Total Elbow Arthroplasty in the Context of a Nonunion of the Olecranon. Surgical Technique and Report of 3 Cases

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ABSTRACT
The integrity of the extensor apparatus is essential for the correct functioning of an elbow prosthesis. Triceps deficiency has been considered a relative contraindication for arthroplasty, because it produces a flexion contracture and an active extension deficit. These limitations can significantly affect the functional improvement that total elbow arthroplasty produces. Faced with an olecranon nonunion, the placement of a total elbow prosthesis is presented as a complex problem to be solved. The objective of this article is to describe the surgical technique for the placement of a total elbow prosthesis in the context of an olecranon nonunion, and to report three cases.
Keywords: Total elbow prosthesis; olecranon nonunion; triceps deficiency; absorber-traction system.
Level of Evidence: IV

Prótesis total de codo en el contexto de una seudoartrosis de olécranon. Técnica quirúrgica y reporte de tres casos

RESUMEN
La indemnidad del aparato extensor es fundamental para un correcto funcionamiento de una prótesis de codo. Se ha considerado que la deficiencia del tríceps es una contraindicación relativa para la artroplastia, porque produce una contractura en flexión y un déficit de extensión activa. Estas limitaciones pueden afectar significativamente la mejora funcional que la artroplastia total de codo produce. Ante una seudoartrosis de olécranon, la colocación de una prótesis total de codo se presenta como un problema complejo que resolver. El objetivo de este artículo es describir la técnica quirúrgica para la colocación de una prótesis total de codo en el contexto de una seudoartrosis de olécranon, y comunicar tres casos.
Palabras clave: Prótesis total de codo; seudoartrosis de olecranon; deficiencia del tríceps; sistema de absorbe-tracción.
Nivel de Evidencia: IV

INTRODUCTION

Total elbow arthroplasty (TEA) is an effective option for the treatment of various post-traumatic and degenerative diseases.[1-8] The integrity of the extensor apparatus is essential for a correct functioning of the prosthesis.[9] Triceps deficiency has been considered a relative contraindication for TEA, because it produces a flexion contracture and a deficit of active extension. These limitations can significantly affect the functional improvement that total elbow arthroplasty produces.[10,11]

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Thus, if a patient has osteoarthritis or elbow arthritis associated with an olecranon nonunion (ON), the placement of a TEA as a salvage procedure is presented as a complex problem to solve.

Although some alternatives for the management of an ON have been described in this context, the literature remains scarce. Some of the proposed treatments include resection of the proximal end of the ulna, osteosynthesis and conservative treatment in the case of fractures without great displacement and with strong fibrous junctions.[12,13]

The objective of this article is to describe the surgical technique for the placement of a TEA in the context of an ON and to report three cases.

Surgical technique

All patients were operated on by the same surgeon. The surgery was carried out with the patient in the dorsal decubitus position under regional anesthesia. After placing a pneumatic tourniquet cuff, a posterior elbow approach was performed and the ulnar nerve was identified, which, after neurolysis, was transposed anteriorly in all cases. The ON focus was identified (Figure 1A) and, through it, the joint was entered, resecting all the fibrous tissue. The proximal end of the ulna, in conjunction with the triceps tendon, was repaired proximally (Figure 1B).

In all patients, the triceps was contracted and strongly attached to the posterior aspect of the humerus, so it was necessary to release it to allow subsequent coaptation of the ulna ends.

Cases 1 and 2 were sequelae of Monteggia dislocated fractures with a subsequent evolution to ON and joint degeneration. Case 3 was a woman with a periprosthetic fracture due to an inverted shoulder arthroplasty who, a year earlier, had presented an olecranon fracture treated conservatively and, in this context, suffered a distal humerus fracture AO C3.

In patients 1 and 2, the entire distal humerus was exposed and the corresponding cuts were made preserving both columns. In the case of the supracondylar fracture, the fractured distal humerus was resected.

At the ulnar level, the medullary canal was reamed until the corresponding implant could be placed. All patients received a Coonard-Morrey semi-constrained prosthesis (Zimmer, Warsaw, IN, USA) in two cases and a Discovery (Biomet, Warsaw, IN, USA) in the remainder.

The pre-assembled trial prosthesis was then placed. This surgical step is important, because placing the implant in this way avoids the possibility of malrotation of the components, which is common when there is a bone deficit at the level of the proximal ulna or distal humerus. To place the prosthesis, the elbow was placed in maximum flexion and both components were introduced, at the same time, into the medullary canals (Figure 1C). The proximal ulna should then be trimmed to better fit the distal ulna.

Before cementing the prosthesis, a transverse hole was drilled in the ulna and a 1.6 mm wire was inserted for the traction-absorber system. A plug was placed in the humeral canal and the final prosthesis was cemented with a gun. In all cases, cement with antibiotics (vancomycin 1 g / dose) was used. Before setting the cement, the proximal ulna fragment was reduced and two 1.6 mm Kirschner pins were placed from the posterior aspect of the ulna to the anterior or intramedullary aspect, attempting to place them on each side of the prosthesis stem. The pins were placed into the cement to prevent their extrusion, and a bone graft was placed in the area of nonunion obtained from the cuts and fracture fragments of the distal humerus (Figure 1D).

Osteosynthesis was carried out at 45° extension of the elbow and was complemented with a non-absorbable thread suture (Ti-Cron® 2-0) from the triceps tendon to the orifice of the absorber-traction system with the intention of reducing the tendon traction.

During the surgery, the complete range of motion of the elbow was verified and the patients were immobilized with a plaster cast in 45° extension, which was left for 15 days, then a sling was placed and an active mobilization plan was started.

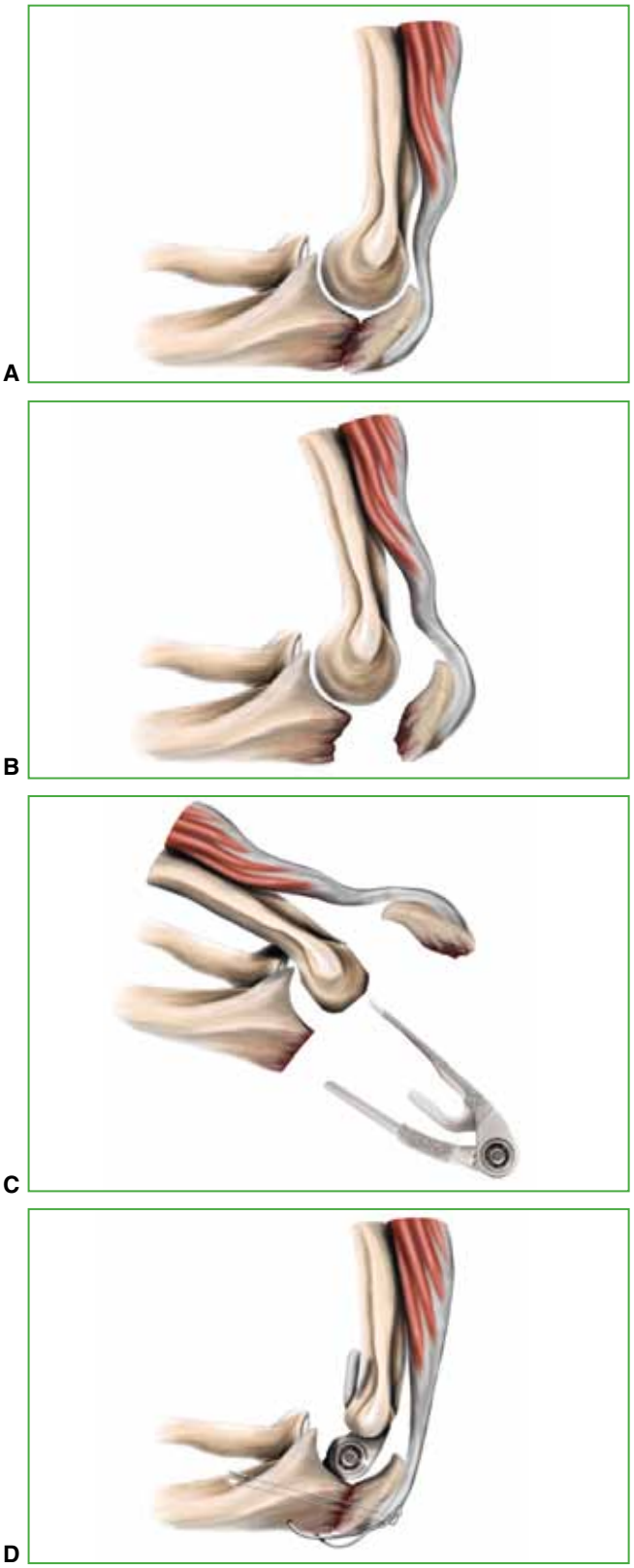

Figure 1. Surgical technique. **A.** Image with olecranon nonunion. **B.** We entered through the nonunion focus. **C.** The cuts are made and the assembled prosthesis is placed. **D.** The proximal olecranon is carved and osteosynthesis is performed with the traction-absorber system.

CLINICAL CASES

From 2007 to date, 115 TEAs have been placed in our service. Only three TEAs were placed in the context of a degenerative pathology, associated with an ON.

Case 1

A 70-year-old woman who consulted for pain and instability in her left elbow. As background, she presented a Monteggia fracture-dislocation of three years of evolution, for which she underwent surgery on three occasions. In the first surgery, the osteosynthesis of the olecranon was performed; in the second, the head of the radius was excised and, in the third, the osteosynthesis material was extracted. Flexion-extension was 90° -30°, with a pain score of 8 on the visual analog scale (VAS), a MEPS score of 40, and a DASH score of 56. On radiological images, the ON and advanced joint degeneration were evident. After puncture to rule out infection, the patient was operated on with the described technique. A Coonrad-Morrey prosthesis was fitted. Five years after surgery, the pins were removed due to discomfort; final flexion-extension was 125° -25°, with a VAS score of 2, a MEPS score of 75, and a DASH score of 32. The nonunion was consolidated and the prosthesis showed no signs of loosening (Figure 2).

Case 2

A 27-year-old man who consulted for pain and instability in his left elbow. As background, he presented a Monteggia fracture-dislocation of three years of evolution, for which he underwent surgery four times. In the first surgery, the osteosynthesis of the olecranon was performed; then, a subluxation traction absorber was placed, the head of the radius was resected and, finally, the entire osteosynthesis was removed. Flexion-extension was 110° -40°, with a pain score of 5 on the VAS, a MEPS score of 35, and a DASH score of 46. Radiographic images showed joint wear and ON. After puncture to rule out infection, the patient was operated on with the described technique. A Coonrad-Morrey prosthesis was fitted. At four years of follow-up, flexion-extension was 120° -35°, with a VAS score of 2, a MEPS score of 75, and a DASH score of 27. The nonunion was consolidated and the prosthesis showed no signs of loosening (Figure 3).

Case 3

A 81-year-old woman who consulted for a C3 supracondylar fracture according to the AO classification. She had undergone surgery for a shoulder fracture and an inverted prosthesis had been placed. She then suffered a periprosthetic fracture that was treated with a plate. A year before our surgery, she had had an olecranon fracture treated in a conservative way. In our surgery, some distal implant screws were removed and a Discovery prosthesis was placed. Three months after the intervention, it was necessary to remove the pins due to protrusion. At one year of follow-up, flexion-extension was 135° -40°, with a VAS score of 2, a MEPS score of 80, and a DASH score of 29. The nonunion was consolidated and the prosthesis had no signs of loosening (Figure 4).

DISCUSSION

The most common indications for prosthetic replacement in the elbow are post-traumatic sequelae and degenerative diseases. Post-traumatic pathology is associated with a greater number of complications compared to rheumatic ones.[3,4] Among them, triceps insufficiency is one of the most published[9,14] and when the patient has previous infections, the results are even worse. Duquin et al.[15] reported that 55% of 91 patients with a history of infection in the elbow had an elbow extension deficit at the end of reconstruction. Therefore, the correct and careful handling of the extensor apparatus is essential to try to prevent complications.

Faced with a proximal ulna without bone deficit, a relative success of reconstruction with bank Achilles tendon grafts and rotational anconeus flap has been reported. Sanchez-Sotelo and Morrey reported seven patients with these types of reconstruction and a good recovery of extension strength in six of them.[9]

In cases with more severe bone deficits, the solution is complex.[16-18]

The ON alters the continuity of the extensor apparatus and, therefore, we consider that it should be solved at the same time the prosthesis is placed. ON is rare in the context of a fracture treated with osteosynthesis.[19,20]

Papagelopoulos and Morrey[12] published a series of 16 ONs treated with autologous bone graft and osteosynthesis; consolidation was achieved in 15 cases. However, in Monteggia fracture-dislocations or transolecranon fractures, it tends to occur more frequently.[21,22]

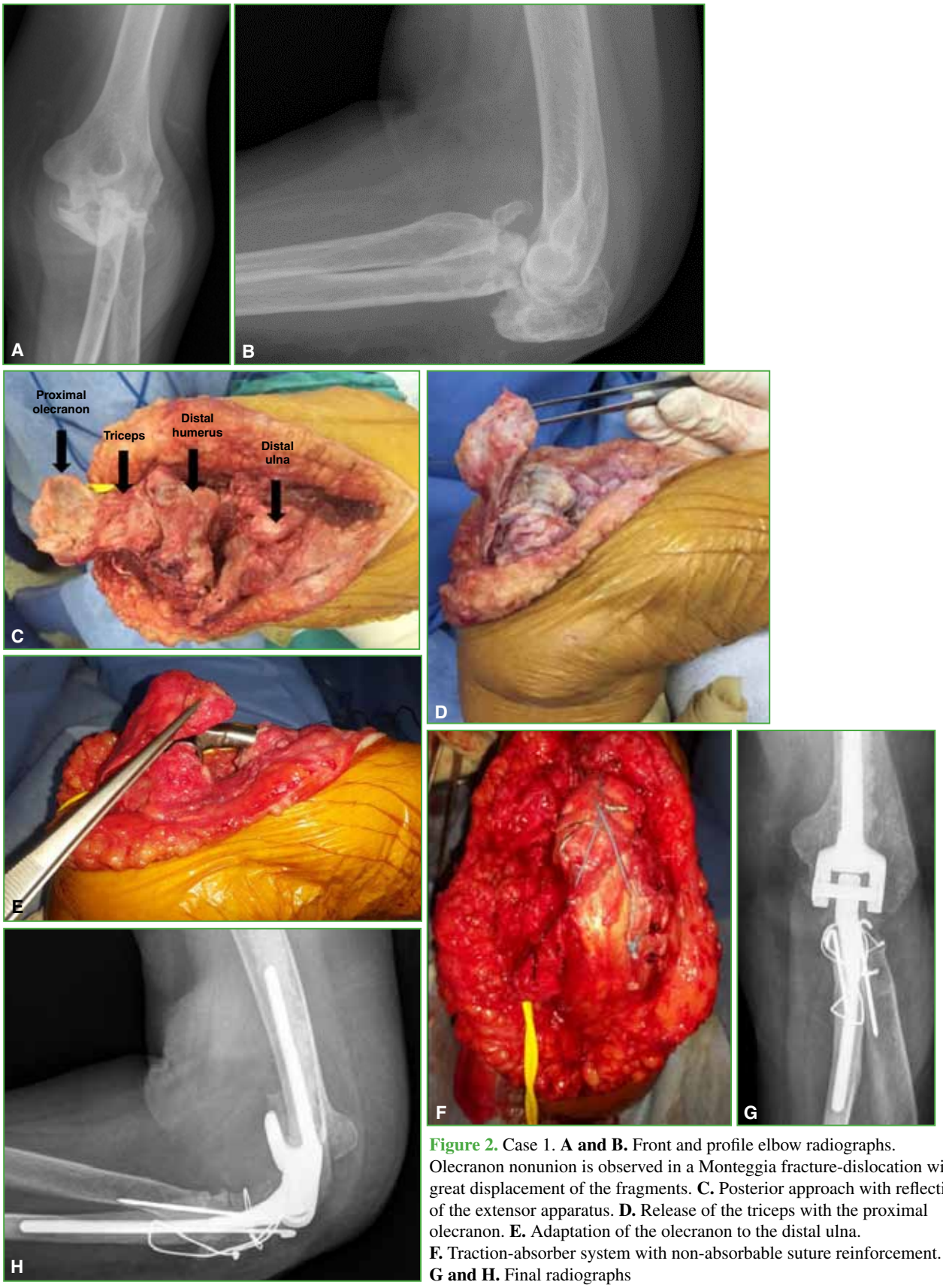

Figure 2. Case 1. **A and B.** Front and profile elbow radiographs. Olecranon nonunion is observed in a Monteggia fracture-dislocation with great displacement of the fragments. **C.** Posterior approach with reflection of the extensor apparatus. **D.** Release of the triceps with the proximal olecranon. **E.** Adaptation of the olecranon to the distal ulna. **F.** Traction-absorber system with non-absorbable suture reinforcement. **G and H.** Final radiographs

Figure 3. Case 2. **A and B.** Front and profile elbow radiographs. Olecranon nonunion is observed in a Monteggia fracture-dislocation. **C and D.** Final radiographs.

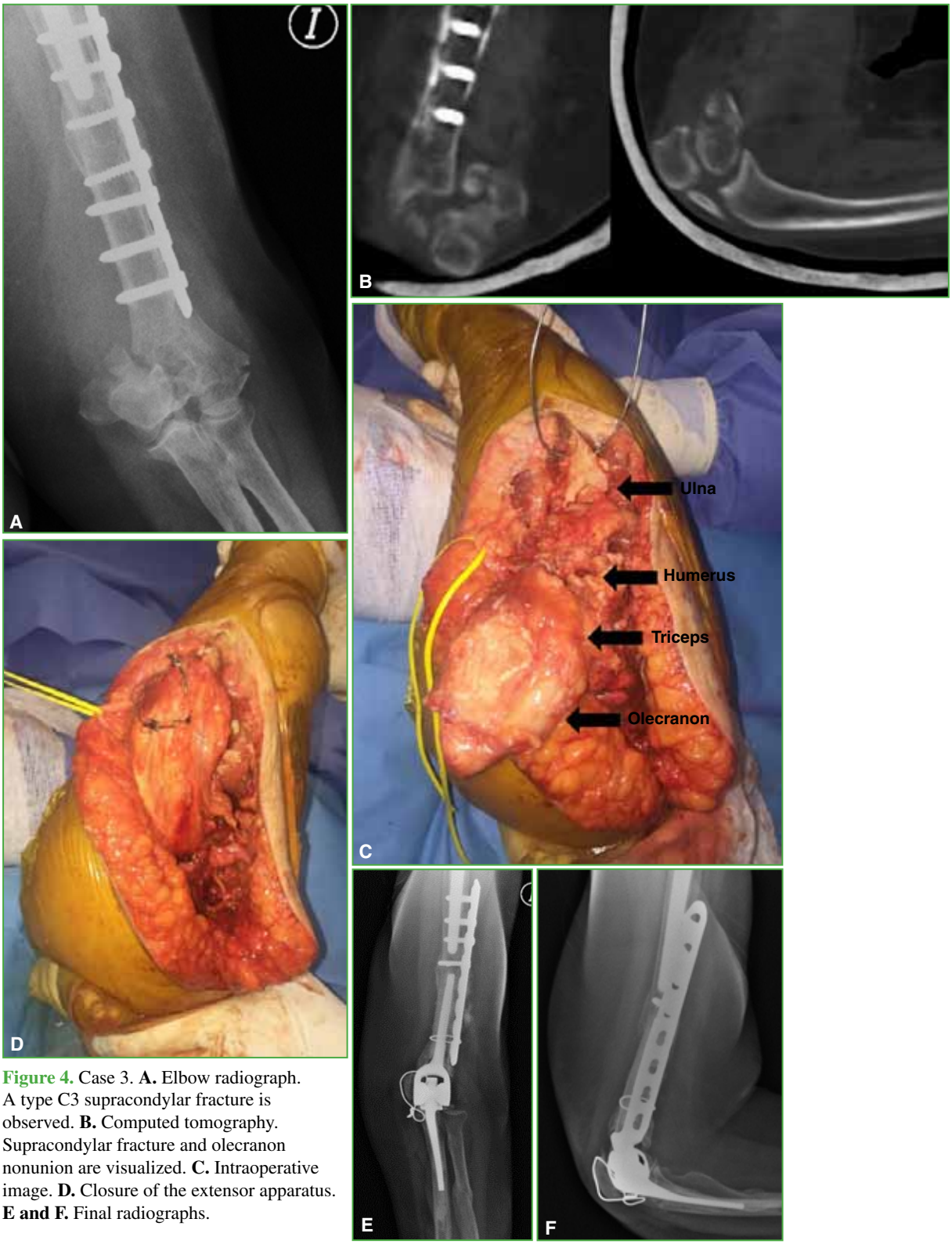

Figure 4. Case 3. **A.** Elbow radiograph. A type C3 supracondylar fracture is observed. **B.** Computed tomography. Supracondylar fracture and olecranon nonunion are visualized. **C.** Intraoperative image. **D.** Closure of the extensor apparatus. **E and F.** Final radiographs.

The described technique allows the prosthesis to be placed while maintaining the continuity of the extensor apparatus by means of its osteosynthesis with a traction absorber system.

Marra et al.[13] published a series of seven patients with post-traumatic pathologies and ON who underwent the placement of a TEA and, in four of them, consolidation was achieved. Two of the three remaining cases without consolidation required a new intervention with plate and screw osteosynthesis. Therefore, the consolidation of the ON is difficult to obtain. In some cases, a strong fibrous union of the nonunion focus can yield good results while maintaining an acceptable function of the extensor apparatus.[13]

In this series, we have added a bone graft taken from the distal humerus in all three cases and consolidation was achieved in all of them.

Chronic triceps retraction can also lead to lack of consolidation. Therefore, we consider that reinforcement with non-absorbable sutures and immobilization at 45° of extension are useful alternatives to reduce the muscle traction force and allow the consolidation of the nonunion.

The placement of Kirschner pins before the cement sets should be quick and accurate, with little chance of repositioning. For this reason, the length of the pins must be previously measured so that they do not extend beyond the anterior cortex of the ulna. However, we had to remove the pins in two of the cases due to protrusion or discomfort. The placement of the traction absorber system once the cement has set instead of with the fresh cement, is possibly useful to achieve a better positioning of the pins, which has been a complicated step in our patients.

CONCLUSIONS

When there is joint wear and an ON, treatment with a previously assembled TEA placed through the nonunion focus, releasing the entire extensor apparatus, an osteosynthesis with an absorbent-traction system and the addition of bone graft can yield good results. This technique allows us to achieve a stable elbow, with little pain, and to maintain the continuity of the extensor apparatus. Obtaining excellent results in this type of reconstruction is difficult and patient follow-up is essential, because complications are very frequent.

Conflict of interests: The authors declare they do not have any conflict of interests.

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