Closed Reduction and Percutaneous Stabilization of Pediatric T-Condylar Fractures of the Humerus

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Abstract: T-condylar fractures of the humerus are a rare fracture pattern in children. The usual recommendation is to treat them with open reduction and internal fixation, in accordance to the usual practice in adult fracture patterns. This involves extensive surgical approach to the elbow to allow anatomic reduction and placement of hardware for rigid fixation. The authors present a technique of closed reduction of the intra-articular component of the T-condylar fracture that is stabilized with partially threaded pins that afford interfragmentary compression, followed by the use of two elastic titanium intramedullary nails to stabilize the supracondylar component of the fracture as well. Two adolescents (12 and 14 years of age) with a T-condylar elbow fracture were treated with the described technique. Both fractures healed without complications. Hardware was removed in the outpatient clinic after 4 weeks, and both patients returned to sports with full range of elbow motion 6 weeks postoperatively.

Key Words: T-condylar, humerus, pediatric, percutaneous fixation

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A T-condylar fracture of the distal end of the humerus is created when a fracture line commences at the central groove of the trochlea and propagates proximally, dividing and separating the medial and lateral bony columns of the distal humerus.[11] It is a rare fracture pattern,[4] created usually when the semilunar notch of the olecranon abuts the distal end of the humerus, acting as a wedge.[7] Usually this is the result of a direct blow or a fall on a flexed elbow.

Despite the small number of reported clinical series, it is widely accepted that this fracture should be treated with open reduction and rigid fixation.[4,8,9] Open reduction causes further iatrogenic injury to the surrounding soft tissues and may lead to postoperative stiffness.[3,5,11] We present a technique of closed reduction and percutaneous fixation of such fractures. This method evolved as an effort to minimize the secondary soft tissue injury in two high-performance competitive swimmers who presented for treatment to our institution with a closed T-condylar distal humerus fracture after a fall.

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MATERIALS AND METHODS

Between 1999 and 2001, two male competitive swimmers, aged 12 and 14 years, presented to our institution for treatment with an isolated closed T-condylar fracture of the distal humerus (Fig. 1). Both sustained a fall on a flexed elbow and were neurovascularly intact on presentation.

Surgical Technique

Under general anesthesia the affected arm was prepped and draped free over a radiolucent operating table. One partially threaded pin (FFS, Orthofix, Italy) was introduced laterally on the lateral aspect of the lateral humeral condyle, parallel to the elbow joint, aided by fluoroscopy. Reduction of the intra-articular component of the fracture was achieved by joysticking the lateral fragment onto the medial one using the already inserted partially threaded pin. The reduction was then held using a large pointed pelvic clamp placed percutaneously, with care taken to avoid the ulnar nerve medially. The accuracy of fracture reduction was verified using the C-arm. At that point the pin was advanced to the medial fragment, while a second one was placed in the same fashion under fluoroscopic control and the clamp was then removed. A 2.7-mm drill was employed to create a path along the lateral column of the distal fragment after a stab wound, in the same mode that a lateral pin would have been placed in a typical two cross-pin fixation of a pediatric supracondylar fracture of the humerus.

A 2.5-mm prebent titanium nail (De Puy International, Leeds, UK) was inserted along the opened path and was manually driven to the fracture site. The supracondylar component was reduced and the nail was advanced 2 to 3 cm past the fracture site. Another 2.5-mm nail was then introduced similarly through the medial column, with care taken to avoid the ulnar nerve. The two nails were advanced to the area of the surgical neck of the humerus. The final fracture reduction was ascertained using radiography. The edges of both nails and pins were then trimmed and left protruding approximately 2 cm from the skin.

The mean time of operation was less than 60 minutes. A long-arm double-sugar-tong splint was then applied for 5 days and was subsequently changed to a long-arm cast. The fracture was monitored radiographically on a weekly basis. Adequate callus was formed in both patients by 3 weeks postoperatively.

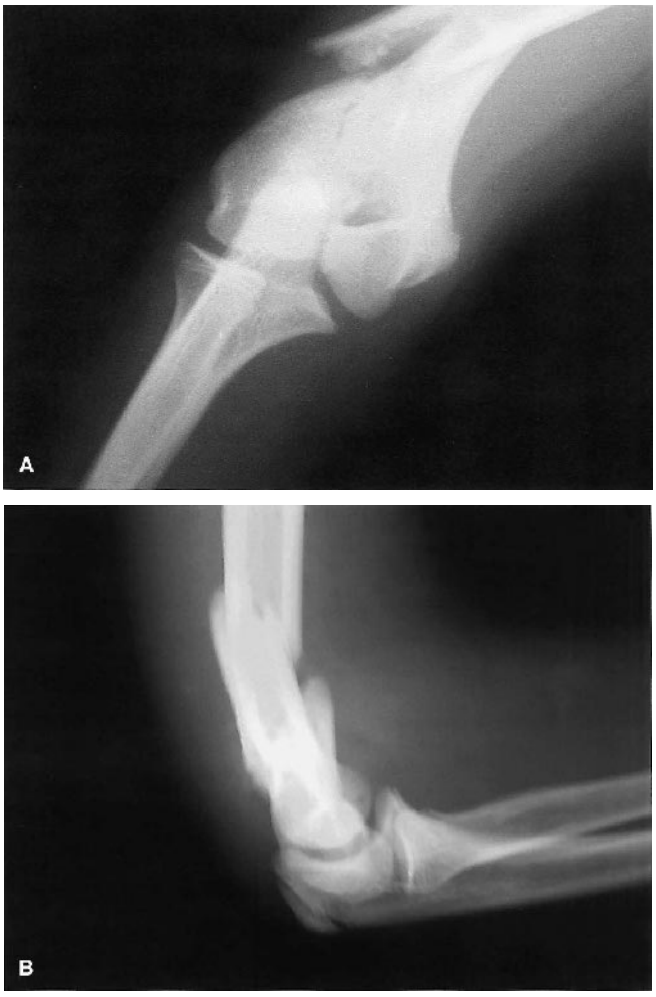

FIGURE 1. Anteroposterior (**A**) and lateral (**B**) radiographs of the right elbow in the 14-year-old patient, on admission.

The cast was removed and protected active assisted exercises of the elbow were initiated (Fig. 2). Hardware was removed in clinic 1 week later.

RESULTS

Both fractures healed clinically and radiographically at 3.5 and 4.5 weeks. No infection or loss of reduction was noted at any point. Six weeks postoperatively both patients were allowed to resume training. At 12 weeks, when range of motion was fully restored, they were able to swim competitively. At the latest follow-up, 12 and 16 months postoperatively, they demonstrated full pain-free range of elbow motion, with excellent radiographic outcome (Figs. 3 and 4).

DISCUSSION

When selecting the appropriate mode of treatment of a displaced T-condylar fracture, the pediatric orthopaedist is mainly influenced by the adult literature,[3,5,6,10] since the rarity of the injury in the pediatric population has not yet made possible the comparison of the various treatment modalities. It is generally accepted a displaced T-condylar fracture of the humerus in an adolescent warrants open reduction and rigid internal fixation.[4,7,9,11] This is usually accomplished using the posterior approach to the elbow without an olecranon osteotomy.[1,2,4,8,9] This surgical approach is traumatic and can lead to postinjury stiffness, since it exposes the extensor mechanism of the elbow to iatrogenic injury.[3,5,11]

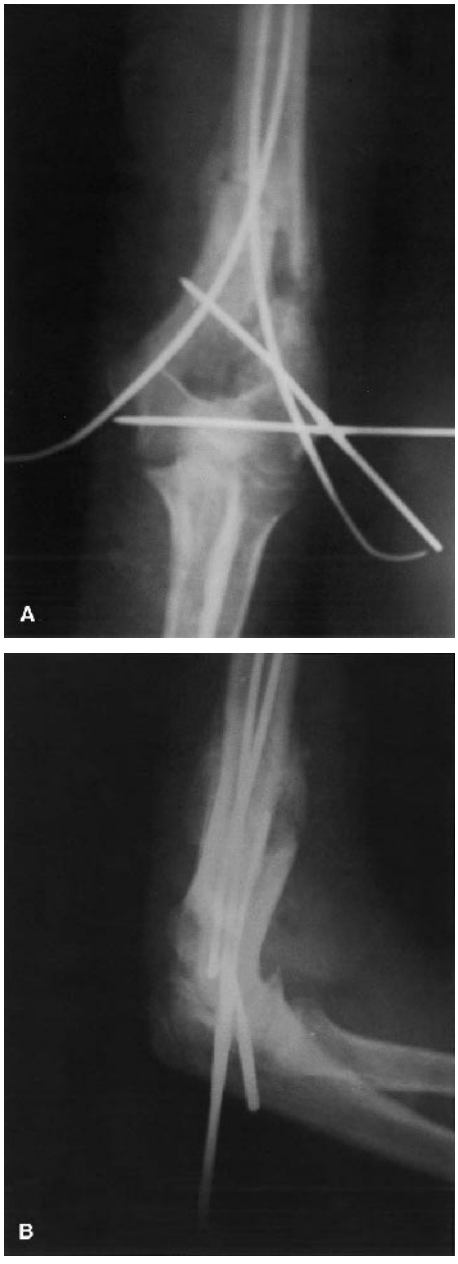

FIGURE 2. Anteroposterior (**A**) and lateral (**B**) radiographs of the right elbow 3 weeks postoperatively.

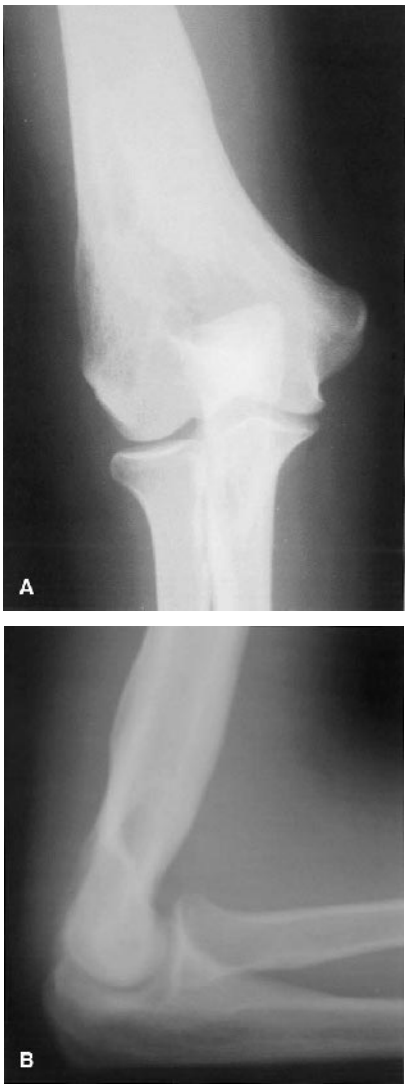

FIGURE 3. Anteroposterior (**A**) and lateral (**B**) radiographs at the latest follow-up.

The aim of the described technique is to transform a three-piece T-condylar fracture of the distal end of the humerus into a two-segment Gartland type III supracondylar fracture. This is achieved with the proper placement of partially threaded pins, which are used to reduce the fracture and to provide interfragmentary compression. Anatomic reduction can be achieved with percutaneous maneuvers and can be monitored using fluoroscopy. The performance of an arthrogram to assess the adequacy of the reduction is also possible. Anatomic intra-articular fracture reduction is the key part of the procedure, and if this cannot be ensured, this technique should be abandoned. If the articular surface reduction is anatomic, then the remaining supracondylar component can be stabilized using elastic titanium nails instead of Kirschner wires. The nails are bent appropriately to fit within the medial and lateral bony columns of the distal humerus. Stability of the fracture is gained following two principles: 1) impacting the tips of the nails at the metaphyseal bone of the surgical neck of the humerus and 2) abutting against the opposite cortex for as long as possible. Two 2.5-mm nails offer adequate stability, since the humerus is a non-weight-bearing bone. The long arm of the nails from the distal tip to the fracture site offers elastic but secure fixation that promotes fracture healing, even when protected elbow motion is allowed in the absence of a solid radiographic union. An advantage of this technique is that hardware can be removed in clinic, since it is left protruding through the skin. Both our patients tolerated removal well and neither had skin irritation or infection around the hardware.

In conclusion, we have presented a technique for fixation of a rare intra-articular pediatric elbow fracture that con-

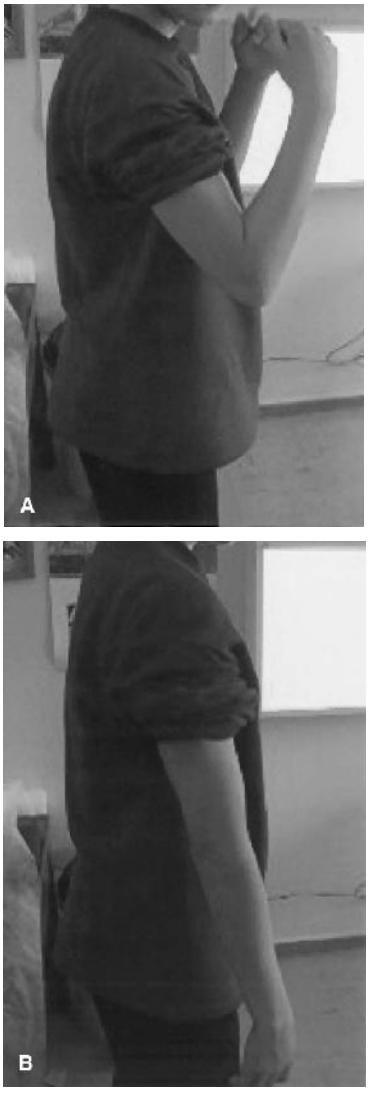

FIGURE 4. Terminal elbow flexion (**A**) and extension (**B**) 6 weeks postoperatively.

sists of percutaneous pin fixation of the intra-articular component of the T-condylar humerus fracture using two partially threaded pins and a pair of elastic titanium nails for fixation of the supracondylar component as well. The fracture fixation is performed percutaneously using fluoroscopic guidance. This mode of treatment requires the achievement and maintenance of closed anatomic reduction of the intra-articular component. This technique yielded excellent clinical and radiographic results in two competitive swimmers who we treated accordingly, but it should be evaluated further after being applied to a larger number of patients with a T-condylar fracture of the distal humerus; this could be a lengthy project given the rarity of this injury in children.

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