Pain relief and functional results after resection arthroplasty of the shoulder

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We have examined the relief from pain and the functional outcome in 18 patients who underwent resection arthroplasty of the shoulder as a salvage operation between 1988 and 2002. The indications included failed shoulder replacement in 17, with infection in 13, and chronic septic arthritis in one. The mean follow-up was 8.3 years (2.5 to 16.6). Two intraoperative fractures of the humerus occurred, both of which healed.

The level of pain was significantly decreased (t-test, p < 0.001) but five patients continued to have moderate to severe pain. The mean active elevation was 70˚ (0˚ to 150˚) postoperatively and represented an improvement from 39˚ (0˚ to 140˚) (t-test, p = 0.003), but internal and external rotation were hardly changed. The mean number of positive answers on the 12-question Simple Shoulder Test was 3.1 (0 to 12) but the shoulder was generally comfortable when the arm was positioned at rest by the side. The mean post-operative American Shoulder and Elbow Surgeon’s score was 36 (8 to 73).

Despite applying this procedure principally to failed shoulder replacements, the results were similar to those reported in the literature for patients after severe fracture-dislocation. Reduction of pain is possible in one half to two-thirds of patients. The outcome of this operation in providing relief from pain cannot be guaranteed, but the shoulder is usually comfortable at rest, albeit with profound functional limitations.

Resection arthroplasty is a rare option for failed total shoulder replacement, persistent chronic infection of the glenohumeral joint, or unreconstructable trauma. There have been few published reports to guide the surgeon on the anticipated results of this procedure. An early description of resection arthroplasty by Steindler1 quoted Garre as obtaining a cure for all conditions in 80 of 105 shoulders. Several other studies have suggested that resection arthroplasty could be a salvage procedure for post-traumatic conditions.2-7 In the largest series, by Féry et al8 of 35 patients, pain was minimal in 19 of the 28 evaluated. Active flexion was less than 40˚ in six, 40˚ to 80˚ in ten and greater than 80˚ in 12. Lettin, Copeland and Scales9 reported removal of a failed constrained shoulder implant in nine patients, of whom six had only mild pain. The mean active abduction obtained by the whole group was 55˚ and the mean external rotation was 10˚. In an earlier publication from our unit describing ten patients treated between 1950 and 1981 by excision arthroplasty, eight obtained relief from pain.10 The mean active abduction was 55˚ (40˚ to 80˚) and the mean external rotation 0˚ (-15˚ to +20˚).10

We report the contemporary results of resection arthroplasty of the glenohumeral joint as a salvage procedure, principally for failed total shoulder replacement, often with associated infection.

Patients and Methods

We identified 34 patients who had undergone resection arthroplasty of the shoulder between June 1988 and May 2002. At the time of the study, four had died, six could not be traced and six declined to participate, leaving 18 available for inclusion. There were ten women and eight men with a mean age at the time of operation of 37 years (51 to 79). The right shoulder was involved in 12 patients and the dominant arm affected in 12. Ethical approval had been obtained for the study.

The patients were asked to return for clinical and radiological evaluation at regular intervals. Those who were unable to do so were sent a validated questionnaire11 and arrangements were made for them to be seen by a local orthopaedic surgeon for clinical and radiological assessment. The findings were then forwarded to us.
The mean follow-up was 8.3 years (2.5 to 16.6) with three shoulders followed up for between two and five years, nine for between five and ten years, four for between ten and 15 years and two to a maximum of 16.6 years. All but one patient had undergone at least one previous shoulder replacement, three had two previous procedures and two had three such operations. Resection arthroplasty was performed for the salvage of a failed prosthetic shoulder replacement in 17 shoulders and for the treatment of chronic septic arthritis with loss of glenohumeral cartilage in one. At the time of the resection arthroplasty there was active infection in 13 patients, persistent uncorrectable glenohumeral instability in four and one had chronic pain after replacement of the humeral head for a complex proximal fracture, complicated by marked bony erosion. The mean time from the last procedure to resection arthroplasty was 33 months (3 weeks to 152 months).

The surgical exposure was through the deltopectoral interval in 16 patients and an anteromedial approach in two. In all patients, existing implants and bone cement were removed and in those with active infection a thorough debridement was performed. The level of humeral resection was at the base of the humeral head in eight shoulders, through the level of the tuberosities in one and inferior to the tuberosities in nine. During removal of the components there was one intra-operative fracture of the humeral shaft and one fracture at the greater tuberosity. In both patients good alignment was maintained without internal fixation and both shoulders subsequently healed without difficulty. All those with continuing infection were treated with intravenous antibiotics for four to six weeks post-operatively.

After surgery the arms were supported in a shoulder immobiliser or sling for a mean of 9.5 weeks (6 to 12). During this period the patients were allowed gentle active use of the hand, forearm and elbow within the limits of comfort. After discontinuing immobilisation a programme of gentle active assisted exercise was started with the aim of achieving elevation of 100°, internal rotation to the abdomen and external rotation of 20°. Strengthening was deferred until at least six months post-operatively (Fig. 1).

Pain was assessed on a ten-point scale with one representing no pain and ten, severe pain. The mean pre-operative pain score was 8.8 (6 to 10; Fig. 2a). Post-operative patient satisfaction was graded in a similar manner on a one- to ten-point scale with one representing extreme dissatisfaction and ten complete satisfaction with the outcome of the procedure. The ranges of pre- and post-operative active elevation and external rotation were estimated in degrees and expressed as means and ranges. The pre- and post-operative ranges of internal rotation were expressed as the median position achieved by the hand when placed into the small of the back. Post-operatively, the patients completed the questions of the Simple Shoulder Test12 and the American Shoulder and Elbow Surgeon’s (ASES) evaluation form.13 There are 100 points available in the ASES score;
come.

the criteria are considered to have an unsuccessful outcome rotation to at least 20˚. Patients who fail to meet any of pain, slight pain or intermittent moderate pain only with treatment a successful result requires the patients to have no temporary designed for assessing the outcome of shoulder replacement.

the distribution of active elevation was 0˚ to 60˚ in 11 patients, 61˚ to 120˚ in four, and 121˚ or greater in three. The value of 39˚ (0˚ to 140˚) to 70˚ (0˚ to 150˚) (Fig. 3).

surgery was 4.6 (1 to 8), but in six shoulders it remained in the lower one-third of the rating scale (Fig. 3). Analgesia continued to be used post-operatively in ten patients and consisted of non-steroidal anti-inflammatory agents in four, opiates in four and a combination of these medications in two. The mean satisfaction rating after the ASES score (Fig. 2b). The functional limitations are profound, as demonstrated by the responses to the Simple Shoulder Test. Only one question, namely, “Is your shoulder comfortable with your arm at rest by your side?” was answered positively by most patients (15 of 18). For all other questions, positive responses ranged from one to a maximum of seven patients. Similarly, because of some continuing pain and functional deficiencies, 14 of the 18 shoulders had an ASES score of 50 points or less. The patients’ satisfaction reflected these lim-

Results

The two intra-operative fractures healed satisfactorily during the post-operative period of immobilisation. All infections were eradicated. No late complications occurred and no additional procedures were performed.

There was significant relief from pain. The mean pain scores decreased from a pre-operative value of 8.8 (6 to 10) to 4.5 (1 to 9) post-operatively (t-test, p < 0.001). However, five patients continued to have moderate to severe pain (Fig. 2b). Analgesia continued to be used post-operatively in ten patients and consisted of non-steroidal anti-inflammatory agents in four, opiates in four and a combination of these medications in two. The mean satisfaction rating after surgery was 4.6 (1 to 8), but in six shoulders it remained in the lower one-third of the rating scale (Fig. 3).

The mean active elevation increased from a pre-operative value of 39˚ (0˚ to 140˚) to 70˚ (0˚ to 150˚) (t-test, p = 0.003). The distribution of active elevation was 0˚ to 60˚ in 11 patients, 61˚ to 120˚ in four, and 121˚ or greater in three. The mean external rotation decreased from a pre-operative value of 33˚ (0˚ to 110˚) to 31˚ (-60˚ to 90˚) post-operatively (t-test, p = 0.88). The median position of internal rotation also showed little change from the sacrum pre-operatively to L5 post-operatively (t-test, p = 0.42).

Post-operatively four patients had no functional activity in their shoulder and nine had function in sedentary activity, two in light activity, and three in moderate activity. One patient participated in professional employment, one continued to be actively involved in domestic activities and the remaining 16 described themselves as retired. The mean number of positive responses to the Simple Shoulder Test was 3.1 (0 to 12) (Table I). The mean post-operative ASES score was 36 (8 to 73) (Fig. 4). Applying the limited-goals aspect of the Neer result rating, only two shoulders could be defined as having a successful outcome and 16 were considered to be unsuccessful. The bad results were due to lack of movement in eight and lack of movement and a high pain rating in the remainder. The outcomes using the Simple Shoulder Test, the ASES score and the Neer result rating were compared for the different levels of resection, i.e. at the base of the humeral head, through the tuberosities and immediately below the level of the tuberosities. The differences in these three groups did not reach a level of statistical significance for the Simple Shoulder Test (t-test, p = 0.09) or for the ASES score (t-test, p = 0.56). There was one successful Neer result rating with a level of resection at the base of the humeral head and one successful rating with a resection below the level of the tuberosities.

Discussion

The main indications for glenohumeral resection have changed from the treatment of complex trauma and septic arthritis to that of infected shoulder replacements. Other indications are uncommon. The operative procedure is not technically demanding and the two fractures which occurred during removal of an implant healed without further surgical treatment or subsequent complication. All infections were eradicated. The potential for rehabilitation is limited and the post-operative programme is straightforward.

However, in common with earlier reports1,2,4-10 of this procedure for the treatment of other conditions, relief from pain cannot be guaranteed; in our series of 18 patients, ten had no or only slight pain at follow-up. The mean active elevation of 70˚ and external rotation of 31˚ were also similar to earlier reports of this procedure.1,2,4-10

The functional limitations are profound, as demonstrated by the responses to the Simple Shoulder Test. Only one question, namely, “Is your shoulder comfortable with your arm at rest by your side?” was answered positively by most patients (15 of 18). For all other questions, positive responses ranged from one to a maximum of seven patients. Similarly, because of some continuing pain and functional deficiencies, 14 of the 18 shoulders had an ASES score of 50 points or less. The patients’ satisfaction reflected these lim-
Table I. The number of positive responses to the Simple Shoulder Test\textsuperscript{12} in the 18 patients

<table>
<thead>
<tr>
<th>Activity</th>
<th>Number of positive responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does your shoulder allow you to sleep comfortably?</td>
<td>7</td>
</tr>
<tr>
<td>Is your shoulder comfortable with your arm at rest by your side?</td>
<td>15</td>
</tr>
<tr>
<td>Can you wash the back of your opposite shoulder?</td>
<td>2</td>
</tr>
<tr>
<td>Can you place your hand behind your head with the elbow straight out to the side?</td>
<td>4</td>
</tr>
<tr>
<td>Can you reach the small of your back to tuck in your shirt with your hand?</td>
<td>3</td>
</tr>
<tr>
<td>Can you lift 8 pounds (3.6 kg) to the level of your shoulder without bending your elbow?</td>
<td>1</td>
</tr>
<tr>
<td>Can you place a coin on a shelf at the level of your shoulder without bending your elbow?</td>
<td>3</td>
</tr>
<tr>
<td>Do you think you can toss a softball overhand 20 yards (18.2 m)?</td>
<td>5</td>
</tr>
<tr>
<td>Would your shoulder allow you to work full time at your regular job?</td>
<td>2</td>
</tr>
<tr>
<td>Do you think you can toss a softball underhand 20 yards (18.2 m)?</td>
<td>5</td>
</tr>
<tr>
<td>Can you carry 20 pounds (9.1 kg) at your side?</td>
<td>7</td>
</tr>
</tbody>
</table>

Bar chart showing the American shoulder and elbow surgeons (ASES) score; combined responses for pain and function.

iterations, both in variability in achieving relief from pain and in recovering function with only six patients scoring their shoulders in the upper part of the ten-point satisfaction scale. Application of the limited-goals rating of Neer et al\textsuperscript{14} initially intended for use in shoulder replacement may not have been completely appropriate, but only two patients had a successful rating using this method.

It is important to view these findings in context. Preoperatively these patients had poor function in their shoulders in terms of pain and limited range of movement, and there was the added problem of infection in 13 of 18 shoulders. Nevertheless, with these limited gains in reduction of pain and increase in the range of movement, the outcome still represented an improvement.

The poor functional results which we have found support the modern approach of attempting to salvage an infected shoulder replacement.\textsuperscript{15} However, there remain certain patients, such as the elderly with limiting comorbidities, who would be best served by a single surgical procedure and those with severe deficiencies of the shoulder capsule, rotator cuff or glenoid which may not be amenable to a further implant. We have outlined the benefits and limitations of resection arthroplasty of the shoulder for future patients who may be candidates for this procedure.

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References