Extended Paratricipital Approach for Intra-articular Fractures of the Distal Humerus

Shai Shemesh, MD; Mark Yan Loebenberg, MD; Yona Kosashvili, MD; Eliezer Sidon, MD; Steven Velkes, MD; Nir Cohen, MD

FRACTURES OF THE DISTAL HUMERUS ARE COMPLEX INJURIES THAT OFTEN REQUIRE SURGICAL TREATMENT.1 OPEN REDUCTION WITH BICOLUMNAR INTERNAL FIXATION HAS BEEN SHOWN TO PROVIDE MORE PREDICTABLE OUTCOMES AND EARLIER JOINT MOBILIZATION. THE HIGH DENSITY OF NEUROLOGIC, VASCULAR, AND LIGAMENTOUS ELEMENTS AROUND THE DISTAL PART OF THE HUMERUS MAKES THESE FRACTURES PARTICULARLY CHALLENGING TO TREAT.

POSTERIOR APPROACHES TO THE DISTAL HUMERUS ARE INDICATED FOR PROCEDURES SUCH AS TRICEPS TENDON REPAIR AND TOTAL ELBOW ARTHROPLASTY, AS WELL AS OSTEOSYNTHESIS OF DISTAL HUMERUS AND OLECRANON FRACTURES.2 SELECTING THE MOST SUITABLE APPROACH DEPENDS ON SEVERAL FACTORS, INCLUDING PATIENT FACTORS, THE DEGREE OF ARTICULAR VISUALIZATION REQUIRED FOR ANATOMIC REDUCTION AND FIXATION, FRACTURE CHARACTERISTICS, AND ANY ASSOCIATED INJURIES.1

THE TRANSOLECRANON APPROACH TO THE ELBOW WAS DESCRIBED BY MACAUSLAND3 IN 1915 AND WAS LATER FURTHER DEVELOPED BY MÜLLER ET AL4 TO INCLUDE A POSTERIOR OBLIQUE OLECRANON OSTEOTOMY. THE TRANSVERSE AND OBLIQUE OLECRANON OSTEOTOMIES HAVE LARGELY BEEN REPLACED BY THE CHEVRON OSTEOTOMY.1

COMPARED WITH OTHER POSTERIOR APPROACHES, OLECRANON OSTEOTOMY ALLOWS THE BEST VISUALIZATION OF THE DISTAL HUMERUS ARTICULAR SURFACE.5,6 OLECRANON OSTEOTOMY PROVIDES EXCELLENT EXPOSURE OF THE DISTAL HUMERUS, IS STRAIGHTFORWARD, AND IS ASSOCIATED WITH LIMITED Complications WHEN AppROPRIATE RECONSTRUCTION TECHNIQUES ARE USED.

The main disadvantages of this approach are related to the osteotomy itself, including non-union, malunion, and hardware irritation.7-9 On the other hand, the paratricipital approach described by Alonso-Llames10 allows bicolumnar exposure and plating, while maintaining the triceps insertion undisturbed, minimizing the risk of postoperative extensor mechanism insufficiency.2,10 Knowledge of the location of the radial nerve with reference to the posterior aspect of the humerus and to the lateral epicondyle, as well as its influence on the potential proximal extent of the operative approach, cannot be over-emphasized.11

SURGICAL TECHNIQUE

The authors routinely obtain conventional anteroposte-

ABSTRACT: This article describes an extensile surgical exposure to the distal humerus that is suitable for complex fractures involving the articular surface and extending into the humeral diaphysis proximal to the radial nerve. This method combines 2 approaches: olecranon osteotomy and the lateral paratricipital approach. This combination allows an appropriate exposure of both the articular surface and the humeral diaphysis up to the level of the deltoid tuberosity, while maintaining the extensor mechanism unharmed. [Orthopedics. 2015; 38(7):435-438.]

The authors are from the Department of Orthopedic Surgery, Rabin Medical Center, Beilinson Campus, Petach Tikva, Israel. Drs Shemesh and Cohen contributed equally to this work and should be considered as equal first authors.

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Correspondence should be addressed to: Shai Shemesh, MD, Department of Orthopedic Surgery, Rabin Medical Center, Beilinson Campus, 39 Jabotinski St, Petach Tikva 49100, Israel (shemesh.shai@gmail.com).

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Abstract: This article describes an extensile surgical exposure to the distal humerus that is suitable for complex fractures involving the articular surface and extending into the humeral diaphysis proximal to the radial nerve. This method combines 2 approaches: olecranon osteotomy and the lateral paratricipital approach. This combination allows an appropriate exposure of both the articular surface and the humeral diaphysis up to the level of the deltoid tuberosity, while maintaining the extensor mechanism unharmed. [Orthopedics. 2015; 38(7):435-438.]

Fractures of the distal humerus are complex injuries that often require surgical treatment.1 Open reduction with bicolumnar internal fixation has been shown to provide more predictable outcomes and earlier joint mobilization. The high density of neurologic, vascular, and ligamentous elements around the distal part of the humerus makes these fractures particularly challenging to treat.

Posteriors to the distal humerus are indicated for procedures such as triceps tendon repair and total elbow arthroplasty, as well as osteosynthesis of distal humerus and olecranon fractures.2 Selecting the most suitable approach depends on several factors, including patient factors, the degree of articular visualization required for anatomic reduction and fixation, fracture characteristics, and any associated injuries.1

The transolecranon approach to the elbow was described by MacAusland3 in 1915 and was later further developed by Müller et al4 to include a posterior oblique olecranon osteotomy. The transverse and oblique olecranon osteotomies have largely been replaced by the chevron osteotomy.1

Compared with other posterior approaches, olecranon osteotomy allows the best visualization of the distal humerus articular surface.5,6 Olecranon osteotomy provides excellent exposure of the distal humerus, is straightforward, and is associated with limited complications when appropriate reconstruction techniques are used.

The main disadvantages of this approach are related to the osteotomy itself, including non-union, malunion, and hardware irritation.7-9 On the other hand, the paratricipital approach described by Alonso-Llames10 allows bicolumnar exposure and plating, while maintaining the triceps insertion undisturbed, minimizing the risk of postoperative extensor mechanism insufficiency.2,10 Knowledge of the location of the radial nerve with reference to the posterior aspect of the humerus and to the lateral epicondyle, as well as its influence on the potential proximal extent of the operative approach, cannot be over-emphasized.11

Surgical Technique

The authors routinely obtain conventional anteroposte-
Prior and lateral radiographs, as well as preoperative computed tomography scans with 3-dimensional reconstruction, to assist in preoperative planning (Figure 1).

The patient is placed on the operating table in the prone position, with the injured arm placed on a support allowing at least 90° of elbow flexion. The limb is prepared circumferentially and draped free in the operative field. The authors use a posterior longitudinal skin incision, begun proximal to the olecranon process, centered on the triceps tendon, and taken distally over the olecranon process. The incision is finished distally, 8 cm distal to the tip of the olecranon. The fascia overlying the triceps is identified and split to allow the elevation of full-thickness fasciocutaneous medial and lateral flaps.

The medial and lateral aspects of the triceps are identified, and the ulnar nerve is isolated. The nerve is identified proximally, decompressed at the level of the 2 heads of the flexor carpi ulnaris, and left in its bed, marked with a vessel loop.

Next, a capsulotomy is performed on both sides of the olecranon. An osteotomy is created with an oscillating saw in a chevron configuration, typically with the apex pointed distally. An osteotome is used to complete the procedure so that a portion of the osteotomy site is serrated.

Afterward, a lateral intermuscular plane is developed between the lateral border of the triceps tendon and the intermuscular septum. The dissection is extended proximally to the point where the lateral branchial cutaneous nerve is identified. The dissection along the lateral branchial cutaneous nerve is continued proximally along its course at the lateral aspect of the humerus up to the trifurcation of the radial nerve into the lateral branchial cutaneous nerve, the

Figure 1: Anteroposterior (A) and lateral (B) radiographs of a 41-year-old patient with a complete articular fracture (OTA 13-C) of the distal humerus extending into the diaphysis. Note the intra-articular comminution on axial computed tomography scan (C).

Figure 2: Lateral dissection along the lateral border of the triceps, continuing proximally to the level of the radial nerve (solid arrow), with elevation of the triceps muscle off the lateral humerus. An Acumed Elbow Plating System (Acumed USA, Hillsboro, Oregon) was used, with a 3.5 20-hole (206 mm) locking lateral plate and a 3.5 16-hole (175 mm) locking medial plate. The radial nerve crosses the plate between the 14th and 16th holes. The open arrow points to the ulnar nerve (A). The ulnar nerve (open arrow) was anteriorly transposed after reduction and fixation of the fracture (B). At the end of the operation, the chevron osteotomy was fixated with a tension band wire, while the triceps muscle was spared and allowed to resume its position (C).
branch to the medial head of the triceps, and the continuation of the radial nerve into the forearm. The lateral head of the triceps is then reflected medially en masse, maintaining the continuity of its fibers. The radial nerve is protected and marked with a vessel loop (Figure 2). Further proximal dissection, above the course of the nerve on the lateral aspect of the humerus, provides exposure of the humeral shaft to the point of insertion of the deltidoid muscle. The dissection between the medial and lateral tissue planes meets at the posterior humeral cortex as the triceps muscle is separated from the humerus. Adequate exposure of the fracture is obtained, allowing open reduction and plate osteosynthesis.

The authors routinely use the Acumed Elbow Plating System (Acumed USA, Hillsboro, Oregon) in an orthogonal (Figure 3) or parallel orientation, depending on the fracture pattern. Long plates are allowed to be placed under the radial nerve and fixation with proximal and distal screws through the plate is achieved. The olecranon is reattached with two 1.8-mm parallel Kirschner wires and a tension band wire in a figure-of-8 configuration beneath the triceps tendon. Thereafter, the medial and lateral heads of the triceps resume their anatomical position. The elbow is then put through a full range of motion to test the stability of the entire fixation.

The elbow usually is immobilized in the perioperative period for less than 10 days to allow for soft tissue healing, at which time a gentle, active rehabilitation program is instituted.

**DISCUSSION**

The extensile posterior approach described here has several distinct advantages. First, it provides excellent visualization of the articular surface, allowing accurate reduction and stable fixation. Second, the radial nerve is explored and protected at the fracture site. Third, it provides adequate exposure of both columns, allowing bicolumnar plating while monitoring both the ulnar and radial nerves. Fourth, it has the potential to be extended as needed should fracture extension or comminution mandate more proximal fixation. Finally, it avoids dissection through the triceps or forceful retraction on adherent tissues, as the dissection is made through natural tissue planes.

The authors believe that distal intra-articular humeral fractures with long column fragments are optimal fracture patterns for this exposure. Although distal humerus fractures can be properly treated using other posterior approaches (eg, simple chevron osteotomy, Alonso-Llames’ or Campbell’s triceps splitting approach), the current authors believe that none of these approaches alone can sufficiently visualize both the articular surface and the mid-shaft extension of the complex fractures described here.

The drawbacks of the extensile posterior approach are the long surgical wound, the extensive soft tissue stripping, and the aforementioned disadvantages of the olecranon osteotomy. Nevertheless, adequate surgical exposure for this type of injury is obligatory.

**CONCLUSION**

The authors’ modified approach to the elbow securely and adequately exposes the elbow joint and the diaphyseal distal humerus for fracture fixation purposes, allowing for safe exploration of the radial nerve. Through this exposure, the entire articular surface is readily accessible. The authors have used this approach in several cases of complex fractures and have found it safe and reproducible.

**REFERENCES**


