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In this Issue

- Orthopedic training in India: Time to change
- Comparison of cutout resistance of dynamic condylar screw and proximal femoral nail in reverse oblique trochanteric fractures: A biomechanical study
- Evaluation of a biodegradable graft substitute in rabbit bone defect model
- Trans-iliosacral plating for vertically unstable fractures of sacral spine associated with spinopelvic dissociation: A cadaveric study
- Osteoporotic profiles in elderly patients with symptomatic lumbar spinal canal stenosis
- Functional outcome of surgical management of degenerative lumbar canal stenosis



Results of vertical figure-of-eight tension band suture for finger nail disruptions with fractures of distal phalanx

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ABSTRACT

Background: Fingertip injuries involve varying degree of fractures of the distal phalanx and nail bed or nail plate disruptions. The treatment modalities recommended for these injuries include fracture fixation with K-wire and meticulous repair of nail bed after nail removal and later repositioning of nail or stent substitute into the nail fold by various methods. This study was undertaken to evaluate the functional outcome of vertical figure-of-eight tension band suture for finger nail disruptions with fractures of distal phalanx.

Materials and Methods: A series of 40 patients aged between 4 and 58 years, with 43 fingernail disruptions and fracture of distal phalanges, were treated with vertical figure-of-eight tension band sutures without formal fixation of fracture fragments and the results were reviewed. In this method, the injuries were treated by thoroughly cleaning the wound, reducing the fracture fragments, anatomical replacement of nail plate, and securing it by vertical figure-of-eight tension band suture.

Results: All patients were followed up for a minimum of 3 months. The clinical evaluation of the patients was based on radiological fracture union and painless pinch to determine fingertip stability. Every single fracture united and every fingertip was clinically stable at the time of final followup. We also evaluated our results based on visual analogue scale for pain and range of motion of distal interphalangeal joint. Two sutures had to be revised due to over tensioning and subsequent vascular compromise within minutes of repair; however, this did not affect the final outcome.

Conclusion: This technique is simple, secure, and easily reproducible. It neither requires formal repair of injured nail bed structures nor fixation of distal phalangeal fracture and results in uncomplicated reformation of nail plate and uneventful healing of distal phalangeal fractures.

Key words: Fingernail disruptions, fracture distal phalanx, vertical figure-of-eight sutures

INTRODUCTION

The germinal matrix of the nail is the tissue that is responsible for the production of the cells that become nail plate¹ (the actual nail). The sterile matrix lies beneath the nail plate.¹ Eponychium is the small band of epithelium that extends from the posterior nail wall up to the base of the nail. The hyponychium is the epithelium located beneath the nail at the junction between its free

edge and the skin of the fingertip. Nail plate or the body of the nail is the actual nail between the lateral and the medial nail folds [Figure 1].

The normal digital tip and nail bed permit an unconscious coordination of effort during pinch and grasp. The altered digit cannot perform with normal efficiency, a conscious impairment exists. Since the tip and nails of the digits of the hand are continuously exposed and commonly injured, they are frequently presented to the orthopedic surgeon for repair or reconstruction.¹

Fingertip injuries commonly found in daily orthopedic practice involve varying degree of fractures of the distal phalanx and nail bed or nail plate disruptions. Treatment modalities recommended for these injuries include fracture fixation with K-wire and meticulous repair of nail bed after nail removal and later repositioning of nail or stent substitute into the nail fold by various methods.²⁻⁵

In this study, fingertip injuries with fracture of distal phalanges and nail bed disruptions were treated by reducing the fracture fragments if possible, repositioning of nail plate

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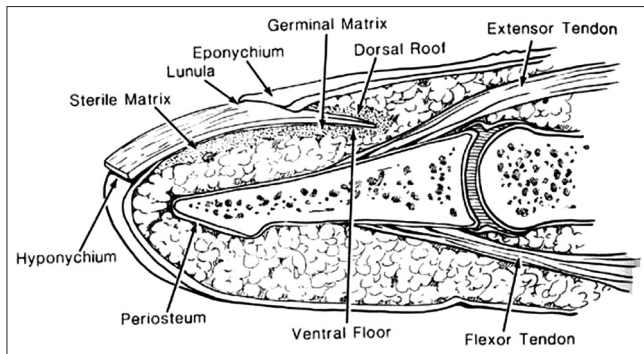


Figure 1: Diagrammatic illustration of fingertip and nail anatomy

in the nail fold, and securing it with vertical figure of eight tension band sutures opposite to the intact soft tissue of the fingertip, usually on the dorsal aspect, without formal nail bed repair or fracture stabilization with K-wire.

MATERIALS AND METHODS

Forty patients with 43 fingertip injuries were treated with vertical figure of eight tension band sutures opposite to the intact soft tissue of the fingertip, usually on the dorsal aspect, without formal nail bed repair or fracture stabilization with K-wire between October 2003 and May 2010. All cases were operated by a single surgeon on an outpatient basis. These included 30 cases of partial nail avulsion, 9 cases of complete nail avulsions, and 4 cases of sharp injury through the nail plate, with a mean age of 28.3 years (range 4–58 years). There were 30 male and 13 female patients. There were 18 cases of proximal or middle shaft fractures and 25 tuft fractures of the distal phalanx. All patients were followed up for a mean of 5 months (range 3–30 months).

The cases of nail avulsions (partial or complete) without fracture of distal phalanx, with distal tissue loss, without nail, and those with crushed fingertips were excluded from the study.

Operative procedure

Under digital block for adults and general anesthesia for children was done through cleaning and draping of the affected hand. The nail plate with its residual attachment, if any, was preserved. Without removing it, the undersurface was thoroughly cleaned by syringe jet and hematoma evacuated. If the fracture fragments were seen, they were reduced under vision. If the nail was completely avulsed, it was cleaned thoroughly. The nail was then repositioned in its eponychial fold anatomically and secured in place with vertical figure-of-eight tension band suture opposite to the intact soft tissue of the injured fingertip, usually on the dorsal aspect, with 3-0 nylon sutures in adults and 4-0 nylon sutures on cutting needle tip in children. Proximally, the suture was placed transversely through the

skin such as to avoid injury to the germinal matrix of the nail [Figure 2a and b]. Then, the distal suture is taken through the tip of finger pulp by crossing over the repositioned nail plate to cause the figure-of-eight loop [Figure 2c]. Now, while maintaining the position of the nail plate, the knot was tied, resulting in figure-of-eight tension band suture [Figure 2d]. The tension given to the loop was adequate enough to maintain reduction [Figure 2e and f]; however, at the same time, it was not compromising the distal vascularity of the fingertip. Try and approximate the lateral skin edges with the same loop to avoid additional insult to the already injured tissue. However, if the need arises, one can take a simple suture for the same.

We did not use any intramedullary fixation for fracture stabilization as the dorsal tension band suture with replaced nail plate acted as the dorsal splint and, coupled with the intact soft tissue on the opposite (volar) side, gave sufficient stability to the fracture fragments and the fingertip. Even the cases of sharp injury through the nail plate were treated similarly by just approximating the nail edges together and placing the dorsal tension band suture over it [Figure 3a–f]. Operating time was noted in each case.

Postoperatively, the fingertip was observed for distal vascularity. Once the vascularity of fingertip was confirmed, dressing was applied with hard splint that was well beyond the tip so as to avoid any direct trauma to the operated fingertip [Figure 4]. Dressing was done after 48 hours and at 5 days postoperatively. The hard splint was removed at 5 days and the dressing was removed when the fingertip appeared dry and healed, usually at 2 weeks. The figure of eight suture was removed at 6 weeks or when the fingertip is stable enough to maintain the fracture reduction. Radiological evidence of fracture healing is not necessary for removal of the figure-of-eight suture. Finger was mobilized at 6 weeks and pinch grip was started.

RESULTS

Our average time of surgery was 15 minutes (Range 10 minutes to 25 minutes). No patient required hospitalization beyond a few hours. All the patients were followed up for the mean period of 5 months (range 3–30 months). The clinical evaluation of the patients was based on radiological fracture union and painless pinch without substitution pattern on Visual Analogue Scale (VAS) as compared to the opposite side to determine fingertip stability. The range of motion (ROM) of distal interphalangeal joint was also studied.

In our series, we found that all the cases healed without clinical deformity [Figures 2g, 5a–e]. All fractures showed radiological union at final followup. We did not mind

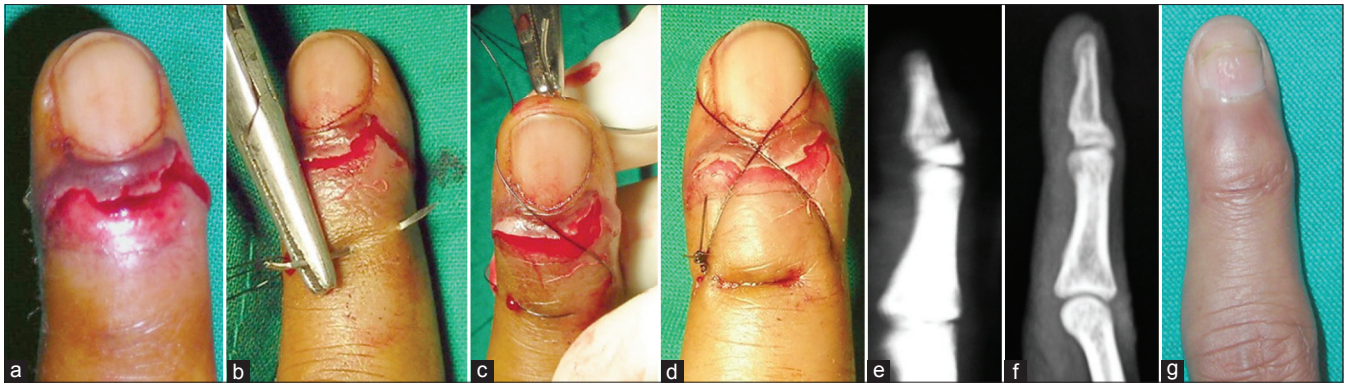


Figure 2: A clinical photograph (a-d and g) and X-rays (e,f) (lateral view) shows (a) Proximal nail plate avulsion with laceration of the nail fold. (b) The suture is placed transversely proximal to the wound such as to avoid injury to the germinal matrix. (c) The distal suture is taken through the tip of the finger pulp by crossing over the repositioned nail to cause vertical figure-of-eight loop. (d) Completed suture over dorsum of fingertip over the nail with adequate tension. (e and f) The fracture of distal phalanx that was reduced without formal internal fixation healed without any deformity. (g) Clinically stable fingertip at 3 months followup

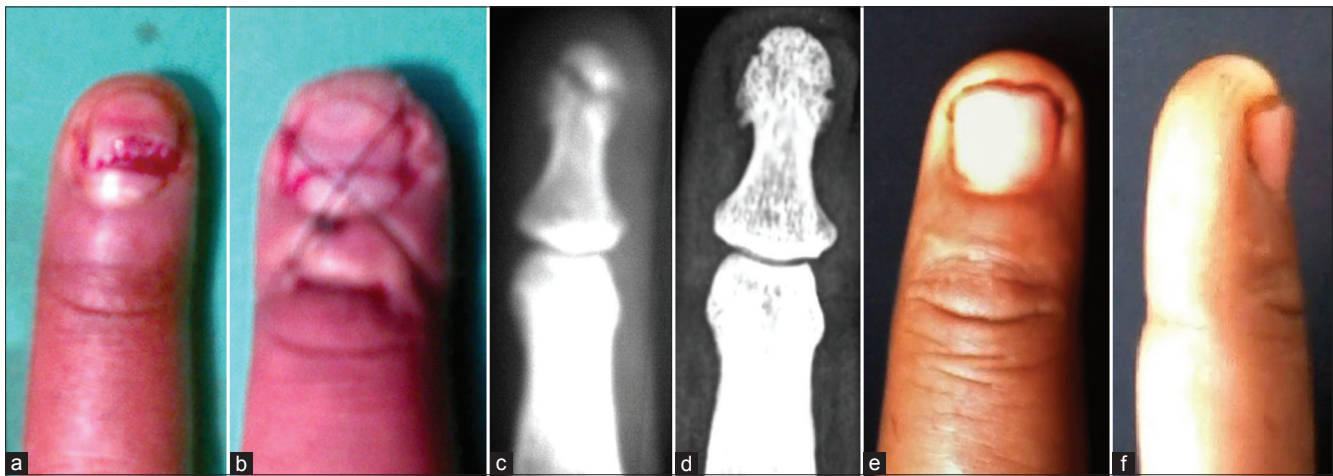


Figure 3: Clinical photographs (a,b,e,f) and X-rays anteroposterior view (c,d) shows (a) A 35-year-old patient with sharp injury through the nail. (b) Vertical figure-of-eight suture placed dorsally over the nail. (c) Fractured distal phalanx. (d) Healed distal phalanx at 2 years. (e and f) Clinically stable fingertip at 2 years



Figure 4: Immediately postoperative, a hard splint is applied well beyond the fingertip to protect the operated finger from direct trauma

minimal degree of fracture malunion (about 2-5 degrees) so long as the fingertip was clinically stable. Every fingertip was clinically stable with comparable pinch strength and

ROM to the opposite side and without deformity at the time of final followup. We used VAS⁶ to subjectively assess the pain at final followup and found it to be almost zero (no pain) in each case.

Two sutures had to be revised due to over tensioning and subsequent vascular compromise within minutes of repair; however, this did not affect the final outcome.

All the patients went back to their original job at an average of 2.5 months. None had to change their job.

DISCUSSION

Distal phalangeal fractures and finger nail disruptions with nail bed laceration to a variable extent are frequently associated with fingertip injuries; blunt or sharp. The fractures of the distal phalanx may be at the tuft, shaft, or base, and there may be partial or complete avulsion of the nail plate

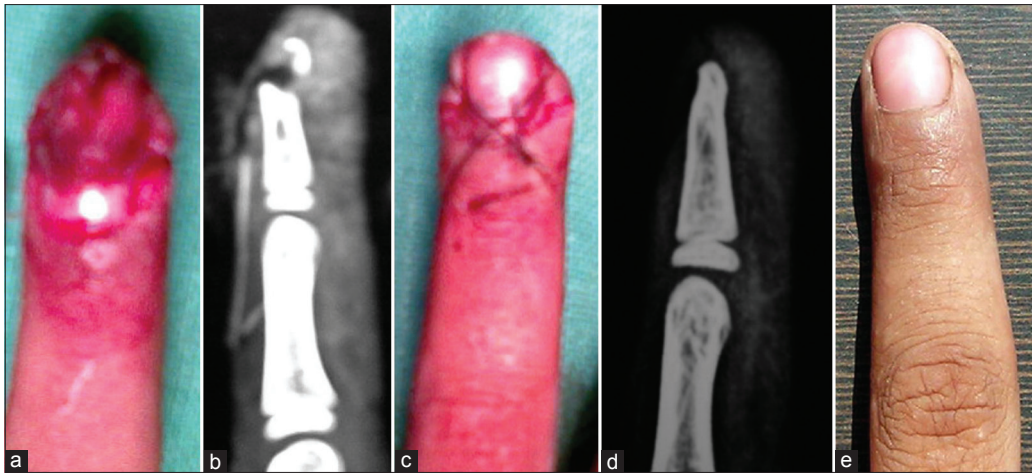


Figure 5: Clinical photographs (a,c,e) and x-rays lateral view (b,d) shows (a) An 8-year-old male child with injury through the proximal nail plate. (b) Fracture of the tuft of distal phalanx with volar displacement. (c) Dorsal vertical figure-of-eight suture maintaining the repositioned nail plate and the fractured fragments. (d) Radiological evidence of healed fracture of distal phalanx. (e) Clinically stable fingertip at 1 year followup

with laceration of the nail bed, which may extend on one or both sides of the nail fold. While treating these permutations of injuries, one must try and reposit the nail in its proper anatomical position without damaging the vital nail bed structures and yet giving adequate fracture stability to the distal phalanx. The integrity of the nail fold is fundamentally responsible for the formation of a smooth, uniform, compact nail.^{1,2} The nail grows distally from pressure extrusion of an expanding cell mass beneath the nail fold. The fold compresses and forms the nail. Permanent damage to the nail fold or bed results in deformity and impaired function. An intact digital tip without the dorsal support of nail may be incapable of performing delicate tip functions.¹

Several treatment modalities have been recommended for these injuries. Some authors have recommended the meticulous repair of the nail bed after evacuation of the hematoma and complete removal of nail plate, reduction of the fracture of the distal phalanx, then repositioning of the nail plate or the stent substitute anatomically into the proximal nail fold, and suturing it to the hyponychium and the proximal nail fold.⁷⁻¹⁰ The repositioned nail fold is believed to permit the new growth of normal finger nail. For securing the nail plate in position, several techniques have been described, namely, suturing the nail to the proximal fold or the distal hyponychium.^{1,4,5,8,10} These techniques traumatize the already damaged tissue due to passage of needle through it.⁷ Often, there may be no normal tissue available for passing the sutures. Passing the suture through nail is difficult. Some authors use acrylic adhesives for the fixation of the nail plate.⁷ Foucher *et al.* recommended nail fixation through nail plate and nail bed and keeping it in place postoperatively.¹¹ The smooth interface of the nail plate helps in healing of the nail bed and results in formation of the normal fingernail.^{1,3,5,10} Several authors have recommended not

removing the attached nail plate in order to suture the nail bed.¹²⁻¹⁵ There are also reports of poor results following conventional nail bed repair.^{16,17} Patankar (2007) in his series used this technique for nail bed injuries, and if there was associated fracture of distal phalanx, he used a longitudinal retrograde K-wire for fracture stabilization.¹⁸ Use of transverse figure-of-eight sutures for the fixation of the avulsed nail is also recommended by some authors.¹⁹

The aim of this study was to establish the efficacy of this technique in obtaining a healed distal phalangeal fracture with intact nail and thus a clinically stable and nondeformed fingertip. In our series, there were 18 middle or proximal shaft fractures and 25 tuft fractures of the distal phalanx with variable degrees of nail bed and nail plate avulsions. Out of these, four cases were of sharp injury through the nail plate. We used vertical nail securing figure-of-eight tension band suture over the nail plate opposite to the intact soft tissue of the injured fingertip, usually on the dorsal aspect, without formally repairing either the nail bed or fixing the distal phalangeal fracture with a K-wire. When the fracture was at the proximal or midshaft level of distal phalanx, usually reduction of fracture fragments could be done under vision. Tuft fractures neither require open reduction nor is it feasible to do so.^{5,12} This technique that was originally described by Bindra for nail bed fracture lacerations avoids any need to place the sutures in already weakened tissue of the nail bed. The nail plate acts as the natural splint.^{3,10,12,15,17} This, when coupled with figure-of-eight suture on one side and an intact soft tissue on the other side, gives good fracture stability to the distal phalangeal fracture, either comminuted or two part, till complete healing. We did not find the need to fix the fracture fragments formally by intramedullary K-wire, etc. Additionally, secured nail plate prevents the formation of subungual hematoma, and thus reduces pain and tenderness

of the fingertip.¹⁰ We used an additional simple suture on the side if the tissue approximation was inadequate. The figure-of-eight suture is removed at 6 weeks or when the tip is stable, irrespective of the radiological evidence of fracture union as by this time the fingertip is stable enough to hold the fracture fragments till complete union.

None of our above patients suffered from functional disability, and all the fractures united. Our results were comparable to Patankar's series that had only two deformed nails due to shortening secondary to comminuted nature of fractures. He used K-wires for fracture stabilization.¹⁸ We found that our results were also comparable to that of Bindra who used this technique in his series of 19 fracture lacerations of fingertips with 100% good results. Bristol *et al.* used transverse figure-of-eight suture to replace the nail; however, they did not have a series of fractures of distal phalanges to compare with.

CONCLUSION

This technique is simple, secure and easily reproducible. It neither requires formal repair or injured nail bed structures nor fixation of distal phalangeal fracture and results in uncomplicated reformation of nail plate and uneventful healing of distal phalangeal fractures.

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