Acute hand injury splinting – the good, the bad and the ugly

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ABSTRACT

Injuries to the hand comprise 20% of all emergency department attendances, with an estimated annual treatment cost of over £100 million in the UK. The initial assessment and management of hand injuries is usually undertaken by junior staff, many of whom have little or no training or experience in splinting hand fractures. In the Department of Orthopaedic Hand Surgery, Morriston Hospital, we regularly observe patients presenting to the specialist hand fracture clinics having had initial management that shows no appreciation for the treatment objectives or the safe positions for splinting. This article aims to provide guidance for frontline staff on the management of hand fractures, with particular emphasis on the appropriate nonoperative care to avoid any unnecessary morbidity.

KEYWORDS

Hand injury – Splints – Fractures

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Introduction

Injuries to the hand comprise 20% of all emergency department attendances with an estimated annual treatment cost of over £100 million in the UK.¹ Functional impairments as a result of hand injuries often necessitate absence from employment, resulting in reduced productivity estimated to incur an additional £600m loss to the UK economy.¹ Appropriate and early management is vital to preserve anatomy, prevent stiffness and permit function. The initial assessment and management of hand injuries is usually undertaken by junior staff, many of whom have little or no training or experience in splinting hand fractures. In the Department of Orthopaedic Hand Surgery, Morriston Hospital, we regularly observe patients presenting to the specialist hand fracture clinics having had initial management that shows no appreciation for the treatment objectives or the safe positions for splinting. Many splints have been so inadequately applied that patients are worse off than before the intervention, in direct contradiction to the Hippocratic doctrine ‘first do no harm’.² This article aims to provide guidance for frontline staff on the management of hand fractures, with particular emphasis on the appropriate nonoperative care to avoid any unnecessary morbidity.

Recognising need for early referral

Almost 90% of hand fractures are appropriately treated without surgery, with simple closed reduction techniques, appropriate splinting and early protected mobilisation.³ It is vital that the minority of patients who require early specialist

input are recognised by frontline staff to prevent morbidity from delayed care. Open injuries require early washout to reduce infection rates;³ intra-articular fractures require anatomical reduction to prevent painful post-traumatic arthritis;⁴ significant deformity, especially rotational, will lead to unacceptable function due to malunion;⁵ and persistent subluxation may lead to pain and instability.⁶ Recognising the 11% of injuries that require early surgical intervention is key in providing safe frontline care.⁷ A simple tool to assess these fractures and decide the appropriate management is shown in Figure 1 and Table 1.

Principles of nonoperative care

For nonoperative management to be successful, the correct treatment should be instigated at the time of the initial presentation. Nonoperative management does not equate to clinical neglect and it is important that treating clinicians understand the fundamental principles of hand splinting. Improper management can itself cause morbidity including skin breakdown, joint stiffness, muscle atrophy and worsening of the deformity in instances of incorrectly applied or poor choice of immobilization.⁸ In the worst-case scenario a poorly applied splint may result in failure of nonoperative treatment, making surgery necessary. It is therefore vital that all clinicians managing hand injuries have knowledge of the principles of nonoperative treatment and splinting techniques. With a basic knowledge of the techniques described in this article (Box 1), good outcomes can be achieved with minimal resources.

Table 1 Assessment of fractures.

Requiring specialist referral	Suitable for nonoperative management
Open fractures	Stable fractures
Displaced intra-articular fractures	Reducible deformity/subluxation
Retracted flexor digitorum profundus avulsions	
Irreducible subluxation	
Unacceptable residual deformity	

Anatomical considerations

When splinting hand injuries, it is important to consider the complex anatomy that needs to be respected if full function is to be returned following injury. The interphalangeal joints are hinge joints reinforced by the volar plate and flexor tendons on the volar surface and the collateral ligaments medially and laterally. This lack of dorsal stability makes these joints more vulnerable to dorsal dislocation. Immobilisation of the interphalangeal joints is best carried out in extension, as immobilisation in flexion leads to stiffness as the ligaments and capsule contract in their flexed resting position. Unlike the interphalangeal joints, metacarpophalangeal joints have a cam-shaped head; the collateral ligaments are loose in extension but become taut and therefore provide stability in full flexion (Fig 2a). The anatomical difference

Box 1 Principles of nonoperative treatment and splinting techniques.

Immobilisation should include the joint above and below the deformity to control the position but no more.

Splints should be placed on the side of initial deformity to prevent redisplacement.

Immobilisation should rarely exceed 3–4 weeks; beyond this time, the benefit quickly becomes outweighed by the morbidity of stiffness.⁹

Elevation above the level of the heart should be encouraged to reduce swelling, which may restrict movement and compromise recovery.

between the interphalangeal and metacarpophalangeal joints forms the basis of the safe position of the hand (Fig 2b) to best resist fracture displacement and soft-tissue shortening with subsequent stiffness. This position is 70–90 degrees of flexion at the metacarpophalangeal joint and full extension at the interphalangeal joints.¹⁰ If the wrist is also immobilised, it should be positioned in 20–30 degrees of extension.¹⁰ The surface anatomy of the hand can be confusing and the level of the metacarpophalangeal joints is often misinterpreted. The correct level corresponds to the distal palmar crease and this should be remembered to avoid placing splints too distally.

Splinting

We now discuss commonly used splinting techniques and highlight examples of inappropriate application.

Edinburgh cast

The Edinburgh cast is traditionally a volar slab immobilising the hand in the 'safe' or Edinburgh position, although a dorsal slab or full plaster of Paris may be employed, using the same principle. It is vital that this position is achieved to reduce stiffness and contractures of the interphalangeal and metacarpophalangeal joints. The plaster should be placed on the side of displacement to best prevent subsequent movement of the fracture. This will usually be on the volar

Figure 2 (a) The cam shape of the metacarpal head leads to the collateral ligaments becoming taut in flexion. (b) A well-positioned Edinburgh splint in the 'safe' position

side for metacarpal shaft or neck fractures, which are usually apex dorsal.¹¹ A circumferential plaster should be avoided or bivalved in the acute setting, as swelling could lead to circulatory embarrassment. This type of splint is suitable for metacarpal shaft, neck and base fractures without carpometacarpal joint subluxation.

Pitfall: In Figure 3, the wrist is flexed, the metacarpophalangeal joints are almost straight and the interphalangeal joints flexed as the plaster is too short to control them. This will lead to stiffness if the safe position that can be maintained with a volar slab is not used as illustrated in Figure 2b.

Barton cast

The Barton cast is a short plaster for immobilising metacarpal shaft fractures.¹² It extends from the metacarpal heads to the wrist crease, with three-point moulding possible for angulated metacarpal shaft fractures. As it leaves the fingers and wrist free to move, the Barton cast is preferred by patients compared with a full Edinburgh cast.¹⁵ Although not immobilising the joint above and below, this plaster is adequate to maintain reduction of mid-shaft fractures provided that adequate three-point moulding is used. Extra padding is recommended on areas of pressure application over volar metacarpal base and head and dorsally over the fracture apex.¹⁴ This cast is suitable for metacarpal shaft fractures.

Dorsal splint

Similar to the volar splint, the dorsal splint can be used to immobilise interphalangeal and metacarpophalangeal joints while providing dorsal support for dorsally displaced fractures, subluxations and dislocations. This splint is suitable

for extra-articular phalangeal fractures and dorsal dislocations or subluxations.

Pitfall: The short splint shown in Figure 4 does not flex the distal interphalangeal joint to reduce this flexor digitorum profundus avulsion as it is too short, which also causes it to dig in to the dorsal skin. A dorsal splint with the distal interphalangeal joint in flexion would control this injury better.

Volar splint

A volar splint is an aluminium splint that can be bent to immobilise the interphalangeal and metacarpophalangeal joints. As with any splint, it should immobilise the joint above and below but should avoid immobilising any further joints unnecessarily. This splint is suitable for extra-articular phalangeal fractures and volar interphalangeal dislocations and subluxations.

Pitfall: The volar splint shown in Figure 5 may exacerbate the dorsal subluxation and it is too short to control the metacarpophalangeal joint. In addition, a ring is seen on the adjacent finger, which should be removed to avoid circulatory embarrassment when swelling ensues. A dorsal extension block splint would prevent dorsal subluxation while allowing an early protected range of motion.

Extension block splint

A dorsal splint can be used to allow motion within a restricted range. A simple dorsal splint can be bent at the

Figure 3 The wrist is flexed, the metacarpophalangeal joints are almost straight and the interphalangeal joints flexed, as the plaster is too short to control them

Figure 4 This short splint does not flex the distal interphalangeal joint to reduce this flexor digitorum profundus avulsion

Figure 5 The volar splint shown here may exacerbate the dorsal subluxation and it is too short to control the metacarpophalangeal joint

level of the proximal or distal interphalangeal joint with the phalanx distal to the bend unsecured to the splint. This allows flexion of the interphalangeal joint to combat stiffness but prevents full extension to protect against dorsal subluxation. This splint is suitable for interphalangeal joint fracture subluxations that are stable and reduced in flexion and reducible flexor digitorum profundus avulsions.

Bedford splint

Buddy strapping or removable Bedford splints use the adjacent finger to provide stabilisation while also encouraging a range of motion. This splint is suitable for stable, extra-articular phalangeal or metacarpal neck or shaft fractures with an acceptable level of deformity.

Mallet splint

Hyperextension of the distal interphalangeal joint is maintained by an appropriately sized preformed splint. This should be of appropriate length to allow full movement at the proximal interphalangeal joint to prevent the unnecessary morbidity of stiffness at this joint. Immobilisation of the distal interphalangeal joint allows healing by callus or granulation tissue of the extensor mechanism and the splint should not be removed for 6–8 weeks so as not to disturb this process.¹⁵ This splint is suitable for bony or tendinous mallet finger without residual subluxation, greater than one-third joint surface involvement.¹⁵

Pitfall: The intra-articular condylar split shown in Figure 6 is not controlled by this poorly applied wrap around splint. This injury should have early referral to a specialist for consideration of surgical management.

Figure 6 This intra-articular condylar split is not controlled by this poorly applied wrap around splint

How to apply an effective splint

Correct bending of the aluminium splint can be difficult and is often easiest to mould and trial the splint on the uninjured side. First it should be decided which joints need to be immobilised. The aluminium splint can then be cut to size and any sharp edges covered. The opposite hand should be positioned as desired and a bend made in the splint to match this position. The metacarpophalangeal joint bend is commonly made more distal than necessary, which leads to an increased risk of pressure necrosis as well as displacement. Correct placement and moulding is vital to maintain reduction and prevent the need for secondary surgical intervention. The procedure for applying a splint is illustrated in Figure 7. The same procedure can be followed for a dorsal splint, and proximal and distal interphalangeal joint extension block splints.

Summary

Fractures of the metacarpals and phalanges are very common, comprising 20% of all fractures in adults.⁷ Nonoperative treatment minimises cost, saves time and avoids some risks of surgery such as infection.¹⁶ Results are good in most fracture types. When the principles of nonoperative management are not followed, splinting may lead to greater morbidity, including stiffness, and a greater need for operative intervention. Complication rates of operative treatments are

Figure 7 (1) You will need scissors, elastoplast and the appropriate width aluminium splint. (2) Place the uninjured hand in the desired position for splinting and bend the splint to conform with this position. (3) Trim the splint to size and round off and cover any sharp edges. (4) Secure the splint in place with further Elastoplast. (5) Note that the level of the bend is in line with the distal palmar crease

Figure 8 (1) Dorsal splint. (2) Proximal interphalangeal joint extension block splint. (3) Distal interphalangeal joint extension block splint

high, with 36% of metacarpal fractures¹⁷ and 50% of phalangeal fractures⁹ suffering postoperative morbidity, with stiffness being the most common. Frontline staff should be familiar, with the basic principles of splinting of hand fractures to avoid repeating some of the common errors shown above. It is important to remember that an aluminium splint should be placed on the side of the original deformity to avoid redisplacement and not wrapped around the whole finger; it should immobilise the joint above and below without immobilising any unnecessary joints and should position the hand as close as possible to the Edinburgh position to minimise stiffness. If still unsure regarding optimal splinting, staff should default to splinting the hand in the 'safe' position and referring for specialist advice at the next available fracture or hand specialist clinic to minimise harm. By

following the basic principles illustrated in this article, we believe that safe and effective treatment for most common hand fractures can be instigated by frontline staff.

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