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CASE REPORT

Reverse Hemi-Hamate Arthroplasty in Chronic Volar Proximal Interphalangeal Joint Fracture Dislocation: A Case Report

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ABSTRACT

Fracture-dislocations of the proximal interphalangeal joints (PIPJ) are uncommon and complex injuries that are often overlooked. These cases often present with a dorsal dislocation, but a subset of patients present with a volar dislocation and fracture of the dorsal lip of the middle phalanx. In reported cases, functional outcomes are poor following traditional open reduction and internal fixation due to persistent limited range of motion. Hemi-hamate arthroplasty is a relatively new technique introduced in 2002, involving an osteochondral graft to reconstruct the deficient base of the middle phalanx. It affords immediate stability to the joint and earlier range of motion, resulting in less joint stiffness.

A 16-year-old male presented with a three-month history of a volar fracture-dislocation of the left ring finger and had a fixed 60° flexion deformity of the PIPJ and limited range of motion at the distal interphalangeal joint (20–70° range of motion). Patient underwent reverse hemi-hamate arthroplasty (rHHA) using two 1.5 mm cortical screws and was placed in a volar splint for six weeks. At seven months post op, PIPJ and DIPJ active range of motion were 0–90° and 0–75°, respectively. Grip strength was 22% weaker than the unaffected hand (32 kg).

Reverse hemi-hamate arthroplasty is an excellent option for patients with chronic volar PIPJ fracture dislocations with favorable outcomes and return to function while having minimal donor site morbidity.

Keywords. proximal-interphalangeal joint fracture dislocations, hemi-hamate arthroplasty, reconstruction

INTRODUCTION

Fracture-dislocations of the proximal interphalangeal joint (PIPJ) are rare complex injuries that are commonly missed and are challenging to reconstruct, especially when neglected.[1,2] These patients suffer a combination of axial and rotational force that causes PIPJ dislocation and fracture of the base of the middle phalanx.[2,3] Most patients present with a dorsal fracture dislocation (DFD) wherein the volar lip is fractured, but in the rare volar fracture-dislocation (VFD), the dorsal lip instead is fractured.[2,4]

Historically, patients have been treated with external fixation or open reduction and internal fixation. However, poor outcomes hinder the functional status of these patients.[2,5] In 2002, a technique using an osteochondral graft from the hamate was developed to recreate the articulating surface of the middle phalanx with minimal implants and promoted early range of motion to address finger stiffness.[6] To date, there are only a few published articles that describe the use of hemi-hamate arthroplasty (HHA) in DFD, and only

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a handful describe the reverse hemi-hamate arthroplasty (rHHA) in VFD.[2,4]

The objective of this study was to present a case of chronic VFD treated with rHHA, review the outcomes, and contribute data for further study.

CASE

A 16-year-old male presented with left ring finger pain and deformity. He initially suffered a fall on this left ring finger three months prior. He consulted a traditional bone setter who performed manipulation and advised observation. However, due to persistence of pain, he consulted at the outpatient department. On physical examination, he presented with a fixed flexion deformity at the PIPJ and reduced range of motion (ROM) (active 20–70°, passive 0–70°) of the distal interphalangeal joint (PIPJ) (Figures 1 and 2).

The patient underwent reverse hemi-hamate arthroplasty as described by London et al., and volar plate repair.[2]

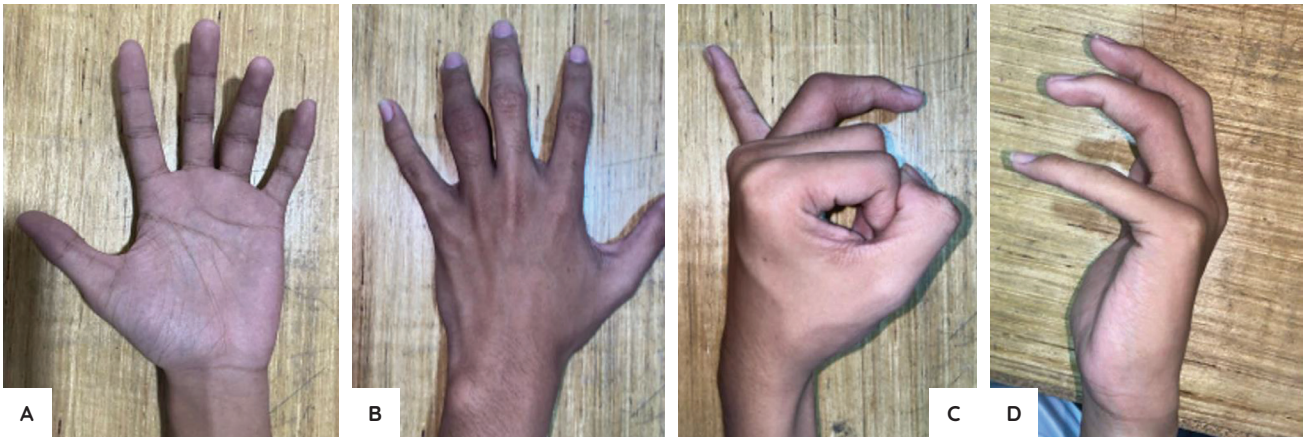

Figure 1. Fixed flexion deformity on the PIPJ of the left ring finger and limited active extension of the DIPJ **(A)**, dorsal view of the left hand **(B)**, attempted active extension demonstrating persistent PIPJ flexion deformity **(C)**, and lateral view showing the fixed flexion deformity **(D)**.

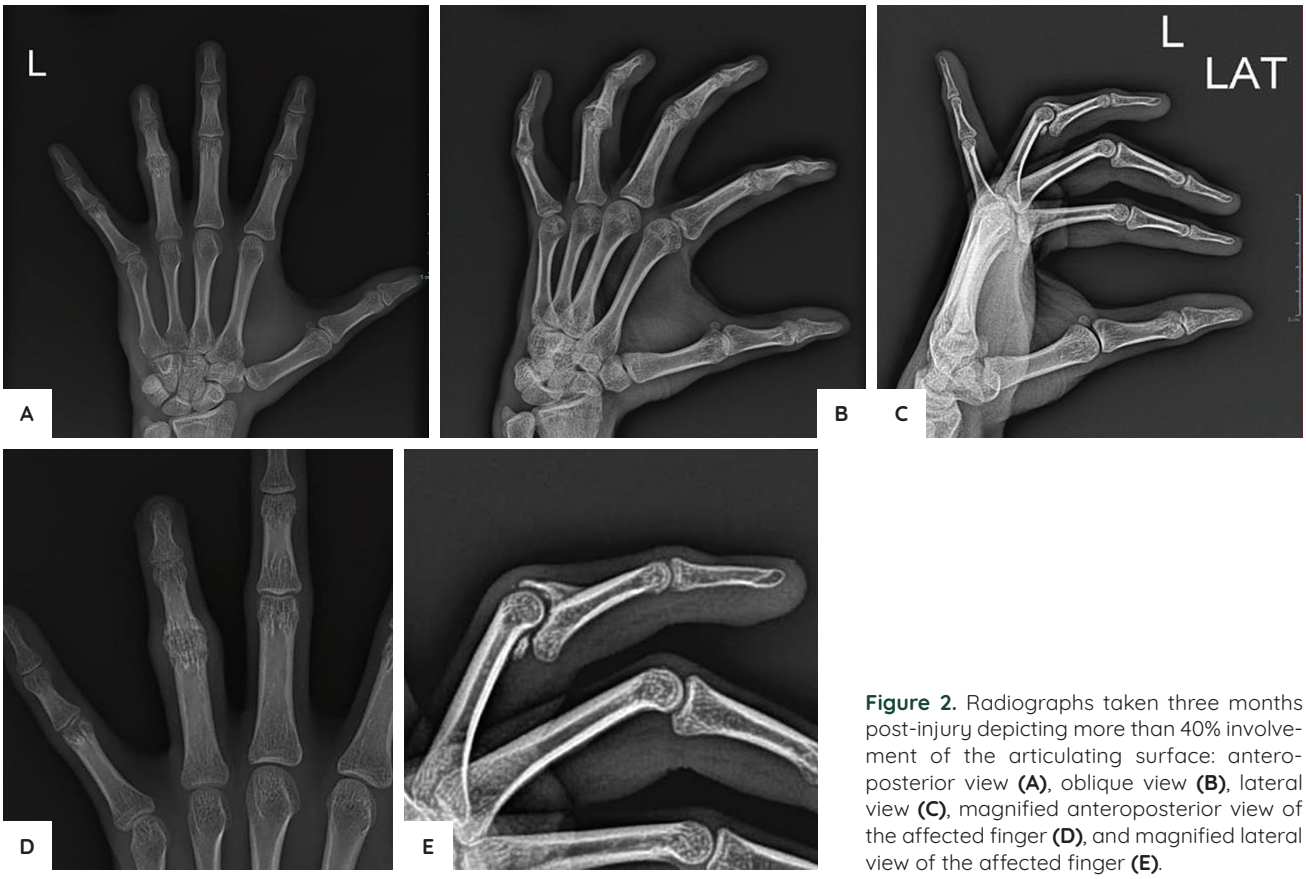

Figure 2. Radiographs taken three months post-injury depicting more than 40% involvement of the articulating surface: anteroposterior view **(A)**, oblique view **(B)**, lateral view **(C)**, magnified anteroposterior view of the affected finger **(D)**, and magnified lateral view of the affected finger **(E)**.

Surgical technique

The PIPJ was accessed using a volar trapezoidal incision and shotgun exposure. The graft recipient site was inspected and prepared. The rHHA differs from HHA since the recipient site is the dorsal base of the middle phalanx; this may require release and later repair of the central slip of the extensor tendon. In the previous case reports,[2,4] the extensor mechanism was preserved either by non-detachment,[2] or reattachment dorsally.[4] In this case, the central slip was not released. The dorsal projection of bone was preserved, and the distal attachment of the central slip was used as a buttress for the graft. Under imaging intensification, the hamate was identified, and a 1 x 1 x 0.8 cm graft was harvested using osteotomes (Figures 3 and 4). The graft was then fixed to the freshened graft site with two 1.5 cm cortical screws, the smallest screw size available (Figure 5).

Post-operatively, a volar splint was applied extending to the ring and small finger in intrinsic plus position to protect our construct and allow passive extension of the PIPJ. Range of motion was delayed for graft incorporation. The splint was discontinued at six weeks, and buddy taping was initiated (Figure 6).

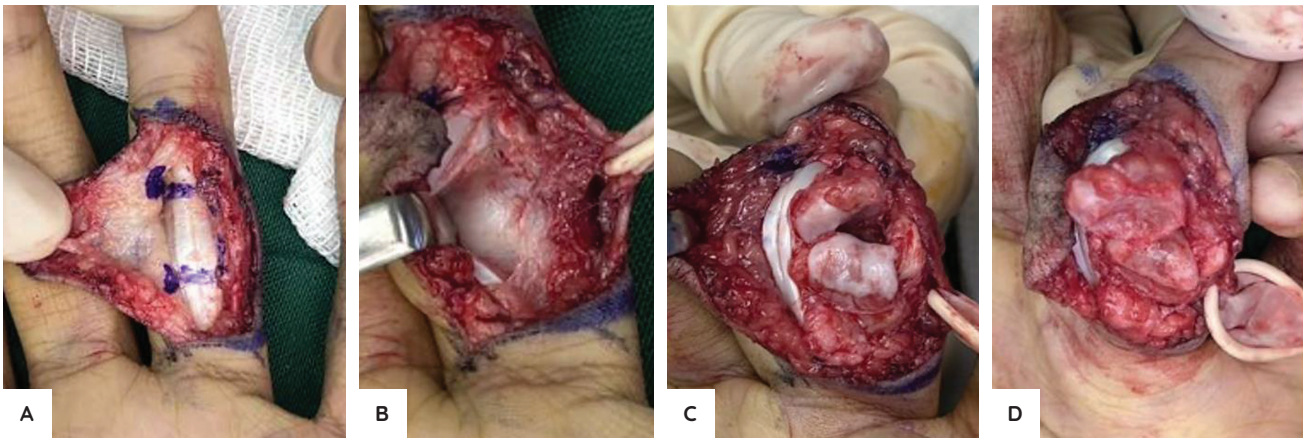

Figure 3. Shows the trapezoidal exposure **(A)**, shotgun exposure of the PIPJ **(B, C)**, and subsequent preparation of the graft recipient site **(D)**.

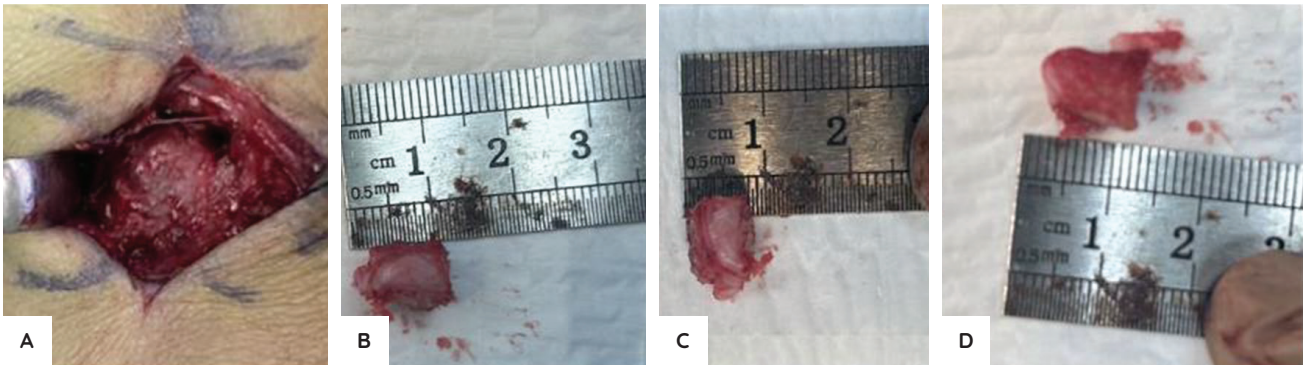

Figure 4. Shows the harvesting of the graft **(A)**, measurement of the graft **(B, C)**, and preparation of the graft **(D)**.

Figure 5. The prepared graft was then secured to the base of the middle phalanx: anteroposterior view **(A)**, lateral view **(B)**, and postoperative lateral view demonstrating graft fixation **(C)**.

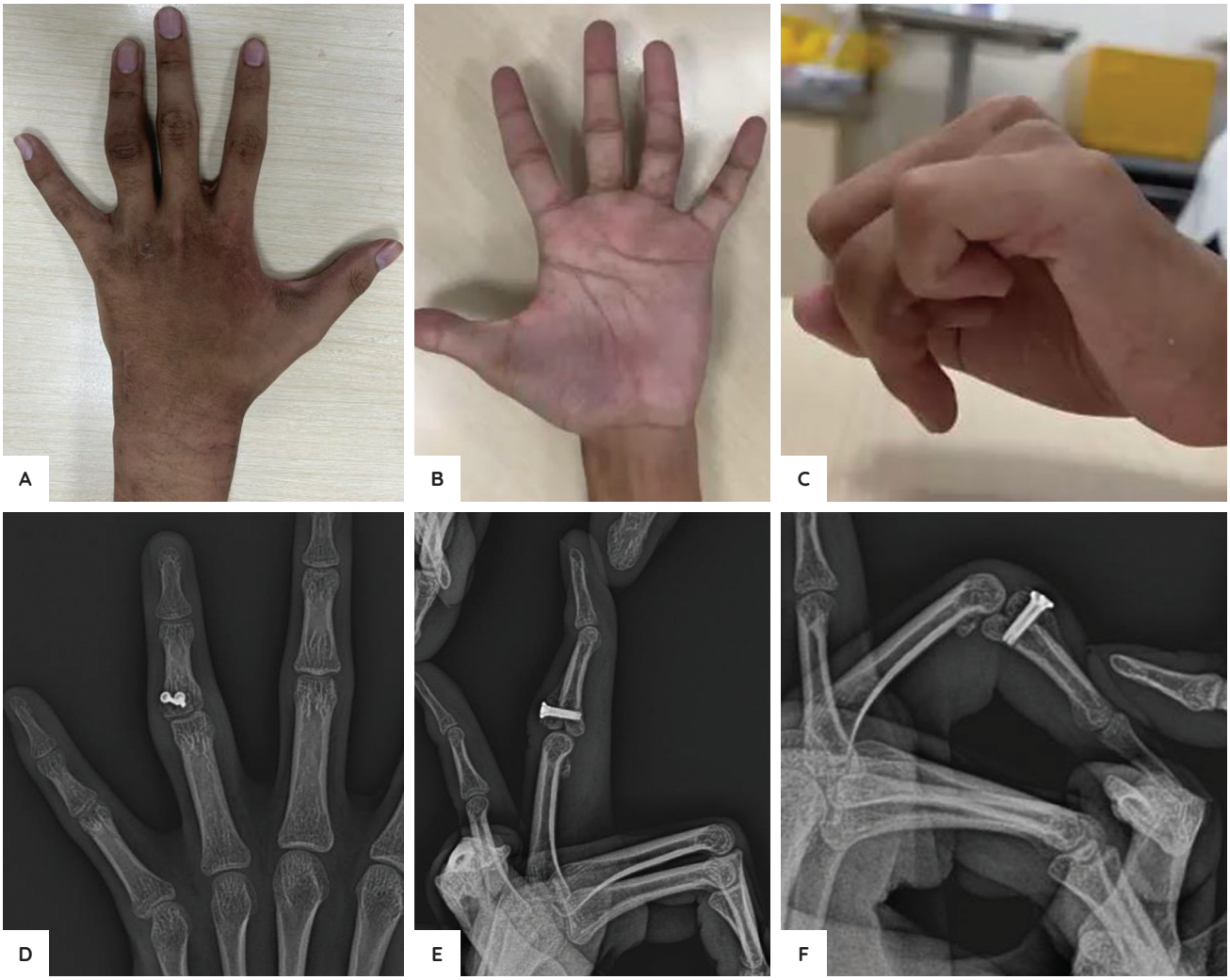

Figure 6. At six weeks postoperatively, wounds were healed. Patient was allowed range of motion as tolerated **(A, B, C)**. X-rays showed partial obliteration of the graft edges, indicating union **(D, E, F)**.

At seven months post op, the patient presented with almost complete resolution of swelling at the PIPJ (Figure 7). Range of motion was 0–90° at the PIPJ and 0–75° at the DIPJ with no extensor lag (Table 1). The good range of motion for the DIPJ was probably due to the stable construct that allowed aggressive range of motion exercises in a motivated patient. The osteochondral graft also shrank in size and was fully incorporated into the middle phalanx, contributing to the improved range of motion. Overall, the patient was satisfied with his functional status with a VAS of 0, FIL-DASH of 10.33, and grip strength 22% weaker than the unaffected hand. The patient had not undergone formal physical rehabilitation but continued to do six-pack hand exercises and stretching of the ring finger.

Table 1. Summary of improvement of range of motion

Follow-up period	PIPJ range of motion active (passive)	DIPJ range of motion active (passive)
Preoperative	Fixed at 60°	20–70° (0–70°)
2 weeks post-op	10–30° (0–45°)	10–20° (10–20°)
3 weeks post-op	10–40° (10–80°)	0–30° (0–30°)
6 weeks post-op	0–90° (0–90°)	0–40° (0–40°)
7 months post-op	0–90° (0–90°)	0–75° (0–75°)

DISCUSSION

Achieving functional range of motion in PIPJ fracture-dislocations has historically been difficult.[7] Our patient's functional outcomes were favorable when compared to existing literature for rHHA. A case report with 10-year follow-up resulted in a ROM of 10–90° of the PIPJ and 20–80° of the DIPJ, but overall patient satisfaction.[2] Another case report with a two-year follow-up resulted in ROM of 10–90° of the PIPJ and 0° of the DIPJ, 100% grip strength compared to the unaffected limb, and overall patient satisfaction.[4]

Low risk of donor site morbidity is another advantage of the hemi-hamate arthroplasty. A systematic review of nine articles with 103 patients reported a low overall morbidity rate of 6.8%; all studies reported pain, with only one patient undergoing revision surgery.[8] Open reduction and internal fixation results in limited PIPJ motion.[5,9,10] Reverse hemi-hamate arthroplasty can be a primary option for patients with

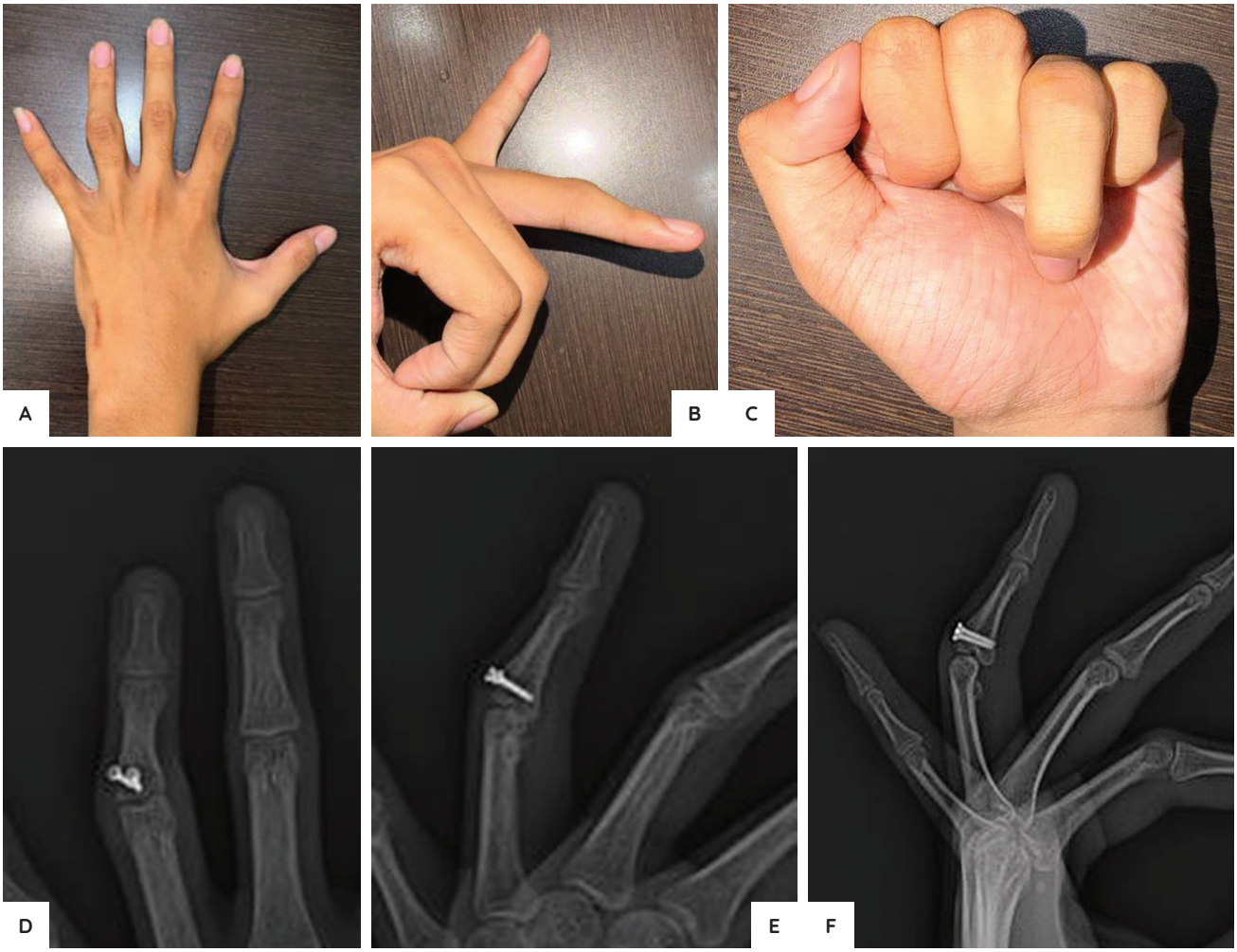

Figure 7. At seven months postoperatively, there was a significant decrease in swelling **(A, B, C)**. The graft was fully incorporated **(D, E, F)**.

comminution of the dorsal lip exceeding 50%, or if fragments are too small to be fixed. The osteochondral graft secured with a low-profile implant allows the patient to have a stable joint for earlier range of motion and therefore less stiffness.

Literature shows different approaches to the reverse hemihamate arthroplasty. One case was approached volarly, as with the usual dorsal fracture dislocation,[2] and the other was approached dorsally.[4] The indication for the dorsal or volar approach lies in the integrity of the central slip mechanism. If the central slip was judged to be intact and attached to the dorsal cortex, a volar approach is used to preserve the central slip. If the central slip was judged to be insufficient,[4] then a dorsal approach is used to also reattach the central slip and reconstruct the extension mechanism. The harvest is similar to the usual hemihamate arthroplasty, but careful trimming is needed to reconstitute the dorsal buttress that was lost in the injury.

CONCLUSION

Reverse hemi-hamate arthroplasty is an effective procedure for chronic volar PIPJ fracture-dislocations. In this case, it provided a stable articular reconstruction that allowed for an excellent functional range of motion (0–90°) and high patient satisfaction with low donor site morbidity despite a three-month delay in treatment. Further studies on outcomes in acutely treated patients should be explored.

ETHICAL CONSIDERATION

Patient consent forms were obtained before manuscript submission.

STATEMENT OF AUTHORSHIP

All authors certified fulfillment of ICMJE authorship criteria.

CREDIT AUTHOR STATEMENT

ATSCN and MLJL: Conceptualization, Methodology, Formal analysis, Investigation, Resources, Data Curation, Writing – original draft preparation, Writing – review and editing, Visualization, Supervision, Project administration; **CECL and EPE:** Conceptualization, Methodology, Formal analysis, Investigation, Resources, Writing – original draft preparation, Writing – review and editing, Visualization, Supervision, Project administration.

DATA AVAILABILITY STATEMENT

The datasets generated and analyzed in this study are included in the published article.

AUTHOR DISCLOSURE

The authors declared no conflict of interest.

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