

Simultaneous Central Slip and Volar Plate Injuries at PIP Joint: A Novel Therapeutic Approach

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Background: Central slip and volar plate injuries rarely occur in the same finger, with only two cases previously reported in published literature. In these two patients, both teenagers, two highly distinct protocols were used. Here, we report a third case involving a 51-year-old gentleman who closed a door on his left third finger.

Methods: Because the fractures were noncomminuted and only minimally displaced, he was treated nonsurgically using a multi-step process of splinting to prevent impairment of either proximal interphalangeal joint extension or flexion, combined with active range of motion exercises. This included five weeks of splinting in neutral, 24-hour daily use of a proximal interphalangeal dorsal block, followed by active range of motion exercises combined with nocturnal splinting using a PIP volar block over the next 7 weeks, with relative motion and Joint Jack splints added over the final 4 of these 7 weeks.

Results: Twelve weeks after initial splinting, the patient's finger was pain free, with swelling largely resolved, normal extension (−10 degrees) and near-normal flexion (95 degrees) achieved, and full function restored. The patient was very satisfied with the result.

Conclusions: Ours is just the third case of concomitant central slip and volar plate injuries reported in the literature. Other surgeons are strongly encouraged to publish similar cases, approaches, and results, as clinical wisdom can sometimes be gleaned from even a small number of well-documented clinical cases. (*Plast Reconstr Surg Glob Open* 2021;9:e3923; doi: [10.1097/GOX.0000000000003923](https://doi.org/10.1097/GOX.0000000000003923); Published online 22 November 2021.)

In hands, both the proximal (PIPJ) and distal (DIPJ) interphalangeal joints are bound by collateral ligaments on the radial and ulnar sides, extensor tendons like the central slip dorsally, and a ligamentous volar plate on their palmar surface.¹ These structures all contribute to PIPJ stability and movement; so injury to any of them can cause significant joint instability and, untreated, chronic finger deformity.² Extensor tendon injuries generally are more common and functionally limiting than flexor tendon

injuries.²⁻⁴ Nonetheless, nondisplaced, noncomminuted finger fractures usually are treated nonsurgically.⁵

Volar plate fractures and central slip injuries typically occur secondary to entirely different mechanisms, the former typically caused by PIPJ hyperextension, a crush injury, or axial loading (eg, someone “jams” their finger). The joint becomes unstable and is at risk of further subluxation. Such injuries are more common in youths, often attributed to sports.⁶ Untreated, a swan-neck deformity can result. Typical management of nondisplaced volar plate fractures involves extension-block splinting,⁷ in which the PIPJ is usually held in some degree of flexion to facilitate volar-plate healing and prevent hyperextension. Conversely, central slip injuries are caused by hyperflexion, or from direct blunt or penetrating trauma, typically to the middle phalanx.⁷ Contrary to volar plate instability, central slip disruption causes the PIPJ to drop into flexion and, when untreated, can result in a boutonnière deformity.

Although both injuries are common, it is highly infrequent to find them simultaneously in the same joint.⁸ Despite protocols existing for each of these injuries occurring separately,^{6,9} no protocol yet exists guiding management

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when they occur concomitantly. This study describes our approach, which yielded highly satisfactory results.

CASE REPORT

A 51-year-old man presented with an isolated injury to the left third PIPJ after he accidentally closed a steel door on his finger. Initial examination revealed swelling in his third left finger (mainly over the PIPJ), tenderness over the

dorsal and volar surfaces, and restricted movement; however, the PIPJ was stable to radial and ulnar stress. Initial X-rays (Fig. 1) showed a minimally-displaced, small-fragment, avulsion-chip fracture at the dorsal and volar base of the middle phalanx of the left third finger at the attachment of the extensor digitorum communes and volar plate, without evidence of PIPJ subluxation. The diagnosis of a central slip injury was made based upon the loss of movement and distribution of swelling and tenderness.

The finger was initially splinted with the affected PIPJ in neutral. The patient was instructed to keep the splint on 24 hours per day and avoid water contact to prevent skin maceration. However, DIPJ active range of motion (ROM) was permitted after 2 weeks to stretch the oblique retinacular ligaments because the gliding of lateral bands during DIPJ flexion should not influence the volar plate or central slip.



Fig. 1. Radiograph of the left third finger at the time of the patient's initial visit: lateral view demonstrating two nondisplaced oblique intra-articular fractures involving the volar and dorsal aspects of the third middle phalanx base, and marked adjacent soft tissue swelling.



Fig. 2. Radiograph of the left third finger 3 weeks after initial splinting: lateral view demonstrating proper alignment of the proximal interphalangeal joint. Here again are two nondisplaced obliquely oriented intra-articular fractures involving the volar and dorsal aspects of the third middle phalanx base. Compared with the prior study, there is mild reduction of the surrounding soft tissue swelling.



Fig. 3. Radiograph of the left third finger 12 weeks after initial splinting: lateral view demonstrating union of the previously-seen fracture involving of the volar and dorsal aspect of the base of the third middle phalanx. Proper alignment is maintained.

An x-ray obtained 3 weeks later showed proper PIPJ alignment (Fig. 2).

Five weeks later, the patient was advised to perform gentle active range of motion exercises every hour. A volar block was fabricated to hold the PIPJ in maximum extension, to be worn nocturnally. Digital swelling was managed with a Coban wrap and a Digi-Sleeve. Within 2 weeks (7 weeks postsplinting), the active flexion and extension of the third PIPJ measured 75 degrees and -7 degrees, respectively, increased from 49 degrees/ -5 degrees 1 week earlier. The patient's digital swelling was moderately reduced, and he reported now using his left hand for activities of daily living without pain. A relative-motion splint and Joint Jack splint were added, both for daytime use.

At 3-month assessment, the third-finger swelling was largely gone and PIPJ ROM had improved to 95 degree flexion/ -10 degree extension (versus 104 degree/ -8 degree contralaterally). Hand radiographs revealed partial union of the fractures with proper alignment maintained (Fig. 3). Figure 4 summarizes the treatment timeline.

DISCUSSION

Only two other patients with combined central slip and volar plate injuries have been reported, both in a single article.⁸ Unlike our patient, both were young and injured playing sports, their fingers struck by a ball. The first, a 16-year-old boy with a right ring-finger injury, was splinted in extension 24 hours daily for 6 weeks, followed by 3 weeks of nocturnal splinting alone, then 4 weeks of dynamic-extension splinting. The second, a 13-year-old girl with a right middle finger injury, underwent just 3 weeks of splinting in extension, after which splinting was discontinued and she was instructed to initiate active finger flexion exercises while wearing a dorsal splint to block hyperextension for 3 weeks, followed by 2 weeks of continued exercises plus buddy taping. Both patients ultimately regained “full ROM.”

One major risk of not restricting flexion in patients with a central slip injury is the almost-inevitable development of a boutonniere deformity,¹⁰ which is why splinting in extension is considered essential. Conversely, most volar plate injuries are splinted in some degree of flexion to enhance healing and prevent the finger from developing a swan-neck deformity. Both boutonniere and swan-neck deformities

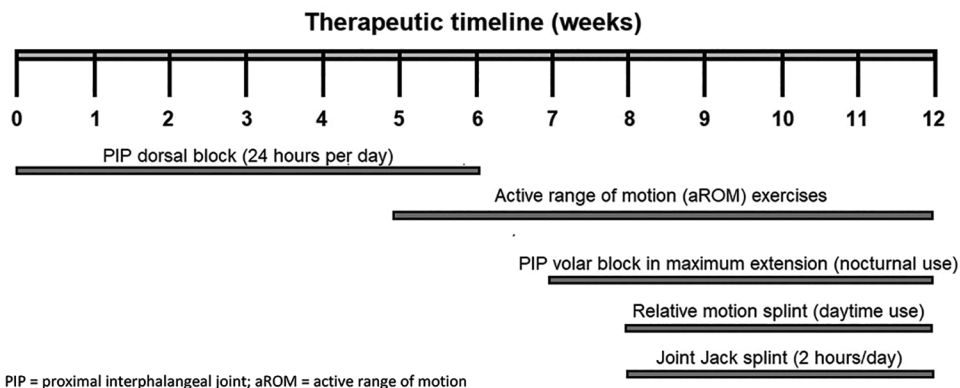


Fig. 4. The therapeutic timeline.

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can cause significant hand impairment, as both render the affected finger almost nonfunctional and adversely impact grasping and fine-motor movements. However, the approaches used to prevent boutonnière and swan-neck deformities are clearly contrary to each other in patients with combined injuries, rendering such patients susceptible to both.

Like the two previously-reported patients with these combined injuries,⁸ we initially extended our patient's finger in the neutral position 24 hours daily, which we continued for 5 weeks, a duration intermediate to the 3 and 6 weeks described by others.⁸ At 5 weeks, based upon our clinical assessment, continuous splinting in neutral was terminated in favor of gentle active range of motion exercises during the day, combined with volar block splinting in full extension at night. To this, 2 weeks later, we added a relative-motion splint and Joint Jack splint to enhance ROM, ultimately achieving 105 degree pain-free ROM from full extension to full flexion, with which both we and the patient were quite satisfied.

Unfortunately, the rarity of this combination of injuries means that clinical trials or even sizeable case series to identify optimum treatment are unlikely. We strongly encourage others to publish reports describing even single cases with this rare clinical scenario, as wisdom sometimes stems from even a few well-documented cases.

REFERENCES

1. Pang EQ, Yao J. Anatomy and biomechanics of the finger proximal interphalangeal joint. *Hand Clin.* 2018;34:121–126.
2. Clark DP, Scott RN, Anderson IW. Hand problems in an accident and emergency department. *J Hand Surg Br.* 1985;10:297–299.
3. Crosby CA, Wehbe MA. Early protected motion after extensor tendon repair. *J Hand Surg Am.* 1999;24:1061–1070.
4. Tuncali D, Yavuz N, Terzioglu A, et al. The rate of upper-extremity deep-structure injuries through small penetrating lacerations. *Ann Plast Surg.* 2005;55:146–148.
5. Imatami J, Hashizume H, Wake H, et al. The central slip attachment fracture. *J Hand Surg Br.* 1997;22:107–109.
6. Pattni A, Jones M, Gujral S. Volar plate avulsion injury. *Eplasty.* 2016;16:ic22.
7. Blazar PE, Steinberg DR. Fractures of the proximal interphalangeal joint. *J Am Acad Orthop Surg.* 2000;8:383–390.
8. Lo I, Richards RS. Combined central slip and volar plate injuries at the PIP joint. *J Hand Surg Br.* 1995;20:390–391.
9. Geoghegan L, Wormald JCR, Adami RZ, et al. Central slip extensor tendon injuries: a systematic review of treatments. *J Hand Surg Eur Vol.* 2019;44:825–832.
10. Williams MS, Fair J, Wilckens J. Quick splint for acute boutonnière injuries. *Phys Sportsmed.* 2001;29:69–70.