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Orthopaedics

A RETROSPECTIVE STUDY OF MINI-EXTERNAL FIXATORS IN HAND FRACTURES

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Abstract:

Fractures of the hand need careful evaluation and proper management to get good functional outcome. Mobility is the watch word during the course of managing the hand fractures. We have analysed various methods of treatment for the phalangeal fractures and compared with mini-external fixators for treating unstable hand fractures.

To evaluate the use of mini-external fixators in hand fractures and analyse the various advantages and disadvantages of this system and how to overcome it.

A retrospective study of hand fractures treated by mini external fixators

Keywords: *Mini external fixator, unstable fractures, hand fracture.*

Introduction

External fixation allows fracture reduction to normal bony length via a rigid external support[1]. Mobilisation at joints proximal and distal to the fracture can be achieved across the external apparatus. External fixation can be used as an alternative to internal fixation. In the hand, however, it is more commonly used when a fracture is not amenable to internal fixation. Highly comminuted fractures or complex intra-articular fractures are such example[2]. In these cases external fixation has advantages. Good results with different formal external fixator sets are reported[3,4,5]. Although many are to be recommended they are universally expensive and sometimes not available to a surgeon, particularly in less developed countries.

Discardable external fixators are commercially available[6] but are still expensive and not always accessible. Other alternative external fixators, using methylmethacrylate rods[7] or k-wires as both the bar and pins held by orthopaedic or dental cement, are well recognised. However, even here a packet of cement is used at relative expense or may not be readily available. We have used with success the discardable plastic sheath of an IV cannula or hypodermic needle as the crossbar for our external fixator. K-wires are passed through the plastic and into the bone acting as the pins. The plastic sheath is slender yet stable, so is not cumbersome. The method is simple, cheap and effective, and the materials are always available.

Objectives:

Fractures of the hand need careful evaluation and proper management to get good functional outcome. Mobility is the vital part during the course of managing the hand fractures. We have analysed treatment for the phalangeal fractures with mini-external fixators for treating unstable hand fractures retrospectively in 15 patients.

Study design:

A retrospective study of hand fractures treated by mini external fixators

Material And Methods

This method was used on 15 patients. All sustained industrial injuries to the hand due to RTA, Industrial accidents and domestic injuries. All the patients had comminuted fractures with varying degree of loss of bone length and volume. The degree of comminution or intra-articular extension was not a parameter. At least one neurovascular bundle and one long flexor tendon were intact. Soft tissue cover was achievable without flaps or skin grafts. All procedures were undertaken under regional anaesthesia within 72 h of the initial injury.

The patients were then assessed regularly in the Hand Unit, and physiotherapy commenced under adequate analgesia. The external fixator was removed at 4-8 weeks, depending on clinical and radiological findings.

The external fixator stability was assessed throughout the treatment period. Once removed, bony union was assessed as stable and to length if no discernable movement could be felt and finger length was equal or near-equal in comparison with the opposite hand. We then attempted to assess functional results at 10 weeks. This was scored by total active range of the affected digit and hand function as assessed by the occupational therapist. Unfortunately, patient return was poor after this period of time, making longer-term assessment difficult.

Operative Technique

Under Axillary block, all the compound fractures were thoroughly debrided. The fracture to be treated is reduced and the length of plastic cross-bar required is measured. The plastic sheath can be from any needle or cannula providing it is rigid and not brittle. The rigidity will improve markedly once the sheath is shortened, as will be done to treat a phalangeal fracture. A range of products meets this criterion and will be easily available in any theatre (see Figure 1). After wound debridement the pin sites are marked on the skin. This can be done under direct vision or with an image intensifier. Pin placement is planned to avoid piercing the extensor mechanism. This position will vary depending on the bone being treated, but always avoids the midline. The proximal K-wire is then placed through the plastic sheath and then into the marked proximal site. It is important to ensure that bicortial bites are taken. We used 1 or 1.2 mm K-wires in the phalanxes and 1.6 mm in the metacarpals.

Figure 1: Plastic sheath of an IV cannula is used whole or cut to length as the cross bar. The plastic bar should be rigid and not brittle as shown

The fracture is then reduced to the appropriate length and to the correct angulation. The distal K-wire is then passed through the plastic bar, skin, and into bone. Having the K-wires slightly divergent will also add to the stability and prevent the cross-bar slipping. The K-wires are shortened and stability assessed. A second K-wire is placed at each end if required. This will always be needed when longer cross-bars are used, as with a metacarpal fracture or across a metacarpophalangeal joint (MCPJ). However, this is often not needed for a phalangeal fracture. A suture is sometimes placed under the bar to prevent slippage, but this is not usually required. The apparatus as applied to a proximal phalanx is seen in Figure 2.

The ex-fix is maintained for 4-8 weeks. Mobilisation was early with all the patients in this series. The apparatus is removed with no or local anaesthetic.

Figure 2: "Alternative" external fixator as applied to a proximal phalanx

Outcome measures:

The outcome of the treatment protocol was assessed by healing of the wound, clinical and radiological union of the fractures and range of movements MCP, IP joints, and hand grips and time taken for return to normal work.

Results

Stability of the apparatus was good; seven of eight remained stable for the planned period. One patient returned from another city after three months requesting removal. In one case, fixator became loose at three weeks. Soft tissue healing was achieved in all fifteen patients. Bony union with appropriate length was achieved in ten of the fifteen patients. Two patients had non-union. In one of these patients, the apparatus was incorrectly applied with poor fracture reduction and, in another, a bone graft was required.

Function was assessed as excellent/ good in three of the fifteen cases, as fair in one of the fifteen cases, poor in two cases, and no comment could be made after six weeks on two non returnees.

Discussion

External fixation is not commonly used in the hand. In its most basic form it will immobilise a comminuted fracture and enable good union. Ability to adjust a fixator, to compress or distract a fracture, is obviously advantageous. This is not possible with this method but should not be required with good application. Careful placement, ensuring bicortial placement, is important. The method presented here is a basic form of external fixation that is very simple to use, providing acceptable results at an extremely low price.

Despite the K-wires not being threaded stability does not appear to be a problem. Only one external fixator came loose after three weeks. There were no cases of pin sepsis.

The use of only one pin at each end for phalangeal fractures is not absolute. A second K-wire should be passed if there is doubt regarding stability. However, to our surprise, this was not usually required in the phalanx. Two pins are always needed for longer lengths of bar or when crossing a joint. With a full bar (see Figure 3a) the stability was reduced slightly. In this patient, an external fixator was used from the scaphoid to the distal thumb metacarpal, to span a complex fracture of the thumb metacarpal and trapezium. The thumb of this patient was extremely unstable pre-operatively. The degree of bone loss and potential shortening are not fully appreciated from the immediate post-operative radiograph (see Figure 3b). A volar cast was used, in addition to the external fixator, for support to allow early inter-phalangeal joint (IPJ) movement. However, the external fixator was rigid enough to maintain bony length and prevent rotation during healing (see Figure 3c). Bone fragments of the second metacarpal with soft tissue attachment were aligned and bony length maintained with trans-metacarpal neck K-wires. This patient had an excellent outcome, returning to work as a fireman.

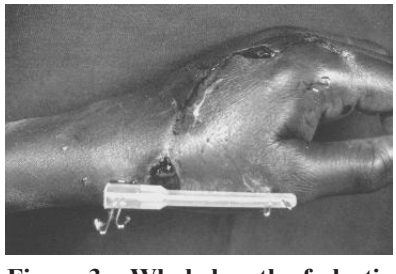

Figure 3a: Whole length of plastic sheath used in the external fixator for a complex thumb fracture

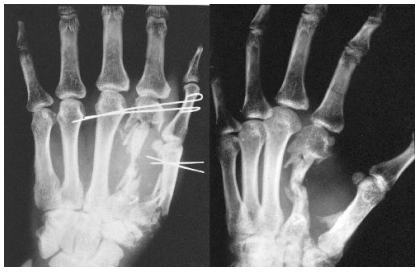

Figure 3b: Comminuted fracture of thumb metacarpal and trapezium with bone loss and marked instability, treated by an external fixator. Early post-operative result Figure 3c: Fracture three months post-operatively, where good union to length has been obtained

Soft tissue healing may well have occurred regardless of the fixation method employed. All patients are initially placed in a functional cast that is removed after a few days. Subsequent soft tissue management, however, is then simplified with the fracture stabilised. Radiographic follow-up is also simplified as the cross-bar is radiolucent.

Bone union was achieved in the majority of patients. Bone union was assessed as stable and of appropriate length if stable in active and passive movement, and the length was equal or close to that of the opposite hand. Bone union did not occur in two patients. This, however, was the result of poor application of the method, and not a result of the method per se. One of these patients had a poor reduction of his middle phalangeal fracture but did not attend the clinic for five weeks for this to be dealt with. The second patient with a non-union had a severe injury with marked bone loss resulting in little bone cortical contact. He also had an associated incomplete flexor and extensor disruption. He should have undergone primary bone grafting from a skeletal viewpoint. His movement and soft tissues were very poor on review, and he eventually came to amputation.

Functional assessment was hindered by poor patient follow-up. Due to socio-economic circumstances we often do not see this population group once they are healed and regaining function. Despite this, results at ten weeks were available for six patients. The poor outcomes in two patients were those with a non-union. The patient with a fair outcome had an associated flexor tendon injury but returned to work with his deficit. Two of the three good/excellent results returned to their pre-morbid activity of work at three months. The third patient with a good/excellent outcome had pain in the injured digit when washing clothes, but otherwise had good movement and function. Two other patients who had good union to length at removal of the apparatus did not return after six weeks for follow-up and no functional assessment could be made.

Conclusion

Despite the deficiencies in our follow-up, we feel that the out-come in this group with severe injuries is acceptable. The proposed method works. It is widely available, simple, quick to use, and costs are minimal. Almost 10 out of fifteen had excellent results, 3 had fair and two had poor results. We feel that this method should be considered when an external fixator is required but no commercial sets are available to the surgeon.

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