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# Patient-reported outcomes for arthroscopic resection of the distal clavicle with concomitant arthroscopic subacromial decompression at a 2-year follow-up: a prospective study of 131 consecutive patients

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**Background:** Arthroscopic distal clavicle resection (DCR) can be offered to patients with persistent acromioclavicular (AC) joint pain who do not benefit from conservative treatment. The aim of this study was to evaluate the outcome of combined arthroscopic DCR and concomitant arthroscopic subacromial decompression in a large consecutive and prospective cohort using patient-reported outcomes.

**Methods:** Consecutive patients were identified from our online database and included based on their primary treatment code. All patients had a diagnosis of shoulder impingement syndrome and persistent AC joint pain resistant to at least six months of conservative treatment. The outcomes from the combined intervention were evaluated by patients through the Oxford Shoulder Score (OSS) questionnaire and EuroQol 5-Dimension 3-Level questionnaire, including a EuroQol visual analog scale score collected preoperatively and at a 2-year follow-up. Patient-reported satisfaction with the procedure was reported at the follow-up. Subgroups were formed to further evaluate outcome based on preoperative OSS (low, moderate, high) and age.

**Results:** 131 patients (75%) were available for analysis at the 2-year follow-up. Sixty seven patients (51%) were female and the mean age was 51 years (range 19-82). A mean OSS change of 12.1 (95% confidence interval, 10.3-14.0; $P < .001$) was observed within the entire study group. In both the low and moderate preoperative-OSS (pre-OSS) groups, a mean change of 14 was found with no difference between groups ($P = .971$). A mean change of 7 was found in the high pre-OSS group, which differed from both the moderate ($P < .001$) and low ($P = .036$) pre-OSS groups. A significant change in EuroQol 5-Dimension and EuroQol visual analog scale was observed within all the pre-OSS groups, and 107 patients (82%) replied that they were satisfied or very satisfied with their outcome of surgery at the follow-up.

**Conclusions:** Patients who suffer from persistent AC joint pain largely benefit from arthroscopic DCR with arthroscopic subacromial decompression through relief of symptoms and improved quality of life, including those with a high self-reported and preoperative level of shoulder function.



Acromioclavicular (AC) joint pathology may constitute the primary reason for a chronic shoulder pain but it is often seen coexistent with subacromial impingement as part of a painful shoulder.[9,19,24,26,34,38] The pain and subsequent loss of function are severe for those patients who live with a persistently symptomatic AC joint. It affects the quality of life of patients in a constant manner in most aspects of their daily activities, with pain at rest and interrupted sleep.

Symptomatic pathology of the AC joint is a common problem,[8] and the incidence of surgical treatment by way of arthroscopic distal clavicle resection (DCR) is increasing in the general population.[1,21,38] Males and females are equally likely to undergo DCR, with the mean age being the middle of the sixth decade for both groups. Females tend to have a peak incidence in the previous ten years, while men peak in the following ten years.[38]

Ethical approval for this study is not applicable as the database and the analysis of its data is considered a quality assurance project by the Danish National Committee on Health Research Ethics.
Patients gave consent to the use of their data when filling out the questionnaires at inclusion.

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A standard treatment regimen for the painful AC joint consists of conservative care, including rest from painful activities or modification of movements, physical therapy, and oral analgesics, which may relieve many patients of their symptoms. If pain persists, injections of local anesthetics and corticosteroids are often attempted as a next step.[26] Some patients may then experience lasting relief of symptoms, while others experience no effect of treatment or only temporary relief with a need for repeated injections. The latter group of patients is often considered as candidates for surgery.[8,18,40,42]

Previous studies[3,9,19,24,29,32,34,37,41] have emphasized the importance of acknowledging the coexistence of AC joint pathology and subacromial impingement when selecting patients for surgery, considering that these conditions tend to overlap as generators of pain in the painful shoulder. Thus, they should be identified and treated coincidently to improve surgical outcomes.

Only a handful of studies have investigated the effect of arthroscopic DCR with concomitant arthroscopic subacromial decompression (ASD) on patients with shoulder pain, selected for surgery, due to AC joint pain being resistant to conservative treatment. The previous literature[19,29,31,32,34,37,41] only comprises smaller groups of patients with varying lengths of follow-up, none of which analyses the effect of treatment through patient-reported outcome measures.

The aim of this study was to evaluate the outcome of combined arthroscopic DCR and ASD at a 2-year follow-up using patient-reported outcomes in 131 consecutively sampled patients with persistent AC joint pain.

## Materials and methods

### *Patients*

Patient data was drawn from our online database, RASKAD, designed to collect replies to questionnaires from consecutive patients undergoing surgery for shoulder and elbow diseases at inclusion and at six months, two years, and five years postoperatively. Enrolment of patients took place in the outpatient clinic where patients were asked to participate by completing questionnaires on their first visit. All answers were given online, unless patients lacked electronic skills, in which case a physical copy was mailed for them to complete. If patients did not reply, they were reminded once to do so by the clinic's secretary staff. All surgical procedures were performed by 3 experienced surgeons at a single-center public hospital in Randers, Denmark.

Patients included in the study had a preoperative diagnosis of shoulder impingement and clinical symptoms of acromioclavicular pathology in the form of pain located at the AC joint upon palpation. In addition, all patients had a positive crossover test. X-ray of the affected shoulder was included as part of the medical examination to rule out other reasons for shoulder pain, such as glenohumeral arthritis, unexpected cuff degeneration, or fracture sequelae which may lead to the exclusion of this study, if found perioperative. Also, the rotator cuff was evaluated clinically before surgery. Patients who were offered surgery had persistent pain, resistant to conservative treatment options, for duration of at least six months, severely affecting quality of life, ie, interrupted sleep or constant pain during activities of daily living. The conservative treatment regimen consists of rest from painful activities, sessions of guided physical therapy with exercises aimed at strengthening the muscles of the rotator cuff and scapula as well as oral analgesics. Up to three injections of 40 mg depo-medrol + lidocaine were given at the AC joint or in the subacromial bursa, each with six weeks intervals, if pain persisted despite the conservative treatment regimen. Patients, who did not gain any relief of symptoms, or only temporary relief, were offered a surgical intervention.

The included patients were drawn from our database according to their primary treatment code decided at the time of operation. Each patient was evaluated by systematic screening of all intra-articular structures. If cartilage defects or severe rotator cuff wear or rupture was observed, the patient was excluded. The exclusion criteria of the study are presented in Table I.

All patients who had arthroscopic DCR also received ASD during surgery. This is due to the inability to make a clear-cut distinction among the pain-causing mechanisms in the painful shoulder where the intraoperative identification of subacromial bursal inflammation and the clinical symptoms from the AC joint often coincide.

### *Surgical procedure*

The procedure is performed under general anesthesia, and the patient is placed in a beach chair position. The glenohumeral joint is inspected. Bursectomy is performed using a soft tissue shaver and the rotator cuff is inspected. The AC ligament is separated from the acromion, then subacromial decompression is performed through a lateral portal removing the inferior part of the acromion from the anterolateral corner to the AC joint. Bone is removed until the inferior border of the deltoid muscle. At this point, arthroscopic resection of the AC joint is performed if the intraoperative appearance of the joint capsule is pathological with or without synovitis or findings of AC joint bone spurs, consistent with the preoperative clinical presentation. A cannula is inserted into the joint for guidance, its placement visualized via the optics, then replaced by the soft tissue shaver used for soft tissue débridement, followed by the bone shaver used to resect the lateral 5 mm of the distal clavicle. Care is taken to preserve the cranial joint capsule. At the end of the procedure 20 ml naropin 7.5 mg/ml is injected into the subacromial space. Following surgery, written information is handed out and patients are scheduled for one session of physiotherapy, where they are instructed in exercises to help mobilize and strengthen the affected extremity. Patients are recommended to use their extremity within the limits of pain, but at the same time refrain from heavy lifting until three months after surgery. At this point in time the patient is scheduled for a postoperative consultation via telephone. No physical revision was made postoperatively.

### *Measures/outcomes*

The Oxford Shoulder Score (OSS)[12] serves as the primary outcome measure. The questionnaire is validated to assess the outcome of surgery for patients suffering from degenerative or inflammatory shoulder diseases.[5,13,23] It consists of twelve questions resulting in a score ranging from 0 to 48 indicating the worst to best possible shoulder function, respectively. A change of six points has previously been found as slight improvement.[10,28]

As secondary outcomes, the EuroQol 5-Dimension 3-Level (EQ-5D-3L) questionnaire[16] and EuroQol visual analog scale (EQ-VAS) scores are used for measuring health-related quality of life. With the EQ-5D-3L, patients indicated their perceived state of health across five domains at three levels, thereby generating an overall score which was calculated into an EQ-5D-3L index ranging from −0.22 to 1, with 1 indicating full health. With the EQ-VAS, patients indicated their overall shoulder function ranging from 0 (worst imaginable) to 100 (best imaginable) on a continuous

**Table I**
Exclusion criteria.

| |
|---|
| Glenohumeral osteoarthritis |
| Major cartilage defects in the glenohumeral joint |
| Instability of the glenohumeral joint |
| Rotator cuff lesions |
| Acute trauma or fracture on the affected shoulder <6 mo prior to surgery |
| Previous surgery on the affected shoulder |

**Table II**
Age distribution and gender comparisons of age at inclusion. Overall and pre-OSS subgroups were analyzed by ANOVA with gender specific and combined means and gender difference (female-male). For age subgroups, Gamma regression was used, and results are shown as back-transformed means and gender ratios (female/male). In addition, 95% confidence intervals (CI) are given.

| Subgroups | N | Mean age (95% CI) | Comparison (95% CI) | *P* value |
|---|---|---|---|---|
| Pre-OSS | | | Female-Male difference | |
| Low | | | | |
| Total | 23 | 48.0 (42.7-53.2) | | |
| Female | 19 | 48.1 (43.8-52.5) | | |
| Male | 4 | 47.8 (38.3-57.3) | 0.31 (−10.1 to 10.7) | .951 |
| Moderate | | | | |
| Total | 48 | 52.8 (49.7-55.8) | | |
| Female | 24 | 52.3 (48.0-56.7) | | |
| Male | 24 | 53.2 (48.8-57.5) | −0.83 (−6.97 to 5.30) | .786 |
| High | | | | |
| Total | 60 | 51.2 (47.4-55.0) | | |
| Female | 24 | 53.2 (47.3-59.2) | | |
| Male | 36 | 49.1 (44.3-54.0) | 4.09 (−3.56 to 11.7) | .289 |
| Age group | | | Female/Male ratio | |
| 18-49 y | | | | |
| Total | 63 | 41.1 (39.0-42.8) | | |
| Female | 31 | 42.2 (39.4-44.3) | | |
| Male | 32 | 39.8 (36.2-42.5) | 0.76 (0.50 to 1.18) | .222 |
| 50-59 y | | | | |
| Total | 33 | 54.3 (53.4-55.5) | | |
| Female | 20 | 54.2 (53.1-55.6) | | |
| Male | 13 | 54.5 (53.1-56.5) | 0.93 (0.57 to 1.51) | .772 |
| 60+ y | | | | |
| Total | 35 | 66.0 (64.3-68.3) | | |
| Female | 16 | 66.0 (63.7-69.6) | | |
| Male | 19 | 66.0 (63.9-69.3) | 0.99 (0.52 to 1.89) | .986 |

*OSS*, Oxford Shoulder Score; *CI*, confidence interval.

scale. Patients also reported their satisfaction with the procedure as follows: very satisfied, satisfied, almost satisfied, or not satisfied.

### *Subgroups*

To investigate the effect of the procedure and possible confounding, patients were grouped according to their preoperative-OSS (pre-OSS) as either low (0-19), moderate (20-29) or high (30-48) and age as either 18-49, 50-59 or 60+ years old.

### *Statistical analysis*

Statistical analysis was carried out using R version 4.0.4 (R Core Team, R Foundation for Statistical Computing, Vienna, Austria), at a significance level of 0.05. Results are shown as Estimated Marginal means and 95% confidence intervals (CI) on the original scales, back-transformed if relevant. Post hoc pairwise comparisons were carried out by Wald t-tests, and *P* values and CIs were corrected for multiple comparisons using a multivariate t distribution. For pre-OSS subgroups and overall, one-way analysis of variance (ANOVA) was used. For the subgroups defined by the three age groups, clear deviations from normality were observed for ANOVA residuals and a generalised linear model with Gamma distribution and logarithmic link function was instead applied on the following centring of ages: 50 minus age at inclusion for the 18-49 years group, age minus 50 for the 50-59 years group and age minus 60 for the 60+ group. Results are shown as Estimated Marginal means (EM-means) and 95% confidence intervals (CI) within each gender and for the combined sample averaged over genders. The results from Gamma regressions were back-transformed to the original scale by use of the exponential function followed by subtraction from 50 (18-49 years group), addition to 50 (50-59 years group) or addition to 60 (60+ group). Moreover, gender differences are shown with 95% CI and tested by F test for the ANOVA models with 1 numerator degree of freedom (df) and N-2 denominator df, where N is the number of patients in the specific group. For the Gamma models, differences were tested by $\chi 2$ likelihood ratio tests on 1 df. EQ-5D index was described with medians and quartiles, and examined by the median test.[11]

Ethical approval for this study is not applicable as the database and the analysis of its data is considered a quality assurance project by the Danish National Committee on Health Research Ethics. Patients gave consents to the use of their data when filling out the questionnaires at inclusion.

## Results

The study cohort consisted of an initial 175 consecutive patients (87 females, 88 males) included in the database from 2012 to 2018, of whom six did not respond preoperatively and 38 did not respond at follow-up, leaving a total of 131 patients (75%) available for analysis, having completed the questionnaires at both the inclusion and at the 2-year follow-up.

Of the 131 eligible patients, 67 were females (51%) and 64 males (49%), with 63 (48%) aged 18-49 years, 33 (25%) aged 50-59 years and 35 (27%) aged 60 years or older at inclusion. The mean age of the study population at inclusion was 51.0 years (95% CI, 48.9-53.1), ranging from 19-82 years, with a mean age of 51.5 years (95% CI 48.5-54.4) for females and 50.6 years (95% CI, 47.5-53.6) for males ($P = .681$). Subgroup demographics are presented in Table II.

The mean change in OSS from inclusion to the 2-year follow-up was 12.1 (95% CI, 10.3-14.0; $P < .001$) for the collective cohort. The mean changes of the three pre-OSS groups are illustrated in Figure 1. Overall, the pre-OSS groups differed ($\chi^2_2 = 28.1$; $P < .001$). The difference in OSS from inclusion to follow-up was larger in the low pre-OSS group compared to the high group ($P = .036$), and even more so for the moderate group compared to the high pre-OSS group ($P < .001$). No difference at all was identified between the low and moderate group ($P = .971$).

The interaction between gender and age groups was significant ($\chi^2_2 = 11.1$; $P = .004$). For females, the mean OSS change in different age groups was similar to each other, it being 12.5, 12.3 and 10.9 for those aged 18-49, 50-59 and 60+ years respectively, while males differed more noticeably, changing 8.2, 12.7 and 16.3 for those aged 18-49, 50-59 and 60+ years, respectively. A statistically significant difference in mean OSS of 8.1 was identified between males aged 18-49 and 60+ years ($P < .001$) following adjustment for multiple testing. Two-way interactions between pre-OSS groups and gender and age groups were not significant ($P = .425$ and $P = .760$).

EQ-VAS range and distribution at inclusion and at follow-up for each pre-OSS group and age group are shown in Figure 2. Overall, the relative EQ-VAS change of the study cohort was 2.31 (95% CI, 2.08-2.56; $P < .001$) and thus significantly different from inclusion to follow-up. The overall effect of pre-OSS groups was clearly significant ($\chi^2_2 = 23.5$; $P < .001$) and with no indication of interaction between pre-OSS groups and age groups ($P = .400$) or gender groups ($P = .324$).

The largest relative increase in EQ-VAS from inclusion to follow-up was seen in the low pre-OSS group with a ratio of 3.2 (95% CI,

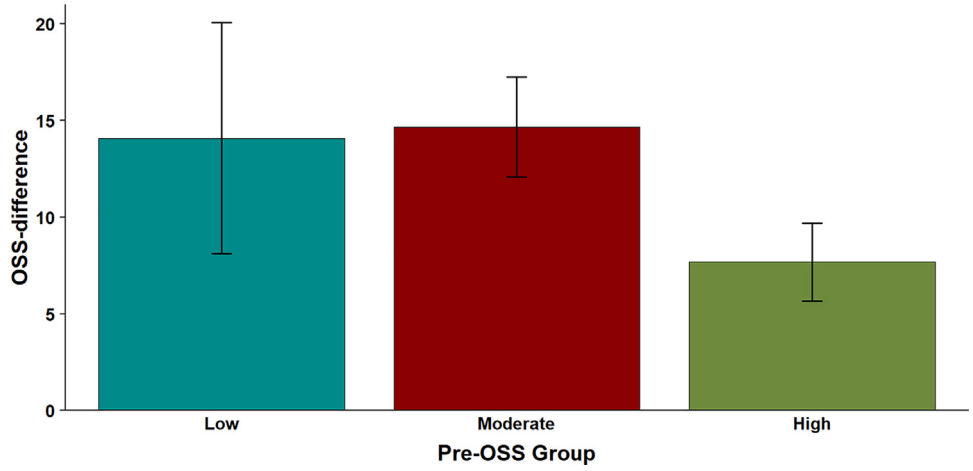


**Figure 1** OSS changes from inclusion until the 2-year follow-up was analyzed by one-way analysis of variance (ANOVA) in pre-OSS groups (low, moderate, high) with adjustment for gender and age groups (18-49, 50-59, 60+), and their interaction. The model was estimated by generalized least squares (GLS) to include heterogeneous variances among pre-OSS groups. *OSS*, Oxford Shoulder Score.

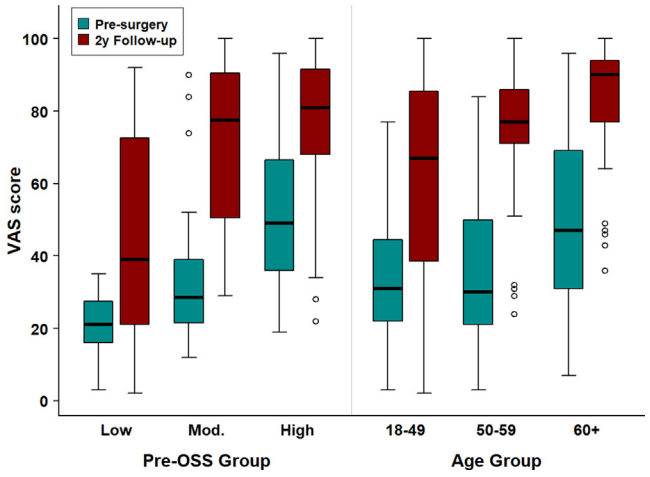


**Figure 2** Box-and-whiskers plots of EuroQol visual analog scale (EQ-VAS) score at inclusion (presurgery) and at the 2-year follow-up for each of 3 groups defined by the presurgery OSS (low, moderate, and high) and for each of 3 age groups (age at inclusion). *OSS*, Oxford Shoulder Score.

2.0-5.0), while the moderate group increased with a ratio of 2.5 (95% CI, 2.1-3.0), and the high group increased with a ratio of 1.7 (95% CI, 1.5-2.0). When comparing the relative changes in VAS of pre-OSS groups, the low group increased 1.25 times more relative to the moderate group, although not significant ($P = .502$), and increased 1.83 times more relative to the high group ($P = .007$). The moderate group increased 1.46 times more relative to the high group ($P < .001$). The interaction between gender and age groups was significant ($\chi^2_2 = 8.9$; $P = .012$).

As data for the EQ-5D index did not follow a normal distribution, quartiles (median, 25% and 75% percentiles) are shown for the subgroups in Table III. Overall, the study cohort changed significantly from median 0.713 at inclusion to 0.776 at the 2-year follow-up ($\chi^2_1 = 51.8$; $P < .001$). The overall median test showed clearly significant differences among pre-OSS groups at inclusion ($\chi^2_2 = 42.7$; $P < .001$) and less clear significant differences at follow-up ($\chi^2_2 = 9.0$; $P = .011$). The pairwise comparisons are indicated in Table III. Among age groups, the oldest age group (60+) differed from the 2 youngest groups, both at inclusion and at follow-up, and overall differences among age groups were also significant both at inclusion ($\chi^2_2 = 7.6$; $P = .023$) and at follow-up ($\chi^2_2 = 9.4$; $P = .009$). Apart from the low pre-OSS group, for which the $P$ value for this comparison was 0.039, all comparisons between the index at inclusion and at follow-up were clearly statistically significant ($P < .001$) within each of the pre-OSS or age groups.

Overall, 107 patients (82%) were satisfied or very satisfied with their outcome of surgery at follow-up, while 16 patients (12%) were almost satisfied, and 6 patients (6%) not satisfied. Within the pre-OSS groups, fewer patients were satisfied or very satisfied in the low group (65%) compared to the moderate group (88%) and high group (83%).

## Discussions

To our knowledge, this is the first paper to use patient-reported outcomes in a large cohort to study the clinical effect of arthroscopic DCR with concomitant ASD on patients primarily selected for surgery due to persistent AC joint pain. The results showed surgery as a relevant treatment in this context.

Because of the study design, our patient cohort is homogeneous compared to previous studies,[29,37] some of which include athletes and similar patients characterized by expectations of recovery of habitual shoulder function. These are different from the expectations of pain relief to improve quality of life and enable activities of daily living, which characterizes our patients and is the main indication for surgery. This circumstance makes our findings particularly relevant to a public hospital setting.

The strengths of this study are the use of prospective data sampling, which minimizes the risk of information bias, and the use of patient-reported outcomes as the measure of clinical effect, which enables improved patient selection and patient-centered treatments. Also, the length of the follow-up likely allows for the observation of close to full effect of surgery compared to a short period of follow-up. Utilizing a short period of follow-up might have caused the mean OSS difference not to reach a relevant minimum of clinically significant change, especially in the group scoring higher functionality at inclusion.

The main limitations of the study are the retrospective analysis of data and the inherent restrictions of our database, which inhibit a more thorough adjustment for potential confounders such as comorbidities and smoking. Also, the study lacks full follow-up at 2 years postoperatively, which introduces selection bias that could

**Table III**
EuroQol 5-Dimension 3-Level (EQ-5D-3L) index quartiles at inclusion (presurgery) and at the 2-year follow-up for each of 3 groups defined by the presurgery OSS (low, moderate, and high) and for each of 3 age groups (age at inclusion). Different superscript small letters (a, b, c) indicate groups within time (presurgery or 2-year follow-up) ie, in columns that are significantly different in EQ-5D-3L index as examined by the nonparametric median test. Correspondingly, different superscript capital letters (A, B) indicate significant EQ-5D-3L index differences within presurgery groups, and within age groups between presurgery and the 2-year follow-up, ie, in rows.

| Pre-OSS subgroups | Presurgery | 2 y FU | Age groups | Presurgery | 2 y FU |
|---|---|---|---|---|---|
| Low pre-OSS | N = 23 | | 18-49 y | N = 63 | |
| Lower quartile | 0.29 | 0.57 | Lower quartile | 0.50 | 0.71 |
| Median | 0.38$^{a,A}$ | 0.71$^{a,B}$ | Median | 0.71$^{a,A}$ | 0.78$^{a,B}$ |
| Upper quartile | 0.65 | 0.78 | Upper quartile | 0.78 | 0.84 |
| Mod pre-OSS | N = 48 | | 50-59 y | N = 33 | |
| Lower quartile | 0.64 | 0.71 | Lower quartile | 0.62 | 0.71 |
| Median | 0.71$^{b,A}$ | 0.78$^{ab,B}$ | Median | 0.71$^{a,A}$ | 0.78$^{a,B}$ |
| Upper quartile | 0.71 | 1 | Upper quartile | 0.71 | 0.82 |
| High pre-OSS | N = 60 | | 60+ y | N = 35 | |
| Lower quartile | 0.71 | 0.78 | Lower quartile | 0.71 | 0.78 |
| Median | 0.78$^{c,A}$ | 0.82$^{b,B}$ | Median | 0.76$^{b,A}$ | 1$^{b,B}$ |
| Upper quartile | 0.78 | 1 | Upper quartile | 0.78 | 1 |

*OSS*, Oxford Shoulder Score; *FU*, follow-up.

lead our results to overestimate the beneficial effect of the procedure, if in fact those lost to follow-up did not respond because they experienced no relief of their symptoms or worsening following surgery. However, the authors consider the 75% response-rate acceptable for a registry-based study of surgical outcome such as ours and the loss to follow-up unlikely to skewer our findings significantly. This notion is supported by a closely similar distribution of baseline demographics between the study cohort and those lost to follow-up.

On average, our patients reported a benefit from surgery in terms of improved shoulder function and quality of life. Previous studies[19,28,30,31,33,36,40] have reported good or excellent results following the same procedure. We considered a mean change in OSS of six points, the minimal clinically important difference, which was observed for all 3 pre-OSS groups. As expected, those with more severely impaired functionality reported better results following surgery, but with no apparent difference between low and moderate preoperative shoulder functionality. Those with the most impaired shoulder function do not appear to benefit more from surgery than those with a slightly better functionality. It is also worth noticing the fact that patients in the high pre-OSS group were largely satisfied with the procedure (83%), although the mean OSS change for this group was significantly less than that of any other group, while patients in the low pre-OSS group were less satisfied on average (65%), although they experienced a larger self-reported improvement of shoulder function. Based on these findings, we argue that eligible patients scored with a high pre-OSS can expect a clinically relevant improvement from arthroscopic DCR with ASD despite an observed mean outcome close to what would be considered only a slight improvement.[10,28] A possible ceiling effect of the OSS instrument should be kept in mind when making the above interpretation, which is why a high rate of satisfaction is considered the core of this argument.

Three negative values of OSS change exist in the high pre-OSS group, reflecting that not all patients experienced a benefit from surgery. Two patients developed capsulitis for 3 to 7 months and have consistent pain, and one patient has consistent pain despite surgery.

No complications in the form of infections or damage to nervous or vascular tissue occurred. A few cases of temporary humeroscapular periarthritis were observed, all of which resolved spontaneously within a maximum period of 2 months.

As previously described the procedure is of a combined nature. The results should be reproduced in a randomized controlled setting to distinguish the effect of the combined procedure. Studies from the past decades have reported the successful outcomes of isolated arthroscopic DCR for AC joint pathology[2,6,7,14,15,20,22,24,25,30,33,39,43] and ASD for shoulder impingement syndrome,[4,17,27,35,36] respectively.

## Conclusions

Arthroscopic DCR with concomitant ASD is an effective treatment for carefully selected patients with persistent acromioclavicular joint pain. These patients can expect to gain a clinically significant relief of symptoms and improved quality of life. We also believe that patients will experience a clinically relevant improvement regardless of preoperative shoulder function if our inclusion criteria are met.

## Disclaimers:

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