International Journal of Innovation Sciences and Research
Vol.4, No, 3, pp. 096-099 March- 2015

Available online at
http://www.ijisr.com

ORIGINAL ARTICLE

A NOVEL INEXPENSIVE TECHNIQUE TO IMMOBILIZE OPEN HAND INJURIES IN A FUNCTIONAL POSITION USING A PREMOLDED LIGHT WEIGHT EXTERNAL FIXATOR

***Dr. Vaibhav Aterkar, Dr. Umang Sanghvi and Dr. Kailash Sethi**

Department of Orthopaedics, Sumandeep Vidyapeeth, Vadodara, India

Accepted 11th February, 2015; Published Online 31st March, 2015

ABSTRACT

Hand trauma is quite frequent and coupled with a loss of function, can have an impact on almost all activities. Prolonged disability is an inherent consequence of such injuries, if they are not treated meticulously. Apt surgical intervention plays an important role in the final functional outcome. Here we have made a custom made *on-table* molded external fixator frame to match the patient's functional position of wrist and hand, and cite its advantage over the conventional splint/cast application for immobilization. Smaller joints have the propensity to get stiff earlier than the larger ones. Here is where our concept of differential unloading of the fixator comes into vogue. This fractional dynamisation of our apparatus gives an opportunity to mobilize the fingers at an early period.

Key Words: Open Hand Injuries, Differential Unloading, Fractional Dynamisation, Functional Position, Molded External Fixator.

INTRODUCTION

From our earliest moments, we use our hands to learn, to explore and to interact with the world around us, and now as working adults, our hands continue to be "out front," touching, grasping, pushing, pulling and lifting our way through work and through life. Unfortunately, being "out front" can also mean them being placed in jeopardy, and suffer the peril. Nowhere in the body, are the form and function so closely related to each other than in hand. Too often hand injuries are treated as minor ones resulting in major disabilities. Hand trauma is very common and associated loss of function can have an impact on almost all activities. A crush injury is more complex than it seems at the surface and resembles "the tip of an iceberg" phenomenon. Open and crush injuries of the hand are all the more difficult to treat because of the underlying extremely complex anatomical arrangement of the structures, which render the hand its supreme function. Protracted disability is an inherent consequence of such injuries, if they are not treated meticulously. Thirty to forty percentages of all fractures in the hand occur in the metacarpal. Border metacarpals (1st and 5th) are more commonly involved, the base being more commonly involved in the former and neck in the latter. Diaphyseal fractures are common in non border metacarpals. Hand fractures can be complicated by deformity from no treatment, stiffness from overtreatment, and both deformity and stiffness from poor treatment .Hence appropriate surgical intervention plays an important role in final functional outcome.

****Corresponding author: Dr. Vaibhav Aterkar***
Department of Orthopaedics, Sumandeep Vidyapeeth, Vadodara, India

Open injuries of the hand are common, yet the use of external fixators in these injuries is new. These injuries require stabilization without further compromising vascularity. Infection, deformity and contracture pose a serious problem in restoration of hand function. The advantages of external fixation were enumerated by Schuind *et al*. (1992). "There is respect of Bone Biology", fracture fragments are not stripped of periosteal blood supply and further devascularized. External fixation does not cause the amount of osteopenia seen with more rigid systems such as plating .However there is adequate stability to permit early mobilization. When there has been concomitant soft tissue injury, external fixation permits ready access to the wound for debridement as well as for reconstruction of tendons, nerves and blood vessels. Here we introduce a custom made *on-table* molded external fixator frame to match the patient's functional position of wrist and hand, and cite its advantage over the customary splint/cast application for immobilization.

MATERIALS AND METHODS

A study of eight (six male and two female) patients with hand injuries during a period of one year. Total forty four fractures were treated by external fixation with 24 phalangeal and 20 metacarpal fractures. Their mean age was 32.3 years (15 to 54). Mode of trauma were as follows; four by machinery (sugarcane milling), two were caused by traffic accident, one by sharp cutting objects and one by physical violence. Depending on the pattern, the fractures in our study were; twenty eight comminuted, three transverse, five oblique and eight intra-articular. In 67.5% of the cases the dominant hand was involved. There were eight open fractures and five with severe soft-tissue injuries (Figure 1).

All the patients had an early operation (4-72 hours) average 12.7 hrs using a light weight external fixate, which was molded on the operation table itself. This specific configuration based on the functional position of hand was common for all the patients treated**.** Depending on the variation in fractures of different patients either the fracture fixing k-wires were incorporated in the frame itself or individual fractures were fixed separately if they were falling out of the way of the regular wire placement. Debridement of the necrotic tissue after provisional reduction was followed by insertion of the pins, with positioning determined by anatomical landmarks and image intensifier. Our premolded frame is applied, so as to maintain the position of immobilization, Metacarpo Phalangeal at 90 degree and with full extension at interphalangeal joints, and abduction and opposition of thumb with 20 to 30 degree of dorsiflexion of wrist. The patients were discharged after the wounds healed and were taught standard pin care.

Follow-up visits were scheduled at weekly intervals for inspection of the wounds and checks of the stability of the device. Radiographs were taken immediately after surgery and at one to two weeks and four weeks to check the position and healing (Figure 2) .When the fractures had united, the external fixator was removed and exercises started in a specific temporal pattern designed by us. Recovery was scored on the basis of the total active range of movement of each injured finger separately, using the scoring system of Duncan *et al* for total active movement. ("This adds the active flexion of the metacarpophalangeal, proximal interphalangeal and distal interphalangeal joints, then subtracts the sum of the extension deficits at these three joints ")

Functional assessment based on total active range of movement in degrees of each injured finger separately according to Duncan *et al*. (1993).

Finger	Thumb	Result
220 to 260	119 to 140	Excellent
180 to 219	98 to 118	Good
130 to 179	70 to 97	Fair
<130	<70	Poor

RESULTS

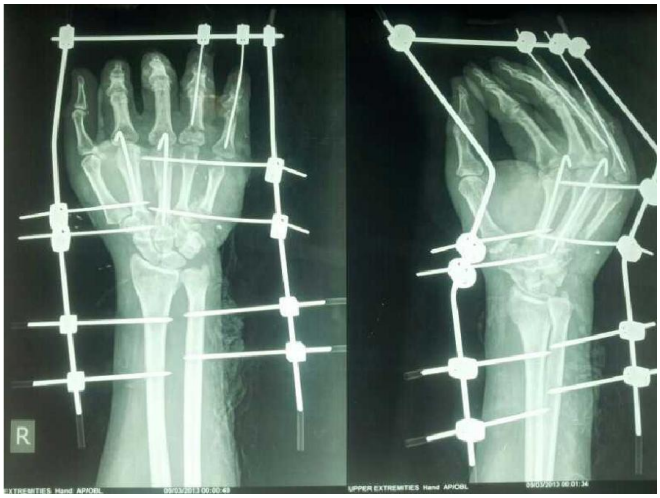
The phalangeal and metacarpal immobilizing frame was removed at a mean of 19 days (<3 weeks) and the wrist frame was mobilized at a mean of 25 days (< 4 weeks). Two patients showed complications during the period of fixation: in one patient a few pins became loose which was managed by removal of the affected pin and the other patient had a superficial infection which was managed with an extended period of antibiotics. All fractures healed without further operation and no patient developed resultant bony deformity.

Results of treatment in 24 phalangeal fractures and 20 metacarpal fractures

	Phalangeal	Metacarpal
Excellent	18	15
Good	04	03
Fair	01	01
Poor	01	01

Case of Crush injury of right hand

Intra operative molded external fixator frame



Radiological image

Final follow up

DISCUSSION

The basic principle of external fixation in this study was "Physiological tension and stress applied to the tissue stimulates histogenesis of tissues; this light weight external fixator has viscoelastic properties similar to the bone". The benefit of external fixation principles in open fractures is well recognized. External fixators have found a sound place in lower limb trauma, but its application in upper limb injuries is still juvenile. There have been few reports of the use of external fixation for these injuries (Freeland, 1987). By the principles of damage control orthopedics, the use of an external fixator device reduces further damage to the delicate soft tissues and bone, thus preventing repeated insults to the injured area (Schuind *et al*., 1993 and Fitoussi, 1996). Patients with unstable fractures require operative reduction and stabilization to obtain the optimal position for bone healing and to allow early movement (Smith *et al*., 1987). Indications for external fixation in open fractures of the upper limb are more restricted and limited to situations of marked fracture comminution, bone loss, or extensive soft-tissue damage (Hand Clin, 1993). Infection rate increased in the presence of wound contamination, delay in treatment greater than twenty-four hours, or systemic illness (Swanson *et al*., 1991). The technique of fixation is relatively simple, and even superior accuracy is supplemented by the use of an image intensifier. The site for pin introduction remains constant for all cases. Hence this particular frame has a very short learning curve. The transverse placement of the pins had an advantage of preventing further damage to extensor or flexor tendons and other delicate soft tissues.

Internal fixation also provides good stability but also have inherent risks of infections and devascularising fragments due to additional soft tissue stripping. Recent advances in external fixation hardware, frame application, and pin-site care have resulted in the evolution of external fixation as a safe and versatile technique. It provides skeletal stability, access to the site of injury, and allows early mobilization. It allows wound care and enables exercise of the finger joints at an early stage as even three weeks of immobilization related to shaft fractures can cause significant joint and soft tissue stiffness (Wright, 1968). Optimal position for bone and soft tissue healing is required to achieve early mobility and the best functional outcome. This most advantageous position for the hand is defined by Metacarpo Phalangeal at 90 degree and with full extension of interphalangeal joints, and abduction and opposition of thumb with 20 to 30 degree of wrist dorsiflexion. The frame was placed in parallel configuration along the radial and ulnar side of the hand to give maximum stability to the injured hand. Placement of k-wires and bends in connecting rods were placed at strategic locations in order to simulate functional position of the hand (Figure 3).

Presently the usual method of treating such injuries is stabilization of individual fractured bones by k-wires and immobilizing the hand and wrist in a splint or a cast. Advantages of the external fixator used were; removal and reapplication of a splint or cast for the purpose of periodic wound dressings is an arduous job. In contrast to this the fixator provides an unimpeded access to the wound for its management. Due to rigid immobilization in a fixator frame, the wound and soft tissues are subjected to less mobility. This has a positive influence on wound healing, thus amounting to better wound healing rates, less scarring, decreased requirement of skin grafting or decreased area needed for a

graft (Figure 4). The fractured bones were given a stable basis for union in a fixator as compared to a cast. Also the injured tendons and neurovascular structures are also at a very low risk of getting re-damaged. It appears to be universally accepted that mobilization of the hand should occur before four weeks. Also the smaller joints have the propensity to get stiff earlier than the larger ones. Here is where our concept of differential unloading of the fixator comes into vogue. We have found from our experience that the best functional results using our technique were achieved by sequential deloading of the apparatus in the following order: phalangeal frame (IP joints) and Metacarpal frame (MCP joints) at 3 weeks and Wrist frame (wrist joint) at 4 weeks. This fractional dynamisation of our apparatus gives an opportunity to mobilize the fingers at an early period. Hence such a fixator frame sculpted in a functional position, potentially outperforms a cast immobilization.

Conclusion

Thus a light weight external fixator molded in a functional position is an excellent choice for management of open and crush injuries of hand , and can be used as a substitute to splint or cast application.

REFERENCES

Lane, CS., Kennedy, JF. and Kuschner, SH. 1992. The reverse oblique x-ray film: Metacarpal fractures revealed. *J Hand Surg Am*.; 17:504–6.[Pub Med]

Duncan, RW., Freeland, AE., Jabaley, ME. and Meydrech, EF. 1993. Open hand fractures: an analysis of the recovery of active motion and of complications. *J Hand Surg* [Am]; 18:387-94.

Freeland, AE. 1987. External fixation for skeletal stabilization of severe open fractures of the hand. Clin Orth; 214:93-100.

Riggs, SA. Jr and Cooney, WP. III. 1983. External fixation of complex hand and wrist fractures. *J Trauma*; 23:332-6.

Swanson, TV., Szabo, RM. and Anderson, DD. 1991. Open hand fractures: prognosis and classification. *J Hand Surg Am. Jan*; 16(1):101-7.

Putnam, MD. and Walsh, TM. 1993. External fixation for open fractures of the upper extremity. *Hand Clin*. Nov; 9(4):613-23. Wright TA. Early mobilization of fractures of the metacarpals and phalanges. *Can J Surg* 1968; 11: 491-8.

Schuind, F., Cooney, WP. III, Burny, F. and An, K-N. 1993. Small external fixation devices for the hand and wrist. *Clin Orth*; 293:77-82.

Smith, RS., Alonso, J. and Horowitz, M. 1987. External fixation of open comminuted fractures of the proximal phalanx. *Orthop Rev*; 16:937-41.

Ashamead, D. 1992. Treatment of Hand Injuries by external fixation. *J. Hand. Surge*: 17: A., 956-964.

Fitoussi, F. 1996. External fixation for Comminuted phalangeal fractures. *J. of Hand*, 21 B, 6, 760-764.

****