The Philippine Journal of Orthopaedics

CASE SERIES

Outcomes of Proximal Interphalangeal Joint Fracture-Dislocations Treated with Hemi-hamate Arthroplasty

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ABSTRACT

Background. Proximal phalangeal joint (PIPJ) dorsal fracture-dislocations (DFD) of the proximal interphalangeal joint are complex injuries that are challenging to treat. Hemi-hamate arthroplasty (HHA) is an excellent option in cases when the volar fragment is large and severely comminuted.

Objective. The objective of this study was to present the clinical outcome of patients with PIPJ-DFD treated with HHA.

Methodology. This case series was a retrospective chart review of all adult patients with PIPJ-DFD treated with HHA between 2015 and 2024. Inclusion criteria included patients with PIPJ-DFD treated with HHA. Patients with multiple digit injuries, open injuries, and associated soft tissue damage were excluded. Primary outcomes measured were the PIPJ arc of motion and the presence of flexion or extension deficits. Secondary outcomes observed include graft healing and post-operative complications.

Results. A total of five patients were included in the study. All were male with a mean age of 33.8 years. Four patients had middle finger injuries, and one patient had a ring finger injury. The mean delay to surgery was 2.8 months (range, one week to six months), and the median follow-up was 32 months (range, two to 72 months). The mean volar lip involvement/fragmentation was 50% (range, 40 to 60%). All grafts healed, with a mean PIPJ extension deficit of 25.8° and a mean flexion deficit of 94°. The mean PIPJ arc of motion was 68°. No sensory deficits or pain were reported during use. One case developed radial collateral ligament insufficiency with ulnar subluxation.

Conclusion. This case series confirms that HHA is an effective treatment for PIPJ-DFD, yielding satisfactory functional outcomes and reliable graft healing.

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

INTRODUCTION

Dorsal fracture-dislocations (DFD) of the proximal interphalangeal joint (PIPJ) are complex injuries and are challenging to treat. Depending on the fracture severity, patients may experience early onset of painful post-traumatic arthritics, deformity, and instability, all leading to increased stiffness and decreased range of motion.[1] Treatment mainly depends on the size of the volar lip fragment, which affects reducibility and stability. A fragment larger than 40 to 50% of the base of the middle phalanx that requires 30° or more of flexion to maintain PIPJ reduction renders the injury unstable and requires surgery.[2-5]

In 1999, Hastings first described a technique called hemi-hamate arthroplasty (HHA) to treat unstable PIPJ fracture dislocations involving more than 50% of the volar lip

ISSN 0118-3362 (Print)
eISSN 2012-3264 (Online)
Printed in the Philippines.

Received: September 18, 2025
Accepted: October 14, 2025
Published Online: November 3, 2025
https://doi.org/10.69472/poai.2025.29

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(presented at the 54th Annual Meeting of the American Society for Surgery of the Hand, September 2–4, 1999).[6] The technique was technically challenging. Stability depended not only on the reconstructed bony buttress but also on the surrounding soft tissues around the PIPJ, including the volar plate and collateral ligaments. The hemi-hamate autograft provided articular congruity by reconstituting the concavity of the middle phalangeal base, affording a volar buttress that prevents dorsal dislocation.[7,8]

The outcomes of HHA have been reported in several systematic reviews, achieving post-operative PIPJ motion arcs of 74.3 to 79.8°. Thus, HHA is a good treatment alternative for fracture-dislocations of the PIPJ that cannot be fixed due to severe comminution or large volar bone loss (>40%).[9-12]

The objective of this paper was to report the outcomes of HHA in the treatment of PIPJ-DFD.

METHODOLOGY

A retrospective chart review was done on patients with fracture-dislocations of the PIPJ treated with HHA from January 1, 2015, to January 1, 2024. Included were all adult patients with fracture-dislocations of the PIPJ treated with HHA. Excluded were patients with multiple digit injuries on the same hand, open injuries, and associated tendon, collateral ligament, or neurovascular injuries. Collateral ligament injuries were diagnosed based on static radiographs (varus or valgus angulation of more than 30°) or direct visualization during surgery.

Surgical technique

The surgery for HHA reconstruction for dorsal fracture-dislocations of the PIPJ has been well described in the literature.[4] A variation of the technique was done with a trapezoidal incision (Figures 1 A-D) with isolation of the flexor sheath between the A2 and A4 pulley for later re-attachment between the joint and flexor tendons. After exposing the PIPJ through a shotgun approach, the volar buttress defect was measured to approximate the size of the graft to be harvested. Through fluoroscopic guidance, the hamate was identified at the base of the 4th and 5th metacarpals. Using small osteotomes and pushing the 4th and 5th metacarpal volarly, a graft slightly larger by 1 mm on all dimensions was harvested from the distal dorsal intra-articular cortex of the hamate. The graft was then trimmed to size using a small rongeur or small bone rasp. Two 1.5 mm cortical screws were used to secure the graft to the intra-articular proximal volar articular cortex of the middle phalanx (1.1 or 1.2 mm screws were not available). The volar buttress was re-created with the graft. Even if radiographs showed step-off of the articular surface, direct visualization showed no step-off (Figures 2 A-F). This difference was due to the thicker cartilage of the hamate graft compared to the phalanx.

Post-operative protocol

Post-operatively, the hand was immobilized in a dorsal blocking splint with the PIPJ flexed at 30°. Post-op radiographs were taken one week post-surgery and then at three weeks. The patient was allowed to do ROM of the PIPJ within the confines of the dorsal blocking splint within one week. Formal therapy was started between three to four weeks post-op. The PIPJ angle was gradually extended, and the splint was discontinued at five to six weeks post-op. Buddy taping was done, and passive range of motion (ROM) exercises were initiated, until the patient achieved an extension deficit of less than 10°. Night splinting using gradual extension splints was done for those with extension deficits of more than 20°. Unlimited activity was permitted at 12 weeks postop.

Bone graft union was evaluated using post-operative radiographs. The absence of the fracture line and the presence of crossing trabeculations between the graft and phalanx

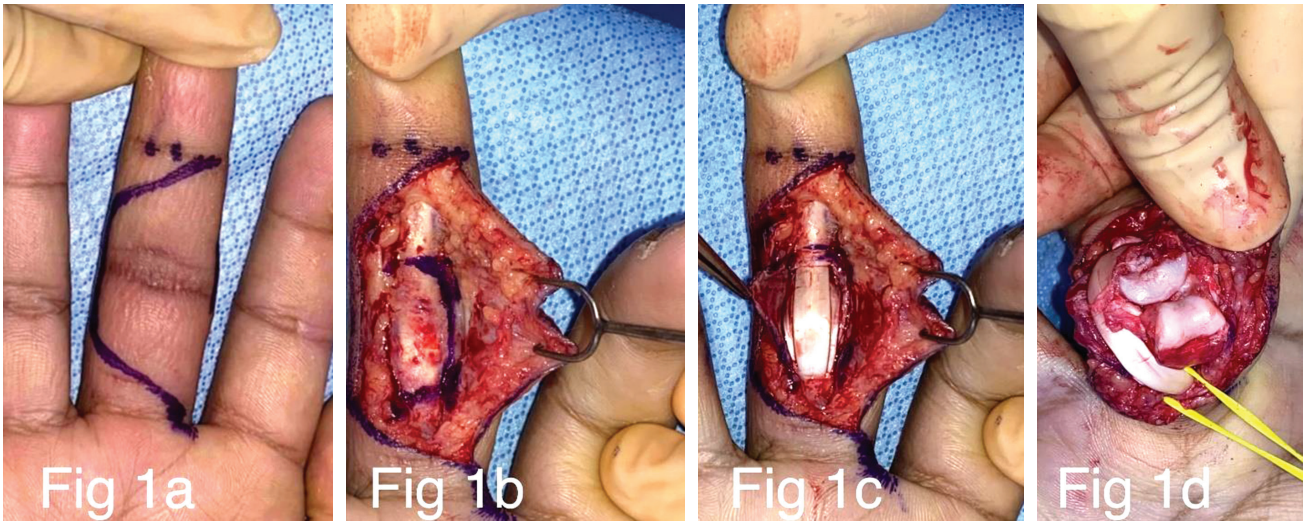

Figure 1. Trapezoidal incision over the volar PIPJ **(A)**. Flap was raised and another flap on the tendon sheath was created between A2 and A4 pulleys **(B)**. The flexor tendons were exposed and the volar plate was released from the accessory collateral ligaments and base of the middle phalanx **(C)**. "Shotgun" exposure of the PIPJ **(D)**.

indicated a united graft. We did not wait for the graft to unite on radiography; full ROM was encouraged, and the splint was discontinued at five to six weeks post-surgery, as long as there was no indication of screw loosening.

On follow-up, PIPJ extension lag, range of motion, graft union, and complications were documented. ROM was measured using a finger goniometer.

RESULTS

A total of five patients were identified (all males) with a mean age of 33.8 years (range, 29-42). The middle finger was involved in four cases, and the ring finger in one. Mean delay to surgery was 2.8 months (range, 7 days to 6 months), mean articular surface involvement was 50% (range, 40 to 60%), and the median follow-up for the five patients was 32 months (range, 2 to 72 months) (Table 1). Two patients received acute reconstructions (<3 weeks from injury). Two had reconstructions at six months, one at one month, and one at two months. Those patients with delayed treatment reported using their hands as tolerated, with no splint. Persistence of limitation of motion and pain prompted their present consult. The reasons were mostly that patients did not want to undergo the surgery at the time of injury.

Table 1. Patient demographic data (n = 5)

	N	Mean, SD*/Range
Age, years (mean, SD)		33.8, 6.8
Sex (all males)	5	
Finger Involved		
Middle finger	4	
Ring finger	1	
Delay to surgery (months, range)		2.8 (range, 0.25 – 6)
Volar lip involvement/fragmentation (%, range)		50 (range, 40-60%)

*SD – Standard deviation

In the five patients, on final follow-up, the mean PIPJ extension deficit was 25.8° and the mean flexion was 94° (range, 80 to 107°, median 96°) (Table 2). There were no sensory deficits

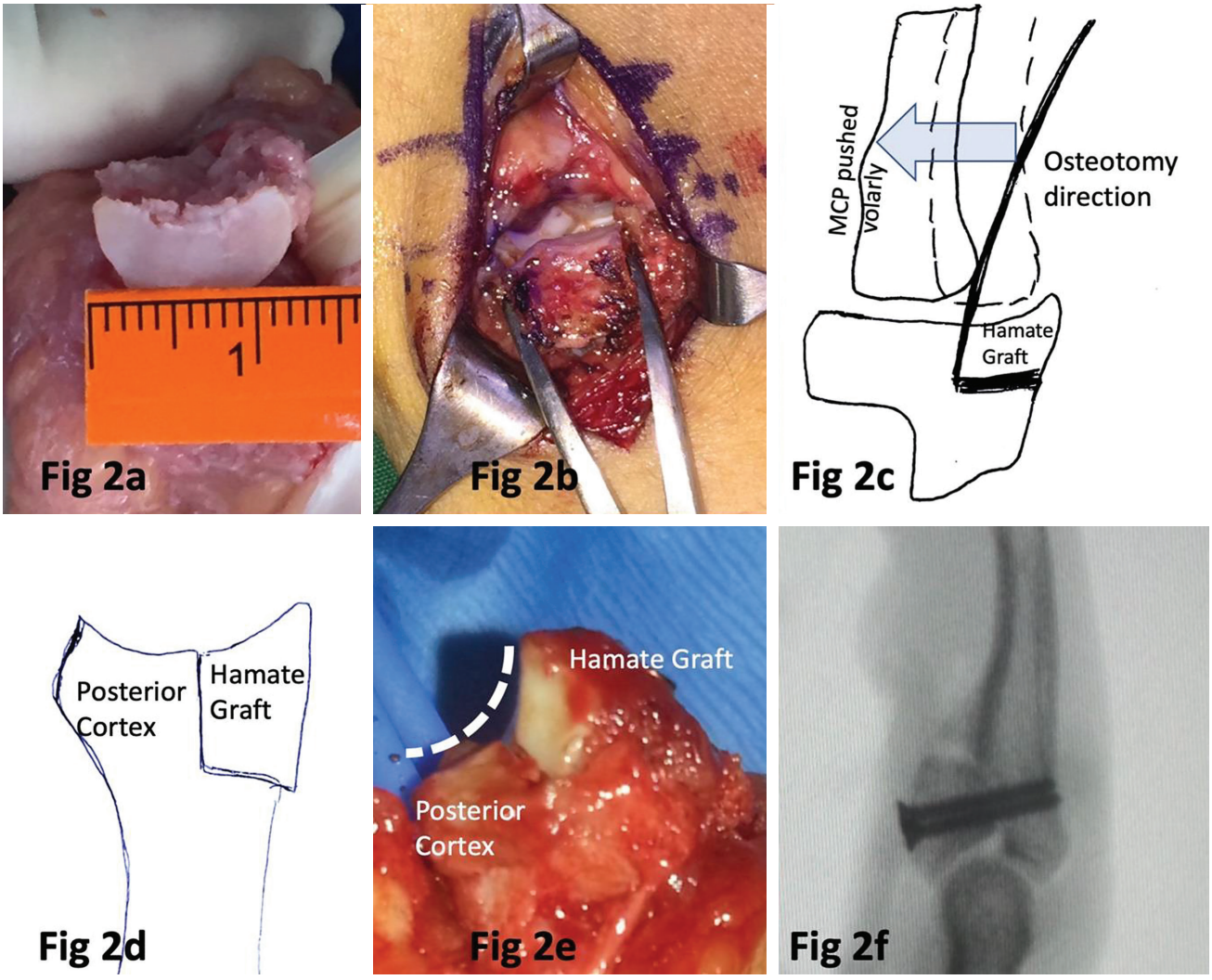

Figure 2. Volar lip defect prepared and measured **(A)**. The measurements were drawn on the hamate, adding 1 mm on all dimensions **(B)**. Osteotomy was done. Intra-articular osteotomy was done by pushing the 4th and 5th metacarpal bases volarly, with a slightly angulated position to achieve a convex surface **(C)**. After harvest, the volar lip was reconstructed, creating a concavity of the middle phalangeal base with no cartilage step-off **(D and E)**. Radiographs may show step-off since the cartilage of the hamate is thicker than that of the base of the middle phalanx **(F)**.

Table 2. Patient outcomes (n = 5)

Patient no.	Delay (months)	Volar lip (%)	Extension deficits	PIPJ* flexion	PIPJ ROM**	Other outcomes	Follow up (months)
1	0.25	50	30°	96°	66°	Healed	2
2	6	50	24°	85°	61°	Healed	72
3	1	50	35°	80°	45°	Healed, RCL insufficiency	53
4	0.5	40	10°	100°	90°	Healed	32
5	6	60	30°	107°	77°	Healed	11
Mean	2.75	50	25.8°	93.6°	68°		34

*PIPJ – Proximal interphalangeal joint; **ROM – range of motion

reported, and no pain was reported during use of the hand. Radiographic union was evident by the 4th to 5th week post-surgery. There was no screw loosening among the five patients. The grafts in all cases were large; however, no intra-operative dislocation occurred after graft fixation. All six patients were satisfied with the outcome.

We had one complication in a 36-year-old male with a four-week history of PIPJ dorsal fracture-dislocation of the right middle finger. The patient at 48 months post-op showed radial collateral ligament insufficiency with subluxation of the PIPJ (Figure 3). The patient had a history of being lost to follow-up for more than a year, and also claimed to have not done physiotherapy. Although the fixation was healed, there was ulnar deviation of the PIPJ. We believe that this was caused by the inadequate repair of the volar plate to the collateral ligament on the radial side. The ROM was 35 to 80°, but there was no pain on ROM both at work and at rest (Figure 4). Patient claimed he was able to use his hand and opted for observation. There were no complications concerning the hamate donor site.

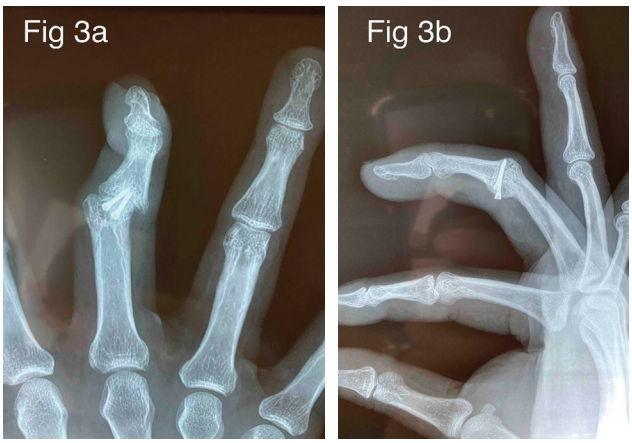

Figure 3. Radiographs showed ulnar deviation of the PIPJ flattening of the head of the proximal phalanx at the ulnar side **(A)**. Lateral radiograph showed stable graft healing **(B)**.

CASE

A 25-year-old male consulted our clinic with a two-week history of left middle finger injury from playing basketball. Radiograph showed a 40% articular involvement. An HHA arthroplasty was suggested if the fragment is not fixable. Intra-operatively, there was fragmentation of the volar fragment, hence an HHA was done. Two 1.5mm cortical screws were used to fix the graft (Figure 5). At 36 months post-surgery, extension deficit was 10° with PIPJ flexion of 100°, and ROM arc of 90°. FIL-DASH (Filipino Version of the Disability of the Arm, Shoulder, and Hand) score was 1 with no pain, and grip was 100% compared to the contralateral side (Figure 6). The patient was able to return to unlimited sports activities, including basketball. There was some remodeling of the graft with stable union (Figure 7).

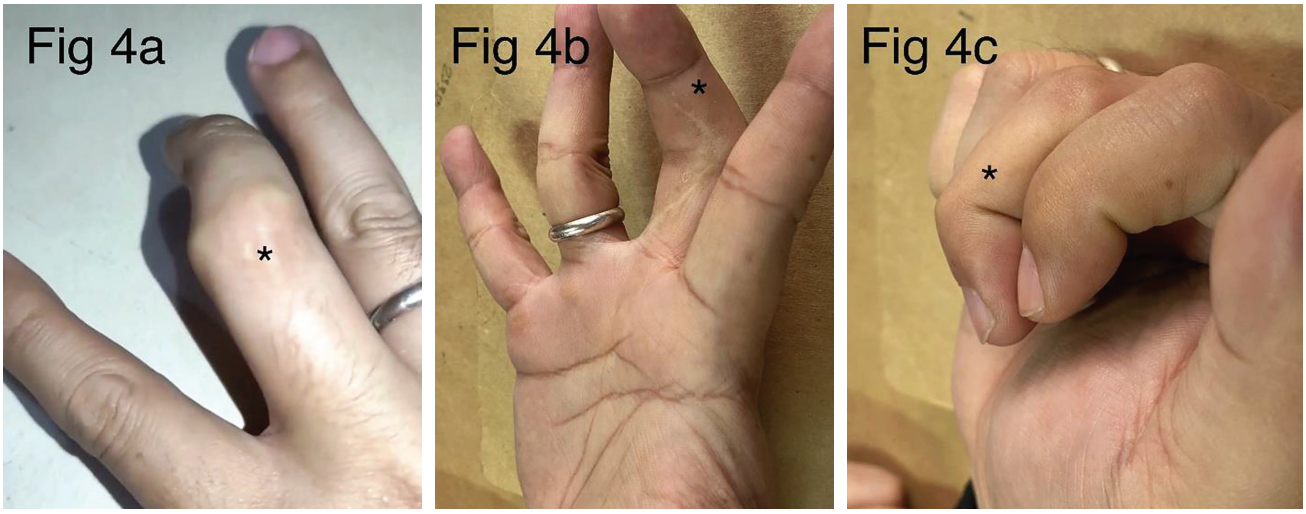

Figure 4. The clinical picture shows ulnar deviation of the middle phalanx **(A)**. There was a flexion contracture of 45° **(B)**. PIPJ flexion was good at 80°. *Middle finger **(C)**.

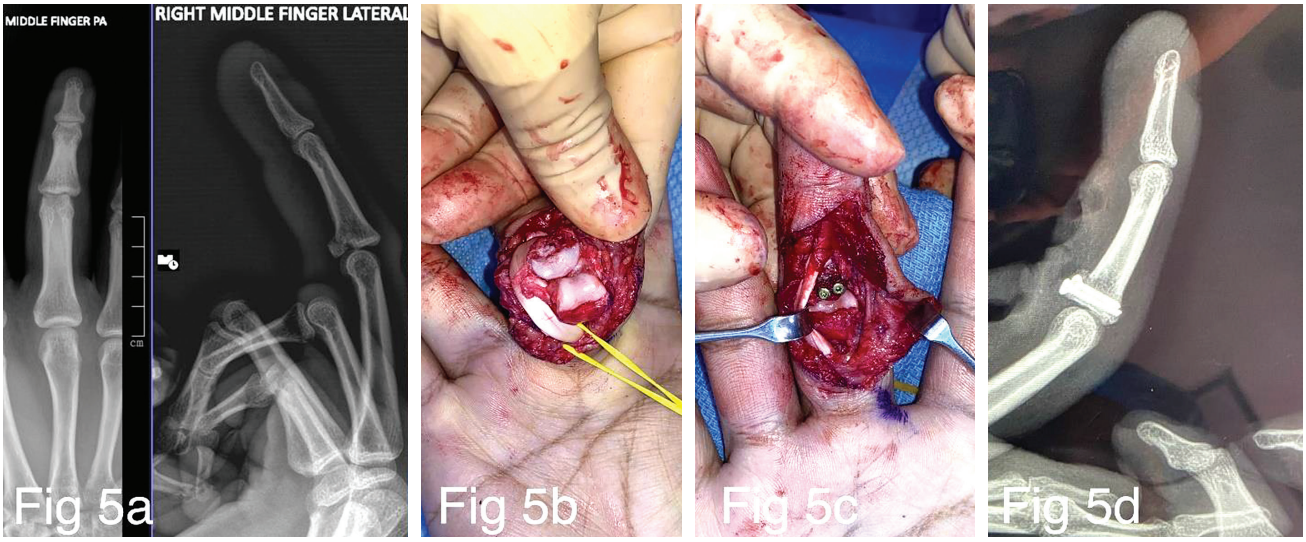

Figure 5. The injury film shows a PIPJ-DFD of the middle finger with approximately 40% volar lip involvement **(A)**. The "shotgun" image of the PIPJ **(B)**. The PIPJ was reduced, and the graft fixation was stable with two 1.5 mm screws **(C)**. Radiograph showing a concentric reduction of the PIPJ and stable fixation **(D)**.

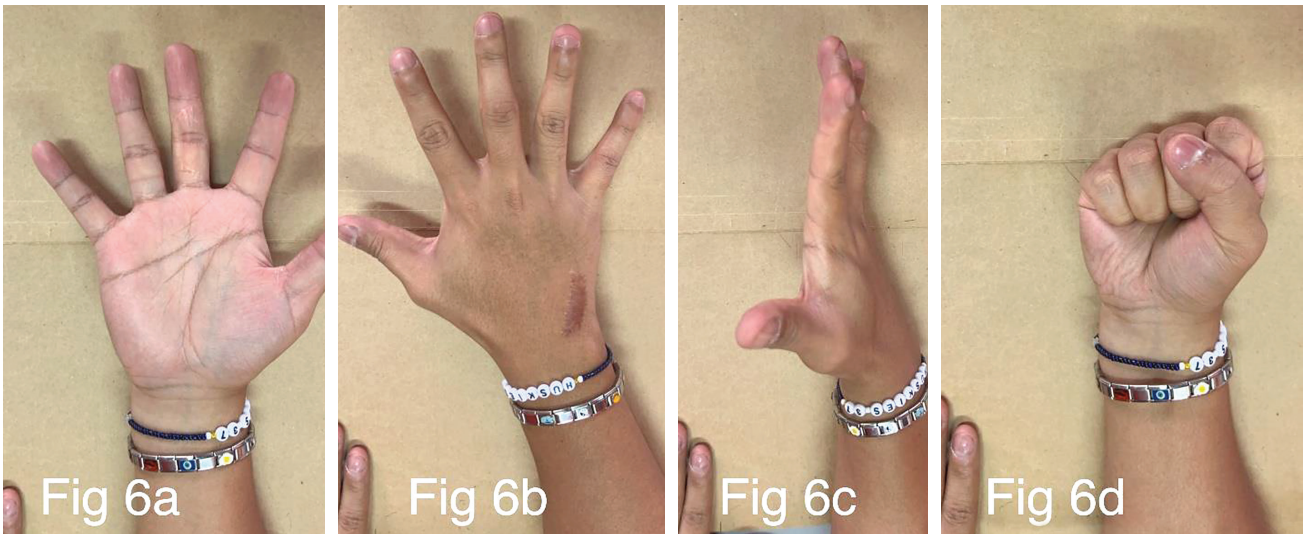

Figure 6. At 36 months follow-up, the middle finger had excellent extension **(A and B)**, with a 10° extension deficit **(C)** and excellent flexion at 100° at the PIPJ **(D)**.

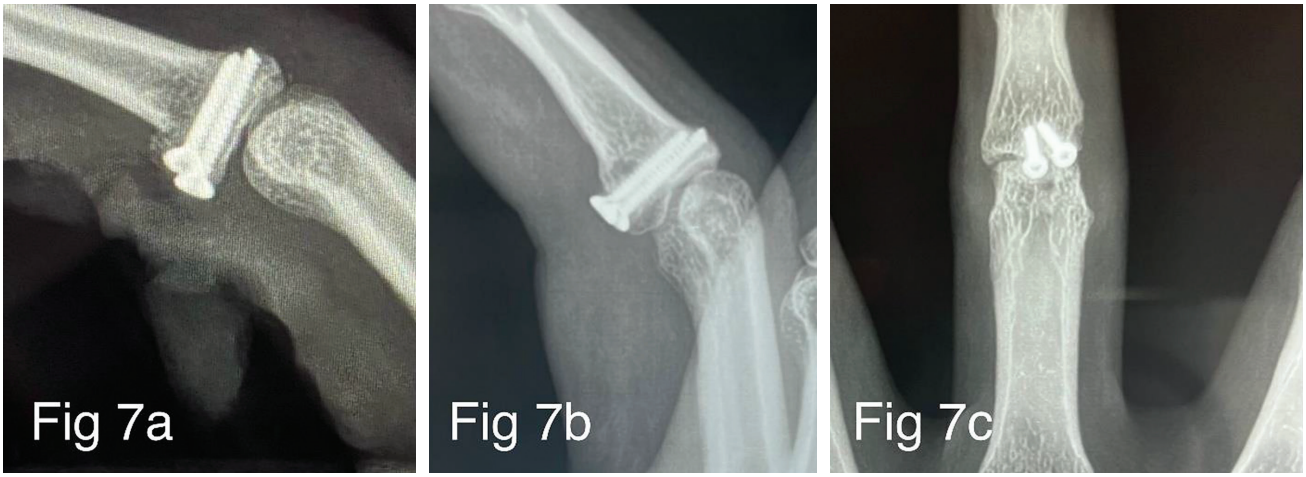

Figure 7. Radiograph immediately post-op **(A)** showed stable reduction. Concavity was a little flat. Radiographs at 36 months follow-up: Lateral and AP views showed signs of remodeling with improvement in the concavity of the graft, which appeared more "flushed" **(B and C)**.

DISCUSSION

This case series demonstrates that hemi-hamate arthroplasty is an effective treatment for PIPJ dorsal fracture-dislocations with substantial articular surface involvement. Our results showed that this technique can achieve satisfactory functional outcomes with reliable graft healing and an acceptable range of motion, even when performed in a delayed fashion. Two systematic reviews analyzed a variety of options in treating these injuries. These included volar plate arthroplasty, ORIF (open reduction, internal fixation), extension block pinning, dynamic external fixation, and percutaneous reduction with K-wire fixation.[9,10] While no treatment option has been accepted as the gold standard, several patient factors were considered for the treatment that will result in the best outcome. Usually, the size and degree of comminution are considered. If the involved segment is smaller than 50% the width of the middle phalanx, percutaneous fixation with K-wires yields the best results in terms of ROM and the least number of complications in two systematic reviews.[10,11] In cases where the volar lip fragment was severely fragmented and could not be fixed by either pin or screws, then volar plate arthroplasty could be used as an option.[10] In addition, due to the technical skill required to perform these surgical procedures, the surgeon's preference should be taken into consideration.

Comparing the results in this small case series with published literature, our results for PIPJ arc of motion (68°, range 45 to 90°) compared favorably, though less reported in four systematic reviews (74.3 to 79.8°).[8-12] The mean PIPJ flexion in this study was 94° (range, 80 to 107), but the mean extension deficit/flexion contracture was 25.8° (range, 10 to 30°). This extension deficit was high compared to studies by Williams (9°), Linderblatt (6.5°), Calfee (19°), Afrendas (10°), and Korambayil (0°).[4,5,8,13,14] This small case series included both acute reconstructions (performed within three weeks) and delayed procedures (up to six months post-injury). The mean delay to surgery of 2.8 months reflects the clinical reality that many of these injuries were either managed conservatively, presented late to hand surgeons, or were missed entirely. This case series suggests that delayed reconstruction does not necessarily compromise outcomes, as all grafts healed successfully regardless of timing. This finding is clinically relevant as it provides surgeons with flexibility in treatment planning and suggests that patients who present late can still benefit from reconstruction.

In our small case series, we noted that the hamate graft was large (Figure 2c). We believe that this may be the reason for the extension deficit/contracture present in our cases, thereby affecting the ROMs of the PIPJ. The large hamate graft is an advantage and provides a stable volar buttress to prevent dorsal subluxation and provide a gliding flexion movement of the PIPJ at the expense of a flexion contracture. This was also noted by Brennan et al.,[15] in their case series of 13 patients. Those with a 'flushed' graft had a higher mean arc of motion (85°) compared to those with a cortical step-off (62°).

A single complication observed in this series highlights an important technical consideration in PIPJ reconstruction. Radial collateral ligament insufficiency and joint subluxation at 48 months post-operatively highlight the relevance of comprehensive soft tissue repair during the primary procedure. This complication likely resulted from inadequate or failed repair of the volar plate to the collateral ligament complex.

In addition, the patient's history of non-compliance with follow-up and physiotherapy may have contributed to this complication, as timely rehabilitation is crucial for maintaining joint stability and preventing contractures.

Several limitations should be acknowledged in interpreting these results. The small sample size of five patients limits the generalizability of our findings and prevents robust statistical analysis. The variable follow-up period makes it difficult to assess long-term outcomes consistently across all patients. Additionally, the study lacks a control group or comparison with alternative treatment methods, which would strengthen the evidence for hemi-hamate arthroplasty.

CONCLUSION

The hemi-hamate arthroplasty can achieve satisfactory functional outcomes with reliable graft healing for PIPJ dorsal fracture-dislocations with substantial articular involvement. While extension deficits are common, patients typically achieve pain-free function with adequate flexion for daily activities. Careful attention to soft tissue repair, particularly the collateral ligament complex, is crucial for preventing long-term instability. The technique appears suitable for both acute and delayed reconstruction, providing surgeons with flexibility in treatment planning.

STATEMENT OF AUTHORSHIP

All authors certified fulfillment of ICMJE authorship criteria.

CREDIT AUTHOR STATEMENT

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

DATA AVAILABILITY STATEMENT

Datasets generated and analyzed are included in the published article.

AUTHOR DISCLOSURE

Dr. Estrella is an Associate Editor of the Philippine Journal of Orthopaedics. Dr. Ngui declared no conflict of interest.

FUNDING SOURCE

None.

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