



Subcondylar Fossa Reconstruction: Outcomes in Pediatric Patients following Malunion of Proximal Phalanx Fractures

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Introduction

Phalangeal neck fractures usually occur as a result of crush injuries and are seen almost exclusively in the pediatric population.¹ For displaced morphologies, the distal fragment can angulate dorsally, causing palmar angulation of the proximal fragment, sometimes more than 90 degrees, that can be underestimated if a lateral radiograph of the fracture is not obtained.¹ Natural realignment is less likely to occur due to the lack of distal growth plate, which may result in a bony block and malunion. Malunion of proximal phalanx fractures require surgical intervention, and corrective osteotomy is technically challenging in this area as the distal bony fragment is often too small for stable internal fixation. Current literature describes multiple techniques with varying complexity to address this injury and there is no consensus on the ideal operation to manage this condition.^{2,3} The subcondylar fossa reconstruction first proposed by Simmons et. al in 1987 is a simple and safe surgical technique that removes the offending bony block to recreate the subcondylar fossa without complex fixation.¹ Since its initial description, there have been no updates on outcomes within the pediatric population in the current literature, with the exception of a single case report in one adult from 2014.⁴ The goal of this study was to provide an update on outcomes following subcondylar fossa reconstruction in a larger cohort of patients.

Methods

We identified four patients who underwent a subcondylar fossa reconstruction at a large tertiary-care pediatric hospital between 2012-2022. Patient age, sex, mechanism of injury, injury location and initial treatment, pre- and post-operative flexion, angular deformity, and complications were recorded. A palmar zigzag (Brunner approach) incision or lateral mid-axial incision centered over the proximal interphalangeal (PIP) joint is made, separating the overlying subcutaneous tissues in the digital neurovascular bundles in the flexor tendon sheath. A small opening in the flexor tendon sheath is made between the A2

and A4 pulleys by lifting a rectangular flap. The flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP) are then retracted to expose the volar aspect of the PIP joint. The volar plate is incised along its proximal and lateral margins, elevated off the phalangeal neck, and the digit is flexed to identify the malunion and bony block. The prominent phalangeal neck is excised with a rongeur or a motorized burr, confirming excision with fluoroscopy. Intraoperative flexion is performed to confirm adequate motion. Removing a significant quantity of bone may be necessary, though care should be taken to preserve the integrity of the dorsal cortex. The palmar plate and flexor sheath are then repaired with interrupting sutures. The patient may be discharged home on the same day, with dressings removed 48 to 72 hours following the procedure. At that time, self-directed range of motion exercises can be initiated, with occupational therapy providing aggressive active and passive range of motion the week following surgery.

Results

Case 1.

IA, a 16-year-old male, sustained a fall while playing football, resulting in a fracture of the right proximal phalanx of his small finger. This was treated with NSAIDs and tape by his athletic trainer and not formally evaluated by a physician until five months later due to prolonged range of motion (ROM) deficit. He was found to have a proximal phalanx long oblique fracture malunion with translation and ulnar deviation. There was hypertrophic bony remodeling noted along the radial aspect of the proximal phalanx on radiographs. His PIP flexion was limited to 30 degrees. A subcondylar fossa reconstruction was performed, achieving 95 degrees of flexion in the operating room, and maintained postoperatively. At 4 months following surgery, the patient had PIP flexion to 90 degrees, with acceptable alignment and no new bony callous formation on radiographs.

Case 2.

CH, a 9-year-old male, sustained a fall while playing football, resulting in a fracture of the right index finger proximal phalanx. He was treated in an ulnar gutter short arm cast, which healed with abundant callous formation at the proximal phalanx, restricting ROM to 40 degrees of flexion. A subcondylar fossa reconstruction was performed, and the patient obtained 90 degrees of PIP flexion at 4 months postoperatively, with no evidence of residual deformity.



Figure 1A



Figure 1B



Figure 1C



Figure 1D

Figure 1. Clinical photographs of an 11-year-old male with (A) volar bony block at the PIP joint of the left small finger, fully extended and; (B) with restricted flexion to 55°; (C) Lateral radiographic view of the patient's bony block on the volar aspect of the PIP joint of the left small finger.;(D) PA view of bony malunion at the volar aspect of the PIP joint of the left small finger.

Figure 2. (A) Subcondylar fossa reconstruction on the left small finger of an 11-year-old male using a mid-lateral approach, incising the flexor tendon sheath between the A2 and A4 pulleys; (B) Exposure of the phalangeal neck of the proximal phalanx of the left small finger of the same patient using a hand osteotome to recreate recess under fluoroscopic guidance.



Figure 2A

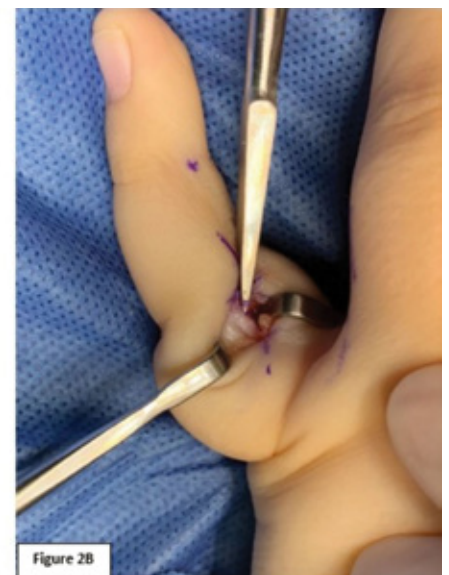


Figure 2B



Figure 3. 11-year-old male post subcondylar fossa reconstruction, demonstrating full flexion of the left small finger PIP joint.

Case 4.

DP, a 15-year-old female crashed into a parked car while riding her bike and sustained a proximal phalangeal neck fracture of the right small finger that was not immobilized or evaluated until 3 months post injury due to persistent ROM deficit. She was found to have a displaced proximal phalangeal neck fracture healing in an extended, shortened pattern, with PIP flexion limited to 55 degrees. She underwent a subcondylar fossa reconstruction and achieved 95 degrees of flexion with no evidence of deformity.

Conclusion

Subcondylar fossa reconstruction provides a safe and effective solution for the surgical correction of malunion in proximal phalanx fractures among pediatric patients. This study contributes valuable data on its outcomes, advocating for its consideration as a preferred technique in appropriate cases.

References

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