Splints are frequently used in the emergency department (ED) for temporary immobilization of fractures and dislocations and for definitive therapy of soft tissue injuries. Patients with a variety of nontraumatic musculoskeletal disorders (e.g., gout, infections, burns) also benefit from short-term immobilization therapy. Immobilization is the mainstay of fracture therapy, but it is difficult to find firm scientific data that support the use of splinting for soft tissue injuries. Although the general principle of immobilizing sprains and contusions is strongly supported by custom and personal preference, its exact influence on healing, number of complications, and ultimate return to normal activity is not known. In most studies of ankle sprains, for example, the function and pain of the injured joint are similar at 6 weeks’ follow-up, regardless of whether treatment consisted of ad lib walking, a simple elastic bandage, a posterior splint, or a formal cast. A systematic review of 22 random clinical trials comparing various treatments for lateral acute ankle sprains (cast, splint, or early immobilization with support) found no favorable effect of immobilization. The current data support functional management for most cases of acute ankle sprains.

Similar concepts have evolved for acute cervical strain and low back strain. Although a strict standard of care cannot be promulgated, the use of short-term splinting in the ED for acutely painful conditions remains a common practice.

Most splinting techniques are handed down from house staff or experienced clinicians, but the procedure is often suboptimal and haphazard. This chapter presents guidelines for the adequate immobilization of injuries commonly encountered by emergency clinicians.

Patients routinely present to the ED with injuries that are amenable to splinting to relieve pain and augment healing (Table 50–1). Emergency clinicians have virtually abandoned the use of circumferential casts in favor of premade commercial immobilizing devices or splints made from plaster of Paris or fiberglass. The impetus for this change is primarily related to the complications occasionally associated with circumferential casts, liability issues, and ease of application brought about by new technology. In most instances, properly applied splints provide short-term immobilization equal to that of casts while allowing for continued swelling, thus reducing the risk of ischemic injury. Other obvious advantages of splints are that patients can take them off when immobilization is no longer needed or can remove them temporarily to bathe, exercise the injured part, or perform wound care.

<table>
<thead>
<tr>
<th>TABLE 50–1</th>
<th>Conditions That Benefit from Immobilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute arthritis, including acute gout</td>
<td></td>
</tr>
<tr>
<td>Severe contusions and abrasions</td>
<td></td>
</tr>
<tr>
<td>Skin lacerations that cross joints</td>
<td></td>
</tr>
<tr>
<td>Tendon lacerations</td>
<td></td>
</tr>
<tr>
<td>Tenosynovitis</td>
<td></td>
</tr>
<tr>
<td>Puncture wounds to the hands, feet, and joints</td>
<td></td>
</tr>
<tr>
<td>Animal bites to the hands or feet</td>
<td></td>
</tr>
<tr>
<td>Deep space infections of the hands and feet</td>
<td></td>
</tr>
<tr>
<td>Joint infections</td>
<td></td>
</tr>
<tr>
<td>Fractures and sprains</td>
<td></td>
</tr>
<tr>
<td>Reduced joint dislocations</td>
<td></td>
</tr>
</tbody>
</table>
INDICATIONS

Theoretically, immobilization facilitates the healing process by decreasing pain and protecting the extremity from further injury. Other benefits of splinting are specific to the particular injury or problem being treated. For example, in the treatment of fractures, splinting helps maintain bony alignment. Splinting deep lacerations that cross joints reduces tension on the wound and helps prevent wound dehiscence. Immobilizing tendon lacerations may facilitate the healing process by relieving stress on the repaired tendon. The discomfort of inflammatory disorders such as tenosynovitis or acute gout is greatly reduced by immobilization (Fig. 50–1). Deep space infections of the hands or feet as well as cellulitis over any joint should similarly be immobilized for comfort. Limiting early motion also may reduce edema and theoretically improve the immune system’s ability to combat infection. Hence, select puncture wounds and mammalian bites of the hands and feet may be immobilized until the risk of infection has passed. Splinting large abrasions that cross joint surfaces prevents movement of the injured extremity and reduces the pain produced when the injured skin is stretched. Finally, patients with multiple traumas should have fractures and reduced dislocations adequately splinted while other diagnostic and therapeutic procedures (e.g., peritoneal lavage, computed tomography scan) are completed. Immobilization decreases blood loss, minimizes the potential for further neurovascular injury, decreases the need for opioid analgesia, and may decrease the risk of fat emboli from long bone fractures.

![Figure 50–1](image1) Acute gout is an indication for splinting for comfort.

Patients often use or request an elastic bandage for many soft tissue injuries. Although applying an elastic bandage to an injured part likely is popular, it is of minimal benefit. The downside is that the bandage may be wrapped too tightly, causing additional injury or distal swelling (Fig. 50–2).

![Figure 50–2](image2) A, An elastic bandage is a popular home treatment for many painful conditions, such as sprains and contusions. An actual medical benefit is unproven. B, Wrapping an extremity too tightly may cause additional injury or distal swelling. This patient complained of a swollen hand after an elbow injury. Note the grooves in the skin (arrows) indicating that the wrap was the culprit, causing the hand swelling. C, Markedly swollen foot after useless elastic bandage to lower leg.

EQUIPMENT
Support Materials
Plaster of Paris

Plaster of Paris is the most widely used material for ED splinting. Its name originated from the fact that it was first prepared from the gypsum of Paris, France. When gypsum is heated to approximately 128°C, most of the water of crystallization is driven off, leaving behind a fine white powder—plaster of Paris. When water is added to plaster, the reaction is reversed, and the plaster recrystallizes or sets by incorporating water molecules into the crystalline lattice of the calcium sulfate dehydrate molecules.
Today, plaster is impregnated into strips or rolls (2-, 3-, 4-, or 6-inch widths) of a crinoline-type material. The crinoline allows for easy application, helps keep the plaster molded to the proper form during the setting process, and adds support to the finished splint. Plaster rolls and sheets are available in a variety of setting times and widths. The distinct advantage of plaster over commercially available premade splints is that plaster can be more easily molded and tailored to the individual's anatomy, negating the "one-size-fits-all" approach. Also, plaster is generally less expensive than premade splints.

Prefabricated Splint Rolls

The use of plaster splints in the form of prefabricated splint rolls (e.g., OCL) is very popular among emergency clinicians. These splint rolls have 10 to 20 sheets of plaster enclosed between a thick layer of protective foam padding on one side and a thin layer of cloth on the other. Like custom-constructed splints, they are secured to the extremity with an elastic bandage. The major advantage of prefabricated splint rolls is that significant time is saved because the splint and padding come ready to apply. In addition, prefabricated splint rolls are ideal for intermittent splinting and can be removed and reapplied by the patient as needed. However, prefabricated plaster splint rolls are more expensive than simple plaster rolls, and they lack some of the versatility and custom-fit qualities of self-made plaster splints. The application of premade splints is shown in Figure 50–3.

Prefabricated splint rolls using layers of fiberglass between polypropylene padding (e.g., Ortho-Glass, 3M) are now commonplace in many EDs (Fig. 50–4). Fiberglass splint rolls offer the same time-saving aspect of prefabricated plaster splint rolls, but require only 3 minutes to set, making application faster. In addition, splints made from prefabricated fiberglass rolls cure more rapidly (20 min), have no messy residue (i.e., they can be hydrated using a conventional sink without a special trap), can be washed and reapplied, and are stronger and lighter than splints constructed from prefabricated plaster rolls. Another advantage is the polypropylene padding, which wicks moisture away from the skin better than polyester, nylon, or cotton padding. Prefabricated fiberglass splint rolls are more expensive than both simple plaster rolls and prefabricated plaster splint rolls and, like prefabricated plaster splints, lack some of the versatility and custom-fit qualities of self-made plaster splints.

Protective and Miscellaneous Equipment

Stockinette

A single layer of stockinette is commonly used under circumferential casts and splints. It protects the skin and, when folded back over the ends of the plaster, creates a smooth, professional-looking, padded rim. Stockinette is available in 2-, 3-, 4-, 8-, 10-, and 12-inch widths.
Padding

Padding under the splint protects the skin and bony prominences and allows for swelling of the injured extremity. Most commercially available splints contain adequate padding in the premade product, but in some instances, additional padding is prudent. In general, the older thin cotton padding known as sheet wadding has been replaced by newer materials such as Webril (Curity) or Specialist (Johnson & Johnson) cast padding. Webril is soft cotton with a much coarser weave than sheet wadding; consequently, it has greater tensile strength, adheres better, and can be applied more evenly. Specialist padding uses micropleated cotton fibers that relax when moistened. This results in uniform, feltlike padding that conforms to the surface being wrapped. Felt (0.5-inch thick) also may be used to pad bony prominences.

Elastic Bandages

Elastic bandages are used to secure the splint in place. Elastic bandages are available in 2-, 3-, 4-, and 6-inch widths. Some bandages use metal clips; others use a Velcro-type arrangement at the end of the roll. Metal clips can be taped in place to avoid inadvertent removal.

Adhesive Tape

Adhesive tape is used to prevent slippage of the elastic bandages, to line the cut edges of a bivalved cast, and to buddy tape digits. Coban tape can be used in a similar manner and has the advantage of adhering only to itself.

Utility Knife, Scalpel, and Plaster Scissors

A utility knife, a No. 10 scalpel blade, or plaster scissors can be used to cut and shape dry plaster.

Bucket

A large bucket (preferably stainless steel) is used for wetting plaster. Plaster should not be prepared in the sink because the residue quickly clogs the drain. A special drain is required to accept plaster residue. A bucket is not required for the minimal amount of water used to soften fiberglass premade splints—they can be placed directly under the faucet.

Protective Gear

Gowns or sheets prevent soilage of both the patient's and the clinician's clothing. Gloves (vinyl or latex) and safety glasses are recommended to prevent skin or eye damage from plaster dust, wet plaster, or uncured fiberglass polymer. Wearing gloves also decreases clean-up time for the clinician.

GENERAL PROCEDURE OF CUSTOM SPLINT APPLICATION

The following section refers to the application of custom-made plaster splints (Fig. 50–5), unless otherwise stated. If periodic wound care is required, a more easily removable splint (e.g., OCL, Ortho-Glass, Velcro-type splint) should be applied in lieu of the standard splint, to be described. The issue of removability should be addressed before the splint is applied. In addition, use of Webril (Curity) cast padding is described, but other suitable cast padding may be substituted. Caveats for proper ED splinting appear in Table 50–2.

Figure 50–5 Principles of custom splint application. A, Stockinette is applied to extend 2 or 3 inches beyond the plaster. B, Two or three layers of Webril are evenly and smoothly applied over the area to be splinted. C, The plaster slab is positioned over the area to be immobilized and the stockinette and Webril are folded back to help secure the slab in place and to form smooth, rounded ends. D, The elastic bandage is applied to secure the splint. E, While still wet, the plaster is molded to conform to the shape of the extremity. This is an important step that is often overlooked. See Fig. 50–6.
TABLE 50–2  -- Caveats for Proper Emergency Department Splinting

- Always use cool, clean water.
- Do not oversaturate the plaster splint. Minimal water is required for fiberglass splints.
- Make the splint smooth when placing on the patient to avoid bumps and pressure points.
- Smooth and mold the splint without squeezing. Use the palms of the hands, not the fingers, to mold the splint to fit the contour of the body part.
- Place padded side against the skin. Extra cotton padding is optimal.
- Simply roll elastic bandages over an extremity without undue tension.
- Protect or pad edges.
- Leave fingertips exposed to check for circulation and sensation.
- Keep the patient still until the splint has dried and hardened.
- Post check includes function, arterial pulse, capillary refill, temperature of skin, and sensation (FACTS).
- Emphasize and demonstrate splint elevation to the patient.
- Tape over metal clips used to fasten the elastic bandage to keep it in place and avoid ingestion by a child.

Patient Preparation

If the clinical situation permits, the patient should be covered with a sheet or gown to protect clothing and the surrounding area from water and plaster. Nursing staff and housekeeping also appreciate this courtesy. The involved extremity should be inspected carefully before splinting. All skin lesions and soft tissue injuries should be examined and documented clearly on the ED record. All wounds should be cleaned, repaired, and dressed in the usual manner. When open fractures or joints are to be immobilized, the soft tissue defect should be covered with saline-moistened sterile gauze.

Padding

When the splint involves the digits, padding must be placed between the fingers and the toes to prevent maceration of the skin. This can be done with pieces of Webbril or gauze cut to the appropriate length.

Following placement of padding between the fingers and the toes, stockinette is often used as the next protective layer in self-made splints (see Fig. 50–5A ). The stockinette should extend at least 10 to 15 cm beyond the area to be splinted at both ends of the extremity. Later, after plaster has been applied, the stockinette can be folded back over the ends of the splint to create smooth, padded rims. Folding back the stockinette can also help hold the splint in place when applying elastic bandages (see Fig. 50–5C ). Care is needed to avoid pressure damage from pulling the stockinette too tightly over bony prominences, such as the heel. Wrinkling over flexion creases should also be avoided by slitting and overlapping the stockinette at bony prominences. One may also use two separate pieces of stockinette (one at each end of the splint) to produce the smooth padded rims. As a general rule, 3-inch-wide stockinette is used for the upper extremity, whereas 4-inch-wide is used for the lower extremity.

After the stockinette has been properly positioned, Webbril should be wrapped around the entire area that will be exposed to plaster. The Webbril should be at least two or three layers thick and each turn should overlap the previous turn by 25% to 50% of its width (see Fig. 50–5B ). In addition, the Webbril should extend 2.5 to 5.0 cm beyond the ends of the splint so that it, too, can be folded back over the splint to help create smooth, well-padded edges (see Fig. 50–5C ). Extra padding should be placed over areas of bony prominence, such as the radial condyle or the malleoli ( Table 50–3 ). Although this can be done with Webbril, the use of Mother's Cotton adds an additional measure of protection without the worry of wrinkling or ischemic injury. If significant swelling is anticipated, three or four layers of Webbril should be applied as padding. Care should be taken to avoid wrinkling because it can result in significant skin pressure when a tight splint is used for a long period. Wrinkles can be eliminated by proportionately stretching or even tearing the side of the Webbril that must wrap around the bigger portion of an extremity. Joints that must be immobilized in a 90° position, such as the ankle, make continuous Webbril wrapping difficult. To avoid
wrinkles in the area of the ankle, the joint should be placed in the proper position before padding. Webril is then wrapped around the malleolar and midtarsal regions first. The bare calcaneal region can then be covered with overlapping vertical and horizontal Webril strips until the entire heel region is evenly padded. The same approach can be used in similar areas, such as the elbow. The width of Webril that should be used varies depending on the extremity to be splinted. In general, the 2-inch width should be used for hands and feet, the 3- or 4-inch width for the upper extremity, and the 4- or 6-inch width for the lower extremity.

<table>
<thead>
<tr>
<th>TABLE 50–3 -- Areas of the Upper and Lower Extremity That Require Additional Padding</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Upper Extremity</strong></td>
</tr>
<tr>
<td>Olecranon</td>
</tr>
<tr>
<td>Radial styloid</td>
</tr>
<tr>
<td>Ulnar styloid</td>
</tr>
<tr>
<td><strong>Lower Extremity</strong></td>
</tr>
<tr>
<td>Upper portion of the inner thigh</td>
</tr>
<tr>
<td>Patella</td>
</tr>
<tr>
<td>Fibular head</td>
</tr>
<tr>
<td>Achilles tendon</td>
</tr>
<tr>
<td>Medial and lateral malleoli</td>
</tr>
</tbody>
</table>

A final caveat when using Webril is to be aware of the potential for ischemic injury. This rare complication is most likely to occur in an extremity that continues to have significant swelling after the patient is released from the ED. Ischemia may result because the concentrically placed Webril can become a constricting band. If this situation is anticipated, it can be prevented easily by cutting through the Webril along the side of the extremity opposite to the plaster splint. The splint is then secured to the extremity in the usual manner. Alternatively, two or three layers of Webril (the same diameter as the plaster) are placed directly over the wet plaster (Fig. 50–6). The Webril-lined splint is then positioned over the area to be immobilized and secured with an elastic bandage.
Figure 50–6  Alternative method of Webril application. A, If significant swelling is anticipated, Webril (the same diameter as the plaster) may be placed directly over the wet plaster, rather than wrapping it around the extremity. The Webril-lined splint is then positioned over the area to be immobilized and secured with an elastic bandage. Sandwiching the plaster strips with Webril will also minimize rigid adherence of the plaster to the elastic wrap. B, A personalized splint. Webril on both sides of a pre-measured slab of plaster provides skin protection and comfort, and the Ace bandage will not stick so the splint can be removed for wound care/exercise. C, Stockinette and optional additional Webril are placed on the extremity, and the splint placed over these items. Note that the padding and stockinette extend 4–5 inches past both ends of the splint. D, Prior to applying an Ace bandage, the Webril and stockinette ends of the splint are rolled back (arrows) to keep the plaster in place and provide a smooth edge. E, To allow a short arm splint to keep the thumb free, cut a hole in the Ace bandage and then put the thumb through the hole. F, Continue to wrap the Ace bandage to assure a perfect fit around the thumb. G, Apply tape to metal clips to avoid inadvertent loss. These clips will readily end up in the mouth of an inquisitive toddler. See Fig. 50–5.

Plaster Preparation

The choice of plaster setting time depends on the nature of the injury and the expertise of the clinician. Extra-fast-setting plaster is typically used when rapid hardening is desired to help maintain alignment of an acutely reduced fracture. However, for the majority of ED splints, plaster with slower setting times (e.g., Specialist fast-drying) is recommended. Plaster that sets more slowly is easier for some clinicians to use because it affords more leeway in applying and molding the splint. Furthermore, plaster with a longer setting time produces less heat, thus reducing both patient discomfort and the risk of serious burns. Table 50–4 lists the setting times for commonly used plaster. These setting times are adjusted by adding different substances to the plaster during the production process (Table 50–5). Given plaster with equal setting times, the most important variable affecting the rate of crystallization is water temperature. Warm water hardens a splint faster than cold water and should not be used when extra time is needed for splint application.
### TABLE 50–4  -- Setting Times of Fast- and Extra-Fast-Drying Plaster

<table>
<thead>
<tr>
<th>Plaster</th>
<th>Setting Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast-drying</td>
<td>5–8</td>
</tr>
<tr>
<td>Extra-fast-drying</td>
<td>2–4</td>
</tr>
</tbody>
</table>

### TABLE 50–5  -- Effect of Water Temperature and Different Additives on Setting Time of Plaster

<table>
<thead>
<tr>
<th>Accelerates Setting Time</th>
<th>Slows Setting Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reusing dip water</td>
<td>Cool dip water</td>
</tr>
<tr>
<td>Higher dip water temperature</td>
<td>Glue</td>
</tr>
<tr>
<td>Salicylic acid</td>
<td>Gum</td>
</tr>
<tr>
<td>Zinc</td>
<td>Borax</td>
</tr>
<tr>
<td>Magnesium</td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td></td>
</tr>
<tr>
<td>Iron</td>
<td></td>
</tr>
<tr>
<td>Aluminum</td>
<td></td>
</tr>
<tr>
<td>Salt</td>
<td></td>
</tr>
<tr>
<td>Alum</td>
<td></td>
</tr>
<tr>
<td>Cool dip water</td>
<td>Glue</td>
</tr>
<tr>
<td>Higher dip water temperature</td>
<td>Gum</td>
</tr>
<tr>
<td>Salicylic acid</td>
<td>Borax</td>
</tr>
<tr>
<td>Zinc</td>
<td></td>
</tr>
<tr>
<td>Magnesium</td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td></td>
</tr>
<tr>
<td>Iron</td>
<td></td>
</tr>
<tr>
<td>Aluminum</td>
<td></td>
</tr>
<tr>
<td>Salt</td>
<td></td>
</tr>
<tr>
<td>Alum</td>
<td></td>
</tr>
</tbody>
</table>

The ideal length and width of plaster depends on the body part to be splinted and the amount of immobilization required. The best way to estimate length is to lay the dry splint next to the area to be splinted. It is best to use a generous length because wet plaster shrinks slightly from its dry length. Also, if the wet splint is too long, the ends can be folded back easily. The plaster width varies according to the type of splint being made and the body part that is injured, but generally, it should be slightly greater than the diameter of the limb to be splinted. Specific recommendations regarding splint length and width are discussed in the sections describing individual splints.

The thickness of a splint depends on the size of the patient, the extremity that is injured, and the desired strength of the final product. An ankle splint may crack quickly and become useless if only eight layers are used, but this thickness may be ideal for a wrist splint. In general, it is best to use the minimum number of layers necessary to achieve adequate strength. Thicker splints are heavier and more uncomfortable. It is also important to note that plaster thickness is a major determinant of the amount of heat given off during the setting process. More than 12 sheets of plaster create an increased risk of significant burns, especially when using extra-fast-drying plaster, using dipping water with a temperature greater than 24°C, or placing a pillow under or around the extremity for support during the setting process (Table 50–6). For an average-sized adult, upper extremities should be splinted with 8 sheets of plaster, whereas lower extremity injuries generally require 12 to 15 sheets. This layering usually gives the strength necessary for adequate immobilization while reducing the patient's discomfort and the risk of significant burns. In a 136-kg (300-lb) patient, however, up to 20 layers may be required to make a durable ankle splint.

### TABLE 50–6  -- Variables That Increase Heat Production during Crystallization

<table>
<thead>
<tr>
<th>Major</th>
<th>Minor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased splint thickness</td>
<td>High humidity</td>
</tr>
<tr>
<td>Setting time</td>
<td>High ambient temperature</td>
</tr>
<tr>
<td>High dip water temperature</td>
<td>Reusing dip water</td>
</tr>
<tr>
<td>Wrapping the extremity for support while drying</td>
<td></td>
</tr>
</tbody>
</table>

8
Faster setting times produce more heat.

Dip water temperature has been a minor determinant of heat production in some studies.

The dipping water should be kept clean and fresh. Reusing water that has been used previously for wetting plaster increases the amount of heat given off during crystallization and causes plaster to set more quickly. As a rule of thumb, the temperature of the water should be kept around 24°C. This temperature allows for a workable setting time and has not been associated with an increased risk of significant burns. As the temperature of the dipping water approaches 40°C, the potential for serious burns increases, even at splint thicknesses of less than 12 plies. It is interesting to note that water temperature has been shown to be only a minor consideration in heat production in some studies (see Table 50–6).

Splint Application

The dry splint should be completely submerged in the water until bubbling stops. The splint is removed and excess water is gently squeezed out until the plaster has a wet and sloppy consistency. The splint is placed on a hard table or countertop (a protective covering is recommended to prevent water or plaster damage) and smoothed out to remove any wrinkles and to ensure uniform lamination of all layers. Lamination helps to increase the final strength of the splint. The splint is placed over the Webril and gently smoothed over the extremity. Plaster is usually somewhat adherent to Webril, but an assistant may be required to hold the splint in place. Once the splint has been properly positioned over the extremity, folding back the underlying stockinette and Webril also helps hold it in place. The splint is secured with an appropriately sized elastic bandage by wrapping in a distal to proximal direction. Finally, the extremity is placed in the desired position and the wet plaster is molded to the contour of the extremity using only the palms of the hand. Finger indentations may cause a ridge that will produce a pressure point.

Molding the wet splint to conform to the body's anatomy is probably the most important, yet the most frequently overlooked, step to ensure adequate immobilization (see Fig. 50–5E). The act of molding may cause some pain, and the patient should be forewarned. All manipulation of the wet plaster should be completed before it reaches a thick, creamy consistency. Any movement after this time, also known as the critical period, results in an imperfect crystalline network of calcium sulfate molecules and greatly weakens the ultimate strength of the splint. While the plaster is setting, a pillow or blanket should not be wrapped around the extremity for support. This leads to inadequate ventilation around the splint and greatly increases the amount of heat produced (see Table 50–6).

If an elastic bandage is applied directly over wet plaster, the elastic bandage may be incorporated into the drying plaster, making subsequent removal of the bandage difficult. To make it easier for patients to remove and reapply the splint, a single layer of Webril or roll gauze can be wrapped around the wet plaster loosely before application of the elastic bandage. This prevents the wet plaster from becoming stuck to the elastic bandage. Only one layer of Webril should be used over the plaster because multiple layers have been associated with high drying temperatures.

Before the patient is released from the ED, the splint should be checked for adequate immobilization and the patient should be observed for any evidence of vascular compromise or significant discomfort. If either occurs, the elastic bandage should be loosened. If the discomfort persists, additional padding should be placed over the painful areas. If this measure, too, is unsuccessful, a new splint should be made, and special attention should be paid to proper molding so that the wet plaster does not become indented. By resting tender tissue, splinting usually relieves discomfort quickly, and patients generally say that they feel better immediately after the splint has been applied. Never release a patient who complains of increased pain after a splint has been placed.

After a properly fitting, comfortable splint has been applied, one may place two strips of tape along each side of the splint to prevent the elastic bandage from slipping. Tape should always be applied over the metal fasteners used to secure the elastic bandages. Note that these objects can be easily swallowed or aspirated by infants and small children. Finally, a sling should be provided for upper extremity injuries, and if required, crutches should be dispensed (and instructions given for their proper use) for lower extremity injuries.

Patient Instructions

Patients should receive both verbal and written instructions on splint care and precautions. The importance of elevation in helping to decrease pain and swelling should be stressed and demonstrated (most patients do not understand the medical definition of elevation). At night, a pillow wrapped and secured around a hand or foot will
help the patient keep the injured extremity satisfactorily elevated. If the injury is less than 24 hours old, the application of ice bags or cold packs also should be encouraged. It is useless to apply cold packs over plaster, but it can be beneficial if it is applied over Webril and an elastic bandage or directly over an injury if the splint is removed. In theory, cold therapy stiffens collagen and thus reduces the tendency for ligaments and tendons to deform. Cold therapy also decreases muscle spasm and excitability, decreases blood flow (thus limiting hemorrhage and edema), raises the pain threshold, and decreases inflammation. Because the thermal conductivity of subcutaneous tissue is poor, cold packs should be applied for at least 30 minutes at a time. This guideline is in contrast to the popular recommendation of “ice 20 minutes on, 20 minutes off,” which does nothing more than cool the skin. Cold packs should not be applied for more than the first 24 to 48 hours because cold can interfere with long-term healing. The patient should be instructed not to stress the splint for at least 24 hours because plaster does not approach optimal strength until evaporation has reduced the water content of the plaster to approximately 21% of its initial hydrated level. This process of removing excess water by evaporation is called curing and it generally takes several days to be completed. However, by 24 hours, the water content of the plaster has usually been reduced enough to produce a strong, resilient splint. In addition, because the chemical process involved in the formation of plaster is reversible, the patient should avoid getting the splint wet. If the injury permits, the splint can be removed for showering and then reapplied. Alternatively, one or more plastic bags may be placed over a splint before showering.

Splints may crack, break, or disintegrate with wear, and such a useless splint should be removed or replaced. Patients should be given general guidelines for length of immobilization and appropriate follow-up care. Long-term immobilization, particularly in the elderly, can produce permanent disability and should be avoided. It is extremely important for the patient to continue to check for signs of vascular compromise. If the patient experiences a significant increase in pain, any numbness or tingling of the digits, pallor of the distal extremity, decreased capillary refill, or weakness, she or he should be instructed to return to the ED or to see the primary clinician without delay. As with casting, increased pain after splinting is a warning sign that should prompt a return visit—not telephone advice. Strong opioids should be avoided during the first 2 to 3 days after splinting to allow pain to prompt a follow-up visit.

UPPER EXTREMITY SPLINTS

Long Arm Splints

Long Arm Posterior Splint

Indications

The long arm posterior splint (Fig. 50–7) is used to immobilize injuries of the elbow and proximal forearm. It completely eliminates flexion and extension of the elbow, but it does not entirely prevent pronation and supination of the forearm. Therefore, it is not recommended for immobilization of complex or unstable distal forearm fractures unless used in conjunction with a long arm anterior splint. Alternatively, a double “sugar-tong” splint can be applied.

Figure 50–7 Application of a long arm posterior splint. A, The posterior portion of the splint begins on the posterior aspect of the proximal humerus. It runs down the arm to the elbow and then continues along the ulnar aspect of the forearm and hand to the distal metacarpals. The elbow is flexed at a 90° angle, the forearm is in the neutral (thumb-up) position, and the wrist is in a neutral position or slightly extended (10°–20°). B, Adding an anterior splint. The anterior splint mirrors the posterior splint by running down the anterior aspect of the arm to the antecubital fossa, where it continues along the radial aspect of the forearm and hand to the distal radius. The anterior splint is never used alone, but rather as an adjunct to the long arm posterior splint. It improves immobilization by increasing stability and preventing pronation and supination of the forearm. C, When measuring for a posterior splint, cut out a notch to allow for a smooth bend. Note that padding needs to be applied before splinting.

Construction

The long arm posterior splint is constructed using 8 to 10 layers of 4- or 6-inch-wide plaster. The splint starts on the posterior aspect of the proximal arm. It runs down the arm to the elbow and then continues along the ulnar aspect of the forearm and hand to the level of the metacarpophalangeal (MCP) joints. The anterior splint is constructed in the same manner. It mirrors the posterior splint by running down the anterior aspect of the arm to the antecubital fossa, where it continues along the radial aspect of the forearm to the distal radius. The anterior splint is never used alone,
but rather, as an adjunct to the long arm posterior splint to improve immobilization by increasing stability and preventing pronation and supination of the forearm.

**Application**

Stockinette and Webril are applied as described previously. A hole should be cut in the stockinette to expose the thumb and extra padding should be placed over the olecranon to prevent pressure injury. The arm is positioned with the elbow flexed to 90°, the forearm neutral (thumb upward), and the wrist neutral or extended slightly (10°–20°). It is helpful to have an assistant hold the wet splint in place, particularly when applying both a posterior and an anterior splint. Once the splint has been properly positioned, the ends of the stockinette and Webril are folded back and the splint is secured in place using 2-, 3-, or 4-inch elastic bandages. Finally, the sides of the splint are folded up to create a gutter configuration and the splint is carefully molded using the palms of the hand. The fingers and thumb should remain free to prevent stiffness from unnecessary immobilization.

**Double Sugar-Tong Splint**

**Indications**

Like the long arm posterior splint, the double sugar-tong splint (Fig. 50–8) is used to immobilize injuries of the elbow and forearm. However, because it prevents pronation and supination of the forearm, it is preferable for some fractures of the distal forearm and elbow.

**Construction**

The splint consists of two separate pieces of plaster, a forearm splint and an arm splint. Each piece is constructed using eight layers of 3- or 4-inch plaster. The forearm portion of the splint runs from the metacarpal heads on the dorsum of the hand, along the dorsal surface of the forearm around the elbow. It continues along the volar surface of the forearm, stopping at the level of the metacarpophalangeal (MCP) joints. The arm portion of the splint begins on the anterior aspect of the proximal arm. It runs down the arm over the forearm splint, and around the elbow. It then continues up the posterior aspect of the arm, once again going over the forearm splint until it reaches the starting point. The fingers and thumb should remain free to avoid stiffness.

**Application**

Use of stockinette, Webril, and positioning is similar to those described for application of a long arm posterior splint. The two splints are secured in place using two 3- or 4-inch elastic bandages starting at the forearm splint at the hand. Once secure, the arm portion of the splint is wrapped beginning at the proximal end. The fingers and thumb should remain free to avoid stiffness.

**Forearm and Hand Splints**

**Volar Splint**

**Indications**

The volar splint (Fig. 50–9A) is used to immobilize a variety of soft tissue injuries of the hand and wrist. It is also used for temporary immobilization of triquetral fractures, lunate and perilunate dislocations, and second through fifth metacarpal head fractures. For these more serious injuries, some clinicians prefer to add a dorsal splint to create a more stable bivalve effect (see Fig. 50–9B). Because the volar splint does not completely eliminate pronation and
supination of the forearm, it may not be ideal for fractures of the distal radius and ulnar, although many clinicians use this splint for nondisplaced or minimally displaced distal ulnar and radial fractures.

**Figure 50–9 Application of a volar splint.** A, The splint begins in the palm at the metacarpal heads and extends along the volar surface of the forearm to a point just proximal to the elbow. If any of the fingers are injured, the splint may be extended to incorporate the involved digits. The forearm is placed in the neutral (thumb-up) position with the wrist slightly extended (10°–20°). Wrist flexion should be avoided. B, For more serious injuries, an additional dorsal slab may be used to create a bivalve splint.

**Construction**

The splint is constructed using 8 to 10 layers of 3- or 4-inch-wide plaster. The splint begins in the palm at the metacarpal heads and extends along the volar surface of the forearm to just proximal to the elbow. If there is an injury to any of the fingers, the splint may be extended to incorporate the involved digit.

**Application**

Stockinette and Webril should be applied as described previously. A hole should be cut in the stockinette to expose the thumb. In addition, Webril or gauze should be placed between any digits that are going to be immobilized. The forearm is placed in the neutral position (thumb upward) with the wrist extended slightly (10°–20°). Wrist flexion should be avoided. After the wet plaster has been properly positioned, the ends of the stockinette and Webril are folded back and a 3- or 4-inch elastic bandage is used to hold the splint in place. The sides of the splint are folded up, creating a gutter effect, and the plaster is carefully molded to conform to the contours of the palm and wrist. Some clinicians prefer to extend the splint to the fingertips and then fold the wet plaster back toward the palm, allowing the fingers to “grasp” the rounded distal end when at rest. In any event, the thumb and fingers should be free to move unless they are injured and are being intentionally immobilized by the splint.

**Sugar-Tong Splint**

**Indications**

The sugar-tong splint (Fig. 50–10) is used for fractures of the distal radius and ulna. The advantage of this splint over the volar splint is prevention of pronation and supination of the forearm. In addition, it immobilizes the elbow, which is desirable for the first few days after a distal forearm fracture.

**Figure 50–10 Application of a forearm sugar-tong splint.** The splint runs from the metacarpal heads on the dorsum of the hand, along the dorsal surface of the forearm, and around the elbow. It continues along the volar surface of the forearm, stopping at the level of the MCP joints. The elbow is flexed at a 90° angle, the forearm is in the neutral (thumb-up) position, and the wrist is in a neutral position or slightly extended (10°–20°). The advantages of this splint over the volar splint are immobilization of the elbow and prevention of pronation and supination of the forearm.

**Construction and Application**

The splint is constructed and applied in the same way as the forearm portion of the double sugar-tong splint, described earlier.

**Thumb Spica Splint**

**Indications**

The thumb spica splint (Fig. 50–11) is used to immobilize injuries to the scaphoid, lunate, and thumb and fractures of the first metacarpal. It is also used in the treatment of de Quervain tenosynovitis. Traditionally, a thumb spica splint or cast was thought to be a requirement to properly immobilize scaphoid fractures; however, there is no totally
agreed-upon standard. Clay and coworkers[13] stated that the optimal method of casting scaphoid fractures has not been definitively established. They were unable to prove a difference in patient comfort, recovery of function, or incidence of nonunion between a Colles cast and a traditional scaphoid cast that included the thumb.

Figure 50–11  A and B, Application of a thumb spica splint. The splint extends from just distal to the interphalangeal joint of the thumb to the mid-forearm. The forearm is placed in the neutral position with the wrist extended 25° and the thumb in the wineglass position (see Fig. 50–12 ). Inset, A small (1- to 2-cm) perpendicular cut is made 1 cm distal to the first MCP joint on each edge of the plaster to allow molding of the splint around the thumb without creating a buckle in the plaster. B, For skier's/gamekeeper thumb, a figure-of-eight thumb splint is ideal. C, Cut this length of material (should be ~14"–16"). Center the splint on the web space, crossing over the dorsal aspect of the thumb in a figure-of-eight fashion and overlapping the cut edges around the styloid process of the ulna. D, Wrap with a small elastic bandage, overlapping in a figure-of-eight formation. Mold and position after placement.

The incidence of nonunion of scaphoid fractures is about 10%, regardless of the type of immobilization in the ED, but it is greatest with unstable proximal pole fractures. Because some scaphoid fractures heal poorly under the best of circumstances, it seems prudent to provide thumb immobilization in the initial splinting. Failure to do so, such as when a "sprained wrist" is suspected, should not be construed as beneath the accepted standard of care. Most volar splints will at least partly immobilize the base of the thumb, so the discussion may be moot.

Construction

The splint is constructed using eight layers of 3-inch-wide plaster. The splint extends from just distal to the interphalangeal joint of the thumb to the mid-forearm.

Application

The forearm is placed in the neutral position with the wrist extended 25° and the thumb in the wineglass position (Fig. 50–12 ). Stockinette and Webril are applied from the base of the palm to the mid-forearm. It may be difficult to place stockinette around the thumb. Instead, a hole can be cut in the stockinette to expose the thumb. The thumb is then padded with small vertical strips of Webril or wrapped with 2-inch Webril. The dry plaster is then placed over the radial aspect of the forearm from just beyond the thumb interphalangeal joint to the mid-forearm. Once in position, the location of the first MCP joint is marked and a small (1–2 cm) perpendicular cut is made 1 cm distal to the mark on each edge of the plaster (see Fig. 50–11 inset). If necessary the plaster distal to the notch may be tapered slightly. This will allow the splint to be molded around the thumb without creating a buckle in the plaster. The plaster is then dipped and secured in place with a 2- or 3-inch elastic bandage. It is important to carefully mold the wet plaster around the thumb and palm and to maintain the thumb in the wineglass position while the plaster is drying.

Figure 50–12  A, The wineglass position, also termed position of function, is a safe splint position for the hand and fingers for short-term splinting (7–14 days). The wrist should allow alignment of the thumb with the forearm, the MCP joint should be moderately flexed, and the interphalangeal joints should be only slightly flexed. The thumb should be abducted away from the palm. B, For longer splinting, fingers should be extended to prevent flexion contractions, termed the intrinsic position. The MCP joint is flexed at 90°. Either A or B are acceptable positions for initial ED splinting.
Ulnar Gutter Splint

Indications

The ulnar gutter splint (Fig. 50–13) is used to immobilize fractures and serious soft tissue injuries of the little and ring fingers and fractures of the neck, shaft, and base of the fourth and fifth metacarpals.

Figure 50–13 Application of an ulnar gutter splint. The ulnar gutter splint incorporates both the little and the ring fingers. Webril or gauze should be placed between the digits to prevent maceration of the skin. The splint runs along the ulnar aspect of the forearm from just beyond the distal interphalangeal joint of the little finger to the mid-forearm. The forearm is in the neutral position with the wrist in slight extension (10°–20°), the MCP joint in 50° of flexion, and the proximal and distal interphalangeal joints in slight flexion (10°–15°). When immobilizing a metacarpal neck fracture, the MCP joint should be flexed to 90°.

Construction

The splint is made using six to eight layers of 3- or 4-inch plaster. It incorporates both the little and the ring fingers. It runs along the ulnar aspect of the forearm from just beyond the distal interphalangeal joint of the little finger to the mid-forearm.

Application

Stockinette and Webril are applied as usual. Additional Webril or gauze should be placed between the little and the ring fingers to prevent maceration of the skin. The forearm is in the neutral position with the wrist in slight extension (10°–20°), the MCP joints in 50° of flexion, and the proximal and distal interphalangeal joints in slight flexion (10°–15°). When immobilizing a metacarpal neck fracture (i.e., boxer's fracture), the MCP joint should be flexed to 90°. Once in the proper position, the sides of the splint are folded up to form a gutter. The ends of the stockinette and Webril are then folded back to help hold the splint while it is secured in place with a 2- or 3-inch elastic bandage.

Radial Gutter Splint

Indications

The radial gutter splint (Fig. 50–14) is used to immobilize fractures and serious soft tissue injuries of the index and long fingers and fractures of the neck, shaft, and base of the second and third metacarpals.

Figure 50–14 Application of a radial gutter splint. The radial gutter splint incorporates both the index and the long fingers. Webril or gauze should be placed between the digits to prevent maceration of the skin. The splint runs along the radial aspect of the forearm from just beyond the distal interphalangeal joint of the index finger to the mid-forearm. The forearm is in the neutral position with the wrist in slight extension (10°–20°), the MCP joint in 50° of flexion, and the proximal and distal interphalangeal joints in slight flexion (10°–15°). When immobilizing a metacarpal neck fracture, the MCP joint should be flexed to 90°.

Construction

The splint is made using six to eight layers of 3- or 4-inch plaster. It runs along the radial aspect of the forearm from just beyond the distal interphalangeal joint of the index finger to the mid-forearm.
Application

Stockinette (with a hole cut to expose the thumb) and Webril are applied as previously described. Additional Webril or gauze should be placed between the index and the long fingers to prevent maceration of the skin. The hand and fingers can be splinted in the position of function or in the intrinsic plus position (see Fig. 50–12). Neither have proven superiority for the first few weeks of splinting. Both are acceptable for initial ED splinting, for hand and finger immobilization. In the position of function, the forearm is in the neutral position with the wrist in slight extension (10°–20°), the MCP joints in 50°–60° of flexion, and the proximal and distal interphalangeal joints in slight flexion (5°–10°). When immobilizing a metacarpal neck fracture, the intrinsic position is often used, with the MCP joint flexed to 90° and the fingers extended (see Fig. 50–12B).

The dry plaster is placed over the extremity and the location of the thumb is marked. A hole is cut in the dry plaster to expose the thumb. The plaster is then dipped and positioned over the extremity. The ends of the stockinette and Webril are folded back to help hold the splint while it is secured in place with a 2- or 3-inch elastic bandage.

Finger Splints

Fingers are splinted after sprains, fractures, tendon repair, or infection. Minor finger sprains can often be managed with dynamic splinting (e.g., buddy taping) (Fig. 50–15) or a commercially available foam splint with aluminum backing (one-surface splint) (Fig. 50–16), but fractures, tendon repairs, and some soft tissue injuries benefit from formal splinting (e.g., thumb spica, ulnar and radial gutter splints). Specific conditions, such as mallet finger, require a specialized splint (plaster or Stack splint) (Fig. 50–17). When complete immobilization of a finger is required (e.g., unstable phalangeal fractures), an “outrigger” finger splint that incorporates the wrist may be used (Fig. 50–18). Both the position of function and the intrinsic position are acceptable for initial splinting.

Figure 50–15 Buddy tape technique. Taping between the digital joints (toes or fingers) allows the normal adjacent finger to protect the collateral ligament of its injured neighbor. Webril should be placed between the digits to prevent maceration of the skin.

Figure 50–16 Dorsal aluminum foam splint. The bone is subcutaneous dorsally, and splints here afford better immobilization of the digit. The dorsal splint also allows preservation and use of tactile sense, which encourages function and better splint acceptance on the part of the patient.

Figure 50–17 A, Splinting a mallet finger. The dorsal splint immobilizes only the distal interphalangeal joint, which allows use of the finger. Hyperextension of this joint predisposes to skin sloughing and should be avoided. The patient should be advised not to flex the joint during splint changes. B, A Stack splint is designed especially to treat a mallet finger. Long-term immobilization (8 weeks) or surgical fixation is required for this injury.
Figure 50–18  “Outrigger” finger splint for complete immobilization of the finger. A padded aluminum splint is incorporated into the middle of a plaster splint, forming an outrigger configuration. The plaster splint is applied to the dorsum of the hand and wrist with an elastic bandage; the finger is then taped to the aluminum splint.

Sling, Swathe and Sling, Shoulder Immobilizer

Sling

The sling is used to maintain elevation and provide immobilization of the hand, forearm, and elbow. It is most often used in conjunction with a plaster splint or cast. There are a number of commercially available slings to choose from. Many of these are fairly economical and simple to use, whereas others are very expensive and do not allow the versatility of a simple, inexpensive triangular muslin bandage. When applying a sling, it is important to have adequate support of the wrist and hand (Fig. 50–19). A sling that is too short will allow the wrist and hand to hang down (ulnar deviate) and can result in ulnar nerve injury.

Figure 50–19  A, Stepwise application of a triangular muslin sling. (1) Place tip X over the uninjured shoulder. (2) Bring tip Y over the injured shoulder to enclose the arm. (3) Draw tip Z around the front and pin. B, Completed triangular muslin sling. (Note: When applying a sling, it is important to have adequate support of the wrist and hand. A sling that is too short will allow the wrist and hand to hang down [ulnar deviate] and can result in hand edema and ulnar nerve injury.)

Swathe and Sling, Shoulder Immobilizer

The swathe and sling is the treatment of choice for most proximal humerus fractures and shoulder injuries, such as reduced dislocations. The sling supports the weight of the arm, and the swathe immobilizes the arm against the chest wall to minimize shoulder motion. In most EDs, the swathe and sling has been replaced by the commercially available shoulder immobilizer (Fig. 50–20). Its advantage is that it may be removed for showering and range of motion exercises and is easily reapplied by the patient (a desirable option in the care of a shoulder dislocation). If the shoulder immobilizer is used for more than a few days, the axilla should be padded to absorb moisture and decrease skin chafing.

Figure 50–20  A, The shoulder immobilizer is used for most proximal humerus fractures and shoulder injuries. It may be removed for showering and range of motion exercises and is easily reapplied by the patient. B, An elastic bandage and sling provide similar shoulder immobilization. Note that the wrist is supported by the slings.
The Velpeau bandage is a sling and swathe device that positions the forearm diagonally rather than horizontally across the chest with the hand elevated to the level of the shoulder. This offers no particular advantage over a standard sling and swathe, is difficult to apply, cannot be removed easily, and is not well tolerated for prolonged immobilization.

**Figure-of-Eight Clavicle Strap**

Clavicle fractures have been traditionally treated with an uncomfortable and complex figure-of-eight bandage. Despite its widespread use, this device has never been proved superior to a simple sling (in terms of cosmesis, functional outcome, or pain relief). Indeed, use of the figure-of-eight dressing should be discouraged because it may actually promote nonunion or increase the deformity at the fracture site; it is very uncomfortable; prohibits bathing, often causing chafing and discomfort in the axilla; and may predispose to axillary vein thrombosis. Although some orthopaedists continue to recommend the figure-of-eight bandage, a simple sling is sufficient to treat most clavicular fractures.

**Pitfalls of Hand Dressings and Splints**

The two most common problems with hand dressings are putting them on too tightly and leaving them on too long (Table 50–7). One must be especially careful to avoid wrapping elastic bandages too snugly. The patient should be instructed to loosen an elastic bandage if it feels too tight. The patient should always have access to emergency follow-up care. It is often advisable to start patients on a regimen of early protected motion. This means that the patient removes the splint for a specified period, does a prescribed exercise, and then replaces the splint. A splint is not an all-or-none device, and the patient is generally weaned from it slowly before it is discarded entirely. A stiff hand is a nonfunctional one, and stiffness is often a consequence of prolonged immobilization. It is important for the patient to be made aware of his or her responsibility for the injured hand.

<table>
<thead>
<tr>
<th>Injury</th>
<th>Splint Type</th>
<th>Immobilization Time *</th>
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</thead>
<tbody>
<tr>
<td>Mallet finger</td>
<td>FIN</td>
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<tr>
<td>Boutonnière deformity</td>
<td>FIN</td>
<td>6 wk</td>
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<td>FIN</td>
<td>1–2 wk</td>
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<tr>
<td>Extensor tendon</td>
<td>DHWF</td>
<td>3 wk</td>
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<td>Sprain-strain†</td>
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<td>1–2 wk</td>
</tr>
<tr>
<td>Interphalangeal joint</td>
<td>FIN</td>
<td>1–2 wk</td>
</tr>
<tr>
<td>Wrist</td>
<td>DHWF</td>
<td>1–2 wk</td>
</tr>
<tr>
<td>Hand burn</td>
<td>DHWF</td>
<td>5–7 wk</td>
</tr>
<tr>
<td>Infection</td>
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<td></td>
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<tr>
<td>Digit</td>
<td>DHWF</td>
<td>5–7 day</td>
</tr>
<tr>
<td>Hand</td>
<td>DHWF</td>
<td>5–7 day</td>
</tr>
<tr>
<td>Severe hand contusion</td>
<td>DHWF</td>
<td>5–7 day</td>
</tr>
<tr>
<td>Fracture</td>
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<td>Middle phalanx</td>
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<td>Proximal phalanx</td>
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<td>Splint Type</td>
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</tr>
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<td>2–3 wk</td>
</tr>
<tr>
<td>Trigger finger</td>
<td>FIN</td>
<td>Night only</td>
</tr>
</tbody>
</table>

DHWF, digit-hand-wrist-forearm; FIN, finger.

* These are average times only. Every patient is treated as an individual when a splint is used. Clinical judgment is critical.

† The diagnosis of a sprain should be made only after a thorough effort has been made to rule out a fracture or dislocation. This is particularly true in the wrist.

LOWER EXTREMITY SPLINTS

**Knee Splints**

**Knee Immobilizer**

**Indications**

The knee immobilizer (Fig. 50–21) is commonly used for mild to moderate ligamentous and soft tissue injuries of the knee. It is removable and extremely easy to apply, making it popular among patients and clinicians alike. In many EDs, it has almost totally replaced the more bulky plaster splint. Its use should be restricted to injuries that do not require immediate surgical intervention, traction, or casting. For these injuries, in which temporary but more complete immobilization is needed, a plaster knee splint can be used because it provides better stabilization and costs much less than a knee immobilizer. The exact scientific benefit of the knee immobilizer is poorly studied and difficult to document. However, it clearly helps relieve pain and, at least theoretically, hastens healing.

**Figure 50–21** The Velcro strap bulky knee immobilizer is easily removed and readily applied by the patient. It can be worn over clothes.

**Application**

The knee immobilizer is available in small, medium, large, and extra-large sizes. To choose the appropriate size, the knee immobilizer is placed next to the injured leg so that the tapered end lies distal to the patient's knee; if present, the cutout patellar area on the anterior aspect of the splint lies adjacent to the knee. In this position, the splint should extend distally to within a few inches of the malleoli and proximally to just below the buttocks crease. To apply the knee immobilizer, the open splint is slid under the injured extremity and firmly secured in place using the Velcro straps. The knee immobilizer can be applied directly over clothing, obviating the need to remove or cut the patient's pants.

**Posterior Knee Splint**

**Indications**

In many EDs, the knee immobilizer has virtually replaced the plaster knee splint for mild to moderate injuries to the knee. However, the plaster knee splint can be particularly useful in patients whose extremities are too large for the knee immobilizer, in the treatment of angulated fractures, or for temporarily immobilizing other knee injuries that require immediate operative intervention or orthopaedic referral. The posterior (gutter) knee splint (Fig. 50–22) is the type most commonly applied, but as alternatives, two parallel splints can be placed along each side of the leg and foreleg, creating a bivalve effect (see Fig. 50–22B) or a long leg U-splint can be applied (see later). The bilateral knee splint is slightly more difficult to apply than the posterior knee splint, but it may provide better immobilization of the lateral and medial collateral ligaments and can be used for injuries to these structures.
**Figure 50–22 Application of a posterior knee splint.** A, The posterior knee splint runs from just below the buttocks crease to approximately 2–3 cm above the malleoli. B, Alternatively, two parallel splints can be placed along each side of the leg and foreleg, creating a bivalve effect.

**Construction**

The knee splint is made with 12 to 15 layers of 6-inch plaster. It should run from just below the buttocks crease to approximately 5 to 8 cm above the malleoli. The sides of the splint are folded upward to form a gutter configuration.

**Application**

A stockinette should be placed in the usual manner, and the leg should be well padded with 4- or 6-inch Webril. If available, an assistant can help elevate the leg and hold the splint in place while it is being secured with 4- or 6-inch elastic bandages. If no aide is available, the patient can be placed in the prone position and the splint laid on the posterior surface of the extremity. The leg is then wrapped in the usual manner without the need for special support of the applied plaster. Also, while in the prone position, the patient's toes can elevate the lower part of the leg off the bed, allowing sufficient room to wrap the Webril and elastic bandages around the injured extremity.

**Jones Compression Dressing**

**Indications**

A Jones compression dressing is commonly used for short-term immobilization of soft tissue injuries of the knee. It immobilizes and compresses the knee, reducing both pain and swelling. However, because it does allow slight flexion and extension of the knee, it should not be used for injuries that require strict immobilization. In addition, it is difficult to maintain the splint for more than a few days.

**Construction**

A Jones dressing is made using 6-inch Webril and elastic bandages.

**Application**

To apply a Jones dressing, the patient is placed on a stretcher, lying supine. If available, an assistant can elevate the patient's leg to facilitate wrapping. If no help is available, a pillow placed under the patient's heel should suffice. Webril is then wrapped around the extremity from the groin to a few inches above the malleoli. Two or three layers of Webril can be used, and each turn should overlap the previous turn by 25% to 50%. The elastic bandage (two are usually required) is then wrapped around the Webril. If more support is required, the process can be repeated with another two or three layers of Webril held in place by additional elastic bandages.

**Ankle Splints**

**Posterior Splint**

**Indications**

The posterior ankle splint ([Fig. 50–23](#)) is one of the most common splints applied in the ED. As noted in the introductory section, the entire concept of splinting an acutely sprained ankle has been questioned, with no firm evidence to support a better outcome of any type of splinting or casting versus functional management (early mobilization with an external support). Nonetheless, an acutely sprained ankle is painful, and if nothing else, splinting for a few days will alleviate pain.
Figure 50–23 Posterior ankle splint. A, Proper application of a posterior ankle splint. This splint extends from the plantar surface of the great toe (or metatarsal heads) along the posterior surface of the foreleg to the level of the fibular head. The ankle should be at a 90° angle. B, The most convenient way to apply an ankle splint is to have the patient lie prone and bend the knee to a 90° angle, thereby relaxing the calf muscles. The ankle should be at a 90° angle so that the foot is flat for partial weight-bearing. C, Incorrect splint application. Three things are wrong with this posterior ankle splint: (1) It does not extend distally enough to support the entire foot. (2) The ankle is not maintained at a 90° angle. (3) The edges and ankle area are not molded or protected. Overall, the splint is sloppy and ineffective. D, This is an unacceptable fiberglass splint. It looked fine under the Ace wrap but the patient complained that it was uncomfortable. When removed the problems were obvious. Note the very sharp frayed fiberglass edges (arrows) and the multiple internal ridges and folds that will produce soft tissue trauma when worn. E and F, Never splint an injured wrist in flexion, even though the patient prefers this position. When immobilizing an infected human bite, this splint was not held in position until hardened, and the patient reflexively flexed the wrist. G, The problem with this splint is that it was intended to be used for only a few days, but the patient wore it and walked on it for 3 wk. Note the resultant full-thickness skin loss. No padding was used under the premade splint. Skin grafting was eventually required.

The posterior splint is used primarily to immobilize severe ankle sprains, fractures of the distal fibula and tibia, and reduced ankle dislocations. It can also be used for fractures of the tarsal and metatarsal bones or for other foot conditions that require immobilization. In particularly severe or unstable injuries, an additional anterior splint may be used to provide extra immobilization resembling that of a formal cast (Fig. 50–24). For severe lateral or bilateral ligamentous injuries, a U-splint or stirrup splint (see later) may be added to the posterior splint for increased immobilization. With minor soft tissue injuries, patients may have partial weight-bearing on ankle splints after 24 hours. If the patient will be bearing weight, a cast shoe over the splint makes it easier to walk. In addition, a cast shoe increases the longevity of the splint because walking on an unprotected splint quickly destroys the device. Generally, walking on the splint is prohibited if immobilization for more than 2 or 3 days is desired.

Figure 50–24 Application of an anterior-posterior ankle splint. In particularly severe or unstable injuries, an anterior splint may be added to a posterior ankle splint to provide extra immobilization resembling that of a formal cast. The anterior splint is never used by itself, but it can augment a posterior splint, creating a bivalve effect. The ankle should be at a 90° angle.
Construction

The posterior splint is made using 4- or 6-inch-wide plaster strips. It should extend from the plantar surface of the great toe or metatarsal heads along the posterior surface of the foreleg to the level of the fibular head. If it hurts to move the toes, they should be incorporated into the splint (after padding is placed between the digits). It is a common mistake to apply a posterior splint that does not extend far enough to support the ball of the foot. Fifteen to 20 layers should be used if partial weight-bearing is allowed because this splint frequently breaks or cracks when walked on.\[16\]

Application

The easiest way to apply a posterior splint is to place the patient in the prone position with the knee and ankle flexed at a 90° angle. Failure to place the ankle in a 90° angle results in a plantar-flexed splint. The supine patient may help maintain the ankle in a 90° angle by pulling up on the foot with a wide stockinette stirrup. Flexing the knee to a 90° angle relaxes the gastrocnemius muscle and facilitates ankle motion. With the knee and ankle in the proper position, stockinette may be applied and the foot and leg padded with Webril, as described earlier. Extra padding is used over bony prominences, particularly the malleoli. Again, Webril or gauze is placed between the toes if they are to be included in the splint. The wet plaster is then laid over the plantar surface of the foot and secured in place by folding back the ends of the stockinette and wrapping with one or two 4-inch-wide elastic bandages. The wet plaster is carefully molded around the malleoli and instep to ensure maximum comfort and immobilization. The toes should be left partially exposed for later examination of color and capillary refill.

Anterior-Posterior Splint

Indications

The anterior splint is never used by itself, but it can augment a posterior splint, creating a bivalve effect (see Fig. 50–24). It is used for serious fractures and soft tissue injuries of the ankle.

Construction

A piece of plaster should be cut several centimeters shorter than the one used for the posterior splint, but because this splint does not bear weight, only 8 to 10 layers are required.

Application

The patient should be positioned and padded as for the posterior splint. After the wet posterior splint has been applied, the anterior splint is placed over the anterior aspect of the ankle and foreleg parallel to the posterior splint. The two are then held in place with elastic bandages as described earlier for the posterior splint alone. An assistant is needed to apply the anterior-posterior splint because it is extremely difficult to hold both splints in place while wrapping the elastic bandages. Once secured, both splints are carefully molded over the instep and ankle joint.

U-Splint (Stirrup Splint)

Indications

The U-splint or stirrup splint (Fig. 50–25) is used primarily for injuries to the ankle. It functions like the posterior splint, and either of the two provides satisfactory ankle immobilization. In one study that compared these splints in normal volunteers, the U-splint allowed less plantar flexion and broke less often with plantar flexion than the posterior splint. Also, because it actually covers the malleoli, the U-splint may protect the medial and lateral ligamentous area from further injury better than the posterior splint.

Figure 50–25  The U-splint (also called sugar-tong or stirrup splint) is also used primarily for injuries to the ankle. The splint passes under the plantar surface of the foot, extending up the medial and lateral sides of the foreleg to just below the level of the fibular head. The ankle should be at a 90° angle. For immobilization of the knee, the sides of the splint may be extended proximally to the groin, creating a long leg splint.
Construction

The U-splint is made using 4- or 6-inch-wide plaster strips. The splint passes under the plantar surface of the foot from the calcaneus to the metatarsal heads and extends up the medial and lateral sides of the foreleg to just below the level of the fibular head.

Application

The patient is positioned, and the extremity is padded as described for the posterior splint. If both posterior and U-splints are used, the posterior splint is applied first. The wet plaster is laid across the plantar surface of the foot between the calcaneus and the metatarsal heads with the sides extending up the lateral and medial aspects of the foreleg. The plaster is secured in place with 4-inch elastic bandages. The elastic bandage should be wrapped around the extremity starting at the metatarsal heads and continuing around the ankle using a figure-of-eight configuration. Once the ankle has been wrapped, another 4- or 6-inch elastic bandage can be used to secure the remainder of the splint in place. The splint should be carefully molded around the malleoli. The plaster may overlap on the anterior aspect of the ankle; this overlap does not interfere with the splint's ability to accommodate further swelling.

Walking Boot (Fig. 50–26A)

Indications

A walking boot (e.g., Cam Boot, DonJoy Boot; see Fig. 50–26A, also called a sugar tong splint) can be used for the treatment of moderate to severe soft tissue injuries of the ankle, including second- and third-degree sprains. In addition, many orthopaedic surgeons use it for isolated, nondisplaced lateral malleolus fractures. The walking boot provides a degree of immobilization similar to that of a U-splint but is easier to remove for bathing and dressing, and the Velcro straps allow adjustment for edema.

Figure 50–26 A. A walking boot can be used for the treatment of moderate to severe soft tissue injuries of the ankle, including second and third degree sprains, and isolated, nondisplaced lateral malleolus fractures. The walking boot provides a similar degree of immobilization as a U-splint, but is easier to remove for bathing and dressing, and the Velcro straps allow adjustment for edema. B. The Unna boot or an Ace wrap provide effective immobilization of an ankle soft tissue injury. The Unna boot is applied from a semisolid paste roll. The wrap is then covered with gauze or an elastic bandage. The entire dressing can be cut off by the patient at home. For similar short-term immobilization without plaster, a modified Jones dressing can be used. Copious Webril is wrapped around the ankle and foot and covered with an elastic bandage. A cast shoe can be used with this dressing.

Patients placed in a walking boot should receive follow-up with an appropriate specialist and advised on the importance of partial or non-weight-bearing as indicated by the type and degree of injury. When cleared by the follow-up physician, the walking boot allows easy transition to full weight-bearing. Studies have shown that rapid mobilization after ankle injuries improves functional outcome and reduces disability time.

Application

Walking boots come in a variety of sizes from extra small to extra large, depending on the manufacturer. The boot should fit comfortably with the patient's calcaneus snugly in the heel of the boot, and the patient's toes close to, but not extending over, the front edge of the boot. Once the appropriate size has been determined, the patient places her or his bare foot and ankle into the boot, which is secured using Velcro straps.

Semirigid Orthosis

Indications

In patients with sprains of the lateral ankle associated with a stable joint, the use of a functional brace with early mobilization is frequently more comfortable, and results in an earlier return to normal function, than complete
immobilization in a plaster splint or cast. Consequently, functional bracing with early mobilization has become the standard of care. However, it should be pointed out that there is no documented difference in long-term outcome between the two methods of treatment.

**Application**

Most functional ankle braces resemble a U-splint with air bladders (Aircast, Inc., Summit, NJ) or foam padding (DeRoyal Inc., Powell, TN) for cushioning the malleoli. The braces are secured about the ankle by Velcro straps. The device is worn within the patient's shoe over a sock and appears to eliminate ankle instability.

**Hard Shoe (Cast or Reese Shoe)**

**Indications**

A hard shoe can help reduce the pain associated with ambulation in patients with fractures or soft tissue injuries to the foot. This device can also be used over a splint or cast to allow partial weight-bearing. This device is commonly used for fractured toes that have been buddy taped.

**Application**

If the cast shoe is going to be used by a patient with a fractured toe, the injured digit should first be buddy taped to the adjacent toe. After this is done, the patient merely slips on the hard shoe like a sandal. The shoe is then fastened with ties or Velcro straps.

**Ankle Wraps and Bandages**

There are no data supporting the routine use of ankle wraps for simple sprains, but some pain relief may be afforded by a proper wrap. Some type of temporary immobilization is commonly used in the ED, and usually requested and expected by patients. For minor ankle injuries, a simple elastic bandage (Ace) can be applied. A figure-of-eight configuration is preferred (see Fig. 50–26B). The wrap is applied only to give lateral support, and minimal compression. It should not be tight enough to impair venous drainage, a common problem when patients apply their own wraps. An Unna boot placed over Webril is an alternative. A modified Jones dressing may also be used for a variety of soft tissue injuries. To apply a Jones dressing, generously wrap the foot and ankle with large amounts of Webril (about five or seven layers) and cover it with an elastic bandage. A cast shoe can be applied over the dressing.

**Soft Cast**

**Indications**

A soft cast is basically a modified Jones compression dressing. It is useful for minor ligamentous and soft tissue injuries of the foot and ankle that do not require prolonged or complete immobilization. A soft cast can help reduce the pain and swelling often associated with mild ankle sprains and gives support for early weight-bearing (see Fig. 50–26B).

**Construction**

A soft cast is made using 3- or 4-inch Webril and elastic bandages.

**Application**

A soft cast is as simple to apply as the Jones compression dressing. To begin, the patient is placed in a supine position with the foot and ankle extending off the end of the stretcher. Alternatively, the leg can be elevated by an assistant or by placing pillows under the knee and foreleg. The ankle and foot are then wrapped with five or seven layers of Webril, starting at the metatarsal heads and continuing around the ankle in a figure-of-eight configuration. The Webril should extend 5 to 7 cm above the malleoli and, as discussed earlier, should overlap by 25% to 50% of its width. After the Webril is in place, an elastic bandage is wrapped around the foot and ankle in a similar fashion. Additional layers of Webril and elastic bandages are seldom required.
COMPLICATIONS OF SPLINTS

Ischemia

A compartment syndrome leading to ischemic injury and ultimately to a Volkmann ischemic contracture is the most worrisome complication of cylindrical casts. Although the risk of ischemia is drastically reduced with splinting, Webril or elastic bandages can cause significant constriction. To reduce the likelihood of this occurring, the elastic bandage should not be excessively tight. If the patient has a high-risk injury, the Webril may be cut lengthwise before the plaster is applied. Elevation, no weight-bearing, and application of cold packs should be stressed to each patient. Furthermore, signs and symptoms of vascular compromise should be explained carefully, and all patients whose injuries have the potential for significant swelling or loss of vascular integrity should receive follow-up in the first 24 to 48 hours. The clinician should not ignore complaints of increasing pain under a splint. Patients with splint-related discomfort should be reevaluated clinically and should not be treated with a telephone prescription for opioid analgesics.

Heat Injury

Fiberglass splints produce minimal heat when drying, but plaster generates considerable heat as it hardens. Many clinicians are unaware of the potential for drying plaster to produce second-degree burns. Thermal injury can occur with both cylindrical casts and plaster splints. Some clinicians have reported a higher incidence of burns with the use of plaster splints, although the reasons for this are unclear. Table 50–6 lists factors that can increase the amount of heat produced during plaster recrystallization. Their effects are additive, and this fact should be taken into account when applying a splint. For example, if 15 sheets of plaster are needed for strength in a particular splint, one should not increase the heat production further by using extra-fast-drying plaster or reusing warm dip water. To avoid plaster burns, use only 8 to 12 sheets of plaster when possible, use fresh dip water with a temperature near 24°C, and never wrap the extremity in a sheet or pillow during the setting process. Peak temperatures usually occur between 5 and 15 minutes after plaster wetting.

The patient should be warned that the hardening process produces warmth. The heat of drying may produce pain in patients with hemophilia-related hemarthroses. Splinting these patients may require that the plaster splint be placed only long enough to verify proper fit; the splint is then reapplied after setting (and cooling) of the plaster. If any patient complains of significant burning while the plaster is drying, do not ignore this complaint! Immediately remove the splint, and promptly cool the area with cold packs or cool water. Patients with vascular insufficiency or sensory deficits (e.g., diabetic neuropathy, stroke) are at high risk for plaster burns and require close observation during the drying process.

Pressure Sores

Pressure sores are an uncommon complication of short-term splinting. They can result from stockinette wrinkles, irregular wadding of Webril, incorrectly padded or unpadded bony prominences, irregular splint ends, plaster ridges, or indentations produced from using the fingers rather than the palms to smooth and mold the wet plaster. Attention to detail during padding and splinting reduces the incidence of pressure sores. However, whenever a patient complains of a persistent pain or burning sensation under any part of a splint, the splint should be removed and the symptomatic area inspected closely. The padding incorporated in premade plaster and fiberglass splints is generally all that is needed for safe short-term splinting. However, the life of a splint applied in the ED may be longer than intended by the clinician; therefore, it is prudent to err on the side of additional padding when putting splints on patients who will overuse the splint, such as those who will not use crutches, or for those who may not have ready access to follow-up.

Infection

Bacterial and fungal infections can occur under a splint. Infection is more common in the presence of an open wound but may occur with intact skin or develop in a skin lesion produced by prolonged splinting. The moist, warm, and dark environment created by the splint is an excellent nidus for infection. Toxic shock syndrome has been rarely reported from a staphylococcal skin infection that has clandestinely developed under a splint or cast. Also, it has been shown that bacteria can multiply in slowly drying plaster. To avoid infection, all wounds should be cleaned and débrided before splint application, and clean, fresh tap water should be used for plaster wetting. In some instances, it is preferable to apply a removable splint that allows for periodic wound inspection or local wound care.
Dermatitis

Occasionally, patients develop a rash under a plaster cast or splint. Allergy to plaster is exceedingly rare, but there are several reports of contact dermatitis when formaldehyde and melamine resins are added to the plaster. The rash is usually pruritic, with weeping papular or vesicular lesions. Because these resins are unnecessary for ED splints, their use should be avoided whenever possible. Dermatitis has also been reported with the use of fiberglass splinting materials.

Joint Stiffness

Some degree of joint stiffness is an invariable consequence of immobilization. It can range in severity from mild to incapacitating and can result in transient, prolonged, or in some cases, permanent loss of function. Stiffness appears to be worse with prolonged periods of immobilization, in elderly patients, and in patients with preexisting joint diseases such as rheumatoid arthritis or osteoarthritis. Thus, splints should be left on for only that period of time necessary for adequate healing. Table 50–8 lists several injuries that commonly require splinting, along with some suggestions for length of immobilization. Fractures, dislocations, or other conditions that require prolonged immobilization (>7 days) should have orthopaedic follow-up. Patients must be told that a splint is only a short-term device and that prolonged immobilization can be detrimental. For minor injuries, the clinician can suggest that the patient use her or his own judgment about when to remove the splint, but a definite end point should be set.

TABLE 50–8  -- Suggested Length of Immobilization for Conditions That Frequently Require Splinting

<table>
<thead>
<tr>
<th>Length of Condition</th>
<th>Immobilization (Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contusions</td>
<td>1–3</td>
</tr>
<tr>
<td>Abrasions</td>
<td>1–3</td>
</tr>
<tr>
<td>Soft tissue lacerations</td>
<td>5–7</td>
</tr>
<tr>
<td>Tendon lacerations</td>
<td>Variable *</td>
</tr>
<tr>
<td>Tendinitis</td>
<td>5–7</td>
</tr>
<tr>
<td>Puncture wounds and bites</td>
<td>3–4</td>
</tr>
<tr>
<td>Deep space infections and cellulitis</td>
<td>3–5</td>
</tr>
<tr>
<td>Mild sprains</td>
<td>5–7</td>
</tr>
<tr>
<td>Fractures and severe sprains</td>
<td>Variable †</td>
</tr>
</tbody>
</table>

* Considerable controversy surrounds the length of immobilization for tendon lacerations, and duration therefore is best left to the consultant surgeon.
† Usually requires prolonged immobilization; best determined by an orthopaedic surgeon.

CAST PAIN

Cast-related pain is a common complaint that brings patients to the ED. Because of the potential for ischemia with circumferential casts, all complaints should be fully investigated, and vascular compromise must be ruled out. If a patient states that a cast is too tight, it probably is too tight (Fig. 50–27). Narcotics should not be prescribed for cast pain until a too-tight cast can be ruled out. A detailed history and physical examination should be performed on all such patients. The nature and onset of the pain are of particular importance. A dull, nonspecific pain that has worsened gradually since the time of injury may be the only clue to an early compartment syndrome (see Chapter 54, Compartment Syndrome Evaluation). The sudden onset of throbbing pain associated with swelling and redness suggests a possible deep venous thrombosis. In both of these cases, rapid intervention is the key to decreasing morbidity and mortality. The physical examination should pay particular attention to the areas of tenderness and the effect of active and passive movement on the severity of pain.

Figure 50–27 If a patient complains of a cast being too tight, it probably is. The cast must be removed to inspect the area for infection or other problems. Complaints of pain under this cast were incorrectly met with a phone call to suggest elevation and a call-in prescription for narcotics.
Itching under a cast can be problematic. Patients, especially children, use various objects such as a pencil, coat hanger, or fork to get to the itch. This can cause skin maceration and possible infection, or a foreign body can be left under the cast (Fig. 50–28).

**Figure 50–28** This 9-year-old tried to scratch an itch under his splint with a pencil and the eraser fell off, creating a skin irritation/infection requiring splint removal.

With a compartment syndrome, tenderness over the involved compartment is a common finding; stretching or contracting ischemic muscle also elicits significant pain. The examination should also evaluate the presence and quality of distal pulses, amount of edema fluid present, distal sensation, capillary refill, and color and temperature of the digits. The finding of pain, pallor, paresthesias, paralysis, and pulselessness (the five Ps) are said to be pathognomonic for ischemia. Unfortunately, they seldom occur simultaneously, and their presence together is usually a late finding that carries a poor prognosis. Hence, the emergency clinician must maintain a high index of suspicion for possible ischemia and remove the cast if any possibility of vascular compromise exists. Almost any cast can be bivalved and reapplied after inspection without significant loss of short-term immobilization.

To loosen a cast, an oscillating cast saw is used to cut along the medial and lateral aspects of the cast (Fig. 50–29). This is called bivalving the cast, and it allows the halves to be spread and reapplied in a less constricting manner while still maintaining proper immobilization. To use the oscillating power saw, proceed in a series of downward cutting movements facilitated by wrist supination, removing the blade between cuts. The blade is removed between cuts to prevent it from getting hot enough to burn the skin. This is particularly important if synthetic materials have been used in the cast. Also, the blade should not be allowed to slide along the skin, and the saw should never be used on unpadded plaster. With an apprehensive patient, the clinician can demonstrate that the cast saw blade only vibrates (it does not turn) and that it does not cut the skin.

**Figure 50–29** A and B, The cast saw vibrates; it does not rotate. It will not cut the patient. The blade is controlled by placing the thumb (arrow) on the splint and lowering the saw blade to the plaster. The blade is raised and lowered for each cut; it is not drawn across the plaster like a knife. C and D, This cast was too tight, and it was therefore bivalved from calf to forefoot with a cast saw. After separation of the edges of the cut cast, the anterior and posterior components were secured in place with an elastic bandage. Note that the underlying Webril padding was cut to relieve pressure but was not removed (inset). A bivalved cast provides temporary immobilization equal to that of an intact cast. Extra padding can be used to protect the skin from the cut edges.

After the medial and lateral sides of the cast are completely cut through, the two halves are separated using a cast spreader, and the padding is cut lengthwise with scissors. This may be sufficient to relieve early ischemia if the problem is simple postinjury swelling, but both the padding and the cast can be totally removed to inspect the injured area if necessary. If ischemia cannot be ruled out, compartment pressures should be measured (see Chapter 54, Compartment Syndrome Evaluation), and an orthopaedic consultation should be obtained.

If vascular integrity is established and no other problems are found, the bivalved cast can be replaced. First, the extremity should be padded in the usual manner using fresh Webril. The cut ends of the bivalved cast are then lined
with white adhesive tape, and the cast is replaced around the extremity. Finally, the cast is secured in place using elastic bandages.

If plaster sores are causing the patient's discomfort, the clinician who placed the cast should be consulted. In some cases, additional padding is all that is needed, but in others, a window should be cut out over the problem area. Because pressure sores can lead to significant tissue necrosis, the patient should receive follow-up care within 24 hours.

If the patient's problem is plaster (or, more likely, resin) dermatitis, treatment generally consists of topical or oral steroids and antihistamines. Therapy should be done in concert with an orthopaedic surgeon because the patient may require admission for other forms of immobilization until the cast can be replaced. With mild cases, changing the cast or splint and using antihistamines for symptomatic relief may suffice. All of these patients should receive close follow-up; if the condition does not improve, the cast must be removed.

CONCLUSION

Splinting represents an important means of temporary fracture immobilization and provides protection and comfort for a variety of soft tissue injuries. The clinician should be aware of potential complications, including ischemia, thermal injury, and pressure sores, that can occur with improper splint application. Proper technique should minimize the risk of these adverse outcomes. The emergency clinician also should be facile in the release of circumferential cast and splint materials when ischemia is suspected.

REFERENCES


