

The Modified Tension Band Suture For Dorsal Disruptions Of The Finger Tip

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❖ Abstract ❖

Purpose

To assess the results of securing the anatomically replaced nail plate or its substitute to the finger tip by the modified tension band suture without formal repair of the nail bed on the formation of the nail plate in cases of dorsal disruptions of the finger tip.

Methods

A series of 66 patients (age range between 1 and 70 years) with 70 finger tip injuries resulting in disruption of the dorsal tissues was reviewed. All the cases either had partial proximal or complete nail plate avulsion or a fracture through its mid-substance. There was associated injury to the nail bed, finger pulp and the distal phalanx. Cases of subungual hematoma without nail disruption and those with tissue loss (amputations) were excluded from the study.

All the cases were treated by cleansing of the finger, evacuation of the hematoma and anatomic replacement of the nail plate or its substitute (stent) without formal repair of the nail bed. The nail plate or its substitute (stent) was secured in position under the proximal nail fold with a modified dorsal tension band suture. K wire fixation of the distal phalanx was employed only in the event of displaced fracture of the distal phalanx, complete absence of the nail plate and laceration extending to the distal pulp.

Results

This method resulted in the reformation of the normal nail plate with functional recovery of the involved finger in all the cases at the minimum follow up of 4 months. There were no complications due to modified tension band suture either at the nail fold or at the finger tip.

Conclusions

The simple method of securing the anatomically replaced nail plate or its substitute by the modified dorsal tension band suture bypasses the injured and friable and vital normal dorsal structures and results in the reformation of a normal nail plate. The removal of the nail plate and formal repair of the nail bed is not necessary in any age group with dorsal tissue disruptions of the finger tip.

Key words

Dorsal disruptions, finger tip, tension band suture.

The modified tension band suture for dorsal disruptions of the finger tip

Introduction

The finger nail is an important structure.^{1, 2} Finger tip injuries, particularly those causing dorsal tissue disruptions are centered on the finger nail. These are among the most common post traumatic conditions affecting the hand and are potentially disabling.^{1,3,4,5} Blunt injuries to the finger tip often result in dislocation of the intact nail plate from the

nail bed to a variable extent and it may come to lie on the dorsum of the proximal nail fold. At times there is a complete avulsion and loss of the nail plate. In approximately 50% of the cases there is usually a fracture of the tuft or shaft of the distal phalanx with laceration of the nail bed which is displaced with the osseous fragments.¹ There is associated laceration of the finger pulp that extends variably on one or both sides from the lateral nail fold to the volar aspect of the pulp. Sharp injuries result in a linear wound involving the nail plate, nail bed and the distal phalanx. This wound generally extends laterally on to the lateral nail fold and involves the pulp to a variable extent. However, a number of permutations and combinations are possible including severe crushing of all dorsal tissues.

Adequate primary treatment is necessary to minimize the subsequent nail deformity. The recommended treatment is evacuation of the subungual hematoma followed by a meticulous repair of the nail bed after removal of the nail plate. This is coupled with stabilization of the distal phalanx fracture with repair of the finger pulp. Lastly the nail plate or its substitute (stent) is repositioned anatomically in the nail fold and sutured.^{1,2,3,4,6,7,8,9,10}

We report a series of 66 patients (70 fingertips) treated by anatomical reposition of the nail plate or a stent in the nail fold and securing it with a modified dorsal tension band suture without formal repair of the nail bed.

Additional K wire fixation of the distal phalanx was performed in cases of irreducible fractures of the tuft of the distal phalanx, displaced fractures of the shaft with proximal nail bed lacerations, absence of intact skin bridge on the volar aspect and in case of severe crushing of the soft tissues of the pulp with avulsion or absence of the nail plate.^{1,2,6,7,8,9,10,11}

The modified tension band suture for dorsal disruptions of the finger tip

Technique

The patient is anesthetized (*GA in children and LA in adults*). The hand is thoroughly cleaned

and draped. A tourniquet is applied after elevation of the hand.

In case the nail is not completely avulsed but just separated / dislocated from the proximal nail fold, it is not removed from the nail bed. The hematoma is completely evacuated and the visible under surface of the nail is irrigated with a jet of saline from a syringe. The nail fold is cleaned and opened gently with a small blunt elevator. The nail plate is then repositioned anatomically and secured in place with the modified dorsal tension band suture technique as described. (Fig.1) 4-0 to 6-0 non absorbable non braided material on an atraumatic cutting needle is used. Proximally the suture is passed transversely in a purse string manner through the skin 8 mm from the edge of the nail fold, superficial to the repositioned nail plate and the underlying germinal matrix. The needle is then carried distally crossing the midline of the finger dorsally. The distal pass of the suture is similarly made through the finger

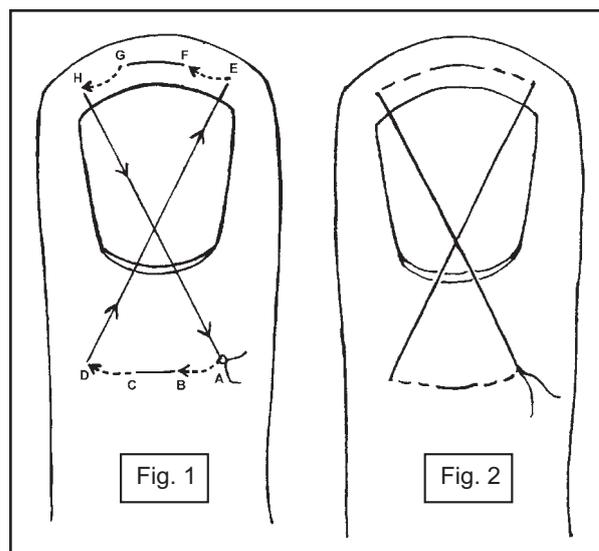


Fig. 1 : Diagram showing the purse string suture method. The needle is passed through the skin proximally at two sites entering at point A and exiting at point B and again at point C and exiting at point D. Similarly the needle is entered distally at E to F and at G to H. The thread is thus visible on the dorsum of the finger between B and C and between F and G. The thread is brought back from the point H to the point A and tied.

Fig. 2 : Diagram showing the completed suture. Note the visible thread proximally and distally in the midline for additional tension banding.

pulp just distal to the nail hyponychium and is directed transversely. With an assistant maintaining the reduction of the nail plate or stent, the suture is then tensioned to just short of skin blanching and

resulting in a dorsal figure of 8 loop. (Fig.2) This dorsal tension band suture results in adequate approximation of the fracture, the nail bed and the skin edges on either side of the nail, avoiding the

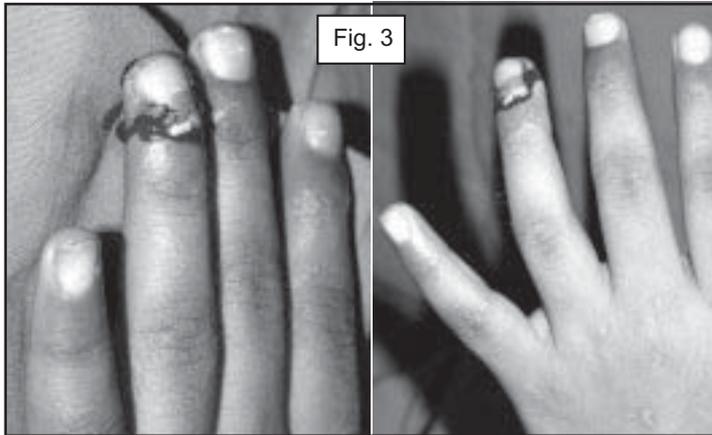


Fig. 3 : Preoperative pictures of proximal nail plate avulsion with laceration of the nail fold in a 10 year old girl.



Fig. 4 : Postoperative pictures with the tension band suture maintaining the repositioned nail plate.

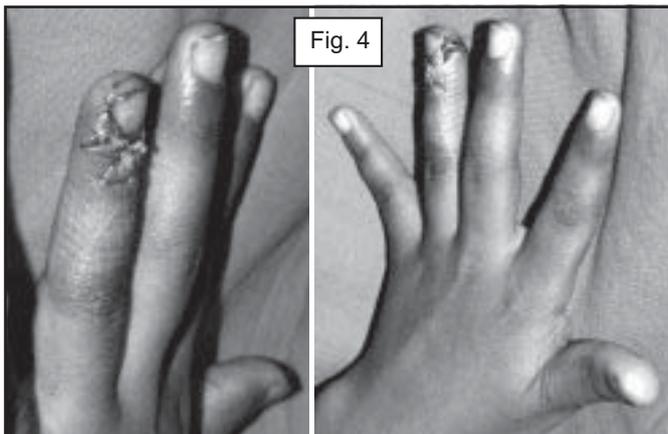


Fig. 4 : Postoperative pictures with the tension band suture maintaining the repositioned nail plate.

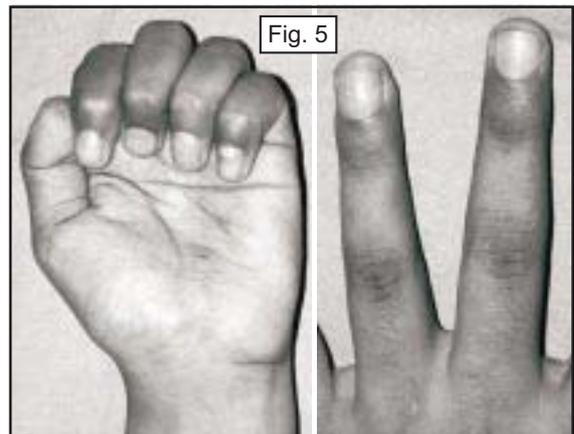


Fig. 5 : Appearances at 18 months follow up. Complete reformation of the nail plate noted with normal finger tip.

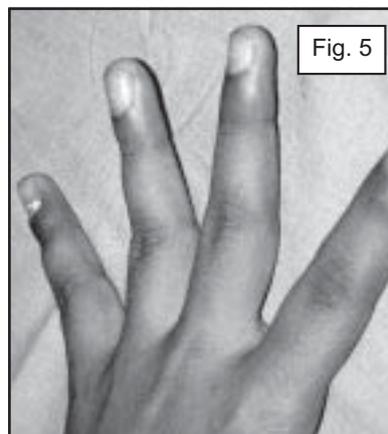


Fig. 5 : Appearances at 18 months follow up. Complete reformation of the nail plate noted with normal finger tip.

use of additional sutures through the crushed soft tissues namely the nail bed and the finger pulp and also through the hyponychium and the proximal nail fold. The replaced nail plate prevents adhesions of the nail fold with the proximal nail bed. (Clinical example1) (Fig.3-5)

In cases of severe injury, the finger nail may be completely avulsed with laceration of the nail bed, lateral nail fold and finger pulp with fracture of the tuft or shaft of the distal phalanx. In these cases the fracture is reduced and stabilized with a K-wire and verified with a C-arm image intensifier. The nail bed is palpated for sharp spikes of bone which are reduced. The lacerated ends of the nail bed are gently spread out with a blunt instrument such as the rear end of the knife handle and positioned as anatomically possible over the dorsum of the distal phalanx. However no attempt is made to suture them. The nail plate (if available) and the nail fold is washed and cleaned. The nail plate or a stent is replaced anatomically under the proximal nail fold and secured in place with a variation of the modified tension band suture technique. (Fig.6) In such cases the distal cut end of the Kirschner wire serves as an anchor point for the distal suture as the tissues may

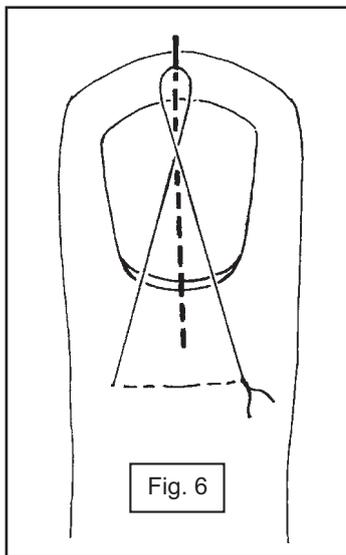


Fig. 6

Fig. 6 : Diagram showing method of securing the nail plate with K wire fixation of the distal phalanx. This technique is used in presence of complete avulsion of the nail plate, displaced fracture of the tuft or shaft of the distal phalanx, lacerated finger tip, absence of intact skin bridge on the volar aspect.

be too lacerated to hold any suture. The Kirschner wire additionally stabilizes the soft tissues also. (Clinical example 2, Fig.7-11) (Clinical example 3, Fig.12-14)

In case of a linear wound due to a sharp instrument, the nail plate, nail bed and the distal phalanx are injured in one plane. This wound generally extends laterally on to the lateral nail fold and involves the pulp to a variable extent. In such situations the hematoma is washed off and the finger is cleaned. The cut (fractured) ends of the nail plate (with the nail bed and the bone) are approximated with the modified tension band suture. An additional

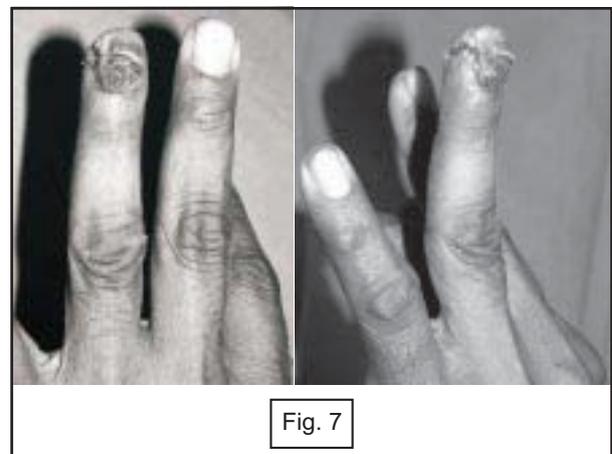


Fig. 7

Fig. 7 : Pre-operative pictures of 2 month old injury with loss of the proximal nail plate, untreated nail bed laceration and fracture of the distal phalanx.



Fig. 7A

Fig. 7A : Pre-operative radiograph showing comminuted displaced fracture of the tuft of the distal phalanx.

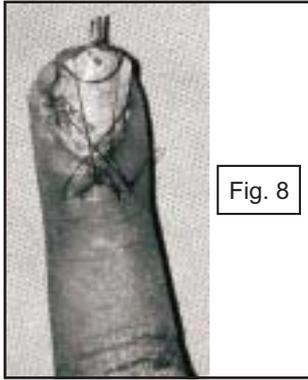


Fig. 8 : Post-operative pictures K wire fixation of the distal phalanx fracture with a stent in position under the proximal nail fold secured with the tension band suture. Note the distal suture anchored to the cut end of the K wire.



Fig. 11

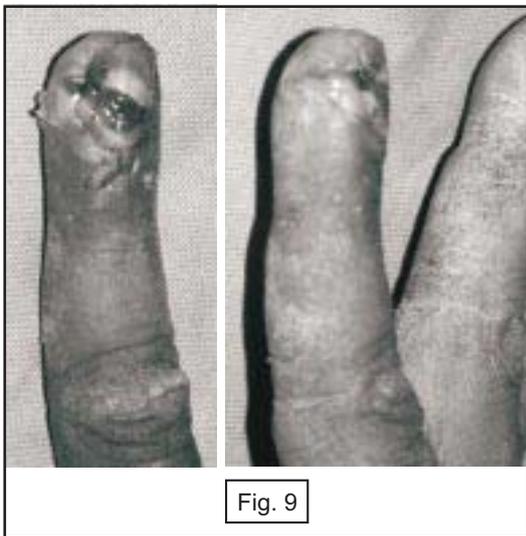


Fig. 9

Fig. 9 : Appearance at 3 months post-operatively. Note the appearance of the new nail plate.

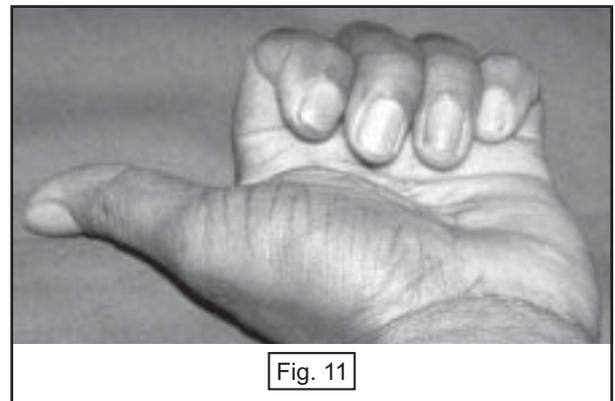


Fig. 11

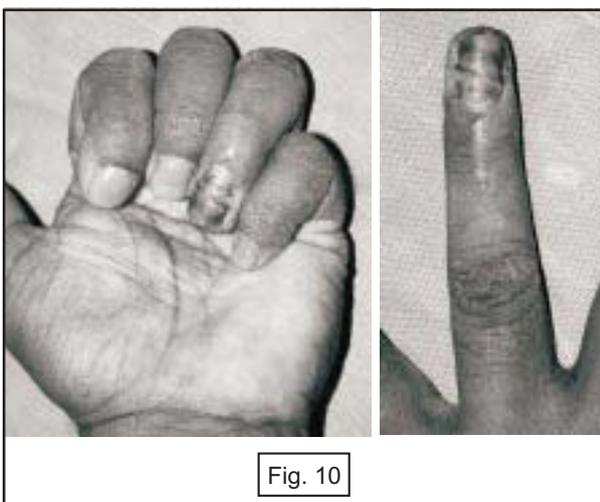


Fig. 10

Fig. 10. Appearance at 6 months follow up.



Fig. 11

Fig. 11 : Appearance at 24 months follow up. Complete reformation of the nail plate noted with normal finger tip.

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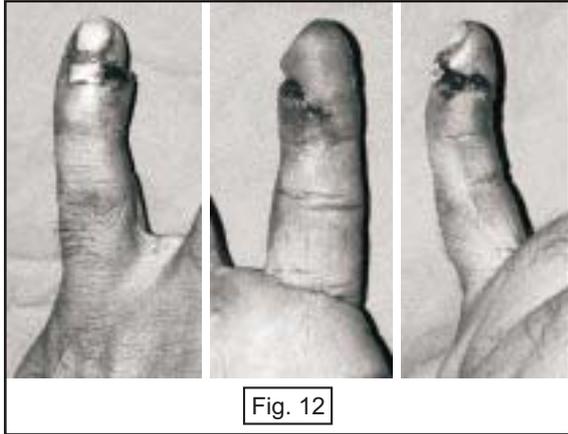


Fig. 12

Fig. 12 : Pre-operative pictures of a severe injury with proximal avulsion of the nail plate, laceration of the nail bed and finger pulp with fracture of the distal phalanx.

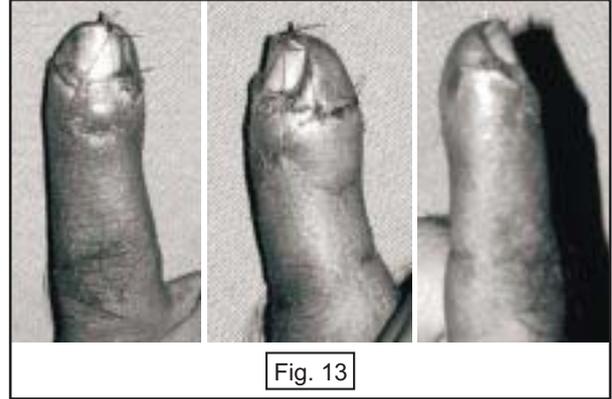


Fig. 13

Fig. 13 : Post-operative pictures with K wire fixation of the distal phalanx and repositioned nail plate secured by the modified tension band suture.



Fig. 12A

Fig. 12A : Pre-operative radiograph showing comminuted displaced fracture of the shaft of the distal phalanx.

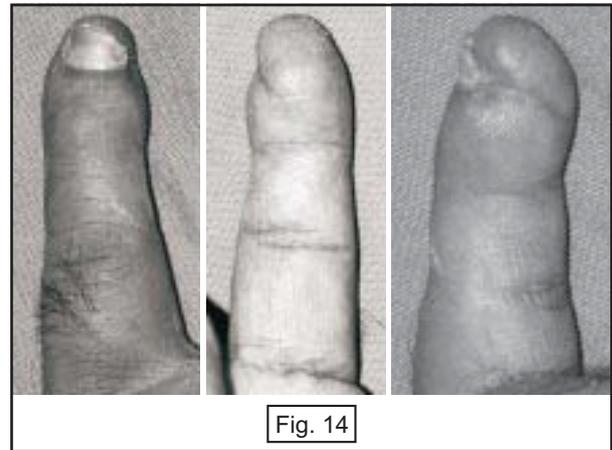


Fig. 14

Fig. 14 : Appearance at 12 months follow up with reformation of the nail plate.

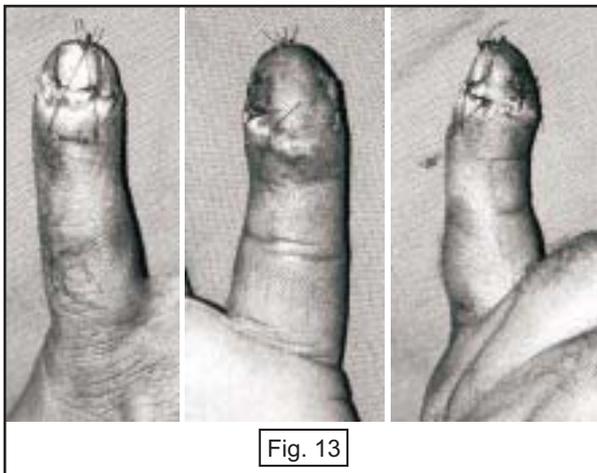


Fig. 13

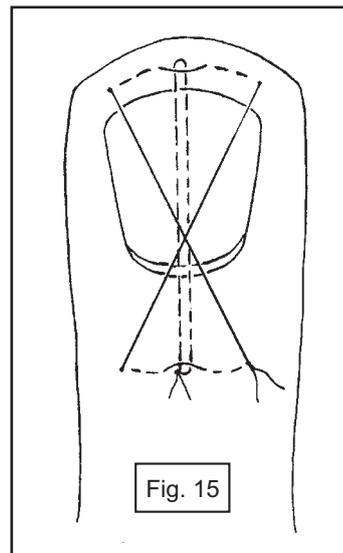


Fig. 15

Fig. 15 : Diagram showing additional tension band suture taken through the thread visible in the midline.

suture through the center of the existing suture is taken dorsally in the midline for augmentation of the repair. (Fig.15) One or two fine atraumatic sutures are taken additionally in the pulp depending upon the condition of the soft tissues. (Clinical example 4) (Fig.16-18)

Retrograde intra-medullary K-wire fixation is used in irreducible fractures of the tuft, displaced fractures of the shaft with proximal nail bed lacerations, absence of intact skin bridge on the volar aspect and in case of severe crushing of the soft tissues of the pulp with absence of the nail plate.

Post-operatively a dorsal gutter splint is applied over a non adherent finger dressing and the hand is elevated and splinted in the functional

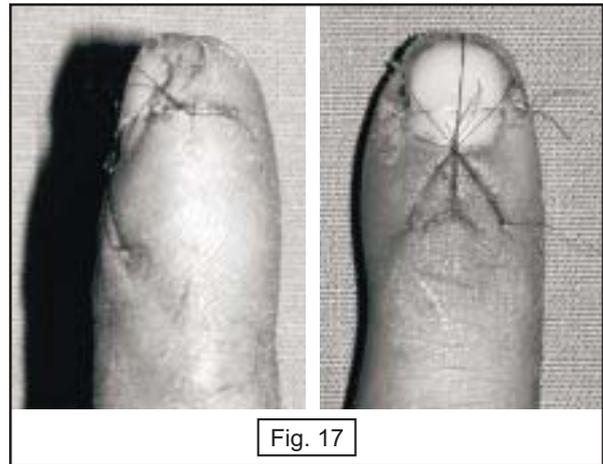


Fig. 17 : Post-operative pictures with the tension band suture and an additional suture securing the distal tissues and the nail plate.

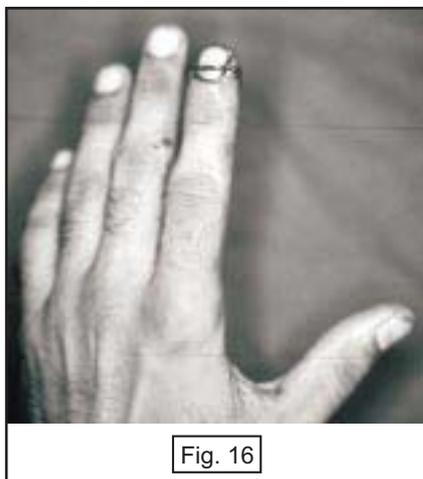


Fig. 16 : Pre-operative pictures of a sharp injury across the nail plate.



Fig. 18 : Appearance at 36 months follow up. Complete reformation of the nail plate noted with normal finger tip.



Fig. 16A : Pre-operative radiograph showing fracture of the distal phalanx.



Fig. 18A : Radiograph taken at 36 months postop showing complete healing of the fracture.

position. The wound is inspected 2 days later and the dressing is reduced to the finger to allow active mobilization of the hand. The tension band suture and the K-wire are removed in the office 3 weeks later. The nail or its substitute usually stays attached to the digit for several weeks.

The modified tension band suture for dorsal disruptions of the finger tip

Results

This technique has been used for the treatment of 70 fingertips in 66 patients who presented with dorsal tissue disruptions. The patients aged between one year and 70 years. There were 55 cases of partial avulsions, 7 cases of complete avulsions and 4 cases of sharp injury to the nail plate. 9 fractures occurred at the level of the middle third of the distal phalanx and the remainder was tuft fractures.

At follow up examination 4 months after the surgery (range 6 weeks to 3 years), no complications were noted due to the modified tension band suture either at the nail fold or at the finger tip. Deformity in the form of shortening and deviation was noted in two finger nails with severe soft injury and comminuted fracture of the distal phalanx. There was no deformity of the nail in the remaining fingertips.

Although radiographic confirmation of the union was not obtained in each case, the fractures were clinically stable in all cases at the time of the final follow up.

The modified tension band suture for dorsal disruptions of the finger tip

Discussion

The recommended treatment of dorsal disruptions of the finger tip is evacuation of the subungual hematoma followed by a meticulous repair of the nail bed after removal of the nail plate. This is coupled with reduction and stabilization of the fractures of the distal phalanx and approximation of the finger pulp. Lastly the nail plate or its substitute (stent) is repositioned anatomically and sutured to the hyponychium and the proximal nail fold.^{1,2,3,4,6,7,8,9,10}

In this series, 7 (seven) patients had complete avulsion of the nail plate exposing the lacerated nail bed. In 4 (four) patients with linear wounds the nail bed injury was obvious but it was not accessible for repair as the nail plate was not separated from the nail bed distally. In the majority of the patients (55 patients with 59 finger tip injuries) the nail bed injury was suspected due to partial avulsion of the intact nail plate from the proximal nail fold,² but it was not visible due to the distally attached intact nail plate.

It has been reported that primary repair of nail bed lacerations is probably not necessary. If the nail plate is partially avulsed but is firmly attached to the nail matrix, exploring the nail bed is difficult and probably unwarranted.¹² Even in the presence of significant subungual hematoma, with or without tuft fracture, the nail need not be routinely removed to search for nail bed laceration, as long as the nail is adherent and disruption of the surrounding tissue is minimal.¹³

There is a firm natural bond between the nail plate and the sterile matrix (distal two thirds) and between the sterile matrix and the periosteum of the distal phalanx.^{1,2,9} and removal of the nail plate is not recommended.^{14,15}

In most of the cases in this series, 59 proximal avulsions and 4 sharp injuries, the nail bed was not readily available for inspection as the nail plate was attached distally to the nail bed and it was considered unnecessary to disturb the secure natural bond between these two structures. There are reports of indifferent or poor results following nail bed repair.^{16,17}

Therefore it was felt that if the distal tissues comprising of the nail bed, distal phalanx and the finger pulp could be approximated as one unit by a simple method as described³ there would be no need for removal of the intact nail plate or for formal repair of the nail bed. Secondly it would be difficult to hold the sutures on the lacerated nail bed.

The previously described method³ was employed to secure the nail in position after repair of the nail bed. Moreover this technique necessitates

passage of the needle through relatively large portions of the proximal and distal tissues of the finger tip. This may not be feasible in cases of lacerations. The purse string modification of the tension band suture method requires minimal bites in the proximal and distal soft tissues. These are usually available except in severe lacerations. In these situations a longitudinal K wire inserted retrograde into the distal phalanx serves to stabilize the soft tissues and its distal cut end acts as anchor point for the distal suture. The retrograde K wire is also used in displaced or irreducible fractures of the distal phalanx and in complete avulsions of the nail plate in which a stent is used.¹⁰

Since the proximal suture is taken well away from the proximal nail fold, this technique can be used in injuries involving the proximal eponychial region as compared to the previous report.³ Moreover additional tension banding is possible with this modification through the visible central part of the suture. This is especially useful in linear injuries causing transverse fractures of the nail plate.

The finger nail serves as a natural splint for fractures of the distal phalanx^{1,3,4,7,14,15,16} and in case of comminuted fractures of the tuft it is neither feasible nor necessary to reduce them.^{8,14} The anatomic repositioning of the nail plate and its natural bond to the distal nail bed coupled with the secure bond provided by the modified tension band suture technique helps to approximate the fracture fragments and the nail bed. The modified dorsal suture technique as described employs the principle of tension band fixation countering bending forces at the finger tip. The anatomic repositioning of the nail plate under the proximal nail fold prevents over reduction of the distal tissues in case of tuft fractures. Therefore this technique can be used in comminuted fractures of the tuft of the distal phalanx as compared to the previous report.³ However, two cases with comminuted fracture of the shaft of the distal phalanx healed with shortening. Although this resulted in shortening of the nails, it did not result in any functional disability in these patients who were manual laborers. This deformity was attributed to the severe injury and the inaccurate reduction of the

of the comminuted fracture of the distal phalanx in these cases. Therefore fingertip injuries with comminuted fractures of the shaft of the distal phalanx should be treated with accurate reduction, stable fixation and confirmation of union before implant removal.

The smooth under-surface of the nail provides a biological template for healing of the nail bed in the anatomical position and results in formation of the normal finger nail.^{1,2,3,8} The repositioned nail plate or stent prevents adhesion formation between the nail fold and the germinal matrix proximally. This keeps the nail fold open and permits growth of the normal new fingernail.^{1,2,6,10}

Additionally the secured nail plate prevents formation of the sub-ungual hematoma and it also reduces pain and tenderness at the fingertip.¹ Numerous techniques have been described to secure the nail plate in its fold; they usually involve suturing the nail, either proximally through the nail wall or distally on to the hyponychium.^{1,2,6,7,8} This involves passage through the already traumatized tissues leading to further damage.⁴ Passage of the needle through the intact nail plate itself can be difficult especially if it has not been avulsed or surgically removed. The nail plate at times is very thick and hard. Occasionally there may not be any normal tissue available for suturing the nail. However these sutures do not provide a firm adherent bond between the nail and the nail bed.

The use of an acrylic adhesive is appealing⁴; but it is applicable in case of complete avulsion or surgical removal of the nail. This was not performed in any of our cases. Secondly, the effects of the adhesive percolating into the fracture site and the germinal matrix area need to be studied in detail. This is possible in this series as the nail bed was not formally repaired in any of our cases.

The novel method of nail syntheses described by Foucher in 1984 uses the principle of tension band fixation.¹⁸ Although it is useful in cases of finger tip amputation, it necessitates passage of the needle through the normal nail plate and nail bed. This would be traumatic in cases of tissue disruption

described here and is not feasible in majority of the cases as the nail plate is intact.

The prerequisite for this technique is stability of the volar tissues. They were intact in most of our patients. In other patients they were stabilized either by suturing of the finger pulp or by fixation of the distal phalanx with a K wire or both.

Finger tip injuries causing dorsal tissue disruptions require optimum and timely management to prevent or minimize chronic nail plate deformity. The simple method of securing the anatomically replaced nail plate or its substitute by the modified dorsal tension band suture bypasses the injured and friable and vital normal dorsal structures and results in the formation of a normal nail plate in most cases. The removal of the nail plate and formal repair of the nail bed is not necessary.

The modified tension band suture for dorsal disruptions of the finger tip

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