Subacromial Decompression Is Not Beneficial for the Management of Rotator Cuff Disease

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Abstract

» Currently, the 2 most common indications for performing a subacromial decompression are subacromial pain syndrome refractory to nonoperative treatment and repair of rotator cuff tears.

» Multiple, high-quality randomized controlled trials showed that subacromial decompression did not provide improvements in pain, function, or quality of life compared with a placebo surgical procedure or other conservative treatments for patients with subacromial pain syndrome.

» Similarly, several randomized controlled trials failed to prove any functional or structural advantage when performing rotator cuff repairs with or without subacromial decompression.

» Imaging studies showed that subacromial decompression did not prevent the development or progression of rotator cuff tears. Moreover, similar retear rates were reported between patients in which rotator cuff repairs were performed with or without subacromial decompression.

» In conclusion, subacromial decompression did not provide any clinical or structurally substantial benefit for the treatment of subacromial pain syndrome or the surgical repair of rotator cuff tears.

Shoulder pain is among the most frequent musculoskeletal symptoms in orthopaedic practice[1], with its most common diagnosis being subacromial pain syndrome[2,3]. Different terminologies have been used to describe subacromial pain syndrome in the literature. There is a wide spectrum of pathologies that can trigger subacromial pain syndrome including subacromial bursitis, rotator cuff tendinopathy, and partial-thickness or full-thickness rotator cuff tears[4,5]. Overall, patients have typically reported pain when raising the arms above 70° and when making forced movements above the head. Pain is often worst at night, may cause shoulder joint function impairment, and may severely affect the activities of daily life[5,6].

The number of operations for subacromial decompression has increased steadily in the last 2 decades[7,8]. Vitale et al.[7] compared the number of arthroscopic acromioplasties performed in 2006 with those performed in 1996 per candidate for the American Board of Orthopaedic Surgery certification. Compared with 1996, the likelihood of patients undergoing an acromioplasty in 2006 was 2.4 times higher relative to all other orthopaedic outpatient procedures ($p < 0.0001$). Moreover, during the studied period, the number of acromioplasties rose by 254.4%, and the total number of all other orthopaedic outpatient surgical procedures only increased by 78.3%. Similarly, there was a sevenfold increase in the number of patients who

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underwent subacromial decompression in the United Kingdom between 2000 and 2010[8].

Subacromial decompression is a procedure that is performed most frequently to repair a rotator cuff tear or to treat subacromial pain syndrome that was not resolved with nonoperative treatment. However, several high-quality studies have recently been published questioning the efficacy of subacromial decompression for both subacromial pain syndrome[9-11] and rotator cuff repair[12-15]. This review aims to summarize and analyze the existing evidence with regard to the efficacy of subacromial decompression both for subacromial pain syndrome and during the arthroscopic repair of rotator cuff tears.

The Rationale Behind Subacromial Decompression: The Extrinsic Theory

Controversy exists with regard to the physiopathology of subacromial pain syndrome. According to the extrinsic theory, different shoulder joint structures experience mechanical conflict[16,17]. Neer postulated that subacromial pain was the consequence of rotator cuff compression between the humeral head and the acromial undersurface[16,18]. According to this mechanistic theory, pathophysiology starts from edema and thickening of bursa (stage 1). It progresses to fibrosis and inflammatory changes (stage 2) and eventually to partial or complete tear of the tendon (stage 3)[16,18].

Other authors hypothesized that the development of rotator cuff tears may be also influenced by the morphology of the acromion[19]. Bigliani et al.[19] classified acromial morphology into 3 categories: type I, flat; type II, curved; and type III, hooked. The authors reported that there was an association between a hook-shaped acromion and cuff degeneration[19]. Therefore, this theory led to the use of acromioplasty to remove the subacromial bursa and some bone from the anteroinferior acromial surface to prevent impingement on the rotator cuff tendons[18].

Acromioplasty experienced various modifications over time. The original techniques included the extirpation of the lateral aspect of the acromion or even a total acromionectomy[20,21]. However, these techniques led to an unacceptable rate of deltoid complications. In 1972, Neer[18] proposed the use of anterior acromioplasty based on cadaveric studies that showed that spurs and excrescences were on the acromial undersurface.

Ellman[22] characterized arthroscopic subacromial decompression, which consisted of bursal debridement, anterior acromial resection, and coracoacromial ligament release, which is actually the most expanded procedure[9-11,15].

Contradictions to the Extrinsic Theory

Unlike the extrinsic theory, the intrinsic theory about rotator cuff pathology postulates that diminished vascular supply, aging, and tensile forces are the factors leading to rotator cuff failure[23-26]. Age-related microscopic changes and decreased vascularity predispose the tendon to degenerative tearing[23-27]. Moreover, both acute trauma and repetitive microtrauma can promote tensile overload and fiber failure of the rotator cuff[27,28]. According to the intrinsic theory, the initial event is rotator cuff degeneration or rupture. This leads to the weakening of the supraspinatus tendon, which becomes unable to center the head of the humerus on the glenoid. Thus, upward migration of the humeral head occurs, abutting the cuff against the undersurface of the acromion. Sustained over time, this mechanism is responsible for the osteophytic spurring of the acromial undersurface commonly seen in patients with subacromial pain syndrome[17,27]. Moreover, acromial morphology on radiographs has shown a fair to poor level of interobserver reliability[29,30].

Furthermore, supporters of the intrinsic theory put in doubt the potential influence of acromial morphology on rotator cuff pathology[31,32]. In a cadaveric study, Ogata and Uhthoff[32] studied 76 autopsy specimens and showed that, despite the degenerative changes observed in the acromial undersurface of 86% of the patients, most of them had articular-sided partial rotator cuff tears, which seems to indicate that it is within the tendon where cuff tendinopathy primarily occurs. Moreover, in another cadaveric study, Wuelker et al.[33] showed in 10 cadavers that acromioplasty only reduced subacromial pressure by 5%. Although some authors have reported that the acromial shape could have an impact on the etiology of rotator cuff disease, several investigations conducted with a large number of patients failed to prove such an association[34-36]. Kim et al.[35] evaluated 227 patients who underwent magnetic resonance arthrography (MRA) and were unable to find a significant association between the severity of supraspinatus tearing and acromial morphology.

Comparison Between Subacromial Decompression, Placebo, and Nonoperative Interventions in Patients with Subacromial Pain Syndrome

Using subacromial decompression as a treatment for subacromial pain syndrome is controversial. In a Cochrane review published in 2008, Coghlan et al.[37] evaluated how effective and safe a surgical procedure is in managing rotator cuff disease. They included 14 randomized controlled trials (RCTs) with a total of 829 participants. Patients with impingement were included in 11 of these trials. The authors did not find any significant differences in outcome when comparing open or arthroscopic subacromial decompression with active nonoperative treatment for the treatment of subacromial pain syndrome. Nonetheless, the authors emphasized that the trials included examined heterogeneous interventions, all of which were prone to bias, limiting their ability to draw firm conclusions about the

benefits and harms of a surgical procedure for subacromial pain syndrome.

However, several studies have been published in the past decade confirming these results (Table I). In 2009, Ketola et al.[38] performed an RCT including 134 patients, comparing a supervised exercise program (n = 66) with arthroscopic acromioplasty followed by a supervised exercise program (n = 68). Despite the fact that some improvement was observed in both groups, no significant difference was found either in relation to the visual analog scale (VAS) or in the secondary outcomes considered, which were pain at night, disability, Shoulder Disability Questionnaire score, number of days experiencing pain, and number of patients without pain. More recently, Farfaras et al.[39] randomized 55 patients with subacromial pain syndrome into treatments of open acromioplasty (n = 15), arthroscopic acromioplasty (n = 19), or physiotherapy (n = 21). In their study, they found there were no significant differences between the 3 groups in a period of 2 to 3 years after the intervention[39]. Some recent RCTs were performed including a placebo surgery control group[9,40]. In 2018, Beard et al.[9] performed a multicenter, randomized, placebo-controlled, 3-group trial in 32 British hospitals. They included 313 patients who were randomly assigned to 1 of 3 treatment groups: (1) decompression surgery (n = 106), (2) diagnostic arthroscopy only (n = 103), and (3) no treatment (n = 104). No clinically important difference was found by the authors in terms of pain or functional scores when comparing the surgical groups with the no-treatment group. Moreover, surgical decompression did not result in any additional positive effect when compared with

TABLE I Summary of Level-I and II RCTs Comparing Subacromial Decompression with Conservative Treatment or Placebo*

Study	Level of Evidence	Sample Size	Interventions†	Age‡ *(yr)*	Follow-up *(mo)*	Main Outcomes	Main Findings
Ketola[38] (2009)	I	134	Arthroscopic subacromial decompression and exercise therapy combined (68), exercise therapy (66)	Combined (46.4), exercise therapy (47.8)	24	VAS	Arthroscopic acromioplasty provides no clinically important effects compared with a structured and supervised exercise program with regard to subjective outcome or cost-effectiveness when measured at 24 months
Farfaras[39] (2016)	II	55	Arthroscopic subacromial decompression (19), open subacromial decompression (15), exercise therapy (21)	Arthroscopic subacromial decompression (48.9), open subacromial decompression (52.4), exercise therapy (49.9)	31.2	Constant score, Watson and Sonnabend score, SF-36 scale	No significant differences between the 3 groups in functional scores and subjective health-related quality of life at 2 to 3 years after intervention in patients with subacromial pain syndrome
Beard[9] (2018)	I	313	Arthroscopic subacromial decompression (106), diagnostic arthroscopy (103), no treatment§ (104)	Arthroscopic subacromial decompression (52.9), diagnostic arthroscopy (53.7), no treatment§ (53.2)	12	Oxford Shoulder Score	Patients treated operatively had better outcomes for shoulder pain and function compared with patients who underwent no treatment, but this difference was not clinically important; surgical decompression appeared to offer no additional benefit compared with arthroscopy
Paavola[40] (2018)	I	193	Arthroscopic subacromial decompression (59), diagnostic arthroscopy (63), exercise therapy (71)	Arthroscopic subacromial decompression (50.5), diagnostic arthroscopy (50.8), exercise therapy (50.4)	24	VAS	No benefit at 24 months with arthroscopic subacromial decompression compared with diagnostic arthroscopy

*SF-36 = Short Form-36. †The values in parentheses are given as the number of patients. ‡The values in parentheses are given as the mean. §No treatment consisted of 1 control at 3 months.

arthroscopy only. The authors postulated that the difference between groups might be explained by postoperative physiotherapy or a placebo effect[9]. Similarly, also in 2018, Paavola et al.[40] performed another multicenter, 3-group, randomized, double-blinded, sham-controlled trial in 3 Finnish public hospitals. They included 193 patients with subacromial pain syndrome who were randomly classified into 1 of 3 treatment groups: (1) decompression surgery (n = 59), (2) diagnostic arthroscopy only (n = 63), and (3) exercise therapy (n = 71). They found that arthroscopic subacromial decompression was not any better than diagnostic arthroscopy at 24 months.

Long-Term Outcomes of RCTs Comparing Subacromial Decompression with Other Treatments

In 2017, Ketola et al.[41] published the long-term outcomes from their previously published RCT in 2009[38]. From the initial 134 patients, 90 (67%) were evaluated for a mean period of 12 years after being randomized. In line with the results obtained in the short-term assessment, the final long-term follow-up revealed no significant differences in either pain or any functional outcome measures. Finally, in a recent, double-blinded RCT, Kolk et al.[42] studied the long-term clinical and structural outcomes of 56 patients by randomly assigning them to arthroscopic bursectomy alone (control) or bursectomy combined with acromioplasty. Patients had a median follow-up of 12 years. At the 12-year follow-up[42], the authors reported that arthroscopic acromioplasty did not reveal any significant additional benefit compared with bursectomy alone in terms of clinical outcomes and rotator cuff integrity.

Rotator Cuff Repair with and without Subacromial Decompression

Partial-Thickness Rotator Cuff Tears

Unlike the cases with subacromial pain syndrome or full-thickness rotator cuff tears, studies comparing partial-thickness rotator cuff tear repair with and without subacromial decompression are scarce. In a recent investigation with regard to long-term results of in situ repair of articular and bursal partial-thickness rotator cuff tears without acromioplasty, Rossi et al. evaluated 62 patients with a mean follow-up period of 10 years (range, 8 to 12 years). In this study, a significant improvement in functional scores and range of motion was observed. Moreover, 87% of the athletes who participated were able to resume sports practice, and 80% achieved the same level that they had before the injury. Functional outcomes were equally favorable in patients with articular and bursal-sided tears. Patients did not undergo any revision surgical procedures. Although no structural assessment was performed, this study showed that partial-thickness rotator cuff tear repair without acromioplasty is a reliable and long-lasting procedure[43].

Full-Thickness Rotator Cuff Tears

The role of subacromial decompression has been reevaluated (Table II). Gartsman and O'Connor[44] performed the first prospective RCT comparing patients who had undergone rotator cuff repairs with and without acromioplasty. The included patients had a full-thickness supraspinatus tear and a type-II acromion. The authors found no significant difference in American Shoulder and Elbow Surgeons (ASES) scores between the groups[44]. Milano et al.[45] examined the role played by subacromial decompression in rotator cuff repair in an RCT including 80 patients evenly distributed between groups with a minimum follow-up period of 2 years. Neither the Constant score nor the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire score revealed any differences between groups[45]. In an RCT, MacDonald et al.[46] compared arthroscopic rotator cuff repair with and without acromioplasty in terms of functional and quality-of-life indices and revision surgery rates. No difference was found in functional scores or reoperation rates between groups[46]. Interestingly, the authors found that 3 of 4 revision cases had an acromion type of III.

In 2012, Shin et al.[47] performed an RCT comparing arthroscopic rotator cuff repair with and without acromioplasty in patients with small to medium-sized tears. This RCT was the first to compare structural healing (with postoperative magnetic resonance imaging [MRI]) in addition to functional scores. Similar to previous authors, no significant differences were found between groups in relation to functional outcomes (range of motion or VAS, ASES, Constant, and University of California Los Angeles [UCLA] scores) and retear rates between groups[47]. In a 2014 RCT, Abrams et al.[48] compared 43 patients who underwent arthroscopic rotator cuff repairs with 52 patients who underwent rotator cuff repair and acromioplasty. The authors reported no difference in clinical outcomes (VAS, ASES, UCLA, Simple Shoulder Test [SST], and Constant scores) following rotator cuff repair with or without acromioplasty at 2 years postoperatively[48]. In 2017, Bond et al.[49] published a collaborative nationwide project that represents the largest study to date comparing rotator cuff repair performed on patients with and without acromioplasty. A total of 2,441 patients were included. In accordance with previous studies, no significant differences were found between the 2 groups in terms of pain or shoulder function[49].

In 2018, Sun et al.[13] published a systematic review with meta-analysis comprising all RCTs and quasi-RCTs to evaluate the outcomes of arthroscopic repair of full-thickness rotator cuff tears with or without acromioplasty in a total of 465 patients. No significant differences were reported in clinical outcomes for patients who had undergone arthroscopic rotator cuff repair with or without acromioplasty at short-term follow-up[13]. Similar findings were reported later by Cheng et al. in another meta-analysis[12]. Koh et al.[36] evaluated 100 patients with postoperative MRI at a mean

TABLE II Summary of RCTs Comparing Rotator Cuff Repair with and without Acromioplasty*

Study	Level of Evidence	Inclusion Criteria	Sample Size	Interventions†	Age‡ *(yr)*	Follow-up *(mo)*	Evaluated Outcomes	Main Findings
Gartsman[44] (2004)	I	Isolated, full-thickness supraspinatus tear and type-II acromion	93	Rotator cuff repair (46), rotator cuff repair with acromioplasty (47)	59.7	15.6	ASES	Arthroscopic subacromial decompression did not change the functional outcome after arthroscopic rotator cuff repair
Milano[45] (2007)	I	Full-thickness rotator cuff tear, and type-II or III acromion	80	Rotator cuff repair (40), rotator cuff repair with acromioplasty (40)	60.4	24	Constant, DASH, Work section of DASH	At short-term follow-up, subacromial decompression did not significantly affect the outcome of arthroscopic rotator cuff repair
MacDonald[46] (2011)	I	Full-thickness rotator cuff tear <4 cm, and type-I, II, or III acromion	86	Rotator cuff repair (41), rotator cuff repair with acromioplasty (45)	56.8	24	WORC, ASES	No difference in functional and quality-of-life indices for patients who had rotator cuff repair with or without acromioplasty
Shin[47] (2012)	II	Full-thickness rotator cuff tear <3 cm and type-I, II, or III acromion	120	Rotator cuff repair (60), rotator cuff repair with acromioplasty (60)	56.8	35	ASES, Constant, UCLA, VAS	Arthroscopic repair of small to medium rotator cuff tear provided pain relief and improved functional outcome with or without acromioplasty; clinical outcomes were not significantly different
Abrams[48] (2014)	II	Full-thickness rotator cuff tear, and type I, II, or III acromion	95	Rotator cuff repair (43), rotator cuff repair with acromioplasty (52)	58.8	24	ASES, Constant, UCLA, VAS, SST	No difference in clinical outcomes after rotator cuff tear with or without acromioplasty at 2 years postoperatively

*WORC = Western Ontario Rotator Cuff Index. †The values in parentheses are given as the number of patients. ‡The values are given as the mean.

period of 13.4 months following rotator cuff repair. In this study, no significant differences were reported by the authors in functional outcomes or retear rates in terms of the postoperative acromial shape.

In patients with subacromial pain syndrome, no study to date has proven that subacromial decompression can prevent the development of rotator cuff tears or can improve structural healing rates[41,47,50-53]. Therefore, the pathophysiological mechanisms that lead to rotator cuff dysfunction are not addressed by using subacromial decompression as a form of treatment.

New Concepts: The Critical Shoulder Angle

Nyffeler et al.[54] utilized the critical shoulder angle, which combines the measurements of glenoid inclination and lateral acromial extension (the acromion index), to study the relation of these radiographic parameters with the incidence of rotator cuff tears. The authors argued that a large index leads to a more vertical orientation of the force vector of the deltoid middle fibers. In turn, this will cause the humeral head to move upwards, thus requiring a greater horizontal force from the supraspinatus to stabilize the center of rotation when active abduction is performed, which might result in rotator cuff tears[55]. The number of publications related to the critical shoulder angle has increased steadily in recent years. Although some studies have identified a greater critical shoulder angle in patients with rotator cuff tears[56-59], others have failed to show an association between critical shoulder angle and rotator cuff tear severity or progression[60,61]. Furthermore, although there seems to be an association between the critical shoulder angle and the development of rotator cuff

pathology, its clinical importance is not clear. This is evidenced by several studies that showed a lack of correlation between the critical shoulder angle and functional outcomes after rotator cuff repair[62,63].

In summary, the role played by the critical shoulder angle in rotator cuff pathology remains uncertain at the moment. Future studies with an adequate number of patients and control groups would be useful to better determine if lateral acromioplasty should be considered a necessary adjunct for a primary repair.

Conclusions

There is substantial evidence showing that subacromial decompression did not lead to a clinically substantial improvement in functional outcomes or patient satisfaction compared with placebo or other conservative treatments for patients with subacromial pain syndrome. Given the high methodological quality of the analyzed evidence, future studies comparing subacromial decompression with other conservative treatments are unlikely to change the results. Furthermore, although adverse events associated with subacromial decompression are low, serious adverse events such as infection, deep venous thrombosis, peripheral nerve damage, and even death following an arthroscopic shoulder surgical procedure have been observed[64,65].

With regard to rotator cuff repair, several RCTs and meta-analyses, most performed in the last decade, revealed no significant differences in clinical or structural outcomes for patients undergoing arthroscopic rotator cuff repair with or without acromioplasty at a short-term follow-up. However, it is important to highlight that, although the current literature strongly favors not performing subacromial decompressions for acromion types I and II, the role of acromion type III is uncertain, as many of the included studies excluded them or only included a very limited number of patients with this type of acromion[44,48].

Finally, long-term studies showed that subacromial decompression did not prevent the development or progression of rotator cuff tears. Moreover, subacromial decompression did not protect rotator cuff integrity, and retears occurred similarly between patients in whom rotator cuff repairs were performed with or without subacromial decompression.

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