Chapter 6
Splinting and Casting Techniques

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Overview

The initial treatment of many orthopedic injuries relies upon casting and splinting of the affected limb to mitigate pain, maintain reduction, and prevent further damage to soft tissues. However, these tools are not without their associated caveats. A poorly applied splint can cause further injury to the patient including pressure sores and thermal burns. The following should serve as general guidelines; however, institutional variance may apply.

In general, the joint "above and below" (or proximal and distal) to the fracture site should be immobilized when possible in order to maintain adequate control over the fracture site. In the emergent setting, splinting is preferred to casting

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as splints can more readily accommodate swelling. If casting must be performed on acute fractures, bivalving (cutting the cast in order to allow for expansion) should be seriously considered as this will reduce the risk of cast-induced compartment syndrome.

The padding applied beneath a splint is of crucial importance, as it is the part of a cast or splint that directly interfaces with the patient. For "slab"-type splints, no less than six layers of padding on the upper extremity and eight on the lower with additional padding on bony prominences are appropriate. For circumferential wrapping, padding should be applied in a 50% overlapping pattern from the most distal portion of the splint to the most proximal. Circumferentially wrapped padding should be a minimum of 3–4 layers with additional padding applied to any prominences. In both splints and casts, wrinkles can lead to pressure points and skin breakdown and should be carefully avoided.

When it comes to splinting material, there are generally two choices, fiberglass or plaster. Fiberglass is faster to harden and less messy to deal with; however, fiberglass does not shape to the patient as closely as plaster. Plaster is generally messier and takes longer to harden; however, it shapes more closely to the patient if applied while wet and arguably holds unstable reductions better. With both materials, the risk of thermal injury is very real as the curing of both plaster and fiberglass is highly exothermic. Splints and casts should be kept in open air while hardening to allow the heat to escape.

Upper Extremity Splinting Techniques

Sugar Tong Splint

A sugar tong splint (Fig. 6.1) is one that wraps around the elbow and onto the volar and dorsal aspects of the forearm, extending beyond the wrist but leaving the MCP joints free.

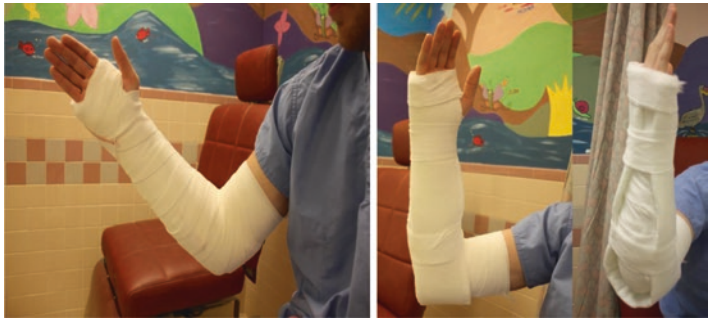

FIGURE 6.1 Sugar tong splint after padding (*left*) and application of splint (*middle*, *right*)

1. *Indications*: For any fractures of the radius/ulna or in conjunction with long-arm posterior splint for unstable elbow fractures or dislocations. Consider immobilizing the forearm in pronation for unstable elbow dislocations.
2. *How to*: Wrap the arm with cast padding from metacarpal heads to the proximal arm. Take care to use additional padding at the medial and lateral epicondyle, olecranon, and over the posterior arm where the edge of the splint rests. Place a "U"-shaped piece of plaster or fiberglass from the dorsal hand, around the forearm and elbow, and back to the palm. Overwrap with an elastic wrap. The splint should be long enough to immobilize the wrist but just short enough to allow full motion of the fingers.

Volar Splint

A single slab of splint material is placed on the volar aspect of the forearm (Fig. 6.2).

1. *Indications*: For stable fractures of the distal radius and mild carpal injuries. May be used for immobilization of infections or soft tissue injuries as well.
2. *How to*: Wrap the arm with cast padding from the metacarpal heads to the proximal forearm. Place a sheet of plaster

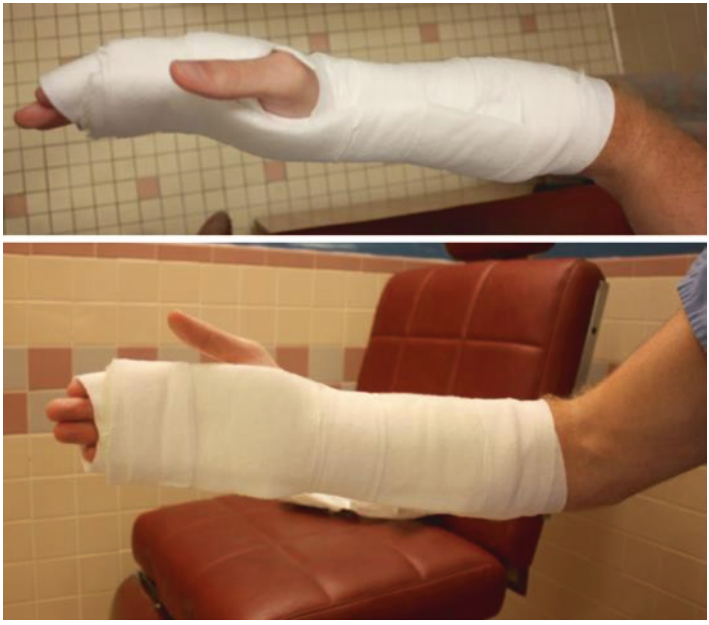

FIGURE 6.2 Volar splint

or fiberglass over the volar palm to the mid-forearm. If the fingers are to be immobilized, both the padding and the plaster should extend beyond the fingertips. Overwrap with an elastic wrap.

Posterior/Ulnar Long-Arm Splint

A slab of splint material is placed along the posterior aspect of the arm from the level of the axilla to the metacarpophalangeal joints, with the elbow flexed to 90° (Fig. 6.3).

1. *Indications*: Stable fractures or dislocations of the elbow. It can also be used as part of a coaptation splint or in conjunction with a sugar tong splint, when more stability is required.

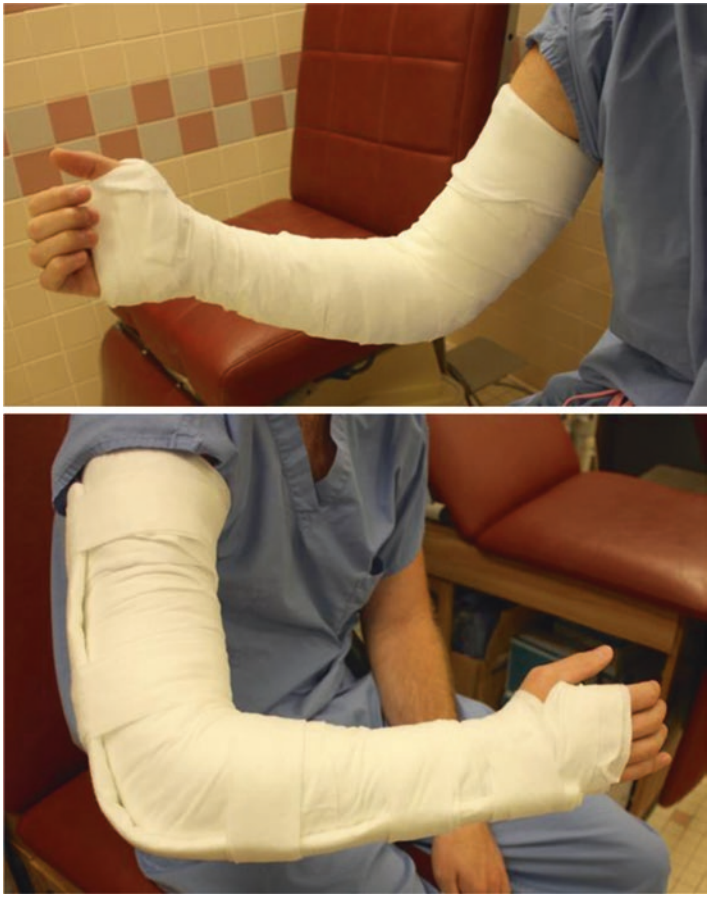

FIGURE 6.3 Posterior/ulnar long-arm splint padding (*above*) and after application of splint (*below*)

2. *How to*: Wrap the arm with cast padding from the metacarpal heads to the proximal arm. Take care to use additional padding at the medial and lateral epicondyle and the olecranon. Place a long slab of plaster or fiberglass from the posterior proximal arm, along the posterior elbow, and around the ulnar forearm. Overwrap with an elastic bandage.

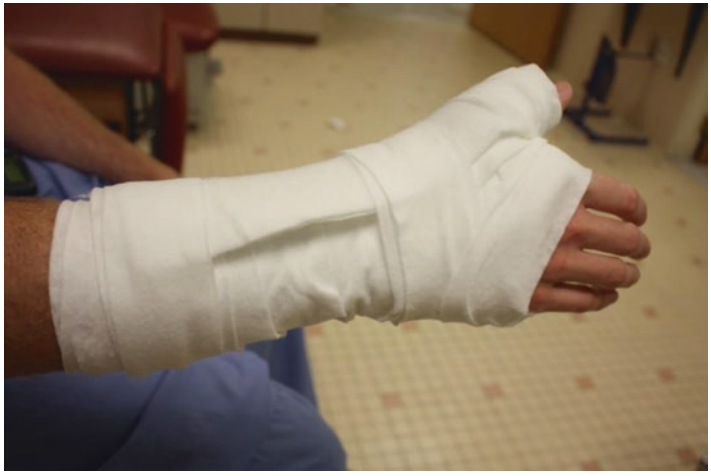

Figure 6.4 Thumb spica splint

Thumb Spica Splint

A radially based splint that begins on the forearm, crosses the wrist, and wraps around the thumb (Fig. 6.4).

1. *Indications*: Fractures or suspected fractures of the scaphoid, fractures of first metacarpal or the phalanges of the thumb.
2. *How to*: Wrap from the distal palm to the proximal forearm with cast padding. Additional cast padding should be wrapped around the thumb, making sure adequate padding is present over all sites. A slab of plaster or fiberglass should then be placed over the radial wrist, extending as far as needed onto the thumb, and gently wrapped around the radial and ulnar aspect of the thumb to immobilize it.

Intrinsic Plus Splint

A splint that has volar and dorsal components. Intrinsic plus describes a position of 20–30° of wrist extension, 70–80° MCP flexion, and full PIP/DIP extension (Fig. 6.5).

FIGURE 6.5 Intrinsic plus splint

1. *Indications*: Fractures of metacarpals.
2. *How to*: Wrap the hand, wrist, and distal forearm with cast padding. This splint should always use plaster, as it molds more tightly to the shape of the hand and maintains the required position. Every effort should be made to hold the patient in a position similar to the desired final result throughout the process to prevent bulging or tearing of the cast padding. Place one slab of 6–8 sheets of plaster on the dorsal aspect and one slab of 5–6 sheets on the volar aspect of the hand and wrist, extending to the distal forearm. The desired position must be maintained until the plaster reaches a rigid state.

Coaptation Splint

A splint that includes both a long-arm posterior slab and a slab which runs from the axilla medially around the elbow and up to the AC joint laterally.

1. *Indications*: Humeral shaft fractures.
2. *How to*: This splint requires at least one well-trained assistant to apply properly. Begin by positioning the patient upright, sitting at the edge of the bed with the affected extremity hanging off the side of the bed. Wrap the arm from hand to shoulder, taking care to adequately cover the shoulder up to the base of the neck and pad the bony prominences of the elbow as well as the axilla. The first slab is placed beginning just distal to the axilla, wrapping down the medial arm, around the elbow, and up the shoulder to the base of the neck. This piece is held in place, while a second slab is placed from the posterior proximal arm, across the posterior elbow and to the distal forearm, with the elbow flexed at 90°. Elastic bandages are then applied, and typically a valgus mold at the fracture site is required to counteract the abducting force of the deltoid.

Short-Arm Cast

This is the workhorse of upper extremity casting. It provides control via circumferential wrapping of fiberglass cast tape (Fig. 6.6).

1. *Indications*: Distal radius fractures.
2. *How to*: Begin by placing pieces of stockinette at the proximal forearm, over the thumb, and over the palm and fingers. Follow by wrapping cast padding from distal to proximal in an overlapping manner. Typically, two passes of 50/50 overlapping padding and three wraps at the distal and proximal end are adequate, with the padding partially covering the stockinette at each end. Fold the excess stockinette over the padding to help prevent breakdown of the

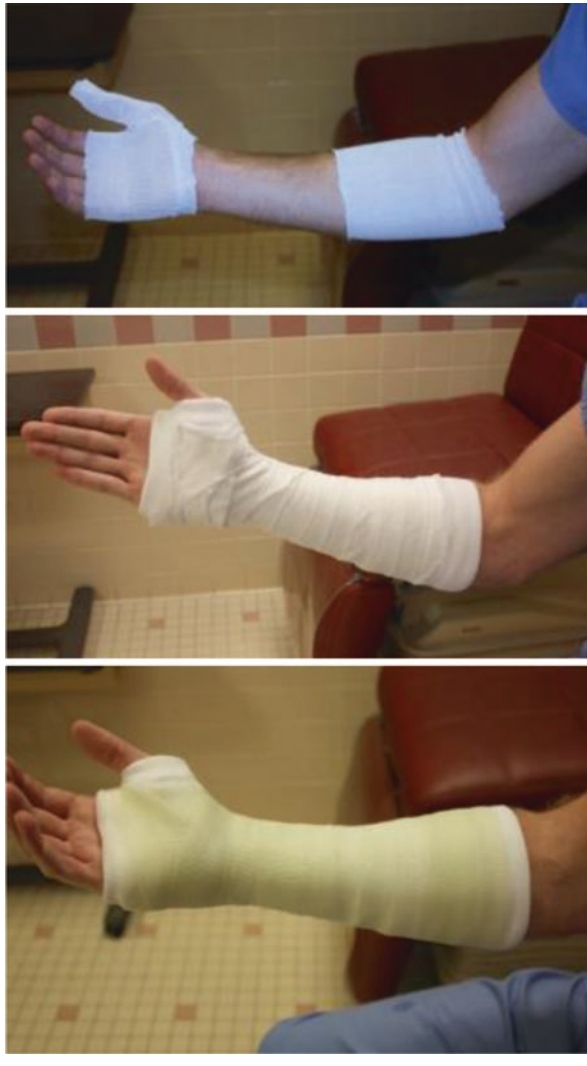

FIGURE 6.6 Short-arm cast with application of stockinette, padding, and fiberglass

padding. Fiberglass cast tape is then wrapped from distal to proximal in a similar manner, again with three layers at each end and two passes of 50/50 overlapping between. A mold can be placed while the fiberglass cures. Care should be taken to allow unrestricted motion of the thumb, fingers, and elbow.

Long-Arm Cast

This is the workhorse of pediatric upper extremity casting. In addition to the benefits of short-arm casting, a longer cast prevents pronation/supination, immobilizes the elbow, and prevents the cast from slipping down (Fig. 6.7).

1. *Indications*: Forearm fractures and elbow dislocations in the pediatric patient.
2. *How to*: Similar to the short-arm cast, the long-arm cast begins with stockinette; however, the proximal segment should be placed at the axilla. Wrap circumferential cast padding from the hand to the upper arm, and provide additional padding for the bony prominences of the elbow. Avoid overstuffing the antecubital fossa. Wrap from distal to proximal with cast tape. We recommend keeping the arm flexed slightly more than 90° during both padding and cast tape wrapping, then extending the last bit to 90°. This helps to avoid creases in the antecubital fossa.

Lower Extremity Splinting Techniques

Posterior Short Leg Splint

A splint which runs along the posterior aspect of the lower leg. Typically, the ankle is kept at 90° (Fig. 6.8).

1. *Indications*: Fractures of the toes or foot, stable ankle fractures, which do not require varus/valgus/rotational control.

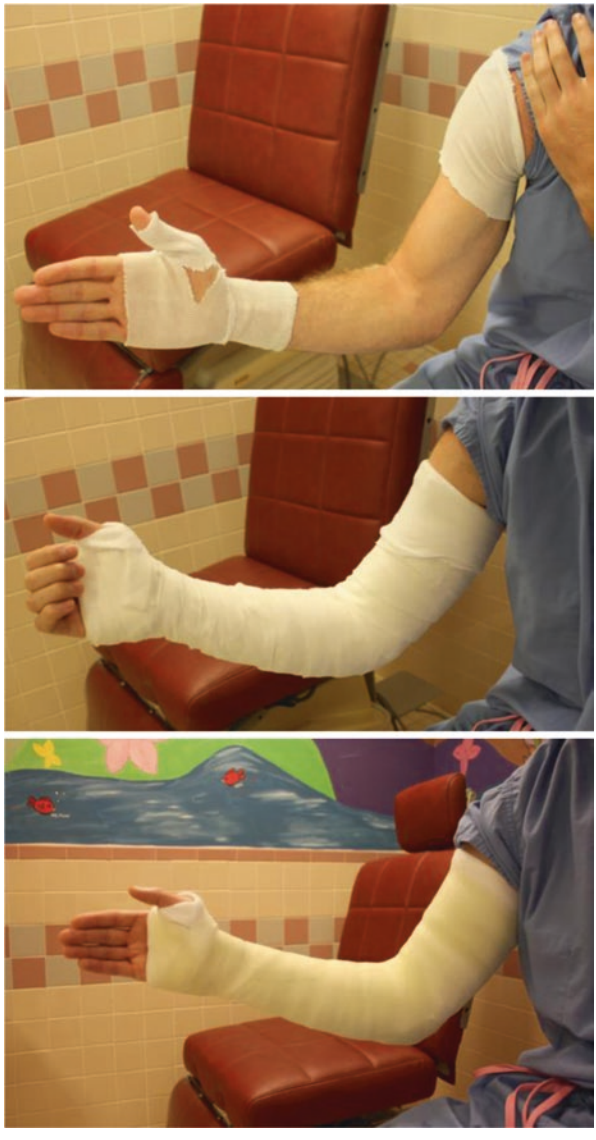

FIGURE 6.7 Long-arm cast application, including stockinette, padding, and fiberglass

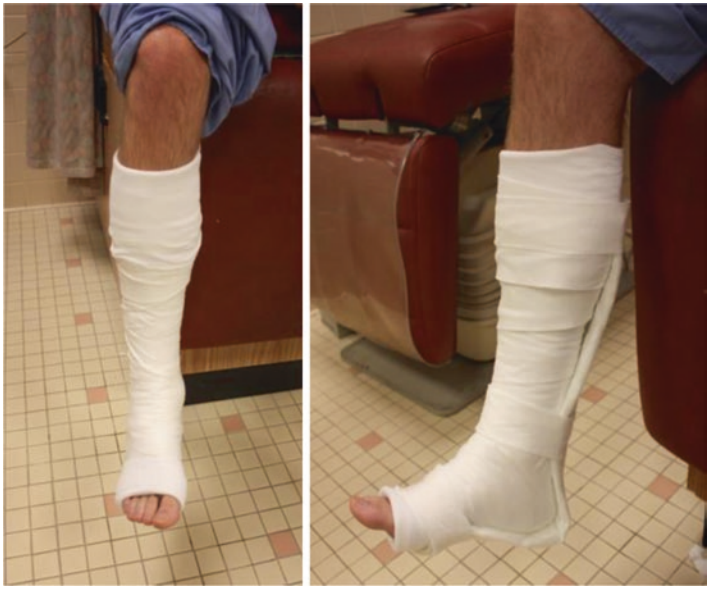

Figure 6.8 Posterior short leg splint

2. *How to*: Wrap the foot with padding from toes to the proximal calf, with additional padding for the heel and malleoli. A slab of plaster or fiberglass is then placed from the toes to the proximal calf. Avoid doubling excess material over on the proximal calf as this can lead to thermal injury or to pressure points. Cover with an elastic wrap.

Posterior Short Leg with Side Gussets

A short leg posterior splint that includes a slab, which wraps around from the medial to lateral aspect of the lower leg (Fig. 6.9).

1. *Indications*: For ankle fractures which require varus/valgus/rotational control.
2. *How to*: Follow similar steps to the short leg splint. After placing the posterior slab, an additional slab is placed that

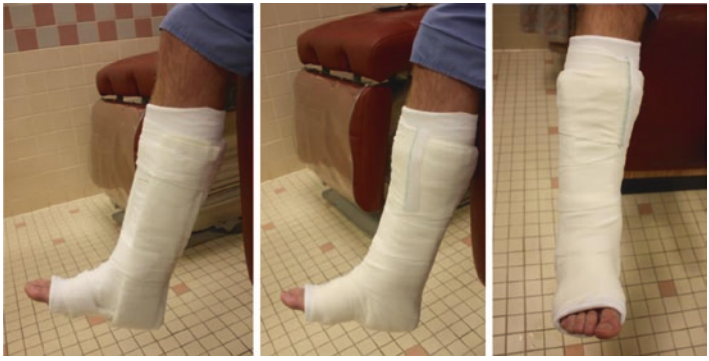

FIGURE 6.9 Posterior short leg with side gussets

wraps from the medial calf, down the side of the leg, under the heel, and up the lateral side. Avoid allowing the two limbs of the gusset to contact each other in front, as this creates an unintentional circumferential construct. Cover with an elastic wrap and apply mold as needed.

Posterior Long Leg Splint

A posterior splint which goes from the proximal thigh distally to the metatarsal heads. May add second slab if varus valgus control is needed.

1. *Indications*: Distal femur fractures and tibial shaft fractures.
2. *How to*: Simple posterior splints extended up the proximal thigh, typically with a gentle bend at the knee.

Knee Immobilizer

A premade device with adjustable straps.

1. *Indications*: Tibial plateau fractures, reduced patellar/knee dislocations, distal femur fractures, and ligamentous injuries of the knee.
2. *How to*: Follow device instructions. In obtunded or frail patients, additional padding is appropriate.

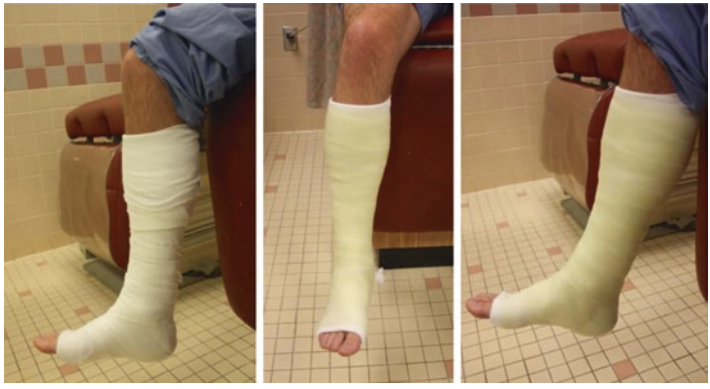

FIGURE 6.10 Short leg cast

Short Leg Cast

The standard means of immobilizing the foot and ankle (Fig. 6.10).

1. *Indications*: Ankle fractures, Achilles tendon injuries, and hindfoot and midfoot injuries.
2. *How to*: Short leg casts are best placed with an assistant holding the hip, knee, and ankle at 90°. Custom stands are available for when an assistant cannot be found. Place stockinette around the proximal calf and an additional piece hanging over the toes and covering the distal foot. Wrap with cast padding, taking care to pad the heel, malleoli, and Achilles tendon. Fold over the stockinette and wrap with cast tape. Take care to avoid overfilling the instep.

Long Leg Cast

An extended version of the short leg cast which provides control at the knee as well.

1. *Indications*: Pediatric ankle fractures and nonoperative tibial shaft fractures in all ages.

2. *How to*: Often the easiest way to place a long leg cast is to do it in parts. Long leg casts require an assistant. Begin by placing stockinette at the proximal thigh and at the toes. If you plan to place the cast in parts, cast padding should be wrapped from the foot to the knee. Carefully, pad the ankle and heel. Follow the padding with cast tape up to the proximal tibia, but leave the proximal aspect only 1–2 layers thick as you will overrun it in the second stage. After the distal portion has hardened, place the patient into the desired amount of knee flexion, and complete the padding as needed up to the proximal thigh. Fold down the stockinette and overwrap with cast tape, ensuring multiple layers crossing from the proximal to the already hardened distal portion in order to make sure the two portions adhere well to each other.