



First Hand News

Topics in Upper Extremity Care

A publication of the Christine M. Kleinert Institute for Hand and Microsurgery, Inc.

Splints of the Hand and Upper Extremity

Splintage is a common form of treatment for many upper limb conditions, particularly in the acute phase after injury. It is used to prevent joint movement, stabilize displaced or mobile parts, and relieve pain. Splintage may be used temporarily or long-term to prevent deformity and protect joints in a way that will allow maximum restoration of function.

Children can be splinted for prolonged periods of time with relatively few sequelae, but this is not the case with adults. Stiffness is a major problem, especially in the elderly, those with rheumatoid arthritis, and manual workers with heavy, thickset hands. These groups of people tend to stiffen at the slightest injury. In these instances, splintage with the hand in an intrinsic plus position is preferable to having a painful hand free to adapt a position of comfort. However, early mobilization should be the goal as soon as the injury permits.

The ideal splint should be light, durable, comfortable, affordable, and easy to make. Many splints are simple to make, very effective in treatment, and can be applied using materials readily available in the emergency room (i.e. aluminium, plaster of Paris, and fiberglass casts). Adults will generally take care of their splints and will cooperate with discharge instructions. However, babies and small children will wiggle out of almost any splint. If the child is under four, use either a soft, bulky dressing as a boxing glove or apply an above-elbow full cast with the elbow flexed to greater than 90°. A body bandage or “baby straitjacket” may help in restraining younger children and is generally well-tolerated.

Joint stiffness is a serious and frequent complication that may result from splinting. To help prevent this problem, splints should be placed properly, immobilizing only those joints that need immobilization. In the acute setting, splints should remain in place only for the minimum time needed for healing to occur. For children, certain splints may be required until skeletal maturity.

Types of Splints

Splints may be prefabricated or custom made. Prefabricated splints are generally metal or plastic and attach with velcro straps. They are quick and easy to use, but are relatively expensive and inexact. Custom made splints provide an individualized splint with an exact fit. Splints may be either static or dynamic. Static splints are rigid without moving parts. They provide support for healing tissues, provide external support for immobilization, and help in gaining or maintaining motion. Static splints are easy to fabricate and are generally well-tolerated. However, a certain amount of remolding may be required to obtain a good fit.

Dynamic splints employ static splint bases with traction devices, using rubber bands, springs, or elastic lines. They are used to start passive motion, replace absent muscle function, and protect injured or repaired structures. Dynamic splints are more complex, technically difficult, and time consuming to make. Frequent splint adjustments are required.

Another form of splintage is serial casting, or splinting with three-point fixation. This method is sometimes used for contractures to provide low load end-range positioning, thus allowing relaxation and lengthening of the tissues. However, active motion is not possible within these splints.

Objectives

After reading this issue you should be able to:

- **DESCRIBE** indications for splints of the upper extremity.
- **DESCRIBE** specific splints for given upper extremity conditions.
- **DISCUSS** components of the ideal splint.
- **LIST** potential complications of splinting.

Splint Classification

Splints may be classified according to their:

- Reason for application
- Site of application
- Material
- Design
- Mechanical characteristics
- Source of power

Reason for Splintage

In most cases, stiffness of the hand is a major problem after injury. The hand becomes swollen, especially if the limb is left dependent and adopts a position of comfort. This position essentially allows the elbow, wrist, and interphalangeal (IP) joints to stay flexed, with the metacarpophalangeal (MCP) joints extended. Leaving the hand in this position for a long period of time allows the intrinsic muscles and collateral ligaments to shorten. When this occurs, regaining mobility of the hand is difficult. If there is a reason why immediate mobilization of the hand is inappropriate, or the patient is unable to comply with such treatment, then it is best to splint the hand in a position that will avoid contractures and maintain the length of the intrinsic muscles until mobilization is possible.

A splint should always be applied to immobilize the joint above and below the injury site. It is essential that padding be used to prevent further injury, such as skin breakdown.

There are several reasons to use a splint. But most important, immobilization may prevent movement of any broken bone fragments. This will promote healing and reduce pain. Splinting will also prevent bleeding and further damage to the surrounding soft tissues, including the muscle, nerves, and vessels. Acute splinting may even prevent a closed fracture from becoming an open fracture.

Indications for Splintage

- | | |
|-------------------------|--------------------------------|
| 1. Fractures | 7. Nerve compression |
| 2. Hand infections | 8. K-wire protection |
| 3. Crush injuries | 9. Severe soft tissue injuries |
| 4. Burns | 10. Contractures |
| 5. Tendon injuries | 11. Post-skin grafting |
| 6. Ligamentous injuries | 12. Post-operative pain relief |

Duration of Splintage

The duration of splintage depends on the age of the patient, the indications for splintage, and the success of splintage in controlling symptoms. For instance, in long-standing problems such as congenital limb abnormalities or rheumatoid disease where deforming forces continue to exert an effect, splintage is likely to be long-term.

In an acute injury a splint is applied with the understanding that the patient will have the splint removed for re-evaluation of the injured part within a few days. The splint must be strong and durable enough to perform its function for the interim.

The splint is then removed in follow-up, and after evaluation a new cast, splint, or the appropriate dressing is applied. The referral MD has the opportunity to determine an accurate diagnosis, judge for swelling or other possible complications, and choose the best dressing for the injury at that time.

Equipment

- Stockinette (varied widths)
- Cast Padding (varied widths)
- Splints and rolls of plaster of Paris (2, 3, 4, and 6")
- Prefabricated rolls of fiberglass splints with polyethylene padding
- Prefabricated splints with padding (variable commercial splints available)
- Plastic knife
- Bucket
- Elastic bandage
- Adhesive tape

Discharge Instructions

Patients that have a splint of any kind should receive careful instructions for aftercare. This should include both verbal and written information about the injury and the splint itself. Most patients will need instructions on the use of ice, heat, elevation, and pain medication. They should also be instructed on splint application, duration of use before next physicians visit, and potential complications from the splint. A splint should allow the patient to loosen or remove it in case of excess swelling or pain. Many patients will need an accompanying sling and will require instructions on maintaining mobility of non-immobilized joints.

Complications

Splints that are applied too tight may be uncomfortable, may create vascular compromise to a digit, or may even cause compartment syndrome in the forearm. More frequently, splints rub in certain areas, producing pressure sores. This particularly occurs in plaster splints that have been applied with insufficient padding, or in custom made thermoplastic splints where the patient has failed to elevate their limb or has developed further complications such as infection. Splints applied to the distal part of the finger that press on the nailbed may cause ridging of the nail. Skin rashes and maceration are common, particularly with thermoplastic splints. Injury to other areas of the body can occur where the edges of the splint are sharp, or if the patient has limited mental capacity. It is wise to have patients seen in a timely fashion for evaluation in the event the splint becomes exceptionally painful

Splints that are applied incorrectly, or those which shift, may cause more harm than good when they fail to immobilize the necessary parts, and instead, immobilize the adjacent joints. Those patients who use splints for an extended period of time may develop muscle wasting and a psychological dependency on the splint. This is most frequently seen in children who wear splints for most of their childhood: weaning them away from splintage can be troublesome.

Stiffness is by far the most common complication of splintage, either of the part splinted or adjacent parts not splinted, due to associated inactivity. The precise indication for splinting should be clear so as to limit the time spent immobilized, and to begin at least passive mobilization as early as is safe to do so. Those joints not immobilized should be actively mobilized even while the splint is in place.

Specific Splints

Intrinsic Plus Resting Splint

The most common splint required is the resting splint, which is a safe immobilization device for a myriad of conditions.

Indication: Hand infections, burns, soft tissue injury, and metacarpal fractures.

Design (Static): The thumb should be included in palmar abduction if it is injured, the hand is swollen, or the first web space is affected. Volar forearm based, with MCP joints at $> 70^\circ$ flexion. Position of wrist depends on indication for splintage: distal radius fracture and radial nerve palsy – extension; carpal tunnel syndrome (CTS) – neutral.

Function: Maintains balance between intrinsic and extrinsic musculature, preventing intrinsic shortening, maintaining length of the collateral ligaments, and preventing volar plate and PIP joint contracture.

Dynamic: Dynamic crane outrigger splint with MP joint control used to compensate for intrinsic loss.



Ulnar Gutter Splint

Indications: Boxer's fractures, 4th and 5th carpometacarpal joint (CMC) dislocations, and 4th and 5th metacarpal fractures.

Design: Ulnar based gutter applied on dorsum, ulnar, and volar sides of hand and wrist, leaving IP joints free if for CMC joint, or including PIP joint if for metacarpal fractures, and extending to proximal forearm.

Use: Wear continuously until fracture unlikely to displace.



Thumb-Spica Splint

Indications: Thumb MCP joint collateral ligament injury (short) and scaphoid fracture (long).

Design: Radially based gutter applied on dorsum and radial side of thumb, leaving IP joint free and extending to level of radiocarpal joint. Dorsal placement allows better grasp as palm is left free.

Use: To be worn continuously for six weeks after ulnar collateral ligament (UCL) rupture in healing phase, and for four weeks when performing sports.



Thumb CMC Joint Splint

Indication: 1st CMC joint arthritis.

Design: Volar construction, leaving the radiocarpal and MCP joints free.

Use: To be worn as functional brace when working, or when joint is particularly painful.



Trigger Finger Splint

Indication: Trigger finger (adult or pediatric).

Design: Volar splint to MCP, DIP, or PIP joint, leaving the other joint free. Limitation of differential gliding of the flexor digiti profundus (FDP) and flexor digiti superficialis (FDS)

reduces synovitis at the chiasm. DIP joint splinting alone showed 55% resolution while 81% resolved when combined with injection. Those with triggering for more than twelve months and those with stage 3 had statistically significant failure rates.



Mallet Finger Splint

Indication: Mallet deformity at the DIP joint.

Design: There are a variety of splints described for use in the treatment of mallet deformity. Some are custom made, while others are prefabricated with numerous designs reflecting the problem with maintaining extension of the DIP joint without producing skin or nail problems. Common splints manufactured from aluminium are placed either dorsally or volarly. If skin problems develop, the side of placement can be alternated. Alternatively, it can be fabricated as a clam shell, which is useful in those patients allergic to adhesive tapes.

The Stack splint, originally described in 1962, is a prefabricated, molded, polyethylene splint which comes in a selection of sizes. Its failure rate has been reported to be as high as 48%, when failure is defined as a residual extensor lag greater than $> 15^\circ$.

The Abouna splint, introduced in 1965, consists of a rubber coated wire, and originally had only an 18% rate of failure. However, it has since shown similar results to the Stack splint but is less comfortable.

If the patient shows any signs of swan neck deformity with hyperextension of the PIP joint, this must be addressed early by including the PIP joint in a flexed position in the splint for a minimum of three weeks either in a custom-made splint or a Pipiflex splint.



Summary

Splintage is a useful adjunct treatment for pain relief immediately following surgery, injury, or infection to the hand. It may be used long-term to maintain function and prevent contractures. Learning techniques to apply simple splints appropriately in the emergency room or office will help reduce pain and prevent further complications that may hinder long-term functional recovery.

The splint chosen must be applied carefully and safely. Complications from the splint itself may occur, but can generally be avoided. All splints applied should be checked for fit and comfort before the patient leaves the emergency department or office.

Suggested Readings

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Discussion

Splints are a useful adjunct treatment for pain relief immediately following injury or infection to the hand. They are appliances used to decrease mobility of a particular body part to help relieve pain and promote healing. Splints are made from varied materials but, in general, should include padding, a rigid, non-circumferential component usually fashioned from plaster, and an outer wrap that holds the splint in place. Splints are used in the emergency department setting, and they can immobilize nearly as effectively as a circumferential cast. The advantage is much less risk of complication. Splints may be removed easily by loosening the outer wrap in the event of swelling, or the need to check for neurovascular status or infection.

The splinted hand or upper extremity should be placed in a sling to maintain elevation. The hand should be placed higher than the heart or the forearm itself. The patient may be instructed to remove the sling and place the hand on a pillow positioned on a table or back of a chair for optimal elevation. The patient should be encouraged to move the hand as early in the healing process as possible. Early, continued motion allows the joint capsules and ligaments to move, thus preventing contractures and joint adhesions.

“The ideal splint should be light, durable, comfortable, affordable, and easy to make.”

It is important to be aware of the options available for splinting. There are many factors to consider, but the choice of splints depends on the individual patient’s diagnosis, mental capacity, and functional requirements of work and social activities.

This edition has presented several splints for varied hand conditions. The splints are effective when used properly. It is important to consider the type of splint being used in relation to the condition. Splints for the hand and upper extremity must be carefully selected in relation to the specific injury, specific area, and joints to be immobilized. These patients should all be given clear, detailed instructions and follow-up with a physician for evaluation of continued treatment.

About First Hand News

First Hand News is the education journal of The Christine M. Kleinert Institute (CMKI). CMKI is a center for hand care research and education. CMKI includes research and education in the areas of hand care, hand and microsurgery, physical therapy, rehabilitation, and injury prevention.

CMKI is affiliated with Kleinert Kutz Hand Care Center at Jewish Hospital in Louisville, Kentucky.

If you have any patient care questions, Kleinert Kutz can be contacted 24 hours a day, seven days a week at the following number: (502) 561-4263 or toll free 1 (800) 477-4263.

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QUESTIONS

Please circle the letter that corresponds to the single most appropriate answer for each of the following questions.

- The following statement concerning splints of the upper extremity are true except:
 - splints are useful to prevent joint movement, stabilize displaced or mobile parts, and to relieve pain.
 - joint stiffness after splinting is a problem, particularly in the elderly
 - the ideal splint should always be prefabricated
 - splints may be either a short or long-term treatment
- Splints are generally classified in the following ways except:
 - dynamic or static
 - prefabricated or custom made
 - by mechanical or design characteristics
 - using the Salter-Harris classification system
- An ulnar gutter splint is most effective in treating:
 - boxer's fractures
 - DeQuervain's tenosynovitis
 - first carpal metacarpal (CMC) joint arthritis
 - trigger finger
- The following statements concerning mallet finger fractures are true except:
 - there are many varied splints described and used for mallet finger fractures
 - a mallet finger fracture results from a fracture at the first CMC joint
 - skin breakdown and maceration are complications of splints for mallet finger fracture
 - the stack splint has been used for mallet finger fractures since the 1960s

OBJECTIVES

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- DESCRIBE indications for splints of the upper extremity.
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- DISCUSS components of the ideal splint.
- LIST potential complications of splinting.

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