhn, John E MD Arthroscopic versus Open Acromioplasty, *Clinical Orthopaedics and Related Research: February 2007 - Volume 455 - Issue*, pp.64-71.
- [15] Wright RW, Baumgarten KM. Shoulder outcomes measures. *J Am Acad Orthop Surg*.vol.18,pp.436-444,2010.
- [16] NL. Saw, S. Jones, L. Shepstone, M. Meyer, PG. Chapman, Logan AM. Early outcome and cost-effectiveness of endoscopic versus open carpal tunnel

- release: a randomized prospective trial. *J Hand Surg Am*.vol.28B,pp.444-9,2003.
- [17] D.Hernández-Vaquero; M. Fernández-Fairen; A. Torres-Perez; A. Santamaría Minimally invasive surgery versus conventional surgery. A review of the scientific evidence.vol.56(6),2012.
- [18] L. Shan, et al., All-arthroscopic versus mini-open repair of small to large sized rotator cuff tears: a meta-analysis of clinical outcomes. *PLoS One*.vol.(4),pp.e94421,2014.
- [19] CL. Baker, SH. Liu Comparison of open and arthroscopically assisted rotator cuff repairs. *Am J Sports Med*.vol.23,pp.99–104,1995.
- [20] M. Paavola, A. Malmivaara, S. Taimela, et al. Subacromial decompression versus diagnostic arthroscopy for shoulder impingement: randomised, placebo surgery controlled clinical trial. *BMJ* .vol.362,pp.k2860,2018.
- [21] DJ. Beard, JL. Rees, JA. Cook, et al. Arthroscopic subacromial decompression for subacromial shoulder pain (CSAW): a multicentre, pragmatic, parallel group, placebo-controlled, three-group, randomised surgical trial. *Lancet*.vol.391,pp.329–38,2018.
- [22] Morsy, Atef & Nasef, Nasef & El-Bana, Emad & Baset, Ayman & Mostafa, Ahmed Gaber & Abdelkader, Mohamed. Treatment of Subacromial Impingement Syndrome Utilizing Arthroscopic Versus Open Subacromial Decompression. *The International Annals of Medicine*. 2. 10.24087/IAM.2018.2.4.457,2018.
- [23] M. Lindh, R. Norlin Arthroscopic subacromial decompression versus open acromioplasty. A two-year follow-up study. *Clin Ortop*.vol.290,pp.174-6,1993.
- [24] L. T'Jonck, R. Lysens, L. De-Smet, et al, Open versus arthroscopic subacromial decompression: Analysis of one-year results. *Phys Res Int*.vol.2 (2),pp.46-61,1997.
- [25] R. Sachs, M L. Stone, S. Devine. Open vs. arthroscopic acromioplasty: A prospective randomized study. *Arthroscopy*.vol.10,pp.248-54,1994.
- [26] CH Chui, C Lee, KH Seow. The results of open acromioplasty in impingement syndrome a retrospective study. *Singapore Med J*. 1997 Jan.vol.38(1),pp.22-4.
- [27] R Alison, A. B Thor, B D. Mathias, S J. Julie, and David H C. Specific or general exercise strategy for subacromial impingement syndrome—does it matter? A systematic literature review and meta-analysis, *BMC Musculoskelet Disord*.vol.18,pp.158,2017.
- [28] P. Hyvonen, S. Lohi, P. Jalovaara. Open acromioplasty does not prevent the progression of an impingement syndrome to a tear . *J Bone Joint Surg [Br]* .vol.80,pp.B:813-6,1998.
- [29] Stefanos Farfaras, Ninni Sernert, Lars Rostgard Christensen et al, Subacromial Decompression in Patients with Impingement Syndrome Results in Better Clinical Outcome Compared to Physiotherapy in the Long Term. A Prospective Randomised Study. *The Orthopaedic Journal of Sports Medicine*,2017.
- [30] S.Ketola, J. Lehtinen, I. Arnala et al. Does arthroscopic acromioplasty provide any additional value in the treatment of shoulder impingement syndrome? September 2009.
- [31] J Mark Spangehl; Robert H Hawkins; Robert G McCormack; Richard L Loomer Arthroscopic versus open acromioplasty: A prospective, randomized, blinded study.vol.11(2),pp. 0–107,2002.
- [32] P.van der Zwaal, et al., Clinical outcome in all-arthroscopic versus mini-open rotator cuff repair in small to medium-sized tears: a randomized controlled trial in 100 patients with 1-year follow-up. *Arthroscopy*.vol.29(2),pp.266-73,2013.
- [33] AM. Sauerbrey, CL. Getz, M. Piancastelli, JP. Iannotti, ML. Ramsey, Williams GR Jr. Arthroscopic versus miniopen rotator cuff repair: A comparison of clinical outcome. *Arthroscopy*.vol.21,pp.1415-1420. ,2005.
- [34] TJ. Shinnors, PG. Noordsij, JF. Orwin Arthroscopically assisted mini-open rotator cuff repair. *Arthroscopy*;18: 21-262002.
- [35] TR. Lenters, AK. Franta, FM. Wolf, SS. Leopold, Matsen 3rd FA. Arthroscopic compared with open repairs for recurrent anterior shoulder instability. A systematic review and metaanalysis of the literature. *J Bone Joint Surg Am*.vol.89,pp.244-54,2007.
- [36] A.W. Pearsall, , K.A. Ibrahim, & S.G. Madanagopal, The results of arthroscopic versus mini-open repair for rotator cuff tears at mid-term follow-up. *J Orthop Surg Res*.vol.2,pp. 24,2007.
- [37] TE. Trumble, E. Diao, RA. Abrams, MM. Gilbert-Anderson. Singleportal endoscopic carpal tunnel release compared with open release: a

- prospective, randomized trial. *J Bone Joint Surg Am*.vol.84,pp.1107-15,2002.
- [38]HE. Henkus, PB. de Witte, RGHH. Nelissen, et al, Bursectomy compared with acromioplasty in the management of subacromial impingement syndrome: a prospective randomised study. *The Journal of Bone & Joint Surgery B*.vol.91(4),pp.504–510,2009.
- [39]JA. Coghlan, R. Buchbinder, S. Green, et al, Database Syst Rev. Surgery for rotator cuff disease,2008.
- [40]R. Norlin. Arthroscopic subacromial decompression versus open acromioplasty.*Arthroscopy*.vol.5,pp.321-323,1989.
- [41]RJ. Neviaser, TJ. Neviaser. Lesions of musculotendinous cuff of shoulder: diagnosis and management. *Instr Course Lect* .vol.30,pp.239-257,1981.
- [42]A. Carr, et al., Effectiveness of open and arthroscopic rotator cuff repair (UKUFF): a randomised controlled trial. *Bone Joint J*.vol.99-B(1),pp.107-115,2017.