ORIGINAL ARTICLE

Acta Orthop Traumatol Turc 2014;48(5):558-562
doi: 10.3944/AOTT.2014.14.0131

# Stiff elbow: Distraction interposition arthroplasty with an Achilles tendon allograft: long-term radiological and functional results

**Ali ERŞEN[1], Mehmet DEMİRHAN[2], Ata Can ATALAR[1], Ahmet SALDUZ[1], Onur TUNALI[1]**

*[1]Istanbul University, Istanbul Faculty of Medicine, Department of Orthopedics and Traumatology, Istanbul, Turkey;*
*[2]Koç University, School of Medicine, Department of Orthopedics and Traumatology, Istanbul, Turkey*

**Objective:** The aim of this study was to evaluate the long-term radiological and functional results of distraction interposition arthroplasty using an Achilles tendon allograft.

**Methods:** The study included 5 patients (3 females and 2 males; mean age: 31 years, range: 25 to 41 years) who underwent distraction interposition arthroplasty for stiff elbow and arthrosis due to intrinsic factors between 2001 and 2010. Interposition with fresh-frozen Achilles allograft and collateral ligament reconstruction were performed in all patients. Mean follow-up period was 87.6 (range: 40 to 131) months. Mean distraction time with an external fixator was 7 (range: 6 to 8) weeks. Elbow motion was allowed in the first postoperative day in all patients. Radiological evaluation was performed pre- and postoperatively. Elbow ROM, and the Mayo Elbow Performance Score (MEPS) and DASH scores were recorded for functional evaluation.

**Results:** Mean preoperative flexion-extension range was 24° (range: 0° to 80°) and mean supination-pronation range was 15°. Two patients had elbow ankylosis in 90° and 60° of flexion at the preoperative examination. Mean postoperative flexion-extension range increased significantly to 81° (range: 50° to 110°) ($p<0.05$). Mean preoperative DASH score improved from 75.3 (range: 53 to 89) to 18.9 (range: 6.7 to 45.8) postoperatively ($p<0.05$). Mean postoperative MEPS were poor (mean: 25, range: 20 to 35) while postoperative MEPS were good (mean: 71, range: 70 to 75) in 4 patients and fair in 1 ($p<0.05$). No patient experienced elbow instability at the final follow-up and none required revision.

**Conclusion:** Distraction interposition arthroplasty is a salvage procedure which appears to have good long-term functional results, especially in patients in which elbow arthroplasty is not suitable. The use of Achilles allograft for interposition can protect the joint space in the long-term.

**Key words:** Achilles tendon allograft; distraction interposition arthroplasty; elbow.

Elbow arthroplasty is considered the first choice in the treatment of painful elbow arthrosis due to intrinsic factors. However, arthroplasty is not preferred in young active patients, especially those who use the elbow in heavy activities. Distraction interposition arthroplasty is one of the preferred treatment option in these patients.[1]

Various types of allografts have been used for interposition in the literature, including Achilles allograft.[2-4] However, the long-term viability and functional and radiological results of distraction interposition arthroplas-

**Correspondence:** Mehmet Demirhan, MD. Koc University School of Medicine, Department of Orthopaedics and Traumatology, Rumelifeneri Yolu, 34550 Sarıyer, Istanbul, Turkey.

Tel: +90 532 – 212 33 37 e-mail: mdemirhan@ku.edu.tr

**Submitted:** April 09, 2014 **Accepted:** May 28, 2014



Available online at
www.aott.org.tr
doi: 10.3944/AOTT.2014.14.0131
QR (Quick Response) Code

**Table 1.** Patient data.

| Patient no. | Age | Etiology | Side-Dominance | Follow-up period (months) | Removal time of the external fixator (days) |
|---|---|---|---|---|---|
| 1 | 25 | JRA sequel | Right - Dominant | 80 | 60 |
| 2 | 28 | Posttraumatic | Right - Dominant | 84 | 60 |
| 3 | 41 | Posttraumatic | Left - Non-dominant | 131 | 45 |
| 4 | 34 | Tuberculosis sequel | Right - Dominant | 40 | 45 |
| 5 | 26 | Posttraumatic | Right - Dominant | 103 | 42 |

JRA: Juvenile rheumatoid arthritis.

ty using an Achilles allograft are unknown. Therefore, the aim of this study was to radiologically and functionally evaluate the long-term results of distraction interposition arthroplasty using Achilles allograft.

## Patients and methods

The study included 5 patients (3 females and 2 males) who underwent interposition arthroplasty using Achilles allograft and distraction with a hinged elbow fixator for the treatment of stiff elbow and arthrosis due to intrinsic factors between 2001 and 2010 (Table 1). Radial head excision in addition to distraction interposition arthroplasty was performed in 3 patients.

Inclusion criteria were young patients who were unable to adopt the limitations of total elbow arthroplasty due to heavy use of the elbow and those with pure intrinsic stiff elbow (Fig. 1). Patients with stiff elbow with limited motion caused by extrinsic or mixed factors were considered unsuitable for this treatment.

Mean age of the patients was 31 (range: 25 to 41) years. The dominant right elbow in 4 patients and the non-dominant left elbow in 1 patient were affected. Three patients had posttraumatic arthrosis, 1 patient chondrolysis and arthrosis after elbow tuberculosis and 1 arthrosis due to Juvenile Rheumatoid Arthritis (JRA). While 2 patients with posttraumatic arthrosis had minor trauma, the third patient experienced a fall from a height. The high-energy trauma patient had an elbow fracture dislocation and proximal humerus fracture. Open reduction and plate fixation was applied for intra-articular distal humerus fracture as an initial treatment. None of the patients experienced any neurological deficits.

Patients were prepared in the supine position so the elbow could be freely brought to flexion and extension. The ulnar nerve was exposed and identified after the posterior skin incision and preserved during the entire procedure. At the end of the surgery, the nerve was subcutaneously transposed to the anterior. Anterior and posterior total capsulectomy was performed to obtain motion in the elbow joint. Nonfunctional remnants of the medial and lateral collateral ligaments were resected

**Fig. 1.** Anteroposterior and lateral elbow radiographs of a patient with pure intrinsic stiff elbow (Case 2).

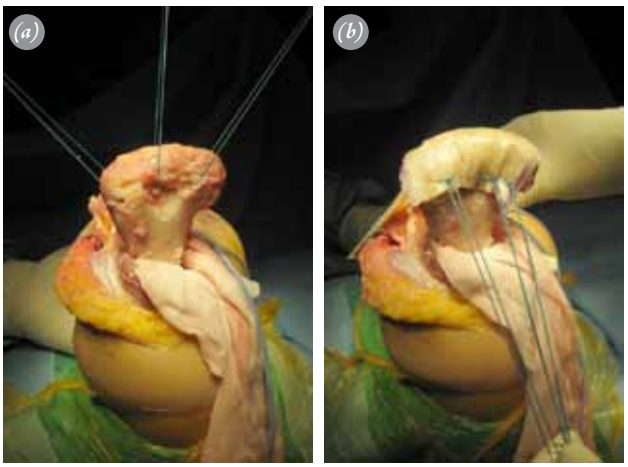


**Fig. 2.** **(a)** Preparation of the humeral joint surface for graft interposition. **(b)** Application of the Achilles tendon allograft to the joint surface and fixation with sutures. [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]

**Table 2.** Preoperative and postoperative ranges of motion.

| Patient No. | Preoperative flexion (degrees) | Preoperative extension (degrees) | Preoperative pronation-supination (degrees) | Postoperative flexion (degrees) | Postoperative extension (degrees) | Postoperative pronation-supination (degrees) |
|---|---|---|---|---|---|---|
| 1 | 90 | 120 | 35 | 110 | 35 | 70 |
| 2 | 40 | 120 | 25 | 100 | 50 | 60 |
| 3 | 60 fixed | 0 | 0 | 130 | 45 | 50 |
| 4 | 90 | 100 | 15 | 130 | 20 | 110 |
| 5 | 90 fixed | 0 | 0 | 105 | 30 | 45 |

in all patients. The joint surface was exposed and the rough surfaces were smoothened to apply the Achilles tendon to a congruent surface.

Fresh-frozen Achilles allograft was used in all patients. Drill holes were prepared on the humerus and the Achilles allograft was fixed by passing sutures through these holes in such a way to cover the entire joint surface (Figs. 2a and b). The remaining part of the grafts were divided into two (Fig. 3) and passed through the drill holes on the distal humerus and proximal ulna to reconstruct the medial and lateral collateral ligaments. In all operations, the joint was distracted with a hinged unilateral external fixator which allowed flexion-extension motion in the elbow to preserve the graft. External fixators were used to stabilize the joint in the coronal plane to allow the collateral ligaments to heal (Fig. 4). Mean removal time of the external fixator was 50 (range: 42 to 60) days.

The Student t-test was used in the comparison of the basic parameters of the results (pre- and postoperative ROM, DASH score and Mayo Elbow Performance Score [MEPS]) using the MedCalc statistical software (MedCalc Software bvba, Ostend, Belgium). Level of significance was accepted as $p<0.05$.

## Results

Preoperative mean flexion-extension range was 24° (range: 0° to 80°) and mean flexion contracture was 74° (range: 60° to 80°). In 2 patients the elbow was fixed in 60° and 90° of flexion. Elbow pronation and supination ranges were extremely limited in all patients.

Only one complication occurred in the early postoperative period. Motor and sensorial deficit of the radial nerve occurred in 1 patient due to pin irritation. All motor functions of the radial nerve recovered without any exploration or extra surgical treatment. However, hypoesthesia continued in the sensorial area of the radial nerve. Graft resorption did not develop in any of the patients in the early period.

Patients were evaluated at a mean follow-up time of 87.6 (range: 40 to 131) months after surgery. None of the patients had significant instability. Mean flexion-extension range increased from 24° to 81° ($p<0.05$). Mean flexion contracture decreased from 74° to 38° ($p<0.05$). Pronation-supination range increased from 15° to 67° at the final follow-up ($p<0.05$) (Table 2).

Significant improvement was also observed in functional scores. Preoperative mean DASH score was 75.3 (range: 53 to 89) and 18.9 (range: 6.7 to 45.8) postoperatively ($p<0.05$). Preoperative mean MEPS improved from 25 (range: 20 to 35) to 71 (range: 70 to 75) ($p<0.05$) (Fig. 5). Whereas the preoperative functional scores of all patients were poor, postoperative scores

**Fig. 3.** Preparation of the Achilles tendon allograft for collateral ligament reconstruction. [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]

**Fig. 4.** Early postoperative radiograph with elbow external fixator (Case 4).

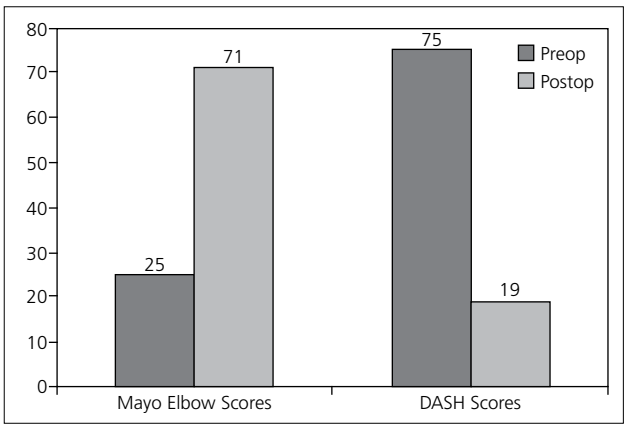


**Fig. 5.** Preoperative and postoperative Mayo Elbow and DASH scores.

**Fig. 6.** Preserved joint space after 10 year postoperatively (Case 3).

were good in 4 patients and fair in one.

In the radiologic evaluation, the improvement in joint space in the early postoperative period was evaluated to determine if the joint space could be preserved or diminished. The joint space was preserved in all 5 patients (Fig. 6).

## Discussion

The indications for the use of distraction interposition arthroplasty are limited and it is a rarely applied treatment. Although satisfactory results can be achieved with semi-constrained elbow arthroplasty in painful elbow arthrosis, there are serious postoperative limitations in the functions of the elbow. Distraction interposition arthroplasty can be preferred as a salvage procedure for young patients who cannot accept the functional limitations of elbow arthroplasty.[5]

The graft is expected to resorb and the joint space to vanish over time. Therefore, the purpose of this treatment is to gain time with a functional elbow in patients in which elbow arthroplasty is not suitable. A lengthy follow-up time is very critical in patients treated with distraction interposition arthroplasty. With the increase in follow-up time, more unsuccessful results can be detected. In our study, the mean follow-up of 87.6 months was longer than other reports in the literature.

Cheng et al.[6] reported 62% perfect and good results in 13 patients after distraction interposition arthroplasty with a mean follow-up of 63 months. Four patients required total elbow arthroplasty in 30 months. Nolla et al. reported 13 patients with a mean follow-up of 4 years and found that flexion-extension range increased from 48° to 110° and 8 patients (62%) had perfect or good results.[7]

The largest case series on distraction interposition arthroplasty was reported by Larson et al.[4] who followed 38 of 69 patients who underwent distraction interposition arthroplasty for 6 years. The authors reported a significant increase in range of motion and functional scores. However, 11 (29%) of the 38 patients had poor results and reported that preoperative elbow instability was related with poor outcomes.

In our study, 5 patients were followed for 87.6 months, with 4 patients having good and 1 patient fair results. As none of the patients experienced instability before the surgery, none had poor results despite the long follow-up time. In addition, none of the patients required total elbow arthroplasty surgery.

Ljung et al.[3] included only patients with rheumatoid arthritis in their study and reported that the bone destruction due to the rheumatoid arthritis made it impossible to apply distraction interposition arthroplasty in these patients. The authors suggested total elbow arthroplasty as an initial treatment in rheumatoid arthritis patients. Larson et al. remarked that the most suitable patients for interposition arthroplasty were those who had posttraumatic elbow arthrosis.[4] In our cases, 3 patients had posttraumatic arthrosis, 1 patient elbow arthrosis secondary to JRA and 1 elbow arthrosis due to tuberculosis of the elbow joint.

Several options for interposition grafts including dermis, dura mater, fascia lata, Achilles tendon and lipid tissue have been reported in the literature.[2-4,6,8] The Achilles tendon and fascia lata were the most frequently used grafts in case series.[7] Cheng et al.'s study included 13 patients in which only fascia lata autografts were used.[6] In a 38 patient case series, Larson et al. used Achilles tendon allografts only.[4] Although no study has compared these two graft options, in the previously mentioned studies, the revision rates were 31% with fascia lata and 16% with Achilles tendon. Morrey hypothesized that Achilles tendon grafts were able to

resist longer, explaining their better revision rates.[4,6] Although our follow-up time was about 7.5 years, none of the patients required revision with elbow arthroplasty, supporting Morrey's explanation.

In the literature, it has been reported that total elbow arthroplasty may be applied successfully after distraction interposition arthroplasty.[9] However, none of our patients required elbow arthroplasty.

The small number of patients may be considered a major limitation of the study. However, single surgeon (MD), standard surgical procedure and Achilles allograft alone and the long-term follow-up were the advantages of our study.

In conclusion, distraction interposition arthroplasty using Achilles tendon allograft can be considered to provide a functional and painless elbow for a long period of time and significantly delay the necessity of additional elbow arthroplasty.

**Conflicts of Interest:** No conflicts declared.

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