

Minimally Invasive Correction of Proximal Phalanx Malunion Using Cannulated Headless Screws: A Case Series

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ABSTRACT

Introduction: Malunion of the proximal phalanx can result in significant aesthetic and functional impairments, including malrotation, finger scissoring, and diminished grip strength. Conventional treatment involves open osteotomy with plate and screw fixation, which is associated with drawbacks such as surgical site scarring, prolonged rehabilitation, and tendon or soft tissue adhesions. This case series evaluates a minimally invasive technique using cannulated headless screws as an alternative approach for correcting proximal phalanx malunion.

Methods: Three patients with proximal phalanx malunion underwent a minimally invasive procedure. The technique involved two small incisions: one for osteotomy and another for guide wire insertion, followed by fixation with a cannulated headless screw under fluoroscopic guidance. Postoperative outcomes were assessed at three months, focusing on hand function, deformity correction, and complications.

Results: At the three-month follow-up, all patients demonstrated significant improvements in hand function, with restored alignment and no reported malrotation or scissoring. Grip strength was enhanced, and no complications, such as infection or hardware failure, were observed. Patients reported minimal scarring and faster recovery compared to traditional open approaches.

Conclusion: The minimally invasive approach using cannulated headless screws offers a promising alternative for correcting proximal phalanx malunion. It minimizes soft tissue trauma, reduces scarring, and promotes faster rehabilitation while achieving favorable functional outcomes. Further studies with larger cohorts are warranted to validate the efficacy and long-term outcomes of this technique.

Proximal Phalanx Malunion, Minimally Invasive Surgery, Cannulated Headless Screw, Osteotomy, Hand Function.

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INTRODUCTION

Phalangeal fractures are prevalent, with over 50% associated with occupational injuries [1]. The small finger is the most commonly affected digit, with the proximal and distal phalanges exhibiting the highest fracture incidence, predominantly at the phalangeal shaft [2]. Proximal phalanx fractures typically result in apex volar angulation due to biomechanical forces: the proximal fragment is flexed by the interossei muscles, while the distal fragment is extended by the central slip [1,2].

Malunion is a frequent complication of phalangeal fractures, leading to deformities such as malrotation, apex volar angulation, lateral angulation, and shortening [3]. These deformities cause both aesthetic and functional impairments, including malrotation deformity, finger scissoring, and reduced grip strength [4,5]. The standard treatment for correcting proximal phalanx malunion involves open osteotomy followed by plate

and screw fixation. However, this approach has significant drawbacks, including surgical site scarring, prolonged rehabilitation, and tendon or soft tissue adhesions [6]. Although plate and screw fixation provides rigid stabilization, it necessitates delayed range of motion (ROM) exercises until bony union is achieved, and the extensive surgical approach increases the risk of soft tissue damage [7].

To address these limitations, this study employs a minimally invasive technique using cannulated headless screws. This method offers rigid fixation, enables early ROM, and requires minimal incisions, potentially reducing complications associated with traditional open procedures [8].

METHODS

This retrospective case series reviewed clinical and radiological data of patients presenting with proximal phalanx malunion, confirmed by plain X-ray radiography, treated with minimally invasive osteotomy and cannulated headless screw fixation at our institution from January 2024 to December 2024. The study included three patients (two male, one female) with a mean age of 42 years (range, 20–73 years). Two patients had no prior medical treatment, while one had received alternative nonmedical therapy. Patients presented 3–6 months post-trauma with complaints of pain, discomfort, finger scissoring, and impaired hand function. All procedures were performed by the second author (OS) following the surgical technique described by del Piñal (2023). This study adheres to the PROCESS 2025 Guidelines for case series reporting.

CASE DESCRIPTION

Table 1. Patient Demographics and Clinical Characteristics

Case	Age (years)	Sex	Affected Finger	Time Since Trauma (months)	Prior Treatment	Deformity Type
1	73	Male	Right third	4	None	Rotatory
2	34	Male	Left fourth	6	Nonmedical therapy	Rotatory, ulnar angulation
3	20	Female	Left third	3	None	Rotatory, ulnar angulation

Notes: summarizes patient demographics, affected finger, time since trauma, prior treatment, and deformity type for three cases of proximal phalanx malunion treated with minimally invasive osteotomy and cannulated headless screw fixation.

All patients underwent a minimally invasive procedure under general anesthesia. Depending on the deformity, a closing wedge, opening wedge, or transverse derotation osteotomy was performed using a narrow oscillating saw (0.5 cm width). Fixation was achieved with a cannulated headless screw. For illustrative purposes, Case 3, a 20-year-old female with discomfort and scissoring of the left third finger due to rotatory and ulnar deviation deformity, is described. A 5 mm sagittal incision was made over the phalanx head for guide wire insertion, advanced to the deformity apex, and confirmed via fluoroscopy (Figure 1).



Figure 1. Guide wire insertion to the apex of the deformity. Place after description of guide wire insertion in surgical technique.

A 2 cm transverse incision lateral to the extensor tendon was made, excising the visible lateral band to prevent adhesion. Osteotomy was performed, followed by guide wire advancement to the proximal phalanx base. Screw length was measured using a depth gauge, and a 2.5 mm diameter cannulated headless screw was

inserted for fixation (Figure 2, Figure 3). Post-fixation, the skin was closed, and immediate range of motion (ROM) exercises were encouraged.

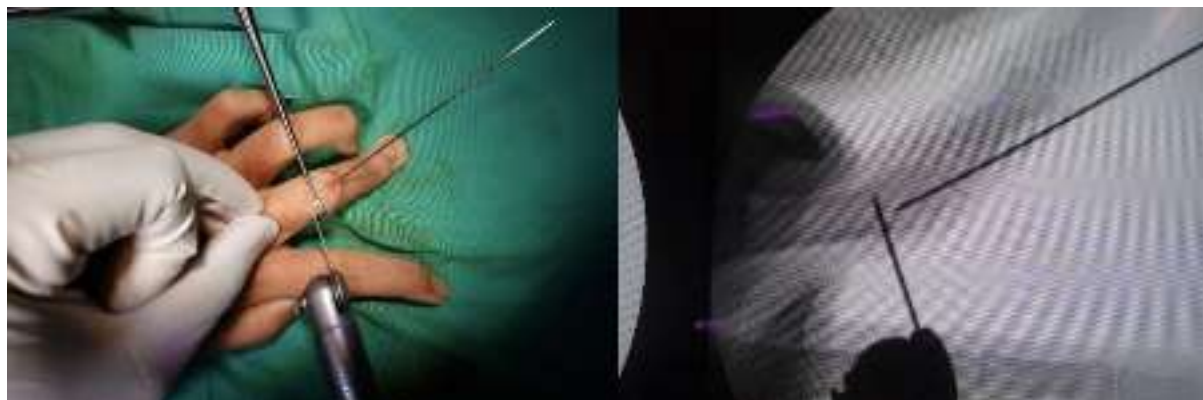


Figure 2: Osteotomy using a narrow oscillating saw with 0.5 cm width. Place after description of osteotomy procedure.

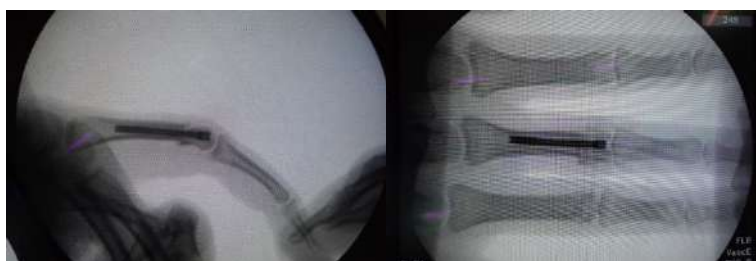


Figure 3: Fixation using intramedullary headless screw. Place after description of screw insertion.

Fluoroscopic image demonstrating fixation of the proximal phalanx malunion using a 2.5 mm diameter cannulated headless screw. The screw is inserted intramedullarily, spanning from the phalanx head to the base, ensuring stable alignment and correction of the deformity. The image confirms proper screw placement with no protrusion into surrounding soft tissues.

Case 1

A 73-year-old male presented with mild pain and scissoring of the right third finger following an accident 4 months prior (Figure 4A).

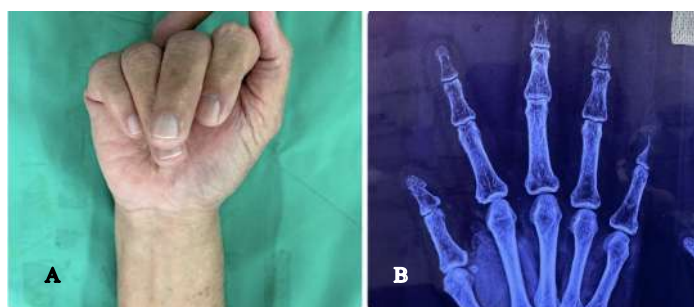


Figure 4: Figure 4. A. Preoperative clinical picture of 1st case. B. Preoperative radiograph of 1st case

A transverse osteotomy with cannulated headless screw fixation was performed using a minimally invasive technique. At the 3-month follow-up, the patient exhibited no residual angulation or scissoring (Figure 5A, 5B). Hand function improved significantly, with grip strength increasing from 55% to 87.5% compared to the contralateral hand and the QuickDASH score improving from 92 to 23. The patient achieved full finger flexion and expressed satisfaction with the surgical outcome.



Figure 5. A. Postoperative clinical picture of 1st case with fingers flexed. B. Postoperative clinical picture of 1st case with fingers extended.

Case 2

A 34-year-old male presented with discomfort, reduced hand function, and scissoring of the left fourth finger 6 months after a motor vehicle accident (Figure 6A).



Figure 6. A. Preoperative clinical picture of 2nd case. B. Preoperative radiograph of 2nd case

He had previously sought treatment from a non-licensed practitioner, where his finger was massaged, yielding no improvement. Radiography confirmed rotatory and ulnar angulation deformity of the fourth proximal phalanx (Figure 6B).



Figure 7. A. 3 months follow-up clinical picture of 2nd case with fingers flexed. B. 3 months follow-up clinical picture of 2nd case with fingers extended.

A closing wedge osteotomy with cannulated headless screw fixation was performed. At 3 months post-surgery, hand function improved markedly, with grip strength increasing from 63% to 100% compared to the contralateral hand and the QuickDASH score decreasing from 64 to 18. No visible deformity remained, and the patient achieved full finger flexion, reporting satisfaction with the results (Figure 7A, 7B).

Case 3

A 20-year-old female presented with discomfort and scissoring of the left third finger 3 months after a work-related injury (Figure 8A). She had no prior medical treatment. Radiography showed rotatory and ulnar angulation deformity of the third proximal phalanx (Figure 8B).



Figure 8. A. Preoperative clinical picture of 3rd case. B. Preoperative radiograph of 3rd case

A closing wedge osteotomy with cannulated headless screw fixation was performed. At the 3-month follow-up, hand function improved significantly, with grip strength increasing from 47% to 95% compared to the contralateral hand and the QuickDASH score improving from 60 to 20. The patient achieved full finger flexion with no residual deformity and was satisfied with the surgical outcome (Figure 9A, 9B).



Figure 9. A. 3 months follow-up clinical picture of 3rd case viewed from above. B. 3 months follow-up clinical picture of 3rd case viewed from left side.

RESULTS

At the 3-month follow-up, all three patients demonstrated significant improvements in hand function, assessed through grip strength measurements using a dynamometer and QuickDASH scores. The mean postoperative grip strength was 94.45% (range, 87.5%–100%) compared to the contralateral hand, indicating substantial recovery of hand strength. The mean postoperative QuickDASH score was 20.3 (range, 18–23), reflecting satisfactory functional outcomes and patient-reported improvement in daily activities. No residual deformities, such as malrotation, angulation, or scissoring, were observed in any patient post-surgery. All patients achieved full finger flexion and expressed satisfaction with the surgical results. No complications, including infection, hardware failure, or soft tissue adhesions, were reported during the follow-up period.

Table 1. Results at 3-Month Follow-Up

No	Age (y)	Sex	Hand	Bone	Location	Deformity	Grip Strength (%)		Quick DASH	
							Preoperative	Postoperative	Preoperative	Postoperative
1	73	M	Right	Phalanx 3	Shaft	Rotatory	55	87.5	92	23
2	34	M	Left	Phalanx 4	Shaft	Rotatory & ulnar angulation	63	100	64	18
3	20	F	Left	Phalanx 3	Head	Rotatory & ulnar angulation	47	95	60	20

Notes: The table is structured systematically, summarizing key variables (age, sex, hand, bone, location, deformity, and pre/postoperative metrics) for clarity and scientific rigor.

The minimally invasive approach using cannulated headless screw fixation facilitated early range of motion (ROM) exercises, contributing to the observed functional recovery. Radiographic evaluations confirmed proper screw placement and bony union in all cases, with no evidence of malalignment or implant-related issues. The outcomes highlight the efficacy of this technique in correcting proximal phalanx malunion while minimizing postoperative complications and promoting rapid rehabilitation.

DISCUSSION

This case series demonstrates the efficacy of a minimally invasive approach using cannulated headless screw fixation for correcting proximal phalanx malunion, as evidenced by the outcomes in three patients. The technique, involving small incisions (5 mm sagittal and 2 cm transverse), minimizes soft tissue damage, reduces scar formation, and facilitates early range of motion (ROM), leading to rapid functional recovery [4-6]. All patients achieved full finger flexion, resolution of deformities (rotatory and ulnar angulation), and significant improvements in grip strength (mean 94.45%) and QuickDASH scores (mean 20.3) at 3 months, consistent with patient satisfaction. These findings align with studies by del Piñal et al., Maes et al., and Zabalo et al., which reported that cannulated headless screw fixation offers a simpler surgical technique, minimal tissue disruption, and faster return to function compared to the standard open approach with plate fixation

Notably, Maes et al. and Zabalo et al. highlighted its applicability in pediatric patients, recommending retrograde screw insertion to avoid proximal phalanx epiphyseal plate damage [9-11].

Concerns regarding the biomechanical stability of cannulated headless screws are addressed by Rausch et al., who demonstrated in a cadaveric study that compression screws withstand higher loads against bending, torsion, and distraction forces compared to T-plates, with crossed Kirschner wires showing inferior stability [12]. The 2.5 mm screw used in this study raised concerns about potential articular damage and iatrogenic osteoarthritis. However, Poggetti et al. found no radiological evidence of osteoarthritis at a mean follow-up of 49 months, with articular surface defects from 2.5 mm screws ranging from 13% to 18% [13]. Similarly, del Piñal et al. reported no articular changes with screws up to 5 mm in midterm follow-up [14]. Warrender et al. noted that screw insertion holes fill with fibrocartilaginous tissue by 3 months, and the proximal interphalangeal (PIP) joint's non-load-bearing nature further reduces osteoarthritis risk [15,16].

Implant removal is generally unnecessary [17]. However, in active patients, screw bending or breakage may occur. Warrender et al. described a technique for removing broken screws, involving proximal fragment extraction at the fracture site and distal fragment removal from the articular surface [15]. This study's limitations include its small sample size and short follow-up period, necessitating further research to validate long-term outcomes and broader applicability.

CONCLUSION

This case series shows that minimally invasive osteotomy with cannulated headless screw fixation effectively corrects proximal phalanx malunion, achieving excellent functional outcomes (mean grip strength 94.45%, QuickDASH 20.3) and patient satisfaction at 3 months. The technique's minimal tissue disruption and early range of motion make it a reliable alternative to open approaches, though larger, longer-term studies are needed to confirm its efficacy.

DECLARATIONS

None

CONSENT FOR PUBLICATION

The Authors agree to be published in the Journal of Society Medicine.

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The authors declare no conflicts of interest in this case report.

AUTHORS' CONTRIBUTIONS

All authors contributed to the work, including data analysis, drafting, and reviewing the article. They approved the final version and were accountable for all aspects.

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