Open acromioplasty does not prevent the progression of an impingement syndrome to a tear
NINE-YEAR FOLLOW-UP OF 96 CASES
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We performed open acromioplasty for intractable impingement syndrome on 96 shoulders (93 patients) with an intact rotator cuff. All the shoulders were examined by ultrasound after a mean interval of nine years. Those showing pathological findings, a poor or fair subjective result, or deterioration of the primary excellent outcome had MRI and/or arthrography.

The mean Constant score for the affected shoulders was 70 points and that for 48 non-involved, symptom-free shoulders, 84 points. The subjective outcome was excellent in 45, good in 24, fair in 18 and poor in 9 shoulders. Complete tears were found in 12 shoulders and partial tears in seven. A total of 14 shoulders was symptom-free after acromioplasty, but after an average of five years became painful again and showed deterioration. Of these, six had complete tears and four partial tears of the cuff. The tear rate was 4% in shoulders initially judged to be excellent, 25% in good, 33% in fair and 55% in poor shoulders. The tear rate was 71% in shoulders which subsequently deteriorated. The incidence was higher in men (25%) than in women (11%).

We conclude that a tear of the rotator cuff may appear after acromioplasty, although there was no evidence of a tear at the time of operation. This is usually the reason for deterioration in a shoulder with an initially good operative outcome.

Received 7 November 1997; Accepted after revision 30 March 1998

An impingement syndrome is a common cause of shoulder pain. Neer1,2 described three progressive stages of impingement. Stage I usually occurs in individuals younger than 25 years of age, especially those who are regularly engaged in overhead use of the arm. The observable pathological changes are oedema and haemorrhage in the subacromial bursa. If impingement continues, the condition becomes chronic, producing thickening and fibrosis of the bursa and tendinitis of the cuff. Stage II is common in patients aged between 25 and 40 years. Stage III results from further impingement, producing degeneration and complete or incomplete tears of the rotator cuff. These more advanced changes are usually seen in patients over the age of 40 years.2,3

It has been suggested that anterior acromioplasty in stage-II impingement syndrome will prevent tears of the cuff.2,4 This makes sense mechanically but has not been proven to be effective. It has also been suggested that acromioplasty relieves the impingement but the change in the rotator cuff persists.5

We analysed the late outcome in the rotator cuff of 96 shoulders in which open acromioplasty had been performed for advanced, intractable impingement syndrome, to see if the tendinitis had improved or if the degenerative process had progressed, resulting in a tear of the rotator cuff.

Patients and Methods
Between 1977 and 1986, we performed open acromioplasty on 102 patients for intractable impingement syndrome5 with no clinical evidence of progression to a tear. Two patients later died and seven could not be contacted. This left 93 patients (96 shoulders) with a mean age at operation of 45 years (26 to 69) available for follow-up after a mean of nine years (6 to 15). There were 60 men and 33 women; in three both shoulders were involved. Of the 96 shoulders, 62 were right and 34 left; 67 were dominant, 23 non-dominant and six patients were ambidextrous. The mean duration of shoulder symptoms before surgery was 3.25 years (0.5 to 15). On admission, all the patients had a painful arc in abduction.6,7 In 49 shoulders there was positional discomfort and rest pain at night. All patients had a positive impingement test1,6,8 and sign.9

Single contrast arthrography had been performed on 33 shoulders and there was no sign of a complete or partial joint-side tear in any. Routine shoulder radiographs of 68 shoulders were examined. Calcific deposits were present in 31, degenerative changes in the acromioclavicular joint in
12, and sclerosis and erosion of the anterior acromion in four.

At the time of the operation 71% of the subjects were doing heavy manual work, while 12% were engaged in moderately heavy tasks and 17% were light manual workers.

**Operative technique.** The procedure followed that described by Neer. The deltoid muscle was detached from the anterior acromion. The coracoacromial ligament was cut off and the superficial layer of the subacromial bursa was removed. The latter was markedly thickened and scarred in 42 cases. The rotator cuff was explored and no sign of a complete or partial superficial (bursal-side) tear was found. Joint-side tears cannot usually be seen without opening the cuff or performing arthroscopy, which was not part of our routine. Evidence of superficial wear of the supraspinatus tendon was found in 35 shoulders and a calcific deposit in four. Using an osteotome, we resected about 1.5 cm of the under surface of the anterior part of the acromion and excised any prominent inferior osteophytes of the acromioclavicular joint (eight shoulders). Excision of the distal end of the clavicle was carried out if there were radiological signs of degenerative change or the acromioclavicular joint was painful on palpation (21 shoulders). The deltoid muscle was reattached through drill holes in the anterior margin of the acromion. Six patients had a repeat acromioplasty later on without success. The complications included one wound infection and eight cases of temporary stiffness of the shoulder.

Active and passive elevation of the arm and rotation of the shoulder began from the first day after operation under the supervision of a physiotherapist, who taught the patient a home rehabilitation programme.

**Assessment.** We used the method described by Thorling et al. to determine the subjective outcome and the Constant Shoulder Functional Score for the functional result comparing it with that of 48 unaffected shoulders.

Ultrasound examination was carried out and routine radiographs obtained for all shoulders. At review, the radiographs revealed 22 calcific deposits, 14 cases of acromioclavicular degeneration and 10 of slight sharpening of the anteroinferior border of the acromion. MRI or single contrast arthrography was undertaken if ultrasonography showed any signs of disorder of the rotator cuff, or if the shoulder was painful (subjective result, poor or fair).

The results were analysed by using SPSS Version 7.0 for Windows. Student’s *t*-test was used in statistical analysis.

**Results**

The overall subjective final result was excellent in 45, good in 24, fair in 18 and poor in nine shoulders. As shown in Table I the mean Constant score at follow-up for the 96 involved shoulders was 70 points (24 to 100) and for the 48 unaffected, symptom-free shoulders 84 (74 to 98). The mean score for pain was 10.5 (0 to 15) and 15 (all 15), for the activities of daily living 26 (0 to 35) and 35 (all 35), for range of motion 35 (14 to 40) and 38 (34 to 40) and for power of abduction nine (0 to 25) and 11 (1 to 25), respectively.

The mean Constant score was higher in men than in women (74 *v* 64 points; *p* = 0.011) and lower in the 21 shoulders with resection of the distal clavicle than that of the remaining 75 shoulders (61 *v* 72 points; *p* = 0.011).

The mean age at operation of these two groups was 48 and 45 years, respectively.

**Tear of the rotator cuff.** A total of 19 tears (20%) was found of which 12 were complete (Table II). In one case,
open repair had been carried out eight years after acromioplasty with an excellent result and no sign of a tear on ultrasound examination at follow-up. Six cases were diagnosed using both MRI and ultrasound, two by MRI, ultrasound and arthrography, three by ultrasound and arthrography and one by MRI and arthrography. The five joint-side partial tears and the two bursal-side partial tears were diagnosed by ultrasound and MRI.

The tear rate of 25% was higher in the men with six partial (2 bursal- and 4 joint-side) and nine complete tears. In women the rate was 11% with one partial joint-side and three complete tears (Table II). The tear rate varied between different subjective outcome groups, being 4% in excellent (2 complete), 25% in good (4 complete, 2 partial, both joint-side), 33% in fair (5 complete, 1 partial on the bursal side) and 55% in poor cases (1 complete, 4 partial, with 1 on the bursal-side and 3 the joint-side) (Table II).

Ultrasound examination showed signs of a partial tear in four additional shoulders with good or excellent results. Three patients refused further examination and are not included here; one had no pathological findings on MRI.

The mean age at the time of the operation was 50 years (37 to 58) in the 12 shoulders with a total tear of the rotator cuff compared with 45 years (37 to 54) in the seven with a partial tear (p = 0.090) and 45 years (26 to 69) for the remaining 77 affected shoulders (p = 0.034).

**Outcome of 14 cases which deteriorated.** Fourteen shoulders which had become completely symptom-free after the acromioplasty developed pain after an average of five years (2 to 10). At the follow-up examination, the subjective outcome for six of these shoulders was still good, while six had a fair and two a poor outcome. The mean Constant score was 60 points (36 to 84) (Table I). The mean age of this group of patients, at the time of operation, was 46 years (34 to 57). Six shoulders (3 good, 3 fair) had a complete tear and four (2 good, 2 fair) a partial tear (Table II). The tear rate was 71%. One shoulder (fair) had a marked spur at the inferior margin of the acromion and thinning of the supraspinatus tendon on MRI. One shoulder (fair) had developed marked osteoarthritis of the glenohumeral joint and had a hemiarthroplasty eight years after acromioplasty. Two shoulders (1 good, 1 fair) showing no pathology of the rotator cuff on ultrasound had no further examination.

**Discussion**

The subjective outcome after open acromioplasty is generally favourable, with excellent and good results ranging from 43% to 94% (Table III). The subjective results in our study were similar to others with shorter follow-up periods (Table III). Objective outcomes, evaluated by the Constant functional score, were not equally favourable. Compared with the non-involved painless shoulder, the mean point

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**Table II. Rotator-cuff tears in different groups**

<table>
<thead>
<tr>
<th></th>
<th>Total number of cases</th>
<th>Total number of tears</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Complete</td>
<td>Joint-side</td>
</tr>
<tr>
<td>All cases</td>
<td>96</td>
<td>12</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>60</td>
<td>9</td>
</tr>
<tr>
<td>Female</td>
<td>36</td>
<td>3</td>
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<tr>
<td>Initial outcome</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>45</td>
<td>2</td>
</tr>
<tr>
<td>Good</td>
<td>24</td>
<td>4</td>
</tr>
<tr>
<td>Fair</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td>Poor</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Late outcome</td>
<td></td>
<td></td>
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<tr>
<td>Deteriorated</td>
<td>14</td>
<td>6</td>
</tr>
</tbody>
</table>

**Table III. Clinical outcome, follow-up time and scoring method after open acromioplasty for advanced impingement syndrome (no tear) in previous series**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Number of cases</th>
<th>Mean follow-up (mth)</th>
<th>Good and excellent results (%)</th>
<th>Scoring method</th>
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</thead>
<tbody>
<tr>
<td>Neer</td>
<td>19</td>
<td>30</td>
<td>94</td>
<td>Own</td>
</tr>
<tr>
<td>Tibone et al</td>
<td>35</td>
<td>28</td>
<td>43</td>
<td>Return to sports</td>
</tr>
<tr>
<td>Thorling et al</td>
<td>51</td>
<td>21</td>
<td>65</td>
<td>Own</td>
</tr>
<tr>
<td>Post and Cohen</td>
<td>72</td>
<td>23</td>
<td>89</td>
<td>Own</td>
</tr>
<tr>
<td>McShane, Leinberry and Fenli</td>
<td>29</td>
<td>25</td>
<td>67</td>
<td>Own</td>
</tr>
<tr>
<td>Hawkins et al</td>
<td>108</td>
<td>62</td>
<td>87</td>
<td>Own</td>
</tr>
<tr>
<td>Jalovaara, Puranen and Lindholm</td>
<td>36</td>
<td>60</td>
<td>69</td>
<td>Own</td>
</tr>
<tr>
<td>Stuart et al</td>
<td>66</td>
<td>96</td>
<td>77</td>
<td>Own</td>
</tr>
<tr>
<td>Rockwood and Lyons</td>
<td>37</td>
<td>24</td>
<td>89</td>
<td>Own</td>
</tr>
<tr>
<td>Sachs, Stone and Divine</td>
<td>22</td>
<td>12 to 24</td>
<td>&gt;90</td>
<td>Unknown</td>
</tr>
<tr>
<td>Hartwig and Burkhard</td>
<td>58</td>
<td>96</td>
<td>86</td>
<td>Own</td>
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</table>
deficit was 14 which corresponds to mild disability according to Constant and Murley.\textsuperscript{11} Constant scoring has not been previously applied as regards the outcome of open acromioplasty, so that no comparison is possible.

We observed a relatively high incidence of tears of the rotator cuff after open acromioplasty at long-term follow-up. We could find no previous reports which showed the development of tears of the rotator cuff after a decompressive operation. Most earlier studies of open acromioplasty have concentrated on the clinical outcome. We have focused on the condition of the rotator cuff and examined all the operated shoulders by ultrasound. In suspicious cases and symptomatic shoulders, both arthrography and MRI were performed. These methods, which have high rates of accuracy, are routinely used in the diagnosis of tears of the rotator cuff. The reliability of our results was assessed by using two or three of these techniques. In one case, diagnosis was confirmed by surgery.

It must be emphasised that in some cases the patient may have had an undetected partial tear of the joint-side at the time of operation, which did not heal or which progressed to a full-thickness tear. As shoulder arthroscopy and MRI were not used routinely at the time when the operations were carried out, the diagnosis of a partial tear of the joint-side could not be confirmed.

According to clinical experience, a good outcome after acromioplasty is not always permanent, and the symptoms may recur after some years. The mean follow-up times in many earlier reports of outcome after open acromioplasty have been too short to show these late failures (Table III). In our study with a longer follow-up time, some shoulders, showing a favourable primary outcome, deteriorated after some years. Most of these had developed a tear. This suggests that the disease process may continue in the rotator cuff after acromioplasty, despite the disappearance of symptoms and the elimination of signs of subacromial compression. Cuff tears were also found in shoulders which did not benefit from acromioplasty, and also in pain-free shoulders. When these are included, nearly one-fifth of the operated shoulders showed either a partial or complete tear. The tear rate was higher in men than in women, which may reflect the greater forces employed in the male shoulder. It has been shown in cadaver and ultrasonic studies that partial and complete tears of the rotator cuff may occur in the asymptomatic population, and that they are age-related.\textsuperscript{12,13}

According to the extrinsic theory of the pathogenesis of impingement, the lesion in the rotator cuff is caused by mechanical compression by the coracoclavicular arch. As a result, the disease process should come to a halt after decompressive acromioplasty; the outcome of surgery should be permanent. If the symptoms recur, however, and the disease progresses to a tear despite acromioplasty, intrinsic factors such as a degenerative process in the cuff may be significant. Based on studies of pathological changes beneath the acromion in shoulders with tears of the cuff, Ozaki et al\textsuperscript{13} suggest that tears or injuries are the result of intrinsic rather than extrinsic causes associated with impingement, as described by Neer.\textsuperscript{8} They found that although a lesion under the anterior third of the acromion was always associated with a tear of the cuff, the reverse was not true. They concluded that the pathogenesis of most cuff tears was probably an intrinsic degenerative process. Our results partially support their findings.\textsuperscript{13} Most of our patients remained symptomless and showed no evidence of a tear, suggesting that the process in the tendon did not progress in these cases. It seems therefore that both extrinsic mechanical and intrinsic degenerative factors are involved in the pathogenesis of impingement syndrome.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References


THE JOURNAL OF BONE AND JOINT SURGERY