TECHNICAL NOTE

Total Elbow Arthroplasty in the Context of an Olecranon Nonunion: A Surgical Technique and Report of Three Cases

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Abstract

The deficiency of the triceps tendon has been considered a relative contraindication to performing a total elbow arthroplasty. One of the conditions that may compromise triceps integrity is the presence of an olecranon non-union (ON). In this scenario, the placement of a total elbow arthroplasty in a patient with end-stage elbow arthritis is a complex problem to be solved. The aim of this study is to describe the surgical technique for the placement of a TEA in the context of a previous ON and to report the results of three cases.

Surgical technique: the focus of the nonunion is identified, and the olecranon fragment is proximally reflected with the triceps tendon to allow accurate exposure of the medullary canal of the ulna and easy access to the joint. With the elbow in a fully flexed position, the previously assembled test prosthesis is placed and the proximal ulna fragment should then be reduced to match the distal ulna. Osteosynthesis with a tension band technique was performed at 45° of elbow extension. A non-absorbable Krackow suture (Ti-Cron 2-0) from the triceps's tendon to the hole of the wire in the distal ulna is applied to decrease the triceps tension traction. Bone grafting is performed when a persistent gap is present at the fracture site following reduction. This technique enables us to achieve a stable elbow with little pain and maintains the extensor apparatus's continuity.

Level of evidence: IV

Keywords: Arthritis, Extensor mechanism, Olecranon non-union, Triceps deficiency, Total elbow arthroplasty

Introduction

The deficiency of the triceps tendon has been considered a relative contraindication to performing a total elbow arthroplasty (TEA) (1,2). This is why the loss of active extension can lead to a flexion contracture. One of the conditions that may compromise triceps integrity is the presence of an olecranon non-union (ON) (3-5). Although uncommon, ON has been reported with an incidence of 0%-7%. In this scenario, the placement of a TEA in a patient with end-stage elbow arthritis is a complex problem to be solved.

There is limited literature about this topic, and the meticulous surgical detail is not widely described. Marra et al. reported, in a series of patients with fractures and ON, different treatment options to address this problem: tension band fixation, olecranon excision and conservative treatment in the context of a stable fibrous union (6). Despite the different treatments performed, they concluded that osseous union in that clinical setting is difficult to achieve and may require multiple procedures.

Sanchez Sotelo and Morrey described some options such as anconeus rotational flap and achillis allograft. Although these techniques are described for triceps insufficiency, they can be used in the presence of small proximal ulnar or poor quality of the triceps (7).

The aim of this study is to describe the surgical technique

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for the placement of a TEA in the context of a previous ON and to report the results of three cases.

Technical note

Surgical technique

Under regional anaesthesia, with the patient in a supine position and arm across the chest, a sterile tourniquet is applied to the arm. It is important that the elbow can be fully flexed during the surgical procedure, especially for insertion of the ulnar component. The patient receives an appropriate intravenous antibiotic before the skin incision. A straight longitudinal incision 15 cm in length is placed over the posterior aspect of the elbow. The ulnar nerve is identified and decompressed throughout the ulnar tunnel, the first motor branch, releasing the fascia proximal to the distal direction and anteriorly transposed into the subcutaneous tissue.

The non-union is identified; the olecranon fragment is proximally reflected with the triceps tendon to allow accurate exposure of the medullary canal of the ulna and easy access to the joint [Figure 1; 2].

Retraction of the muscle–tendon unit makes it difficult to diminish the significant gap of the non-union. For this reason, the dissection must be carried out proximally.

Triceps are usually contracted and highly adhered to the posterior aspect of the humerus, which might hinder the subsequent reduction of the ulnar fragments unless carefully released. Once the humerus is exposed, the medial and lateral collateral ligaments are released from their distal humerus attachments. Finally, the anterior capsule is carefully released from the humerus to avoid any flexion contracture.

Subsequently, either of the osseous components can be prepared first; we prefer to begin with the ulna. With the help of a pilot rasp, the medullary canal is opened until the desired implant is placed. If the canal is too small, flexible reamers can be inserted to prepare it. Great care should be taken to avoid penetration of the dorsal cortex of the ulna with the tip of the rasp. It is essential to determine the final orientation of the implant by placing the rasp down the canal with the handle perpendicular to the dorsal

Figure 1. Olecranon non-union.

Figure 2. The olecranon fragment is proximally reflected with the triceps tendon.

aspect of the olecranon. The centre ring of the ulnar component should replicate the normal anatomic axis of the greater sigmoid notch. It is not easy to perform due to the sigmoid notch being affected by the non-union.

The next step is to prepare the humerus. With the help of a rongeur or saw, we must remove the mid-portion of the trochlea to allow access to the roof of the olecranon fossa. A small portion of the cortical bone of the fossa must also be removed to enable the insertion of the reamer into the medullary canal of the humerus.

The humeral cutting guide is inserted, and the corresponding cuts in the distal humerus are performed while carefully taking care to avoid violating the supracondylar bony column. Subsequently, the humeral medullary is prepared by serial rasping until the selected size of the humeral component fits comfortably. Cement restrictors or bone plugs are placed into the humerus to improve cement pressure and limit expansion of cement into the proximal humerus.

The fragment of the proximal olecranon usually needs to be fashioned to accommodate the rasp and the implant.

With the elbow in a fully flexed position, the previously assembled test prosthesis is placed and the proximal ulna fragment should then be reduced to match the distal ulna [Figure 3].

We used two types of semi-constrained TEA: Coonrad-

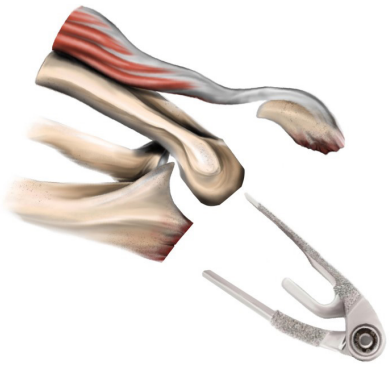

Figure 3. With the elbow in a fully flexed position, the previously assembled test prosthesis is placed.

Figure 4. Before cementing, the proximal fragment of the ulna is reduced, and the tension band technique is performed.

Morrey (Zimmer®, Warsaw, IN, USA) in patients 1 and 2; and Discovery (Biomet, Warsaw, IN, USA) in patient number 3.

Before cementing the prosthesis, a transverse hole is drilled in the distal ulnar fragment, proximal to the tip of the ulnar stem, and a 1.6 mm wire is inserted to assemble the tension band fixation.

After cleaning and drying both medullary bone cavities, the cement is placed in a viscous state with a cement gun followed by pressure packing. The previously coupled implant is inserted. This method of inserting the components is to prevent their bad rotation. In all cases, the antibiotic was mixed with vancomycin (1g/dose).

Before the cement has hardened, the proximal fragment of the ulna is reduced, and two 1.6 mm K-wires are placed from the posterior side of the ulna to the anterior cortex or in the medullary canal, aiming to introduce them on either side of the prosthesis stem. The K-wires are included in the cement to avoid their extrusion [Figure 4]. Subsequently, with the elbow in 45° elbow extension, a cerclage is performed with the previously inserted wire in a standard fashion. Bone grafting is performed when a persistent gap is present at the fracture site following reduction. A non-absorbable Krackow suture (Ti-Cron 2-0) from the triceps's tendon to the hole of the wire in the distal ulna is applied to decrease the triceps tension traction.

A small piece of bone graft tacked from the excised trochlea is introduced between the anterior flange of the prosthesis and the anterior humeral cortex.

The elbow is protected in a brace for 2 weeks using an extension-assisted orthosis, limiting flexion to 100°. The range of motion is progressed as a home programme, emphasizing active extension and flexion. The patient is advised not to lift more than 1 lb during the first 3 months after surgery and observe a 5lbs permanent lifetime lifting restriction for the extremity.

In summary, the essential steps to be taken during this technique are:

A- Identify the non-union and reflect proximally the olecranon fragment.

B- Prepare the bone extremes to introduce the prosthesis.

C- Fashion the fragment of the proximal olecranon.

D- Insert the components assembled.

E- Perform the osteosynthesis with a tension band technique.

Results

We reported three patients treated with this technique. The causes, functional results and complications are included [Table 1] [Figures 5-10].

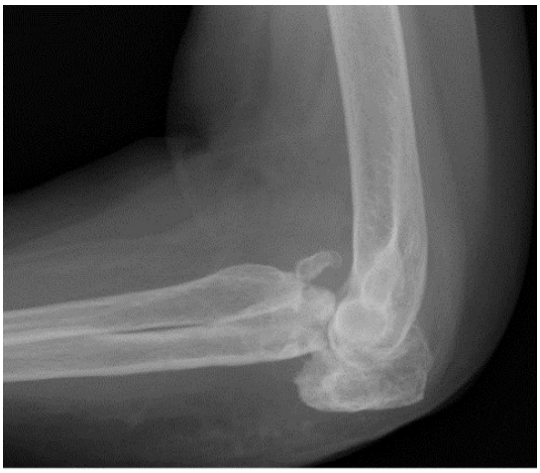

Figure 5. Radiograph of a 70-year-old patient (case No. 2) with sequelae of a Monteggia fracture-dislocation with an ON and an advanced degenerative joint

Table 1. Functional results and complications

Pat	Sex	Age	Cause	Evolut time (year)	Follow-up (year)	Mobility		Pain		MEPS		DASH		Consol	Complic
						Pre°	Post°	pre	post	pre	post	pre	post		
1	M	27	Mont / ON	3	4	110-40	120-35	5	2	35	75	46	27	yes	no
2	F	70	Mont / ON	3	5	90-30	125-25	8	2	40	75	56	32	yes	Remove TB
3	F	81	DHF / ON	2	1	----	135-40	---	3	---	80	---	29	yes	Remove TB

Mont: Monteggia; DHF: Distal Humerus Fracture; ON: Olecranon Nonunion; TB: Tension Band

Figure 6. Posterior approach with the release of the proximal olecranon and triceps tendon.

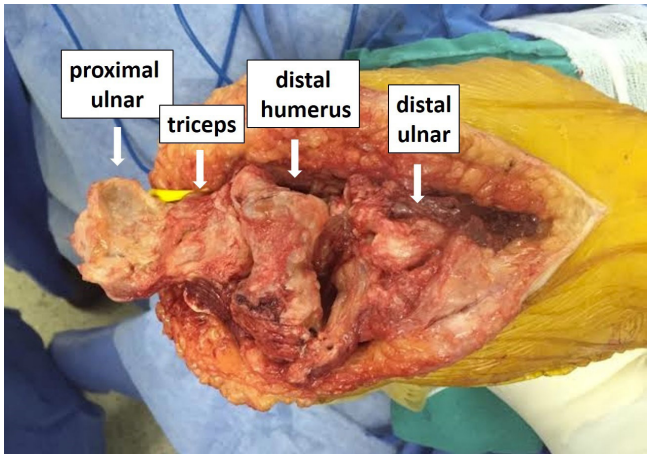

Figure 7. Posterior view of repaired structures and identification of the distal humerus and olecranon.

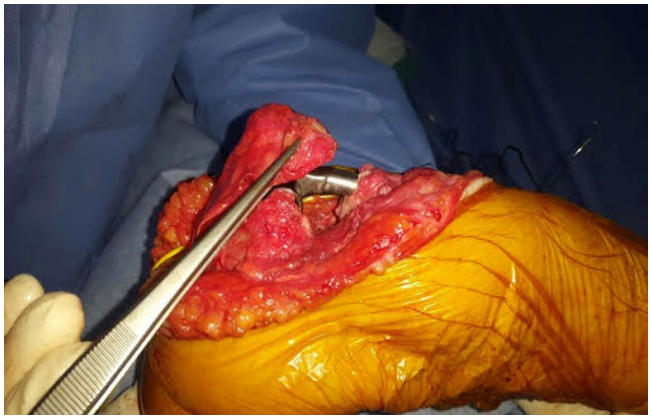

Figure 8. The fragment of the proximal olecranon is fashioned to accommodate the implant.

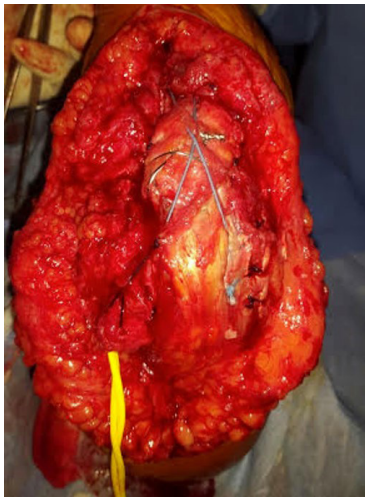

Figure 9. Tension band technique with the addition of a non-absorbable Krackow suture from the triceps's tendon to the distal ulna.

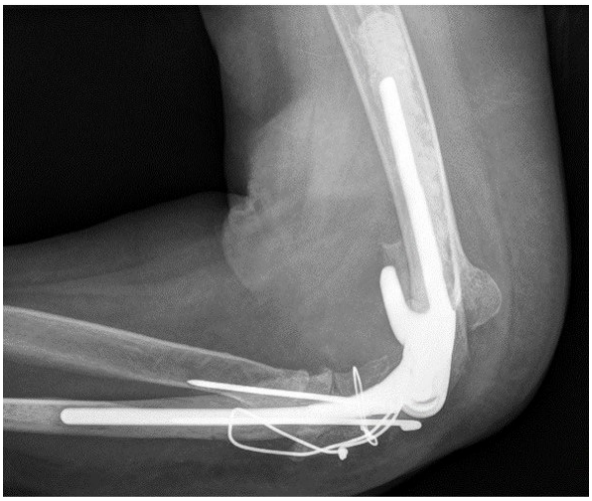

Figure 10. Final radiograph.

Discussion

The most frequent indications for prosthetic elbow replacement are post-traumatic sequelae and degenerative pathologies. Post-traumatic pathology is associated with a more significant number of complications compared to rheumatic pathologies (3,4). Among these, triceps insufficiency is one of the most reported in the literature, and in cases with previous infections, the results are even worse (7-9). Therefore, the correct and careful management of the extensor apparatus is essential to try to prevent complications.

In the presence of a proximal ulna with no bony deficit, reconstruction with Achilles tendon allografts and anconeus rotational flap have been reported with relative success. Sanchez Sotelo and Morrey reported seven patients with these reconstructions, with recovery

of good extension strength in six cases (7).

ON alters the continuity of the extensor apparatus, and therefore it should be resolved at the time of prosthesis placement.

The described technique allows the prosthesis placement to maintain the extensor apparatus's continuity through its osteosynthesis with a tension band technique. In this way, we have achieved consolidation in all patients. In cases where consolidation is not achieved, a solid fibrous union of the focus can give good results (6). Chronic retraction of the triceps can also favour non-union. Therefore, we consider that strengthening with non-absorbable sutures and immobilization at 45° of extension are useful alternatives to decrease muscle traction force.

The placement of the Kirschner wires before cement setting should be done quickly and accurately and with limited possibility of repositioning the pins. Consequently, the pins should be measured beforehand to prevent them from going beyond the anterior cortex of the ulna. However, we had to remove the pins in two cases due to protrusion or discomfort.

This procedure is particularly indicated in patients with a proximal ulna non-union/fracture and advanced elbow osteoarthritis or post-traumatic arthritis in which the non-union or the fracture gap allows insertion of components while preserving the triceps attachment to the proximal ulnar fragment. This technique enables us to achieve a stable elbow with little pain and maintains the extensor apparatus's continuity. Achieving excellent results in this type of reconstruction is challenging. Despite the consolidation of the ON, patient follow-up is essential due to the frequent complications.

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