Long-term results after surgical treatment of subacromial pain syndrome with or without rotator cuff tear

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ABSTRACT

Purpose: Some studies suggest a common degenerative path might contribute to a range of shoulder diseases involving subacromial pain syndrome and full-thickness rotator cuff tears. One could therefore theorize arthroscopic subacromial decompression and rotator cuff repair as interventions at different stages of a degenerative shoulder disease. Few studies have compared long-term outcomes after these two procedures.

Method: Matched case-controls undergoing arthroscopic rotator cuff repair combined with subacromial decompression (N = 180) or subacromial decompression only (N = 180) were evaluated pre- and 7.5 years postoperatively using QuickDASH score, VAS of function, VAS of pain and VAS of satisfaction. New surgery and complications were recorded. Baseline characteristics were related to outcomes to investigate predictors of good/poor outcome.

Results: A general improvement from baseline was seen – from 51 to 14 (QuickDASH) in the combined group and from 53 to 16 in the decompression only group. No differences in outcomes were seen between groups (n.s.). Age above 55 at surgery predicted better VAS of function (P = .04) while acute onset of symptoms predicted better QuickDASH in the combined group (P = 0.03). None in the decompression group had undergone later rotator cuff repair.

Conclusion: Major improvements in pain/function were seen at mid- to long-term after isolated arthroscopic subacromial decompression and combined decompression/rotator cuff repair. Several patient-specific factors predicting worse outcomes were identified.

1. Introduction

Subacromial pain syndrome (SPS), is a common shoulder disorder constituting a major disease burden for the health care sector.¹ Traditionally, SPS has been viewed as a condition where tightness and friction in the subacromial space can lead to bursitis, cuff tendinopathy and eventually cuff tears.^{2–4} More recently the proposed extrinsic mechanical pathogenesis has been challenged by findings suggesting an intrinsic degenerative process, adding to the complexity of this likely multifactorial disease.^{4–6}

An ongoing debate has yet to resolve if different stages of SPS, thereunder tendinopathy, partial- and full thickness cuff tear are separate disease entities or represent stages of a shoulder disease continuum.^{7–9} Jo et al. found a histological relation between degree of tendon degeneration and the severity of shoulder disease – from tendinopathy to full thickness cuff tears – suggesting a common pathogenesis.⁹ Other studies, like those by Farfaras et al. and Yanggisawa

et al., have indicated that early stages of SPS show inflammatory and degenerative signs alike those seen in patients with full-thickness cuff tears.^{5,10}

In light of the debated degenerative shoulder disease continuum one could speculate how results after treatment of different stages of this disease would differ, assuming that the theorized natural history would go towards a common end-stage.^{8,9} Jeager et al. has formerly suggested that deterioration in functional outcome after surgery can be related to a more progressive disease at the time of intervention.¹¹ Thus, the purpose of the current study was to investigate the long-term results after isolated subacromial decompression as compared to those after rotator cuff repair combined with subacromial decompression. Our null hypothesis was that worse patient-reported results would be seen in patients that were treated for a more advanced shoulder disease; full thickness cuff tear compared to those treated at a potential earlier stage; SPS without cuff tear.

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2. Materials and methods

Patients with symptomatic chronic subacromial pain syndrome treated surgically by subacromial decompression and patients undergoing repair of a degenerative small to medium sized rotator cuff tear at our Clinic from 2004 to 2008 were eligible. Symptoms for at least 6 months; insignificant improvement of conservative treatment (3–6 months);¹² MRI verified cuff tendinopathy and reduced subacromial space; positive Neer sign and Hawkins test; and normal passive ROM was required for surgical treatment to take place.

Exclusion criteria included previous surgery in the same shoulder; previous significant shoulder trauma; significant concomitant pathology (e.g. osteoarthritis, adhesive capsulitis, chondral lesions, labrum avulsions and loose bodies); American Society of Anesthesiologist (ASA) 3 and higher; and inability to undertake a standardized postoperative rehabilitation. For patients undergoing the combined surgery, acute, traumatic cuff lesions; massive, irreparable lesions; and lesions requiring more than a single-row suture repair (e.g., side-to-side sutures, margin convergence, interval slide) were excluded.

Patients undergoing decompression and cuff repair were matched, with regard to sex and age, with a patient that underwent isolated subacromial decompression within a week before or after (Fig. 1).

2.1. Outcome measures

Primary outcome measure was the disabilities of the arm, shoulder and hand outcome measure (DASH), represented by the QuickDASH 11-item disability/symptom subset, collected prior to surgery and at follow-up.^{13,14} Each answer was graded from 0 to 4. The component total score, from 0 to 100, was calculated by multiplying the average score by 25. A higher score indicates greater disability. Outcome by QuickDASH was rated as excellent (< 20 points), good (20–39 points), fair (40–60 points) or poor (> 60 points).¹⁵

VAS of pain (0 = no pain, 100 = worst possible pain) and VAS of function (0 = useless, 100 = perfect function) were included as secondary outcomes. In addition, a VAS of satisfaction with the result of the treatment (0 = very dissatisfied, 100 = very satisfied) was included at the final follow-up evaluation.

2.1.1. Surgical technique

A posterior approach for visualization and additional lateral/anterior portals for instrumentation were used. A diagnostic glenohumoral arthroscopy was performed before switching into the subacromial space. The subacromial bursa was debrided using a soft tissue resector and a radiofrequency probe — and the rotator cuff was inspected. Thereafter, a wedge-shaped acromioplasty was performed to relieve the rotator cuff of mechanical symptoms.

If a full-thickness rotator cuff tear was present, mobility of the ruptured tendon(s) was assessed prior to repair. Debridement of the footprint on tuberculum majus was performed to facilitate tendon healing. A single-row repair, using one-to-four titanium screw anchors (Fastin RC, Depuy Synthes, Raynham, USA), depending on the tear size, was performed.

After cuff repair, patients were instructed in passive exercises and the use of a sling for 6 weeks. Thereafter, they were guided in active exercises by a physiotherapist. Ethical approval was sought before commencing the study (*Blinded for review purposes* ID 2010-0110), all patients gave their informed consent prior to inclusion.

2.1.2. Statistical analysis

Analyses were performed in SPSS 24 (SPSS Inc., Chicago, IL, USA). Shapiro Wilk test was used to check and confirm normality of the data. An a priori value of 0.05 was used to denote statistical significance. Demographic data were described using mean and SD and inter-group differences were tested using the independent samples *t*-test. A former study investigating cuff-suture using QuickDASH as primary outcome has shown that a sample size of 147 would give an 87% power in calculating a minimal clinical difference of 10 in the questionnaire.¹⁶

3. Results

One hundred and eighty patients that underwent combined subacromial decompression and repair of rotator cuff tear were matched with 180 patients undergoing subacromial decompression only – constituting the study group of 360 whereof 287 (80%) were available for follow-up at a mean of 7.5 years (Fig. 1). Demographic data for the two groups are presented in Table 1. Thirty-four of patients in the combined surgery group (19%) reported to have had an acute trauma at the debut of symptoms; these were classified as traumatic tears and excluded for

Fig. 1. Flow-chart showing patient inclusion, matching and loss to follow-up at 7.5 years in the decompression and cuff repair groups.

Table 1

Demographic data of decompression only (Group A) and combined decompression and cuff repair (Group B) groups.^a

	Group A (N = 180)	Group B (N = 180)	P-value ^b
Female gender (%)	60	60	N.s.
Right shoulder treated (%)	56	72	0.002
Mean age at surgery (years)	52	58	0.001
Mean length of symptoms at surgery (months)	35	34	N.s.
Available at follow-up evaluation (%)	73	77	N.s.

^a At follow-up evaluation 140 from group A and 147 from group B were available.

^b Based on Chi-square statistics and two-samples *t*-test.

most analyses.

3.1. Secondary operations and complications

In the combined surgery group, 12 (8%) underwent a new arthroscopic procedure; 6 a new repair, 3 capsular release due to a postoperative frozen shoulder and the last patient underwent an acromioplasty. Twenty-two patients (15%) reported transient postoperative stiffness; 4 patients (2%) had been treated for a superficial infection. In the subacromial decompression group, 15 patients (10%) had undergone new surgery; 8 had an acromioclavicular resection whilst 5 had a renewed subacromial decompression, 1 had a frozen shoulder that required intervention (capsulotomy) whilst another had undergone a superior labrum tear from anterior to posterior (SLAP) repair. Fourteen patients (9%) reported transient postoperative stiffness; 1 had been treated for a superficial infection and 1 patient had undergone treatment for a deep infection.

3.2. Clinical outcome at baseline and follow-up

For both the decompression only and the combined surgery groups, an overall significant improvement was seen in QuickDASH, VAS of pain and VAS of function, from the preoperative assessment to the follow-up assessment (Tables 2 and 3). VAS of satisfaction was found to be 82 (out of 100) and 86 in the decompression only and the combined surgery groups, respectively. When comparing outcomes between the groups, no differences were seen in pre- or postoperative QuickDASH, pre- or postoperative VAS function or the postoperative VAS satisfaction (n.s.). A significant difference was found in VAS preoperative pain between groups – 72 in the decompression only group versus 65 in the combined surgery group ($P = .005$). Such a difference could, however, not be found at the follow-up evaluation (n.s.).

3.3. Results dependent on age at time of surgery

In the group as a whole, no difference was found between patients 55 years or older ($N = 137$) and those below 55 ($N = 102$) in terms of pre- and postoperative QuickDASH, pre- and postoperative VAS pain and preoperative VAS function (n.s.). Postoperative VAS of function

Table 2

Shoulder function before surgery and at 7 years after isolated decompression.

	Preoperative assessment	Follow-up evaluation	P-value ^a
Mean QuickDASH score	53.1 (SD 18.1)	16.2 (SD 17.6)	< 0.001
Mean VAS function	31.0 (SD 23.7)	79.4 (SD 24.8)	< 0.001
Mean VAS pain	71.8 (SD 19.2)	14.7 (SD 22.1)	< 0.001
Mean VAS satisfaction		82.6 (SD 23.7)	NA

^a Independent samples *t*-test.

Table 3

Shoulder function before surgery and at minimum 7 years after combined decompression/cuff repair.

	Preoperative assessment	Follow-up evaluation	P-value ^a
Mean QuickDASH score	50.9 (SD 19.8)	14.4 (SD 18.5)	< 0.001
Mean VAS function	33.0 (SD 23.7)	83.5 (SD 21.4)	< 0.001
Mean VAS pain	64.8 (SD 22.0)	14.7 (SD 22.1)	< 0.001
Mean VAS satisfaction		86.1 (SD 21.3)	NA

^a Independent samples *t*-test.

was, however, found to be 84 in those above 55 years at surgery and 77 in those below 55 years at surgery ($P = 0.038$). When comparing groups below and above 55 years in the subacromial decompression group only, no differences (n.s.) could be found in QuickDASH or VAS pain/VAS function dependent on age. Neither if looking at the group undergoing combined surgery, were any differences in outcomes seen dependent on age (n.s.).

3.4. Results dependent on acute or traumatic debut of symptoms in combined surgery group

Nineteen percent ($N = 34$) of the patients in the combined surgery group reported to have an acute onset of their symptoms. When compared to those with a gradual onset of symptoms, no differences (n.s.) were found in the preoperative scores (DASH or VAS pain/function). In the postoperative scores, however, poorer results were seen in those with gradual onset of symptoms: QuickDASH was 9 compared to 16 in those with gradual onset ($P = 0.02$); and VAS of pain was 9 compared to 18 in those with gradual onset ($P = 0.03$).

4. Discussion

The main finding is a general improvement of results from the baseline preoperative assessment to follow-up at 7.5 years after either isolated subacromial decompression or combined subacromial decompression and rotator cuff repair. In the combined surgery group, patients with an acute onset of symptoms had significant better results than those with gradual onset. Further, in the study group as a whole, a larger improvement in function (evaluated as VAS of function) at the final evaluation was seen in patients above 55 years at the time of surgery when compared to the younger patients.

A range of studies have reported on results after isolated arthroscopic subacromial decompression (ASD) or arthroscopic rotator cuff repair but none, to the best of our knowledge, have made a comparative follow-up evaluation of both. Jeager et al. evaluated 95 patients at 20 years after subacromial decompression.¹¹ Results were stratified after the intraoperatively assessed degree of impingement, ranging from intact tendons to those with full-thickness tears with secondary osteoarthritis. Based on the rate of successful endpoints (Constant score > 70 and no revision surgery), there was a clear tendency towards a lower success rate at follow-up with increasing rotator cuff damage at the time of surgery. In another study, Kartus et al. investigated the preventive effect of surgical intervention in 26 patients with SPS and partial thickness cuff tear.¹⁷ By assessing the integrity of the supra- and infraspinatus tendons with ultrasound, they found that 9 out of 26 patients (35%) had progressed to have a full-thickness cuff tear after the ASD. The authors concluded that ASD and debridement did not, on its own, protect the further degeneration of the rotator cuff tendon. Contrasting that study, none of the patients in the current group that had undergone isolated subacromial decompression surgery did later undergo any cuff repair (during the observation period). One could speculate whether the ASD did protect against further development of rotator cuff tear in the current population, but lack of information of presence of partial thickness tears makes such a comparison hard. The

present study did not use ultrasound (nor MRI) at the final evaluation and the true rate of later progression of SPS to full thickness rotator cuff rupture is therefore not known.

The age of the patients presenting with a shoulder disease could possibly affect the choice of treatment. Whereas older patients with cuff tears previously may have been more likely to receive a non-operative treatment, studies now suggest surgery might be a good option. Flurin et al. reported a major improvement in function 1 year after rotator cuff repair in patients of 70 years and above, leading the authors to recommend surgical intervention in selected active elderly patient.¹⁸ The current study shows excellent results in those above 55 years of age at mid- to long-term follow-up with a VAS of function of 84 and DASH of 16 and a (somewhat surprising) better results than in the younger patient group (VAS of function 77). A formerly stated notion of less functional demand in the elderly population might be challenged by the ongoing demographic shift towards more healthy and active mid-aged/elderly citizens. Given that these groups will desire a continued active lifestyle, we might see a shift towards more active surgical treatment in the older age group since the prevalence of rotator cuff disease is strongly correlated with age.¹⁹

Routinely performing concomitant ASD with repair of chronic cuff tears has been challenged by studies that have found similar outcomes if performing cuff repair in isolation.²⁰ Ames et al. reported on outcomes after performing isolated arthroscopic rotator cuff repair in 115 patients.²¹ An overall improvement in function was seen, with results comparable to the current study (QuickDASH of 10.2) at the 2-year follow-up. By measuring the so-called AI-index (the degree of acromial coverage of the humeral head) a relation between high AI-index – representing a mechanical pathogenesis – and the presence of cuff tear was investigated. Although no such relation was found, worse patient-specific outcomes, a higher number of tendons torn and the use of more suture anchors (for the repair) were found in patients with a high AI-index. An important critique pointed out clear limitations of the above studies, but also of those included in an extensive review that analyzed the role of ASD in cuff repair.^{22,23} In addition to a call for more clinical studies – a clear need was seen for a more concise terminology describing this “spectrum of shoulder diseases”. In sum, the decision to leave out ASD when performing rotator cuff repair does seem to need some nuancing.

Some inherent limitations in the current study needs to be addressed. A more comprehensive evaluation of outcomes including radiological and clinical measures could have shed light of potential disease progression (including re-rupture) that is perhaps not reflected in patient-reported scores due to patient adaptation. Another limitation is in the case-control study design that does not offer optimal control of confounding factors. Finally, there is no control-group of untreated or non-operatively treated patients that will allow for comparison of the effectiveness of the surgical interventions. Strengths include the large patient series – with the combined surgery group being the largest to date with a mid- to long-term follow-up of rotator cuff repair. Also, the rare 80% follow-up rate in a long-term follow-up provide more reliable and generalizable results.

5. Conclusion

The current work found an overall improvement in outcomes from baseline to the mean 7.5- year follow-up evaluation of patients that underwent ASD for SPS and ASD combined with cuff repair for a full thickness rotator cuff tear. There was no evidence of inferior outcomes in SPS – a proposed earlier stage of a degenerative shoulder disease – as compared to patients with combined ASD and rotator cuff surgery. The finding of better outcomes in those above 55 years at the time of surgery adds to the debate on how age should influence the choice of

treatment in rotator cuff disease.

Conflict of interest

None.

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References

1. Linsell L, Dawson J, Zondervan K, et al. Prevalence and incidence of adults consulting for shoulder conditions in UK primary care; patterns of diagnosis and referral. *Rheumatology*. 2000;45:215–221.
2. Bigliani LU, Levine WN. Subacromial impingement syndrome. *J Bone Jt Surg Am*. 1997;79:1854–1868.
3. Neer CS. Anterior acromioplasty for the chronic impingement syndrome in the shoulder. *J Bone Jt Surg Am*. 1972;54:41–50.
4. Ogata S, Uthoff HK. Acromial enthesopathy and rotator cuff tear: a radiologic and histologic postmortem investigation of the coracoacromial arch. *Clin Orthop Relat Res*. 1990;254:39–48.
5. Yanagisawa K, Hamada K, Gotoh M, et al. Vascular endothelial growth factor (VEGF) expression in the subacromial bursa is increased in patients with impingement syndrome. *J Orthop Res*. 2001;19:448–455.
6. Jo CH, Shin JS, Kim JE, Oh S. Macroscopic and microscopic assessments of the glenohumeral and subacromial synovitis in rotator cuff disease. *BMC Musculoskel Dis*. 2005;1–9.
7. Papadonikolakis A, McKenna M, Warme W, Martin BI, Matsen FA. Published evidence relevant to the diagnosis of impingement syndrome of the shoulder. *J Bone Jt Surg Am*. 2011;93:1827–1832.
8. Fukuda H, Hamada K, Yamanaka K. Pathology and pathogenesis of bursal-side rotator cuff tears viewed from en bloc histologic sections. *Clin Orthop Rel Res*. 1990;254:75–80.
9. Jo CH, Shin WH, Park JW, Shin JS, Kim JE. Degree of tendon degeneration and stage of rotator cuff disease. *Knee Surg Sports Traumatol Arthrosc*. 2016;25:2100–2108.
10. Farfaras S, Sernert N, Rostgård-Christensen L, Hallstrom E, Kartus J. Subacromial decompression in patients with impingement syndrome results in better clinical outcome compared to physiotherapy in the long term. A prospective randomised study. *Orthop J Sports Med*. 2017;5 [2325967117S0011].
11. Jaeger M, Berndt T, Rührman O, Lerch S. Patients with impingement syndrome with and without rotator cuff tears do well 20 years after arthroscopic subacromial decompression. *Arthroscopy*. 2015;32:409–415.
12. Ryölä A, Laimi K, Äärämaa V, Lahtimäki K, Kukkonen J, Saltychev M. Surgery or conservative treatment for rotator cuff tear: a meta-analysis. *Disabil Rehabil*. 2016;1–7.
13. Beaton DE, Wright JG, Katz JN, Upper Extremity Collaborative Group. Development of the QuickDASH: comparison of three item-reduction approaches. *J Bone Jt Surg Am*. 2005;87:1038–1046.
14. MacDermid JC, Khadilkar L, Birmingham TB, Athwal GS. Validity of the QuickDASH in patients with shoulder-related disorders undergoing surgery. *J Orthop Sports Phys Ther*. 2015;45:25–36.
15. Phillips NJ, Ali A, Stanley D. Treatment of primary degenerative arthritis of the elbow by ulnohumeral arthroplasty. *J Bone Jt Surg*. 2003;85:347–350.
16. Inderhaug E, Kollevold KH, Kalsvik M, Hegna J, Solheim E. Preoperative NSAIDs, non-acute onset and long-standing symptoms predict inferior outcome at long-term follow-up after rotator cuff repair. *Knee Surg Sports Traumatol Arthrosc*. 2015;25:2067–2072.
17. Kartus J, Kartus C, Rostgård-Christensen L, Sernert N, Read J, Perko M. Long-term clinical and ultrasound evaluation after arthroscopic acromioplasty in patients with partial rotator cuff tears. *Arthroscopy*. 2006;22:44–49.
18. Flurin PH, Hardy P, Abadie P, et al. Arthroscopic repair of the rotator cuff: prospective study of tendon healing after 70 years of age in 145 patients. *Orthop Traumatol*. 2013;99:S379–S384.
19. Sher JS, Uribe JW, Posada A, Murphy BJ, Zlatkin MB. Abnormal findings on magnetic resonance images of asymptomatic shoulders. *J Bone Jt Surg Am*. 1995;77:10–15.
20. Mardani-Kivi M, Karimi A, Keyhani S, Hashemi-Motlagh K, Saheb-Ekhtiari K. Rotator Cuff Repair: is there any role for acromioplasty. *Phys Sportsmed*. 2016;44:274–277.
21. Ames JB, Horan MP, Van der Meijden OA, Leake MJ, Millett PJ. Association between acromial index and outcomes following arthroscopic repair of full-thickness rotator cuff tears. *J Bone Jt Surg Am*. 2012;94:1862–1869.
22. Chahal J, Mall N, Macdonald PB, et al. The role of subacromial decompression in patients undergoing arthroscopic repair of full-thickness tears of the rotator cuff: a systematic review and meta-analysis. *Arthroscopy*. 2012;28:720–727.
23. Schneider M. The changing role of Acromioplasty. *Arthroscopy*. 2012;28:1047–1048.