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Interposition Arthroplasty with an Achilles Tendon Allograft as a Salvage Procedure for the Elbow

By A. Noelle Larson, MD, and Bernard F. Morrey, MD

Investigation performed at the Department of Orthopedic Surgery, Mayo Clinic, Rochester, Minnesota

Background: Interposition arthroplasty is often considered to be a salvage option for the treatment of severe elbow arthritis when conservative treatment has failed and total joint replacement is contraindicated. The present retrospective study summarizes the results of a specific interposition arthroplasty technique for the treatment of inflammatory and posttraumatic arthritis of the elbow.

Methods: Between 1996 and 2003, sixty-nine elbows were treated with interposition arthroplasty with an Achilles tendon allograft. Forty-five elbows, including eleven with inflammatory arthritis and thirty-four with posttraumatic arthritis, met our inclusion criteria. The mean patient age was thirty-nine years. The mean duration of clinical follow-up was 6.0 years. Seven patients subsequently underwent revision surgery and were excluded from the analysis. For the thirty-eight remaining patients with surviving allografts, the current Mayo Elbow Performance Score and Disabilities of the Arm, Shoulder and Hand score were obtained and the most recent clinical outcomes and radiographs were reviewed.

Results: In the group of thirty-eight patients with surviving allografts, the mean flexion-extension arc improved from 51° preoperatively to 97° postoperatively (p < 0.001). The mean Mayo Elbow Performance Score improved from 41 points preoperatively to 65 points postoperatively (p < 0.0001). Thirteen patients had a good or excellent result, fourteen had a fair result, and eleven had a poor result; the remaining seven had a revision. On the basis of the Mayo Elbow Performance Score, twelve patients rated the elbow as somewhat better and nineteen rated the elbow as much better following the interposition procedure. Despite efforts to reconstruct the collateral ligaments, preoperative instability on physical examination (found in eleven patients) was associated with low Mayo Elbow Performance Scores (p = 0.03) and high Disabilities of the Arm, Shoulder and Hand scores (p = 0.006). Four of five patients undergoing reconstruction of both collateral ligaments had a net decrease in the Mayo Elbow Performance Score.

Conclusions: We consider interposition elbow arthroplasty to be a salvage procedure as it neither completely eliminates pain nor restores full function. It may be indicated for young active patients with severe inflammatory or posttraumatic arthritis, especially those with limited elbow motion. Furthermore, we do not recommend this procedure when patients present with preoperative instability on physical examination.

Level of Evidence: Therapeutic Level IV. See Instructions to Authors for a complete description of levels of evidence.

Severe elbow arthritis secondary to trauma or inflammatory disease is a difficult problem in the young or active individual. Treatment options include resection arthroplasty, total elbow arthroplasty, arthrodesis, and interposition arthroplasty. Resection arthroplasty and arthrodesis, even as salvage options, are both poorly tolerated. Total elbow arthroplasty yields good results, with initial pain relief and improved function1. There is concern that younger patients with posttraumatic arthritis will require additional surgery following semiconstrained total elbow arthroplasty because of infection, fracture, or bushing wear1–2. Many of these complications can be attributed to strenuous use of the elbow, with forces applied across the joint being greater than the recommended 5-kg weight-lifting restriction. Interposition arthroplasty does not carry the same weight-lifting restriction as total elbow arthroplasty does and may be more durable in the active patient.

Various interposition materials have been used in the ulnohumeral joint, including fascia lata3, cutis graft4, Achilles...
tendon allograft, AlloDerm (LifeCell, Branchburg, New Jersey), bovine collagen, Gelfoam (Pharmacia and Upjohn, Kalamazoo, Michigan), and silicone. Hinged external fixation has been used as a means of initiating early motion while neutralizing forces and thus protecting the soft tissues, the interposed graft, and any ligament repair or reconstruction. We could not find a previously reported series of elbow arthroplasties performed with an Achilles tendon allograft as the interposition material.

The present study was undertaken to assess and compare the outcomes of interposition arthroplasty performed with use of a standardized technique employing an Achilles tendon allograft, ligamentous reconstruction, and an articulated external fixture to protect the soft tissues during the healing phase. We hypothesized that patients presenting with instability and undergoing this interposition arthroplasty would have poorer functional outcomes, including lower Mayo Elbow Performance Scores (MEPS) and higher Disabilities of the Arm, Shoulder and Hand (DASH) scores, in comparison with patients presenting with stiffness or pain.

Materials and Methods

Patients

Inclusion Criteria

Between January 1996 and December 2003, sixty-nine consecutive patients underwent sixty-nine interposition elbow arthroplasty procedures with an Achilles tendon allograft. Nine patients with a congenital, developmental, or post-infectious etiology of the elbow dysfunction were excluded from the study. Three patients were excluded from the study because of a concomitant ulnar or humeral reconstruction with a structural osseous allograft. Twelve patients with less than two years of follow-up also were excluded. The remaining forty-five patients undergoing an arthroplasty for the treatment of inflammatory or posttraumatic arthritis constituted the study cohort.

Demographic Characteristics

The mean age of the patients at the time of the index procedure was thirty-nine years (range, seventeen to sixty-nine years). The study group included fifteen female patients and thirty male patients. The dominant arm was affected in twenty-six patients. The mean age of the patients at the time of the index procedure was forty-two years (range, sixteen to sixty-nine years).

Of the thirty-four patients in the posttraumatic group, thirty had sustained an elbow fracture or dislocation as an adult; three of these fractures were open injuries. One patient had contractures following a burn, complicated by the development of heterotopic ossification. One adolescent patient had osteochondritis dissecans of the capitellum with subsequent development of a severe contracture and arthritis. One patient had an elbow contracture following an injury that had been sustained in a motor-vehicle collision with no associated fracture. Two patients had sustained an elbow fracture during childhood, resulting in pain and poor motion in adulthood. The mean age at the time of presentation was forty-two years (range, sixteen to sixty-nine years).

The chief complaint was pain, stiffness, instability, or some combination of these complaints. Interposition procedures were not performed for patients with an active infection. Three patients had a known history of infection around the prosthesis, complicating previous treatment, but intraoperative tissue analysis and cultures revealed no evidence of current infection.

Previous Procedures

Interposition arthroplasty is typically performed as a salvage procedure in the young patient. In the thirty-four patients in the posttraumatic arthritis group, the mean interval between the injury and the interposition arthroplasty was 8.7 years (range, 0.6 to 40.2 years). The patients in the posttraumatic arthritis group had had a mean of 2.9 previous procedures (range, zero to ten previous procedures) on the affected arm, and the eleven patients with inflammatory arthritis had had a mean of 0.6 previous procedure (range, zero to two previous procedures). A fascial interposition procedure had been previously performed in six patients.

Treatment

Surgical Technique

The surgical exposure is performed as described by Cheng and Morrey, with the exception that an Achilles tendon allograft is used as the interposition material rather than autogenous fascia lata. The ulnar nerve is identified and is only transposed subcutaneously if it is found to subluxate at the completion of the operation. A combined anterior and posterior capsulotomy is performed to obtain useful elbow motion. The joint is

graft that would result. Interposition procedures were not performed for patients with intact articular cartilage, with the preliminary assessment being based on radiographic findings and the final decision to proceed with interposition arthroplasty being made intraoperatively.

The elbow arthritis was inflammatory in eleven patients and posttraumatic in thirty-four. Of the eleven patients with inflammatory disease, four had juvenile rheumatoid arthritis, four had rheumatoid arthritis, and one each had ankylosing spondylitis, psoriatic arthritis, and monoarticular inflammatory arthritis. The mean age at the time of presentation in the group with inflammatory arthritis was thirty-two years (range, twenty to fifty-four years).

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exposed and inspected for the quality and status of the articular cartilage. If >50% of the trochlea and capitellum are covered by articular cartilage, interposition is not carried out. Sufficient bone is resected from the ulnar and humeral articular surfaces to obtain a congruent joint and to accommodate at least 2 to 3 mm of joint space laxity even after insertion of the tendon to avoid overstuffing the joint. Care is taken to avoid resection of the subchondral bone, which may lead to excessive osseous resorption, although the medial and lateral trochlear ridges are removed if necessary to obtain a smooth articulation.

Fresh-frozen Achilles tendon allograft is used as the interposition material and is affixed through drill holes to the distal part of the humerus (Figs. 1, 2, and 3), and additional length of the graft is preserved to use for lateral or medial collateral ligament reconstruction if required (Figs. 4 and 5). The ulnohumeral joint is then reduced, and the integrity of the collateral ligaments is assessed. If adequate tissue is present, the collateral ligaments are repaired primarily. Otherwise, reconstruction of the remaining portion of the ligament is carried out with use of the allograft tendon.

In four cases in the present series, both the lateral and medial collateral ligaments were found intraoperatively to be deficient and a sling reconstruction was undertaken. To accomplish this reconstruction, a tunnel was drilled through the distal part of the humerus, replicating the axis of rotation. A second tunnel was developed through the ulna, connecting the sublime tubercle and the supinator crest. The distal strands of the allograft were then threaded through the humeral and ulnar tunnels to create a sling to reconstruct both collateral ligaments. The sling was tensioned by hand to maintain joint stability but still allow for smooth flexion and extension across the articulation. This procedure was used in three patients in whom the primary complaint was instability and in one patient who had a painless ankylosis. One additional patient had reconstruction of both the medial collateral and lateral collateral ligaments without the use of the sling procedure.

Next, an external fixator (Dynamic Joint Distractor [DJD I or II]; Stryker, Kalamazoo, Michigan) is applied to maintain stability and to distract or separate the joint, allowing for motion while protecting the interposition graft and any ligament reconstruction. In fourteen patients in the present series, however, no fixator was used because the surgeon deemed the stability and motion to be excellent without a fixator. Also, in several instances, patient preference or geographic distances made follow-up impractical, and therefore the external fixator was not applied.

Aftercare
All patients were managed with continuous passive motion in the hospital, typically with an axillary block for regional pain control. Patients were routinely discharged to home on the second postoperative day. Continuous passive motion therapy at home was prescribed for thirty-one patients in whom final motion goals were not achieved during hospitalization. At a mean of thirty-six days (range, sixteen to 121 days) postoperatively, the thirty-one patients with an external fixator were seen for removal of the fixator and gentle elbow manipulation under anesthesia to maximize motion. Four additional patients without an external fixator underwent subsequent examination under anesthesia with gentle elbow manipulation. The mean range of motion at the time of examination with the patient under anesthesia was 114° (range, 80° to 140°). Twenty-eight of these patients had persistent stiffness and were managed with static adjustable flexion and extension splints that were to be worn twenty-three hours per day for three weeks to maintain the range of motion obtained during the examination under anesthesia. Subsequently, part-time maintenance bracing was continued in the same flexion and extension splints for eight to twelve weeks. No dynamic splinting was used, and no patient was managed with formal physical therapy.

Evaluation
The clinical records and radiographs of all forty-five patients were reviewed in detail, and any complications or additional procedures were identified. The mean duration of clinical follow-up was 6.0 years (range, 2.9 to 10.5 years). Preoperative
and postoperative range of motion, including pronation, supination, flexion, and extension, was noted. Varus-valgus stability was assessed as mild (slight instability observed only by the examiner), moderate (definite instability noted by the examiner), or severe (instability that the patient could perceive) 10. The final range-of-motion values and the assessment of instability were typically documented by the operating surgeon.

Fig. 2
Drill holes are placed from posterior to anterior in the distal part of the humerus, just proximal to the articular surface, and sutures are placed in the Achilles tendon graft.

Fig. 3
At completion, the graft makes a smooth, taut, and stable surface without wrinkles or redundancies across the capitellum and trochlea. Horizontal mattress sutures are secured through the drill holes. Centrally, the excess tendon is excised.
The clinical records and all radiographs were reviewed by one of us (A.N.L.), who was not involved in the surgical procedure or the aftercare for any of the patients. Humeral bone was classified, as previously described, as grade I (subchondral bone stock intact), grade II (medial and lateral columns intact), grade III (medial or lateral column absent), or grade IV (entire distal part of the humerus absent). Furthermore, it was noted whether the olecranon was present or absent and whether the coronoid was present, present but with a thinned cortex, or absent. For patients with inflammatory arthritis, radiographs were classified as stage 1 (normal joint surface), stage 2 (joint space narrowing but contour maintained), stage 3 (erosions), and stage 4 (frank destruction).

Fig. 4
Excess graft is preserved medially and laterally for ligament reconstruction should the native medial collateral ligament or lateral collateral ligament be insufficient for a stable repair.

Fig. 5
The deficient lateral collateral ligament is reconstructed with allograft remaining from the Achilles interposition arthroplasty. The hinged external fixator allows motion and protects the reconstruction. (Reprinted, with permission, from: Morrey BF, editor. Master techniques in orthopaedic surgery: the elbow. 2nd ed. Philadelphia: Lippincott Williams and Wilkins; 2002. p 403.)
3 (loss of joint space and mild alteration of articular surface), stage 4 (joint space destruction and loss of joint contour), or stage 5 (ankylosis). For patients with posttraumatic arthritis, radiographs were classified, according to the system of Broberg and Morrey, as 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), or grade 4 (ankylosis).

The MEPS was calculated at the time of the latest follow-up. This scale assigns a maximum of 45 points for no pain, 25 points for the ability to perform functional activities, 10 points for stability, and 20 points for motion. The score is classified as excellent (>90 points), good (75 to 89 points), fair (60 to 74 points), or poor (<60 points). Additionally, Question 15 asks, “Compared with your condition before surgery, how would you rate your elbow function?” with the choices of “much better now,” “somewhat better now,” “the same,” or “worse.” Given the severe disability of many of these patients, we considered this question to be an important subjective measure of their clinical outcome.

The DASH score was also determined. In this questionnaire, twenty-three questions address how difficult it is to complete common daily tasks using both arms. Five questions pertain to the degree of symptoms in the affected arm. Finally, the patient is asked whether he or she is less capable or confident because of the condition of the upper extremity. A higher numeric score indicates greater disability.

Matched-pairs analysis was used to assess differences in the continuous variables reflecting patient outcomes before and after surgery (range of motion and MEPS). Mayo Elbow Performance Scores were binned into a good or excellent result (75 to 100 points) or a fair or poor result (0 to 74 points). DASH scores were binned into a good result (≤40 points) or a poor result (>40 points). The two-tailed Fisher exact test was used for nominal variables (preoperative elbow instability, MEPS, DASH score, postoperative elbow instability). Observed differences with a <5% likelihood of occurring by chance were considered significant.

Approval by the institutional review board was obtained for all aspects of this study, and informed consent was obtained.

**Results**

**Intraoperative Findings**

Four surgeons performed the forty-five procedures, with thirty-nine procedures being performed by the senior author (B.F.M.). Seven patients had complete ankylosis of the joint. An anterior capsulotomy was performed in thirty-two patients, and a posterior capsulotomy was performed in thirteen patients. In twenty-one instances, the tip of the olecranon was removed to improve extension. The greater sigmoid notch was removed in twenty patients. Portions of the coronoid were removed in eight patients in order to achieve articular congruity.

Two patients had removal of a radial head prosthesis at the time of surgery because of implant loosening, although neither patient required replacement of the prosthesis to treat elbow instability. One patient who presented with complete resorption of the radial head and instability of the elbow with valgus stress had a new radial head prosthesis inserted at the time of the interposition arthroplasty. The radial head was partially or completely excised in twelve patients without rendering the elbow unstable, and no radial head implant was placed in these cases.

**Treatment of the Ulnar Nerve**

Nerve complaints were common at the time of presentation. Seven patients had undergone previous transposition of the ulnar nerve. At the time of surgery, twelve patients had neurologic symptoms or pain over the ulnar nerve distribution, and one patient had median nerve dysfunction.

Eighteen patients (six with preoperative ulnar nerve symptoms) had a primary ulnar nerve transposition performed at the time of interposition arthroplasty.

**Clinical Assessment**

Follow-up data were available for thirty-eight of the forty-five patients in the study as seven patients underwent revision surgery with removal of the allograft. All analysis was performed with use of the data on the cohort of thirty-eight patients with remaining allografts in place. The seven revisions are discussed later in the section on complications.

The mean preoperative range of motion was from 49° short of full extension to 100° of flexion, for a mean arc of 51°. At the time of follow-up (mean, 6.0 years), the range of motion was from 28° short of full extension to 125°, for a mean arc of 97°, with a mean improvement of 46° (p < 0.001). Preoperatively, the mean pronation was 44° and the mean supination was 41°, creating a mean arc of 85°. Postoperatively, the mean pronation was 65°, and the mean supination was 58°, creating a mean arc of 123°. This increase in pronation-supination was significant (p = 0.003).

Among the thirty-eight patients, the mean preoperative MEPS was 41 points (range, 5 to 65 points). The mean postoperative MEPS was 65 points (range, 30 to 100 points), with a mean improvement of 24 points (range, −20 to 65 points) (p < 0.0001). Of interest, there was significant improvement in every component of the MEPS, with the exception of the stability score (Table I).

Four patients had a decrease in the MEPS when the preoperative score was compared with the score at the time of the most recent follow-up, including two patients who initially did well after surgery but who were considering revision surgery at 9.4 and 5.6 years following the index procedure. The third patient had preoperative instability, and the fourth patient was managed for a painless ankylosis. Of note, painless ankylosis yields 55 points on the MEPS, making it difficult to show a marked improvement in the score following an arthroplasty despite an improved range of motion. In spite of the 24-point improvement of the MEPS, only thirteen (29%) of the forty-five patients in the overall study group had a good or excellent result (a MEPS of ≥75 points), fourteen patients (31%) had a fair result (a MEPS of ≥60 but <75 points), eleven patients (24%) had a poor result (a MEPS of <60 points), and seven patients (16%) had a revision.
Subjectively, however, patients expressed a high degree of satisfaction with the procedure. According to Question 15 on the MEPS scale, answered by thirty-eight patients, nineteen patients (50%) rated the elbow as much better after surgery as compared with before surgery, twelve patients (32%) rated the elbow as somewhat better, and five patients (13%) rated the elbow as the same. Two patients stated that the elbow was worse following surgery. In both patients, the surgical indication was pain alone, in the absence of stiffness or instability. The rate of subjective satisfaction with the procedure is likely due to the increased range of motion and functionality that patients obtained after the interposition arthroplasty. In an assessment of the pain component of the MEPS, with 45 points representing no pain and 0 point representing severe pain, the mean improvement of 4 points was modest (Table I). The mean postoperative DASH score was 31 points (range, 3 to 73 points). No preoperative DASH scores were available for comparison.

Radiographic Assessment
Preoperatively, of the twenty-seven patients in the posttraumatic arthritis group with sufficient follow-up, seven had complete ankylosis, thirteen had grade-3 changes, and seven had grade-1 or no changes. At the time of the latest follow-up, no patient had persistent ankylosis, fourteen had grade-3 changes, and thirteen had grade-1 or 2 changes. Preoperatively, seventeen patients with posttraumatic arthritis had grade-1 humeral bone stock and ten had grade-II humeral bone stock. In some instances, the preoperative deficiencies in bone stock were substantial. At the time of the latest follow-up, all patients retained the same preoperative level of humeral bone stock, with the exception of one patient who had progression from grade-I to grade-II humeral bone stock. Three patients presented with subluxation of the ulnohumeral joint, and one patient presented with frank dislocation of the joint. Following surgery, one patient had residual subluxation of the joint.

Of the eleven patients with inflammatory arthritis, two had complete ankylosis preoperatively. Three patients each had grade-2, 3, and 4 changes. Postoperatively, two patients had grade-2 changes, two patients had grade-4 changes, and seven had grade-3 changes. All patients with inflammatory arthritis presented with grade-I humeral bone stock. Postoperatively,
three patients had progression from grade-I humeral bone stock to grade-II humeral bone stock. One patient presented with subluxation, which reduced after surgery.

Inflammatory Arthritis and Posttraumatic Arthritis Groups
The inflammatory arthritis group was significantly younger and had a higher percentage of female patients in comparison with the posttraumatic arthritis group. With the numbers available, both groups seemed to have similar results following this procedure (Table II).

Complications/Revisions
Seven patients required revision surgery for the treatment of complications, which were primarily related to infection (two cases) or instability (three cases). Two elbows were converted to a total elbow arthroplasty at 3.8 years and at 2.0 years postoperatively for unknown reasons (Table III).

Kaplan-Meier survival analysis with revision as the end point showed an 88% survival rate at five years postoperatively. Three patients had development of postoperative ulnar nerve symptoms, including one with ulnar nerve weakness and two with paresthesias. All symptoms resolved within one year postoperatively. One patient had development of weakness in the radial nerve distribution, which also resolved.

Impact of Surgical Indications and Techniques on Patient Outcomes
All interposition arthroplasties were performed for the treatment of stiffness, instability, or pain.

Pain
Procedures performed for the treatment of isolated pain had less satisfactory outcomes. Of the seven patients with the preoperative complaint of pain alone, two stated that the elbow was worse, one underwent revision surgery, and four stated that the elbow was somewhat or much improved postoperatively, reflecting an unpredictable result. In comparison, of the ten patients undergoing surgery for the treatment of stiffness, nine stated that the elbow was much or somewhat improved and one patient required revision surgery.

Instability
Procedures performed for the treatment of instability also had unpredictable results. Compared with painful or stiff joints, the elbows that were treated for instability had more frequent postoperative instability on examination, despite efforts at ligamentous reconstruction and restoration of articular congruity. Preoperative varus-valgus instability on examination (noted in eleven patients) was associated with postoperative instability ($p = 0.0005$), low postoperative function scores (MEPS of $<74$ points; $p = 0.03$), and high disability scores (DASH scores of $>40$ points; $p = 0.006$).

Surgical Factors
Five elbows were found to have insufficient tissues for primary repair of both the medial collateral ligament and the lateral collateral ligament and thus underwent reconstruction of both ligaments. The patients requiring reconstruction of both ligaments with the allograft had a marked decrease of 8 points

### TABLE III Summary of Complications Following Interposition Arthroplasty*

<table>
<thead>
<tr>
<th>Case</th>
<th>Sex, Age (yr)</th>
<th>Condition</th>
<th>Chief Complaint</th>
<th>Other Information</th>
<th>Complication</th>
<th>Treatment</th>
<th>Interval from Index Procedure to Most Recent Follow-up (yr)</th>
<th>MEPS (points)</th>
<th>At Time of Most Recent Follow-up</th>
<th>DASH Score at Time of Most Recent Follow-up After Revision (points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F, 53</td>
<td>Trauma</td>
<td>Pain/stiffness</td>
<td>Diabetic</td>
<td>Infection, triceps dysfunction after total elbow arthroplasty</td>
<td>Total elbow arthroplasty</td>
<td>7.0</td>
<td>25</td>
<td>60</td>
<td>NA</td>
</tr>
<tr>
<td>2</td>
<td>F, 32</td>
<td>Trauma</td>
<td>Stiffness</td>
<td></td>
<td>Infection</td>
<td>Graft removed</td>
<td>7.3</td>
<td>60</td>
<td>65</td>
<td>26</td>
</tr>
<tr>
<td>3</td>
<td>M, 42</td>
<td>Trauma</td>
<td>Pain</td>
<td>Laborer</td>
<td>Instability</td>
<td>Total elbow arthroplasty</td>
<td>1.5</td>
<td>10</td>
<td>65</td>
<td>69</td>
</tr>
<tr>
<td>4</td>
<td>M, 30</td>
<td>Trauma</td>
<td>Instability</td>
<td></td>
<td>Instability</td>
<td>Graft removed</td>
<td>5.4</td>
<td>35</td>
<td>65</td>
<td>61</td>
</tr>
<tr>
<td>5</td>
<td>M, 36</td>
<td>Trauma</td>
<td>Pain/stiffness</td>
<td>Laborer</td>
<td>Instability</td>
<td>Total elbow arthroplasty</td>
<td>6.8</td>
<td>35</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>6</td>
<td>M, 46</td>
<td>Trauma</td>
<td>Instability</td>
<td>Laborer</td>
<td>Unknown</td>
<td>Total elbow arthroplasty</td>
<td>NA</td>
<td>35</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>7</td>
<td>M, 33</td>
<td>Trauma</td>
<td>Instability</td>
<td>Laborer</td>
<td>Instability</td>
<td>Arthrodesis</td>
<td>NA</td>
<td>40</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

*MEPS = Mayo Elbow Performance Score; DASH = Disabilities of the Arm, Shoulder and Hand; and NA = not recorded, not available.
(range, −20 to 5 points) when the postoperative MEPS (at the time of the most recent follow-up) was subtracted from the preoperative MEPS. This finding contrasts with a mean increase in the MEPS of 27 points (range, −5 to 65 points) in the cohort of thirty-three patients with one or no ligamentous reconstruction. The five patients with reconstruction of both the medial collateral ligament and the lateral collateral ligament also had a higher disability score postoperatively. All patients who were available for follow-up who had had reconstruction of both the medial collateral and lateral collateral ligaments had a mean MEPS of 43 points (range, 35 to 50 points), compared with a mean MEPS of 68 points (range, 30 to 100 points) for those who had one or no ligamentous reconstruction.

Discussion

The present study assesses our experience with Achilles tendon interposition arthroplasty when used as a salvage procedure for selected patients with severe inflammatory or posttraumatic elbow arthritis presenting with pain, stiffness, or instability. On the basis of the results of the present study, the indications for interposition arthroplasty include elbow stiffness or pain in patients who, because of livelihood or preference, will not accept the 5-kg weight-lifting restriction of total elbow arthroplasty and yet wish to maintain mobility of the elbow. Other treatment alternatives include elbow arthrodesis and resection arthroplasty, neither of which are well tolerated. It should be noted that we believe that instability on physical examination and pain without elbow dysfunction are contraindications to interposition arthroplasty. The fact that interposition arthroplasty does not eliminate pain or restore full function is consistent with the typical outcome of a salvage procedure. However, we believe that it is appropriate for some patients in that it allows for an overall higher level of function than that obtained by means of arthrodesis or resection arthroplasty and that patient satisfaction is high in spite of low MEPS ratings.

The present study is limited by its retrospective design. However, we know of no other reports of an Achilles tendon allograft being used as an elbow interposition material.

In this cohort of forty-five interposition arthroplasties that were performed with an Achilles tendon allograft, we found a significant association between poor outcomes and preoperative instability. Even mild instability on examination was significantly associated with worse MEPS and DASH scores as compared with no preoperative instability. In a study of thirteen patients undergoing autogenous fascia lata interposition arthroplasty, Cheng and Morrey found that, of the four elbows with preoperative instability, one had a poor outcome and two required revision. However, that study demonstrated a 31% rate of revision to total elbow arthroplasty, whereas the present study demonstrated a much lower revision rate, with only 16% of the elbows having been revised at a mean of six years postoperatively. The robust Achilles tendon allograft may provide more longevity for the interposition arthroplasty as compared with a fascial interposition graft, perhaps leading to fewer revisions to total elbow arthroplasty in the early postoperative years.

We noted a significant increase in range of motion, including flexion, extension, supination, and pronation. This increase is likely due to the recontouring of the joint and extensive capsular release performed at the time of surgery. In many cases, protected immediate postoperative range of motion in an external fixator may have helped to attain this much motion.

It should be noted that we found no difference in the clinical outcomes in the cohort of patients who were managed with an external fixator as compared with those who were managed without a fixator. However, we hesitate to draw definitive conclusions from this finding because patients who were deemed by the surgeon to have delicate reconstructions or a history of instability were managed with a fixator whereas those who had excellent stability intraoperatively were not. Hence, there was selection bias in applying the external fixator to those who were considered to be more at risk for instability.

Aside from the standard risks of operative intervention, there appears to be little downside in pursuing interposition arthroplasty in the young patient with disabling dysfunction. It is important to emphasize that the majority of patients were satisfied with the operation and would be willing to have it repeated. With use of careful technique, interposition arthroplasty does not destabilize the joint. With the exception of one case in which total elbow arthroplasty was required, all cases of postoperative instability occurred in elbows with preoperative instability. Ljung et al. recommended against interposition arthroplasty because of the risk of attrition of the ulnar and humeral joint surfaces, although they found interposition with a bovine collagen membrane to be quite effective for pain relief in rheumatoid elbows. In the present study, there was no evidence of Achilles tendon interposition arthroplasty resulting in substantial humeral, radial, or ulnar bone loss. Blaine et al. showed that elbows that have a failure of interposition arthroplasty can be converted safely and effectively to total elbow arthroplasty, and we believe that interposition arthroplasty is a safe, intermediate-term procedure that preserves substantial bone stock for future revisions.

In conclusion, interposition arthroplasty can preserve function in selected patients who have inflammatory arthritis of the elbow. For those with posttraumatic arthritis, interposition arthroplasty serves as a salvage procedure to defer elbow fusion or total elbow arthroplasty and to improve range of motion. Hence, in selected individuals who are too young or too active for total elbow replacement, interposition arthroplasty may be a reasonable interim treatment for severe elbow arthritis, giving improved motion with fair to good functional outcomes, subjective satisfaction surpassing 80%, and proven successful conversion to total elbow arthroplasty, if needed.
References


