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Rotational Sequelae of the Phalanx in a Pediatric Patient: Correction with Metacarpal Derotator Osteotomy and Osteosynthesis with an Endomedullary Compression Screw. Case Report

Secuela rotacional de falange en paciente pediátrico: Corrección con osteotomía desrotadora de metacarpiano y osteosíntesis con tornillo compresivo endomedular. Reporte de un caso

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Abstract

Phalangeal rotational sequelae are fortunately rare in pediatric patients, and their treatment may involve corrective osteotomies of the affected bone. The ideal treatment must correct the rotational defect, preserve the physis and its growth potential, avoid extensive scars, and provide friendly postoperative care with few procedures, such as wire removal. We present a case of a pediatric patient with rotational sequelae from a subcondylar fracture of the proximal phalanx of the fifth finger of the dominant hand. We performed a derotating osteotomy of the fifth metacarpal and stabilization with a headless endomedullary screw for defect correction.

Keywords
- Phalanx fracture
- rotational sequelae
- pediatric hand
- metacarpal osteotomy
- endomedullary screw

Resumen

Las secuelas rotacionales en las falanges de pacientes pediátricos son, afortunadamente, poco frecuentes y se pueden tratar mediante osteotomías correctivas del hueso en el cual presenta la secuela. El tratamiento ideal debe lograr, además de la corrección del defecto rotacional: conservar el cartílago de crecimiento indemne junto con su potencial de crecimiento, evitar cicatrices extensas y un postoperatorio mas confortable sin el retiro de clavos. Presentamos el caso de una paciente de edad pediátrica con una secuela rotacional de una fractura subcondilar de falange proximal de 5° dedo mano hábil en la cual se realizó una osteotomía desrotadora de 5° metacarpiano y estabilización con tornillo endomedular sin cabeza para corrección del defecto.

Palabras Clave
- fractura falange
- secuela rotacional
- mano pediátrica
- osteotomía metacarpiano
- tornillo endomedular

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Introduction

Although most hand fractures in pediatric patients are candidates for closed reduction and orthopedic treatment, some cases require surgery for anatomical reduction, stabilization, and normal function. Open physes allow the hand surgeon to accept some displacement of the fracture lines and still achieve excellent long-term function. However, it is also true that growth potential can give a false idea of security and comfort when treating these injuries in children. Bones have good remodeling potential when the displacement is in the same plane of movement in fractures close to the physis and younger subjects, who have more time to remodel.[1] There is little information on protocols for acceptable and unacceptable deformities.[2] Rotational deformities are usually an indication for surgical treatment.[2,3] Phalangeal and metacarpal fractures in pediatric patients require a differential approach compared to adults due to the growth cartilage, the small size of their structures, a thick periosteum, and the remodeling potential.

Fortunately, phalangeal rotational sequelae in pediatric patients are rare, and their treatment may involve a corrective osteotomy of the affected bone. The ideal treatment must correct the rotational defect, spare the growth cartilage and its growth potential, avoid extensive scars, and provide a more comfortable postoperative period with no nail removal.

Hand surgeons increasingly use endomedullary screws. The benefits of these screws include low morbidity, minimal incisions, small dissection, lower tendon manipulation, and deperiostization. Their uses in hands from pediatric patients include wrist injuries[4–6] and metacarpal fractures[2] in subjects with closed physes but not in metacarpals with open physes or rotational sequelae of phalangeal fractures.

We present the case of an 11-year-old patient with rotational sequelae from a subcondylar fracture of the proximal phalanx of the fifth finger of the dominant hand. We performed a derotation osteotomy of the fifth metacarpal and stabilization with a headless endomedullary screw for defect correction.

Case Report

Right-handed 11-year-old female patient. She had a closed subcondylar fracture of the first phalanx of the fifth finger of the right hand. The medical history reported no angulation or rotational deformity. The patient opted for orthopedic treatment for four weeks. The patient returned to the clinic two months after the initial consultation and orthopedic treatment removal with external 25°-rotational sequelae of the fifth finger of the dominant hand (►**Fig. 1**). She reported functional alteration but no pain.

Under general anesthesia and using a pneumatic cuff, we performed a small (1.5 cm) incision on the dorsoulnar sector of the fifth metacarpal. We dissected the area between the common extensor tendon of the fifth finger and the extensor digitorum muscle until we reached the periosteum. After minimal deperiostization, we performed a transverse osteotomy with an electric saw (►**Fig. 2**). We clinically confirmed the rotational deformity correction per nail parallelism and digital cascade.

From the focus, in a retrograde manner, we passed the guide proximally until it emerged at the base of the metacarpal bone (►**Fig. 3**). Next, we passed the guide nail anterogradely through the distal fragment without reaching the physis (►**Fig. 4**). We used a 32-mm long, 3.0 self-drilling endomedullary screw (Synthes) with a short thread in an anterograde manner without reaching the physis (►**Fig. 5**). We verified the

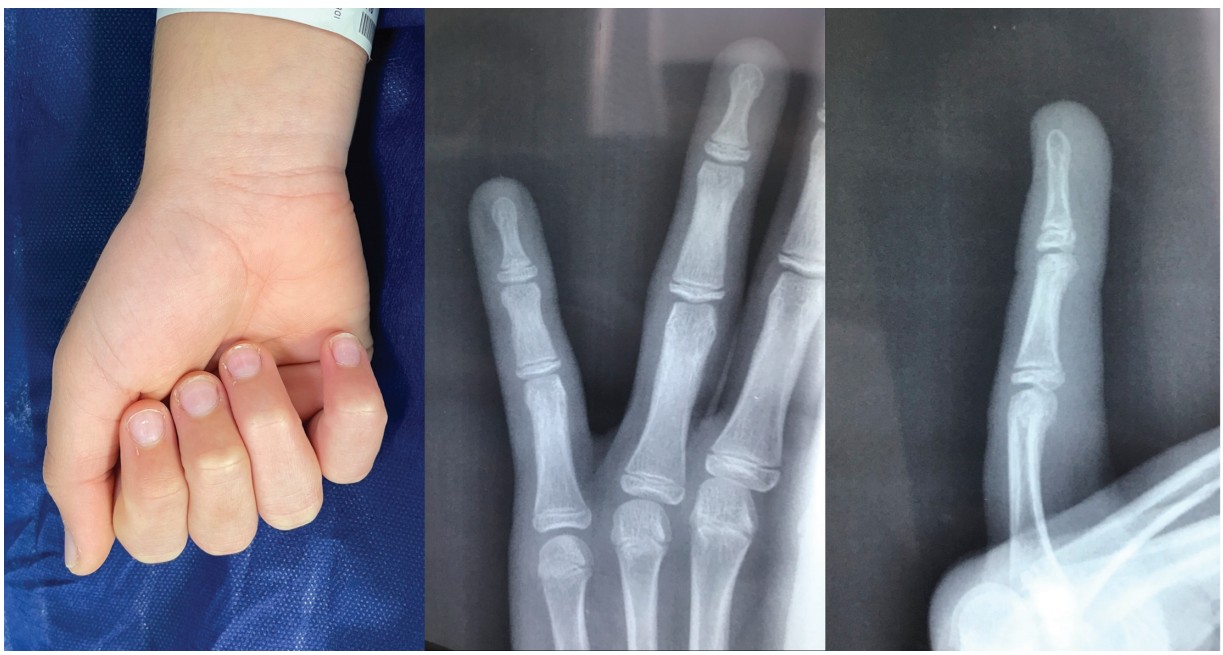

Fig. 1 Rotational alteration of the 5th finger and front and profile radiographs.

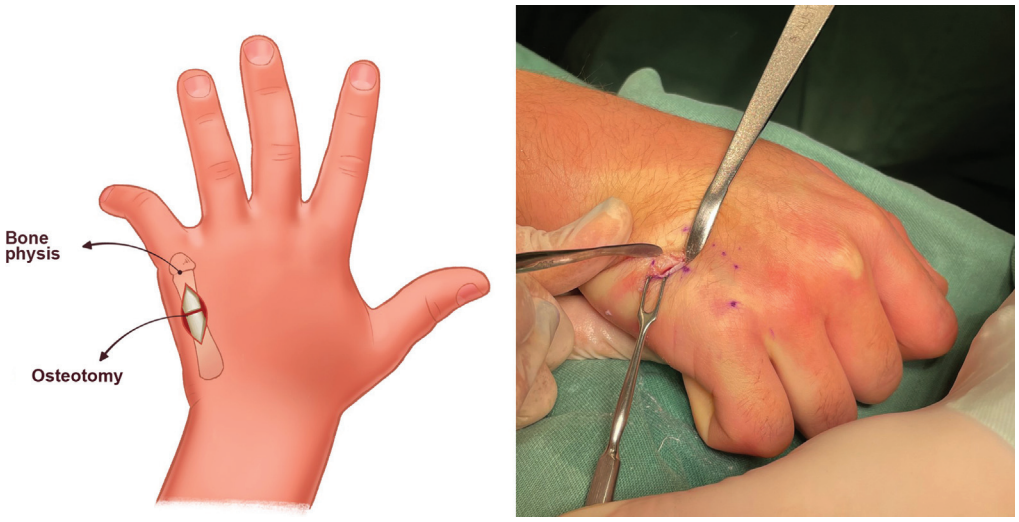

Fig. 2 Illustration shows topography of osteotomy in reference to physis. Intraoperative image with osteotomy and approach on the back of the hand.

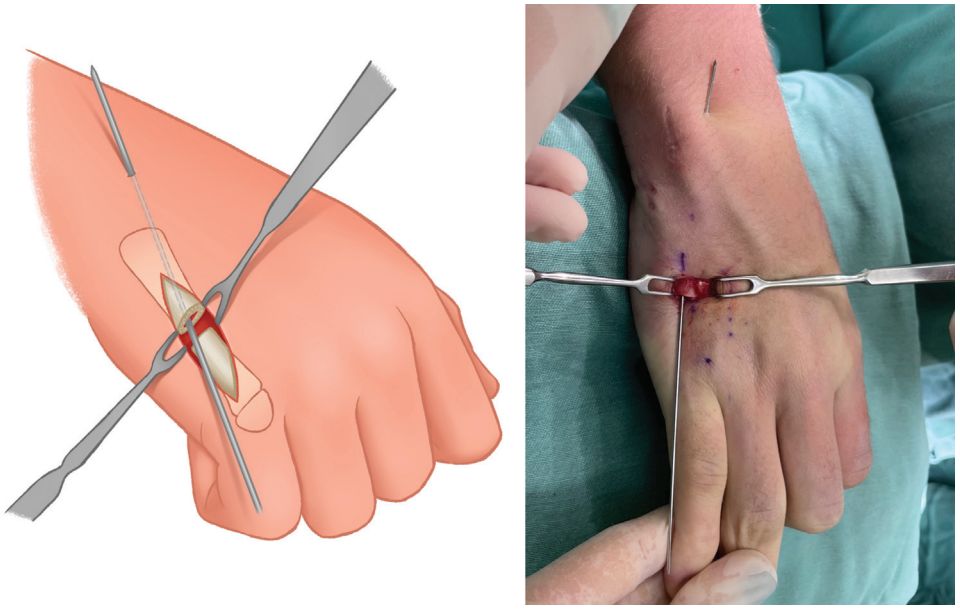

Fig. 3 Illustration shows retrograde placement of the nail through the osteotomy site. The maneuver is visualized in the intraoperative image.

correct digital alignment again, observing adequate digital cascade in static position (►**Fig. 6**) and tenodesic maneuvers. We infiltrated 0.25% bupivacaine in the ulnar nerve and performed wound closure with a monofilament absorbable suture. Before placing the antebrachial digit splint, we proceeded to fourth and fifth finger syndactylization.

The patient remained with the splint for a week and continued with the fourth and fifth fingers in syndactyly for a month. Her subsequent evolution was good, with rotational defect correction and no stiffness or pain. She reported the resolution of the previous functional limitation and had no infections or other complications. (►**Fig. 7 a, b, c**, and **d**)

Discussion

This work is the first report on correcting rotational sequelae of a phalanx fracture through a metacarpal derotation osteotomy and stabilization with an endomedullary self-drilling screw.

The remodeling potential of neck fractures of the proximal and middle phalanges is higher than previously believed. Notwithstanding, rotational or coronal alterations >15° or patients with less than a year of bone growth potential require surgery.[2]

Kebrle and Schmoranzova describe good outcomes in 13 pediatric patients undergoing phalangeal and metacarpal osteotomies who, after the initial orthopedic treatment, presented malunion. These authors reported that they did not perform posterior osteosynthesis in three patients and four osteotomies; however, they did not describe the type of osteosynthesis performed in the remaining patients[7] or sequelae.

Phalangeal corrective osteotomies are technically very demanding. These procedures require tenotomy of the extensor apparatus and extensive detachment with the

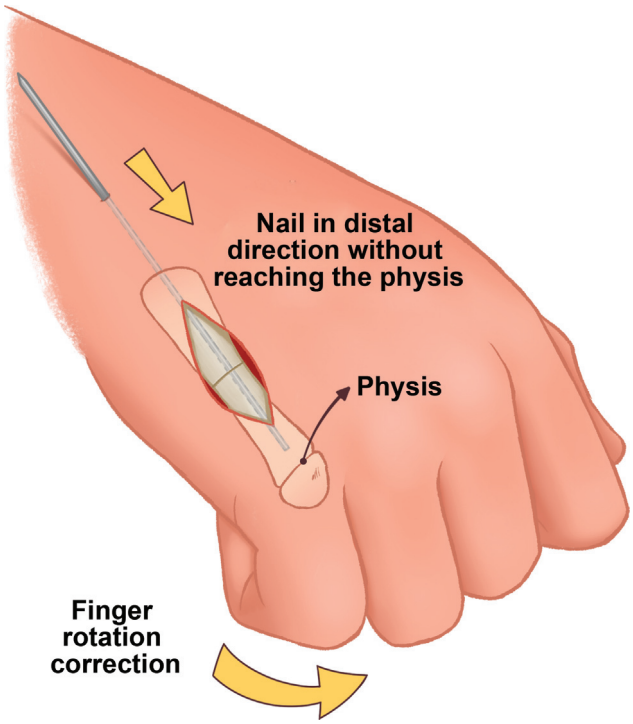

Fig. 4 Maneuver to reduce rotational alteration by counteracting sequelae. Subsequently, the nail is passed anterogradely without reaching the physis.

Fig. 6 Immediate postoperative period after reduction and stabilization with intramedullary screw.

consequent risk of producing scars and stiffness. Furthermore, it may be difficult to recognize the fracture line, especially in pediatric patients, due to its consolidation characteristics. In subcondylar fractures, corrective osteotomies have a high risk of condylar osteonecrosis resulting from poor vascularization.[8] Wecksser was the first to publish a metacarpal osteotomy to correct a phalangeal rotational deformity.[9] This technique has demonstrated good outcomes in rotational sequelae of the middle and proximal phalanges in adult and pediatric patients.[10,11] he advantage of using the metacarpal bones for deformity correction lies in its technical lower complexity resulting from less tendon dissection and manipulation, fewer adhesions, and a lower tendency to delayed consolidation. In addition, metacarpophalangeal joint rotation does not hinder a good functional outcome.[12]

Berthold et al. described a technique for measuring the rotation degrees of the long fingers using computed tomography. Although these authors concluded that this was a reproducible and accurate study, it employed adult cadavers. Moreover, it involved radiation and required strict positioning, often difficult to achieve in children without general anesthesia or sedation. Yet, the authors mentioned not only interindividual variability but also interindividual variability between both hands. We did not find similar studies in pediatric patients, and we infer that its implementation is

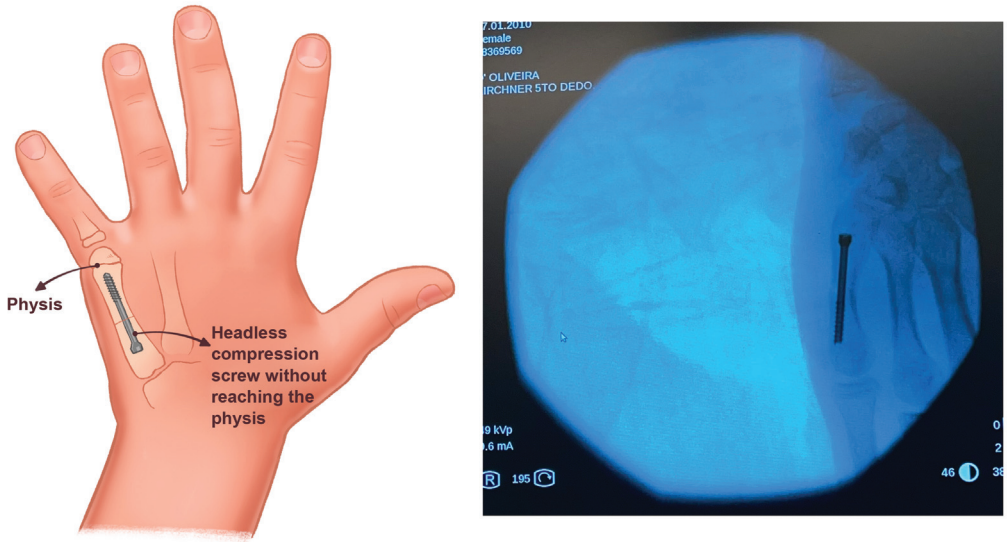

Fig. 5 Illustration of final result and position of the intramedullary screw together with intraoperative fluoroscopy. Note that the screw does not reach the physis.

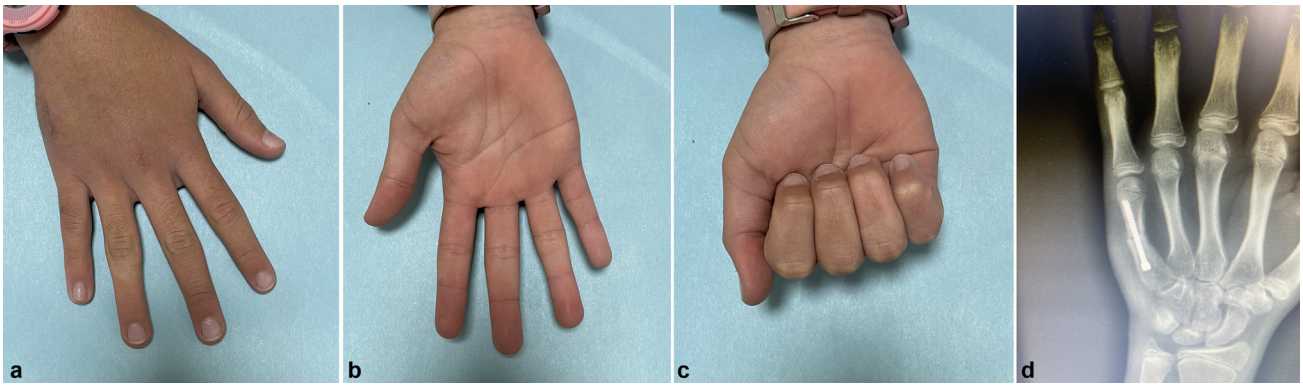

Fig. 7 Final functional result and radiography. Correction of the rotational defect is evident.

more complex due to the age-related variability of the bone skeleton, the importance of reducing irradiation at early ages, and considering the significance of the clinical picture of the patient with the dynamic intraoperatively examination.[13]

Two authors reported good outcomes post-osteotomy: Kebrle et al., with orthopedic treatment,[7] nd Bindra et al., after fixation with plates and screws.[8] Each fixation method has its advantages and disadvantages, and its selection relies on the analysis of each clinical case. Endomedullary screws avoid the greater deperiostization required for plate and screw placement and result in minimal scars and early mobilization. In addition, they do not require nail removal, which is a traumatic event for children is still a traumatic event.

Although articular cartilage damage was a concern soon after endomedullary screw introduction, several papers minimize this injury.[14] To date, there are no long-term studies published attributing this technique to metacarpophalangeal osteoarthritis.[15] The anterograde use of the screw avoided physeal injury rather than the eventual articular cartilage damage. When treating acute fractures and their sequelae, it is paramount to avoid injury and address the physis. This is not feasible in all cases. On these occasions, instruments of the smallest possible caliber and with no thread are preferred to reduce the potential for injury.[16] In our clinical case, the screw had commercial measurements, and we would have selected one with a smaller diameter. We cannot ensure this technique does not compromise metacarpal growth until bone maturity. Even so, we believe there will be no bone growth delay because of the antegrade screw placement and physeal sparing. The patient will undergo clinical and radiological follow-up semiannually in the first year and, if possible, annually until bone maturity.

Proximal phalangeal malrotation correction through metacarpal rotation positions the metacarpophalangeal joint relatively rotated compared to its peers. Clinically, this procedure did not result in a functional deficit in our patient.

As disadvantages, this technique is difficult to implement in the central metacarpal bones due to the anterograde placement of the screw since retrograde placement would imply its passage through the physis. In addition, the nail guide and the screw could have been placed exclusively in a retrograde and anterograde manner, respectively. However, the entry through the central metacarpal bones is more complex compared with the radial and ulnar edges. Proximal phalangeal and fifth finger fractures are among the most frequent in the pediatric population.[17–19] Therefore, we believe this technique must be within the therapeutic arsenal of a pediatric hand surgeon.

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Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

No conflict of interest.

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