Revision interposition arthroplasty of the elbow

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Between 1996 and 2008, nine patients with severe post-traumatic arthritis underwent revision of a failed interposition arthroplasty of the elbow with a further interposition procedure using an allograft of tendo Achillis at a mean of 5.6 years (0.7 to 13.1) after the initial procedure. There were eight men and one woman with a mean age of 47 years (36 to 56).

The mean follow-up was 4.7 years (2 to 8). The mean Mayo Elbow Performance score improved from 49 (15 to 65) pre-operatively to 73 (55 to 95) (p = 0.04). The mean Disability of the Arm, Shoulder and Hand score was 26 (7 to 42). One patient was unavailable for clinical follow-up and one underwent total elbow replacement three months post-operatively. Of the remaining patients, one had an excellent, two had good, three fair and one a poor result. Subjectively, five of the nine patients were satisfied. Four continued manual labour.

Revision interposition arthroplasty is an option for young, active patients with severe post-traumatic arthritis who require both mobility and durability of the elbow.

Interposition arthroplasty may be used in the treatment of post-traumatic osteoarthritis of the elbow.1,2 Other options include resection arthroplasty, arthrodesis and total elbow replacement (TER). Interposition arthroplasty is particularly suitable for active patients with severe joint destruction who are unable to comply with the 5 kg weight-lifting restriction required following TER.3 Restrictions on lifting may not be required after interposition arthroplasty and it may be more durable than a prosthetic joint in the active patient. There is also less bone resection compared with arthroplasty and little subsequent bone loss, so the potential for revision might be better than that expected after a failed arthroplasty.2,4

To our knowledge, revision of an interposition arthroplasty of the elbow with the introduction of another graft has not previously been published. We describe a series of nine patients who underwent this procedure. We aimed to document the outcomes and determine the variables that might indicate which patients could be candidates for this procedure.

Patients and Methods

Between January 1998 and December 2008, nine consecutive patients underwent revision interposition arthroplasty. In five patients, the first procedure was performed at our centre, and in four it had been undertaken elsewhere. In five the interposing tissue was fascia lata and in four it was tendo Achilles. Seven patients initially obtained good function following the interposition arthroplasty. Two had a poor result less than one year after undergoing the operation elsewhere.

There were eight men and one woman, and the non-dominant arm was affected in seven patients. The mean age at revision was 47 years (36 to 56). At the time of revision arthroplasty, five patients were performing manual labour tasks, one had a sedentary job and three were retired or disabled.

The initial diagnosis was post-traumatic arthritis in all patients. They had undergone a mean of 3.1 (2 to 5) previous operations. The initial injury had been a fracture of the head of the radius in three, a fracture of the distal humerus in two, of the ulna in one, a dislocation of the elbow in one, and fractures in childhood in two. Three had undergone excision of the head of the radius.

The typical candidate for a revision interposition procedure would be a young patient who had a satisfactory initial result from a primary interposition arthroplasty, but who had developed further symptoms.

The mean time from initial injury to primary interposition arthroplasty was 14.5 years (9.0 to 30.0), and the mean time between primary and revision interposition arthroplasty was 5.6 years (0.7 to 13.1). The
main symptom was pain in three patients, stiffness in four and instability in two. Lateral radiographs of the elbow in a patient with post-traumatic arthritis upon presentation to our centre who was treated with interposition arthroplasty are shown in Figure 1.

**Surgical technique.** The surgical exposure used is described by Cheng and Morrey with the exception that the allograft of tendo Achillis is used as the interposition tissue rather than autogenous fascia lata. The ulnar nerve is identified and protected, but only transposed subcutaneously if it is found to sublux from the cubital tunnel at the completion of the operation. A combined anterior and posterior capsulectomy is performed to obtain useful movement of the elbow. Sufficient bone is resected from the articular surfaces of the ulna and humerus to obtain a congruent joint with at least 2 mm to 3 mm of joint space after insertion of the tendon. Care is taken to avoid resection of subchondral bone, which may lead to bony resorption, although the medial and lateral trochlear ridges are removed if necessary to obtain a smooth articulation.

The fresh-frozen allograft of tendo Achillis is affixed to the distal humerus with nonabsorbable sutures placed through drill holes. An additional length of graft is preserved for reconstruction of the collateral ligaments if required. The lateral structures were deficient in seven of the nine cases and reconstruction was carried out. In two cases, both the lateral and medial collateral ligaments were deficient and subsequently reconstructed. In one of the three patients who had undergone excision of the head of the radius, a prosthesis was introduced in order to restore stability of the elbow. A fourth patient underwent resection of the head to restore pronation and supination.

In six patients an external fixator (DJD I or II Dynamic Elbow Joint Distractor, Stryker, Kalamazoo, Michigan) was used to allow movement while protecting the interposition tissue and the ligament reconstruction. It was removed during an examination under anaesthesia performed at a mean of 33 days (27 to 36) after surgery. We now routinely use an external fixator under these circumstances.

**Assessment.** The medical records and radiographs were reviewed by ANL who was not involved in the care of the patients. The pre- and post-operative ranges of movement and stability were recorded by the operating surgeon (BFM). Varus-valgus stability was graded as mild when observed only by the examiner, moderate when there was definite instability and severe if reported by the patient.

The quality of the humeral bone was assessed as previously described: grade I, subchondral bone stock intact; grade II, medial and lateral columns intact; grade III, medial or lateral column absent; grade IV, entire distal humerus absent. Radiological evidence of arthritis was graded according to Broberg and Morrey; grade 0, no degenerative change; grade 1, slight narrowing of the joint space; grade 2, moderate narrowing and osteophytes; grade 3, severe degenerative changes with destruction of the joint; grade 4, ankylosis.

The Mayo Elbow Performance (MEP) score was recorded. A score > 90 is considered excellent, 75 to 89 good, 60 to 74 fair, and < 60 poor. The Disability of the
Arm, Shoulder, and Hand (DASH) score was also recorded. A higher score indicates greater disability.

**Statistical analysis.** Ethical approval was granted and informed consent was obtained. A paired t-test was used to assess the difference in outcome measures before and after surgery. A p-value of < 0.05 was considered significant.

**Results**

The mean follow-up was for 4.7 years (2.0 to 8.0). The results are shown in Table I. Patient four did not complete a survey or return for review, but stated that no further surgery had been performed and that the elbow was unchanged. Patient nine underwent revision to TER at three months after operation because of severe pain and instability. No post-operative DASH or MEP score is available for this patient (Table I).

The pathological findings were noted at surgery. Of the four patients with a previous tendo Achillis interposition, one had graft and fibrocartilage remaining in the joint, and three had remnants of the graft anteriorly and posteriorly on the humerus with a bare articulation. In the five patients with a previous fascia lata graft, two had only fibrous tissue in the joint and three had no evidence of the previous graft.

In the seven patients available for review, the mean arc of flexion-extension increased significantly from 73° (40° to 120°) to 106° (80° to 143°) (p = 0.005). The mean maximum flexion improved from 111° (70° to 135°) to 131° (100° to 195°) (p = 0.1). The mean flexion contracture was 29° (10° to 55°) pre-operatively and 27° (0° to 60°) at follow-up (p = 0.77). The flexion contracture improved in three patients, became worse in three patients, and remained the same in one patient. The mean arc of supination/pronation improved from 105° (10° to 175°) to 138° (90° to 170°), although this only reached statistical significance (p = 0.05). The ranges of movement are shown in Table II.

Two patients presented with severe varus/valgus instability. After revision with reconstruction of the medial and lateral ligaments, the first patient had persistent moderate instability. The second required reconstruction of the lateral ligament only and had persistent mild instability. No patient developed new or additional instability post-operatively.

Two patients had ulnar nerve symptoms at the time of presentation; in one the symptoms resolved after release of

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**Table I. Demographics and outcome measures of the nine patients undergoing revision interposition arthroplasty of the elbow**

<table>
<thead>
<tr>
<th>Patient number</th>
<th>Gender</th>
<th>Age at revision surgery (yrs)</th>
<th>Previous graft*</th>
<th>Time to revision (yrs)</th>
<th>Time to follow-up (yrs)</th>
<th>MEP†</th>
<th>Post-operative rating</th>
<th>Post-operative DASH‡</th>
<th>Patient opinion</th>
<th>Labourer</th>
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<tr>
<td>1</td>
<td>M</td>
<td>50.8</td>
<td>TA</td>
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<td>4.3</td>
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<td>2</td>
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<td>TA</td>
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<td>55</td>
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<td>M</td>
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<td>FL</td>
<td>6.0</td>
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<td>3.0</td>
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<td>Good</td>
<td>Yes</td>
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<tr>
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<td>M</td>
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<td>FL</td>
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<td>60</td>
<td>60</td>
<td>Fair</td>
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<td>FL</td>
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<td>85</td>
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<td>9</td>
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<td>482</td>
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<td></td>
<td></td>
<td>78</td>
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</table>

* TA, tendo Achillis; FL, fascia lata
† MEP, Mayo Elbow Performance
‡ DASH, disabilities of the arms, shoulder and hand
§ N/A, not available

**Table II. Pre- and post-operative range of movement**

<table>
<thead>
<tr>
<th>Patient number</th>
<th>Flexion arc (°)</th>
<th>Flexion contracture (°)</th>
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<tr>
<td></td>
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<td>Post-operative</td>
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<tr>
<td></td>
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<td>Post-operative</td>
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<td>7</td>
<td>40</td>
<td>80</td>
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<tr>
<td>8</td>
<td>65</td>
<td>105</td>
</tr>
<tr>
<td>9</td>
<td>125</td>
<td>N/A, failed</td>
</tr>
</tbody>
</table>

* N/A, not available
the ulnar nerve at the time of surgery. The other underwent transposition of the nerve at the time of revision arthroplasty with full resolution of symptoms. No patients had new nerve symptoms post-operatively.

**Radiological findings.** All elbows were noted to have severe arthritis pre-operatively; eight elbows had grade 3 and one grade 2 degenerative changes. All elbows had grade II humeral bone stock, except one in which it was grade I. At follow-up, one patient advanced from grade II to grade III bone stock. All other patients remained at grade I or II.

**Outcome measures.** In the seven patients available for review the mean MEP score improved from 49 (15 to 60) pre-operatively to 73 (55 to 95) \( (p = 0.04) \). Post-operatively, one patient had no pain, two had mild pain, three had moderate pain with activity, and one patient had severe pain. The mean post-operative DASH score was 26 points (11 to 42). Pre-operative scores were not available. Based on the MEP scores, one patient had an excellent result, two were good, three fair and one poor (Fig. 2).

Two patients rated the elbow as much better, three somewhat better, and three patients rated the elbow as the same following the revision interposition arthroplasty. Following revision arthroplasty four patients were still employed in heavy labour, one continued with sedentary work and three remained disabled or retired. Of the two patients with a poor result from the primary procedure (nos 2 and 5, Table I), the first felt the elbow to be much improved and the second found the elbow to be unchanged. The MEP scores corresponded appropriately, with an increase of 40 points in patient no. 2 and no change in patient no. 5.

**Discussion**

Revision interposition arthroplasty is particularly suitable for the young patient with persistent symptoms following previous interposition arthroplasty. At a mean of almost five years following revision, seven patients with complete follow-up found their elbow to be either improved or no worse. Four patients continued to work in physically demanding careers that a TER would preclude.

Interestingly, there was only limited or no evidence of fibrous tissue at operation in the five patients who had previously undergone interposition arthroplasty using fascia lata. Of the four patients with a previous tendo Achillis
interposition graft, remnants were present in the joint, although the graft over the articulation was worn in three cases. Tendo Achillis may therefore be a more durable allograft than fascia lata under these circumstances.

This study is limited in that it is retrospective with few patients. The procedures were performed over a time span of 12 years by the senior author (BFM) and another surgeon.

The study adds to the limited literature on this subject (Table III). Nolla et al recorded the results of teno Achilles interposition arthroplasty in 16 patients with post-traumatic arthritis. Three patients were lost to follow-up, and two patients had early failure. Of the remaining 11 elbows, one had an excellent result, four good, four fair and four poor, using the MEP scoring system. We previously described the results following primary interposition arthroplasty in 45 patients with post-traumatic arthritis. Seven patients required revision surgery. In the current study, we found similar outcomes in the revision arthroplasty group compared to the primary interposition arthroplasty, with one excellent, two good, three fair, and one poor result.

Both series of primary interposition arthroplasties found a significant improvement in the arc of movement of the elbow by 46° and 73° respectively. In our patients with a revision arthroplasty, there was no improvement in elbow extension, and the total arc of movement only improved by a mean of 23° (5° to 40°). In both series of primary interposition arthroplasty, however, 15% to 45% of the patients had near or complete ankylosis of the elbow, rendering it easier to achieve improved post-operative movement. In the revision interposition arthroplasty group, all patients had at least a 40° arc of movement pre-operatively. Despite this, these findings of reduced patient satisfaction and less improvement in movement may suggest that revision surgery is another significant operative procedure with only modest gains in function.

We therefore conclude that revision interposition arthroplasty should be considered as one salvage treatment for patients with post-traumatic arthritis who wish to continue with active lifestyles and occupations. Revision to TER is a viable alternative, but limits lifting and manual labour. In a recent series, nearly 85% of TERs performed for post-traumatic arthritis in patients under the age of 40 had a good or excellent result. However, 37% required revision within a mean of seven years. For patients who must continue with heavy lifting, the alternatives include resection arthroplasty and arthrodesis, both of which are poorly tolerated due to compromised function. Interposition arthroplasty allows for a mobile joint with greater stability and, we believe, less pain compared with resection arthroplasty.

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