The role of acromioplasty when repairing rotator cuff tears—no difference in pain or functional outcome at 24 months in a cohort of 2,441 patients

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ABSTRACT

AIM: The role acromioplasty with rotator cuff repair remains unclear. This study aims to test the null hypothesis—that acromioplasty in conjunction with rotator cuff repair has no effect on improvement in pain or shoulder function at two years follow up.

METHODS: Data was obtained from a collaborative nationwide project between March 2009 and December 2010, and consisted of a total of 2,441 patients undergoing primary repair of superior rotator cuff tears. Multivariate analysis was performed to assess the effect of the inclusion of acromioplasty at the time of rotator cuff repair on visual analogue scale (VAS) pain scores and Flex Shoulder Function (Flex SF) scores at 24-month follow up.

RESULTS: On univariate analysis there was a significantly higher Flex SF score in the acromioplasty group (40.5) compared to the no acromioplasty group (38.7) and a lower mean pain score at 24 months in the acromioplasty group (1.44 vs 1.74). There was a significant difference in tear area and surgical repair technique between the two groups. On multivariate analysis there was no statistically significant difference in Flex SF or VAS pain scores between the two groups.

CONCLUSION: There was no difference in pain or function scores at two years following rotator cuff repair regardless of whether or not acromioplasty was performed. This paper represents the largest study to date comparing acromioplasty to no acromioplasty in the setting of cuff repair. It supports previous literature in showing no significant difference in pain or shoulder function between the two groups.

The concept of acromioplasty aiming to reduce extrinsic mechanical impingement was introduced by Dr Neer in 1972,[1] however, the exact role of acromioplasty when repairing rotator cuff tears remains unclear. Acromioplasty is commonly performed in conjunction with rotator cuff repair (RCR), with 94% of cases in this study utilising the technique despite a paucity of support in the literature.

Rising use of acromioplasty worldwide has been reported.[2] However, a number of recent randomised studies have failed to show a benefit to acromioplasty in conjunction with rotator cuff repair,[3–5] and current AAOS guidelines suggest that routine acromioplasty is not required at the time of RCR.[6,11] The number of patients in these studies was relatively small, and it is possible they lacked sufficient power to detect a smaller clinical benefit to acromioplasty with RCR. This paper details the first large-scale registry data relating to RCR and aims to answer the clinical question as to whether acromioplasty at the time of RCR is associated with improved post-operative pain and functional scores.

A collaborative nationwide project was established to collect prospective function and pain outcome scores on patients undergoing RCR in 2009. To date, it forms the largest prospective cohort of RCRs. It presents multi-centre, multi-surgeon data and has the advantage of large patient numbers encompassing a wide range of orthopaedic practice from large academic institutions to smaller community hospitals. We used registry data to test the null hypothesis—that acromioplasty has no effect on improvement in pain or shoulder function at two years follow up.

Materials and methods

The group collected information from 92 surgeons operating in various centres across the country between 1 March 2009 to 31 December 2010. All surgeons performing rotator cuff repairs in the country were invited to participate. The registry was approved by the National Ethics Committee and patient consent was obtained prior to data collection. Procedures included primary and revision repairs of full thickness rotator cuff repair. Patient recruitment occurred in the pre-assessment clinic or at time of surgery booking. A total of 2,571 patients were recruited. For the acromioplasty analysis, patients undergoing revision RCR and isolated subscapularis repairs were excluded, leaving a total study population of 2,441 patients. Follow-up for pain and shoulder function scores in this group was 71.3% at 24 months.

Pre-operative questionnaire

The pre-operative questionnaire was self-administered and collected baseline information, including age, gender, self-reported ethnicity, hand dominance, smoking status, recreational and occupational activity, duration of symptoms and whether the tear was trauma related. Pre-operative pain and Flex-Shoulder Function (Flex SF) questionnaires were also collected.

Shoulder function assessment

The Flex-SF score is a validated shoulder-specific functional assessment score, that is rated highly when compared to other shoulder scores.[7,8] A lower score represents a greater disability. This questionnaire was self-administered pre-operatively.

Pain assessment

Pain levels were ascertained by a four question self-administered questionnaire about pain status over the preceding month. Patients were asked to grade (max 10) their "pain at its least", "pain at its worst" and "average pain". Patients were also asked if pain had disturbed their sleep more than once per night, once per night, almost once per night, a few times per week, less than once per week or never.

Operation day questionnaire

This questionnaire was completed on the day of surgery by the primary operating surgeon. It detailed specific intra-operative findings, surgical techniques and post-operative instructions. Limited bursectomy was defined as "enough clearance to perform surgery only", extensive bursectomy was defined as "deliberate circumferential clearance of subacromial bursa". The operative approach was considered arthroscopic when the entire repair was performed through arthroscopic ports; mini-open if the acromioplasty was done arthroscopically with no deltoid detachment; or open if the RCR was directly visualised and repaired through an incision with partial deltoid take-down.

Intra-operative findings were recorded, including which tendons were involved, tendon quality, tear size and presence of long head of biceps or labral pathology. Tears were classified as partial or full thickness. Tendon quality was reported as poor, thin, good (some deterioration) or very good (normal thickness). Tear size was reported in both the anterior-posterior (AP) dimension and extent of retraction. These were each estimated by the operating surgeon and classified into five categories, <1cm, 1.1 to 2.0cm, 2.1 to 3.0cm, 3.1 to 4cm, 4.1 to 5cm. Tear area was a multiple of AP tear size and tear retraction.

Post-operative questionnaire

Flex SF and VAS scores were collected at 6, 12 and 24 months post-operatively.

Statistical analysis

Data was analysed using GenStat 18 (VSN International, UK) and Minitab 17.2 (Minitab Inc, USA) software with the assistance of a professional statistician (LH). Differences between groups were considered statistically significant when p values were less

than 0.05. A multiple linear regression model was used to control for potential confounders and included the variables age, gender, ethinicity, smoking status, tear area, surgical approach and repair technique. The effect of acromioplasty on improvement in VAS pain score and improvement in Flex SF score at 24 months was evaluated while adjusting for the other predictors listed.

Results

Of 2,441 patients included in this study, 2,293 (94%) had an acromioplasty performed and 148 (6%) had no acromioplasty at the time of RCR (Table 1). Twenty-four month follow-up data was obtained for 71.3% of Flex SF scores and VAS pain scores.

Demographics

1,892 (78%) patients were below the age of 65 years and 549 (22%) were over 65 years. There were 736 (30%) female patients and 1,705 (70%) male.

On univariate analysis there was no difference in mean Flex SF scores at 24 months for age, smoking status and surgical approach. The mean Flex SF score at 24 months was higher for males than females. Ethnicity also appeared to have an effect on the mean Flex SF scores, with Pacific Islanders having the lowest scores compared to Asians, Europeans and Māori (Table 2).

There was no difference in pain scores at 24 moths for age, gender and surgical approach. Pacific Islanders have the highest

Table 1: Technical information from operation day questionnaire.

Surgical approach	Arthroscopic Open Mini-open Not recorded	418 (17%) 1,044 (43%) 956 (39%) 23 (1%)
Type of repair	Single row Double row Not recorded	970 (40%) 1,284 (53%) 187 (7%)
Fixation method	Bone tunnels Suture anchors Combination Not recorded	195 (8%) 1,753 (72%) 350 (14%) 143 (6%)
Associated acromioplasty	Yes No	2,293 (94%) 148 (6%)
Bursectomy	Nil Limited Extensive Not recorded	154 (6%) 1,072 (44%) 1,195 (49%) 20 (1%)
Distal clavicle resection	Yes No Not recorded	156 (6%) 2,143 (88%) 142 (6%)
Long head of biceps intervention	Left in situ Tenodesis Tenotomy Not recorded	926 (38%) 392 (16%) 491 (20%) 632 (26%)

Table 2: Univariate comparison of mean pain and functional scores by demographic variables.

	Flex SF (24 months)	VAS Pain (24 months)
Overall mean	40.3	1.5
Age		
<65 years	40.0	1.4
>65 years	40.5 (p=0.307)	1.5 (p=0.650)
Gender		
Male	40.8	1.5
Female	39.3 (p=0.001)	1.4 (p=0.149)
Ethnicity		
Asian	37.4	2
European	40.5	1.4
Māori	38.2	1.9
Pacific Island	33.8	2.6
Other	42.4 (p=0.023)	1.4 (p<0.001)
Smoking status		
Smoker	40.1	1.8
Non-smoker	40.1 (p=0.931)	1.4 (p=0.021)
Approach		
Open	40.1	1.5
Mini-open	40.7	1.4
Arthroscopic	40.5 (p=0.420)	1.4 (p=0.454)
Acromioplasty		
Yes	40.5	1.4
No	38.6 (p=0.029)	1.7 (p=0.005)

mean VAS pain scores compared to other ethnicities. There was a higher mean VAS pain score for smokers compared to non-smokers (Table 2).

Acromioplasty

The acromioplasty and no acromioplasty group were similar with regards to age, gender, ethnicity, smoking status, approach and fixation method (Table 3). Acromioplasty patients had a mean tear area that was significantly smaller than the mean tear area for those who didn't have acromioplasty (4.75 vs 6.97, p=0.00). There was also a statistically significant relationship between acromioplasty and repair technique (p=0.007) with fewer double-row repairs in the acromioplasty group (55% vs 65%) (Table 4).

There was no difference in mean pain scores for the acromioplasty and no acromioplasty groups pre-operatively, at six months or at 12 months (Figure 1). On univariate analysis there was a small difference in mean pain scores for the acromioplasty and no acromioplasty groups at 24 months (Table 2). There were also higher mean Flex SF scores at each post-operative time point for the acromioplasty group (Table 2, Figure 2).

Multivariate analysis was performed controlling for age, gender, ethnicity, smoking status, tear area, surgical approach and repair technique with the effect of acromioplasty on improvement in VAS pain and Flex SF scores investigated using a multiple linear regression model. This analysis showed no difference at 24 months for improvement in pain (3.23 vs 2.95, p=0.379) or improvement in Flex SF score (16.19 vs 14.74, p=0.230) between acromioplasty versus no acromioplasty groups (Table 5).

Table 3: Demographic data by acromioplasty status.

	Acromioplasty (n=2,293)	No acromioplasty (n=148)
Age >65 years	515 (22.4%)	19 (12.8%)
Age <65 years	1,775 (77.4%)	129 (87.2%)
Not recorded	3 (0.2%)	0
Male	1,596 (69.6%)	110 (74.3%)
Female	698 (30.4%)	38 (25.7%)
Asian	20 (0.9%)	1 (0.7%)
European	1,058 (46.1%)	62 (42%)
Māori	69 (3%)	2 (1.3%)
Pacific Island	20 (0.9%)	0
Other	23 (1%)	0
Not recorded	1,102 (48.1%)	83 (56%)
Smoker	133 (5.8%)	8 (5.4%)
Non smoker	1,056 (46%)	58 (39.2%)
Not recorded	1,105 (48.2%)	82 (55.4%)
Approach:		
Open	996 (43.4%)	47 (31.8%)
Mini-open	884 (38.5%)	72 (48.6%)
Arthroscopic	392 (17.1%)	26 (17.6%)
Not recorded	22 (1%)	2 (1.4%)
Fixation method:		
Bone tunnels	194 (8.5%)	1 (0.8%)
Suture anchors	1,627 (70.9%)	124 (83.8%)
Combination	333 (14.5%)	17 (11.7%)
Not recorded	140 (6.1%)	5 (3.4%)

Table 4: Analysis by acromioplasty status.

	Acromioplasty	No acromioplasty	
Tear area	4.75cm^2	6.97cm^2	p<0.01
Repair technique	55% double row	65% double row	p=0.007

Discussion

This study showed that there is no difference in pain or functional outcome scores following RCR regardless of whether or not acromioplasty is performed. This paper represents the largest study investigating the effect of acromioplasty on outcome following RCR and includes 2,441 patients with follow up to two years post-surgery.

The extrinsic theory of rotator cuff failure was first postulated by Neer in 1972, and acromioplasty was advocated during rotator cuff repair to prevent impingement.[1] However, recently many authors have challenged this hypothesis, as more advanced surgical and imaging techniques have implicated intrinsic pathology in the etiology of rotator cuff tears.[2,5,9,10] Accordingly, the clinical value of acromioplasty has been questioned. Despite this, acromioplasty continues to be performed frequently in conjunction with arthroscopic RCR. This is likely due to both an ongoing belief that acromial impingement contributes to rotator cuff disease and the improvement in visualisation accorded by acromioplasty, especially when performing a RCR.Four randomised controlled trials and one systematic review have looked at the role of acromioplasty in

Figure 1: Comparison of mean pain scores at different time points.

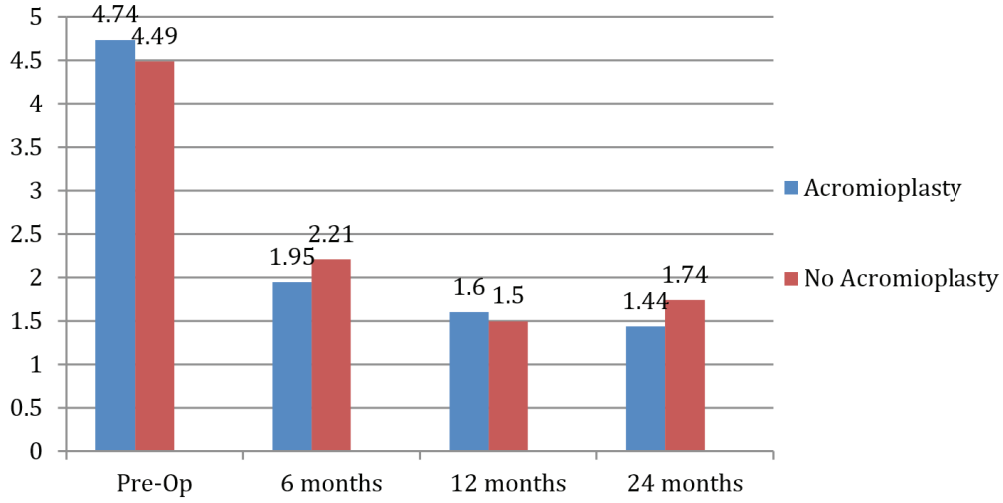
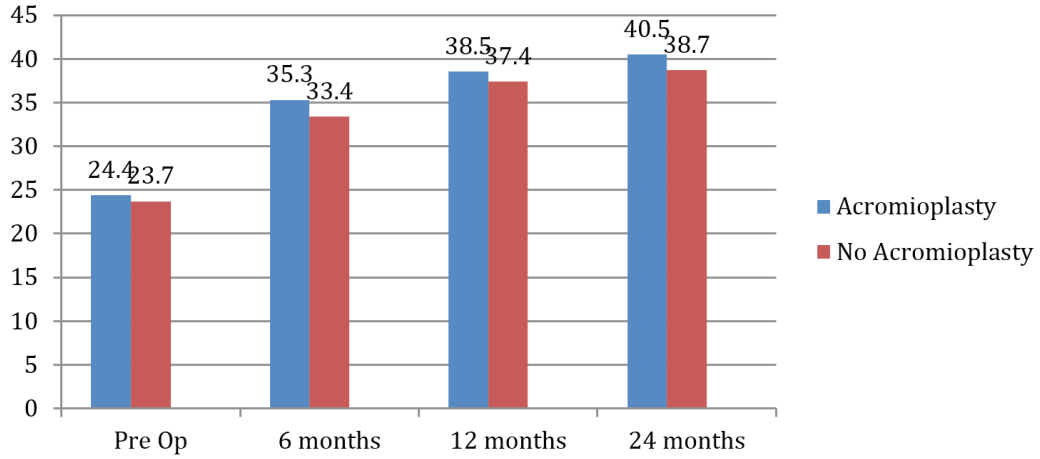


Figure 2: Comparision of mean Flex SF scores at different time points.



association with RCR.[4,5,9,11,12] Abrams et al[5] performed a randomised controlled trial to compare the outcomes of patients undergoing arthroscopic rotator cuff repair for full thickness tears with or without acromioplasty. With a total study population of 114 (43 non-acromioplasty; 52 acromioplasty) and an 83% follow-up rate at two years, they demonstrated no significant difference in functional outcome between the groups at any time point. Similarly, Gartsman et al[12] showed no significant difference in functional outcome with a randomised prospective trial and a minimum of one year follow up. Their study included 93 patients (46 non-acromioplasty; 47 acromioplasty) with full thickness supraspinatus tears and a type 2 acromion. In a randomised study of 86 patients (45 non-acromioplasty; 41 acromioplasty), MacDonald

Table 5: Mean pain and function scores by acromioplasty status after multivariate analysis.

	Acromioplasty	**No acromioplasty**	
Pain (improvement in VAS pain score)	3.23	2.95	p=0.379
Function (improvement in Flex SF score)	16.19	14.74	p=0.23

et al[4] reported no functional difference between the groups at any time point up to 24 months, but did report a greater number of non-acromioplasty patients requiring reoperation compared to acromioplasty patients (p=0.05). Finally, Milano et al[11] have compared two groups of 40 patients with one group undergoing a subacromial decompression in conjunction with an arthroscopic repair of a full thickness rotator cuff tear. They concluded that subacromial decompression did not significantly alter outcome at two years.

Our study supports the findings of these trials in a larger registry-based cohort. Although there was a small difference with the acromioplasty group having superior outcomes with univariate analysis, after controlling for potential confounding variables, we found no difference in pain or function regardless of whether or not acromioplasty is performed in conjunction with RCR. This adds weight to and is concordant with previously published literature.[3,9] Data for this study was collected from 92 surgeons and therefore provides a real-world analysis.

In this study, the decision on whether or not to perform acromioplasty was based on individual surgeon's judgement, and reasons for the decision were not collected. We found no difference between the acromioplasty and non-acromioplasty groups with regards to patient factors and surgical approach. However, there was a higher number of large tears in the non-acromioplasty group. It may be that the decision not to perform an acromioplasty in patients with larger tears was to avoid anterosuperior escape of the humeral head and subsequent rotator cuff arthropathy. Similarly, there were more double row repairs in the non-acromioplasty group, and this likely reflected the higher number of larger tears in this group.

There are a number of limitations to this study. Firstly, the results of the current study must be considered taking into consideration the inherent limitations associated with registry data, which is not randomised or interventional. However, use of this cohort provided a large sample size and was collated from 92 surgeons using a range of approaches (arthroscopic, mini-open and open). There was a high percentage of follow up at 24 months post-operatively. Secondly, no information was collected regarding the reasoning behind the surgical decision-making and description of surgical findings. To counter this, attempts were made to standardise groupings of surgical data to make recording reproducible. Suggestions were made in the operating day form on how to group categories, but some categories, for example tendon quality, were difficult to standardise. Finally, despite the large number of patients in this study, the number treated without acromioplasty was relatively small. This perhaps reflects that despite recent data most surgeons still feel that acromioplasty is a standard part of rotator cuff repair and this may have contributed to the study being underpowered. However, the group is significantly larger than in previous studies. Although the surgical decision-making in this study was in 2009 and 2010, which predates the more recent articles on this subject. It may be that factors other than clinical outcome are important in the decision to perform an acromioplasty during RCR, such as surgical visualisation.

Conclusion

In conclusion, in this large registry study we found no difference in pain or functional outcome at two years regardless of whether or not acromioplasty was performed in conjunction with RCR. Acromioplasty at the time of RCR remains the choice of the operating surgeon.

Competing interests:
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Acknowledgements:
No outside funding source was involved in the data collection, data analysis or the preparation or editing of this study. The New Zealand Rotator Cuff Registry is a charitable trust which has received funding from a number of sources. The authors wish to acknowledge the Accident Compensation Commision research grant which provided the majority of the funding. We also wish to acknowledge funding from the New Zealand Shoulder and Elbow Society, The New Zealand Orthopaedic Association Trust, The Wishbone Trust, Device Technologies, Johnson & Johnson and Smith & Nephew.
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