

ORTHOPAEDIC IMMOBILIZATION TECHNIQUES

A STEP-BY-STEP GUIDE FOR CASTING AND SPLINTING



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Samuel A. Brown M.S., OTC | **Frank Radja** OTC

ORTHOPAEDIC IMMOBILIZATION TECHNIQUES

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Samuel A. Brown, MS, OTC

Frank E. Radja, OTC

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DISCLAIMER

The procedures in this text are based on current research and recommendations from professionals in the field of orthopaedic technology and related health care professionals. The information is intended to supplement, not substitute, recommendations from a qualified physician or qualified health care professional. Sagamore Publishing LLC, and the authors disclaim responsibility for any adverse effect or consequences resulting from misapplication or injudicious use of material contained in the text. It is also accepted as judicious that the health care students must work under the guidance of a licensed physician or qualified health care professional.

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SAMUEL AYERS BROWN MS, OTC

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FRANK E. RADJA, OTC

PREFACE

Established in 1982, the National Association of Orthopaedic Technologists (NAOT) is a nonprofit membership association dedicated to the continued educational and professional development of orthopaedic allied health care professionals who specialize in casting, splinting, and bracing.

MISSION STATEMENT

NAOT is dedicated to the pursuit of excellence through education of orthopaedic technologists, and other related allied health care professionals, and the general public. NAOT believes that the profession of orthopaedic technology can only reach full potential and universal acceptance through widespread educational opportunities. Certification of all orthopaedic technologists underscores NAOT's commitment to these professional goals.

WHAT IS AN ORTHOPAEDIC TECHNOLOGIST?

The orthopaedic technologist is a specialized physician extender who is an expert in casting and splinting immobilization techniques. Orthopaedic technologists work under the direct supervision of the orthopaedic surgeon to manage the care of the orthopaedic patient in the clinic and sometimes perform as first assistant in the operating suite. Typical functions of an orthopaedic technologist include the following:

- Application and removal of all types of casts and splints
- Assist with history and physical assessment
- Assist with fracture and dislocation reduction
- Wound closure and care
- Patient education and follow-up care
- Assist in the operating suite

NAOT HISTORY

The National Association of Orthopaedic Technologists (NAOT) was founded on August 29, 1982, in Boston, Massachusetts. NAOT was originally conceived in the minds and hearts of a few members of the National Federation of Orthopaedic Technologists many years prior to 1982. The group recognized that strength is fostered in unity, and professionalism is rooted in the formulation of goals and standards. A core group of orthopaedic technologists committed themselves to the formulation of an independent, self-governing organization. They presented their concepts to the full membership of the Federation in Dallas, Texas in 1981. A vote was taken, and the decision was made to prepare to launch the new association at the 1982 convention. Representatives from the various regional, state, and local groups (members of the Federation) came together in Boston to adopt a charter and by-laws for a truly national organization. Officers were elected, and the Executive Board was established. NAOT was born, and the parent Federation became a thing of the past.



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FUNDAMENTALS OF CASTING AND SPLINTING PROCEDURES

1

EDUCATIONAL OBJECTIVES

After reading this chapter, the reader will be able to

- explain philosophies and principals surrounding the use of orthopaedic casts (fiberglass and plaster) and splints,
- select the supplies and specialty items used for casting and splinting, and
- describe and demonstrate the basic safety precautions associated with application and removal of cast and splints.

INTRODUCTION

The fundamentals of casting and splinting techniques are important for the safety and management of various orthopaedic conditions. Scholars and health care professionals collaborated on this chapter to highlight the philosophies and other key components that revolve around casting and splinting.

TERMINOLOGY

Calcaneus. The largest of the tarsal bones forming the heel of the foot

Cast. A hard circular dressing with soft padding inside of it used to immobilize body parts. It immobilizes and protects until healing occurs. It is usually made from Plaster of Paris or fiberglass materials.

Cast padding. A cotton or synthetic roll of material used to pad orthopaedic casts and splints

Cast saw. An oscillating action power saw designed to cut plaster and fiberglass casting materials

Cast spreaders. A two- or three-pronged tool used to pry open orthopaedic casts

Cast tape. A fast-drying adhesive or resin-impregnated mesh used for orthopaedic casting

Compartment syndrome. A condition where there is increasing pressure within a muscle compartment, which eventually leads to the death of the muscle tissue; A TRUE ORTHOPAEDIC MEDICAL EMERGENCY

Exotherm. The heat given off from a setting cast or splint that is made of Plaster of Paris or fiberglass immobilization products. Use caution to prevent exotherm from burning the skin of a patient.

Malleolus/malleoli. A rounded bony prominence such as those on either side of the ankle joint

Olecranon process. A large process on the ulna projecting behind the elbow joint and forming the bony prominence of the elbow

Ortho-Glass®. A fiberglass splinting system that provides strength and durability in a padded splint; available in rolls and precuts in 1-in., 2-in., 3-in., 4-in., 5-in., and 6-in. widths with various lengths.

Palmar crease. Flexion creases normally found on the palm of the hand, occurring at the metacarpophalangeal joints

Splint. A half cast used to temporarily immobilize and protect body parts. It consists of a deep layer of soft padding next to the skin, a middle layer of rigid fiberglass or Plaster of Paris, and a superficial layer of compression wrap securing it to the patient. Also, an orthotic used to immobilize and protect a body part.

Stockinette. A stretchy, knitted fabric used as a barrier between skin and cast padding in casts.

Volkman's contracture. Occurs when there is a lack of blood flow (ischemia) to the forearm. This usually occurs when there is increased pressure due to swelling, a condition called compartment syndrome.

INJURY ASSESSMENT

Before applying a cast or splint, a qualified physician or qualified health care professional should complete an injury evaluation. A strong working knowledge of anatomy, physiology, and biomechanics is

essential. Following the injury evaluation, a qualified health care professional can then recommend the treatment options that may include the application of a cast or splint. This ensures that the cast or splint is applied for support and immobilization of the injury. Developing a thorough knowledge of casting and splinting is also imperative for the conservative treatment of orthopaedic injuries and conditions by the qualified health care professional.

PURPOSES OF SPLINTING

- Provides immobilization
- Protects the injury
- Prevents further injury
- Decreases pain
- Allows for easy application and removal compared to a cast
- Allows for swelling better than a cast

The use of a splint is indicated for a wide variety of orthopaedic injuries that include fractures, sprains, and postoperative immobilization. In particular, fractures and sprains are placed in splints in order to accommodate for frequent swelling associated with these injuries. Swelling is the body's natural reaction to an injury and is the key reason why splints are used during the acute phase of an injury. Since splints are noncircumferential, they will accommodate for swelling. Casts are circumferential and therefore do not accommodate for swelling of the injury during the acute injury phase. Uncontrolled swelling can eventually progress to compartment syndrome, which can compromise the neurovascular integrity of the injured extremity.

All efforts should be made to minimize injury swelling. This is best accomplished by using the RICE (rest, ice, compression, and elevation) method after a splint has immobilized the injury.

After the initial swelling has subsided, the patient should transition into a cast for more definitive immobilization if indicated by a qualified health care professional.

PRESPLINTING PROCEDURE

Before applying any splint, an accurate diagnosis should be made by an orthopaedic physician or other qualified health care professional (physician, physician assistant, nurse practitioner) who orders the treatment for the injury.

- A complete neurovascular assessment should be performed before treatment.
- Any wounds should be appropriately covered with a sterile dressing. The sterile dressing should be secured with the use of a rolled gauze.
- For acute fractures, immobilize the joint above (proximal) and below (distal) the fracture when possible.
- Gather all supplies necessary for completion of the splint. It is better to have more supplies than necessary rather than not have enough. This will prevent you from having to leave the patient in order to go get more supplies.
- Explain the treatment to the patient so he or she will have a thorough understanding of the splinting procedure.

SELECTION OF SPLINT SUPPLIES

If you are using prefabricated splinting materials (Ortho-Glass®), the use of cast padding may not be necessary. Ortho-Glass® has a felt covering over the inner fiberglass that will protect the patient from fiberglass abrasions. The use of Ortho-Glass® without cast padding will decrease the overall bulk of the splint.

Be sure to consult the qualified health care professional who ordered the splint if he or she desires the use of cast padding. Cast padding should be utilized when the technician must fabricate a splint from separate materials. The cast padding will supply a barrier from the fiberglass/plaster that will protect the patient from abrasions.

Cast padding comes in three forms: cotton, synthetic, and water resistant. Cotton material is easy to apply, tears easily, and self-bonds to create a smooth, padded undercast surface. It provides excellent cohesion for custom padding around bony prominences. Synthetic material is nonabsorbent and does not hold moisture against the skin. Its conformable stretch allows narrow widths around small anatomies without cutting or tearing.

Water-resistant material should only be used with fiberglass cast tape. The water-resistant qualities of the material allow water to quickly drain from the cast, which allows patients to shower. This material should not be used for patients who swim on sandy beaches or in lakes. It should also not be used when wounds, abrasions, or surgical incisions as they may become infected when wet.

The width of the splint and cast padding is generally determined by the width of the patient's hand at the MCP joints (upper extremity) and foot at the MTP joints (lower extremity).

Pediatric patients generally require smaller sized materials (1-in. to 2-in. cast padding and splint material), while adult patients require larger sized materials (3-in. to 4-in. cast padding and splint material).

Even larger sized patients require the use of the largest sized materials (5-in. to 6-in. cast padding and splint material).

STOCKINETTE

If swelling is present or anticipated, the use of stockinette is not advocated due to the compressive factors that may contribute to circulatory issues. Consult your health care professional on the use of stockinette with splint applications.

FIBERGLASS

Fabrication of a splint with the use of fiberglass cast tape allows for a faster setting time when compared to plaster. With this in mind, the time available for fabrication is decreased compared to plaster. Be sure to address the edges of the fiberglass tape by providing sufficient padding around all edges. A minimum of seven layers of fiberglass cast tape should be used if you are fabricating the splint.

PLASTER

Fabrication of a splint with the use of plaster cast tape will need additional time to set in order to become rigid. A minimum of 10 to 15 layers should be used if you are fabricating the splint.

PREFABRICATED

Prefabricated splinting materials have many advantages over having to fabricate a splint with raw materials. Prefabricated splints either come in a roll that can be custom measured for the patient or pre-cut strips at various sizes. The core of the prefabricated splint is typically fiberglass, so the handling time is the same as using traditional fiberglass.

SPLINTING PROCEDURE

IF USING CAST PADDING

The sized cast padding should be selected and applied to the patient. The cast padding should start distally and proceed proximally. Overlap the first circumference by 100% in order to keep the cast padding from slipping. An overlap of 50% should be used to cover the extremity. The cast padding should be wrapped at a slight angle to preventing gapping in the cast padding. The proximal and distal ends should overlap 100% for three circumferences to ensure a comfortable cuff will be established.

Be sure to evaluate bony prominences (ulnar and radial styloids, olecranon, malleoli, calcaneus) to make sure they are adequately padded. This will prevent the possible formation of pressure sores within the cast. Add additional strips of cast padding over bony prominences, such as the calcaneus, to prevent a bulky circumferential wrap. A minimum of three to four layers of cast padding should cover the entire extremity.

WATER

Use cool or room-temperature water near 70 degrees for saturating fiberglass, plaster, or prefabricated splinting materials. NEVER use hot or warm water! Warm water speeds the setting time and creates a more exotherm reaction that can burn the patient. Cooler water slows the setting time with less of an exotherm reaction. The technician should never repeatedly use the same water from splint to splint. Residue in the dip water acts as an accelerant and will cause splints to set quicker with more heat.

PATIENT PROTECTION AND COMFORT

Effort should be made to make the patient comfortable and protected during the splinting technique. The use of a drape will protect the patient from getting excessively wet during the procedure.

PATIENT POSITION

The patient should always be directly in front of the technician during the procedure. This will ensure that the correct anatomical position is monitored and maintained during the application.

EXOTHERM

The patient should be advised that a certain level of exotherm (heat) will be experienced during the setting of the splint. This exotherm will subside once the splint is fully set.

SPLINTING

Please reference Chapters 2 and 4 to review specific applications for various splints.

MOLDING AND SECURING THE SPLINT

Once positioned, splints should be secured with an compression bandage. Splints should be well molded to the body in order to maximize strength and increase the patient's comfort. It is important to make sure the compression bandage is NOT wrapped too tightly to allow for possible swelling.

Allow circulating air to cool the splint's heat production (exotherm) when setting. Do not rest a fresh splint on a pillow or exam table that could trap the exotherm and potentially burn the patient. Be sure to wait until the exotherm has subsided before allowing the patient to leave. This will prevent burns and also

ensure that the splint has achieved sufficient strength for immobilization.

If applying a splint that will go around a body part (e.g., sugar tong, lower leg with stirrup), make sure the splint does NOT completely encompass the body part. Be sure to leave at least a 1-in. gap between the edges of the splint. If the splint overlaps, it will become circumferential and therefore will NOT accommodate for swelling.

POSTAPPLICATION PROCEDURE

Be sure to evaluate the patient's neurovascular status after the completion of the splint. The patient's range of motion of nonsplinted joints on the injured extremity should also be evaluated to ensure the splint is not limiting the range of motion of those joints.

PATIENT INSTRUCTIONS

The patient should be advised of the basic symptoms of compartment syndrome and instructed to call a physician or visit an emergency room if the following symptoms occur:

- **Pain:** A steady increase of pain out of proportion to the injury. Pain sensation is greater than that experienced at the time of injury.
- **Pressure:** Splint has the sensation of "being too tight"
- **Paresthesias:** Sensation of tingling, burning or prickling
- **Pulselessness:** Weak or absence of distal pulse
- **Swelling:** Excess swelling below the splint

If any of these symptoms are present, the following steps should be taken:

1. Contact physician and outline the symptoms. If a physician cannot be reached, proceed to the closest emergency room for evaluation.
2. Elevate the extremity above the level of the heart.
3. In EXTREME cases, the qualified health care professional may advise to loosen the compression bandage that is securing the splint. This should only be advised if the patient is en route to a health care facility. Loosening the compression bandage may alter the reduction of the fracture.

The patient should avoid placing objects (pens, pens, etc.) into the splint in order to scratch the skin. Avoid getting the splint wet during bathing by wrapping it with plastic and tape. Several commer-

cial products are available to aid in the avoidance of getting the splint wet.

Also instruct the patient (especially pediatric) to avoid using the splint as a weapon. Do not use it to hit other children.

PURPOSES OF CASTING

- Provide immobilization
- Protect the injury
- Prevent further injury
- Decrease pain

The use of a cast is indicated for a wide variety of orthopaedic injuries that include fractures, sprains, and postoperative immobilization. In particular, fractures and sprains are transitioned into casts after the use of a splint during the acute injury phase. Acute injury swelling must be minimized prior to transition into a cast for more definitive injury management.

Casts are a circumferential form of immobilization that will not accommodate for swelling. If swelling occurs in a cast, the patient runs a high risk of compartment syndrome that can compromise the neurovascular integrity of the injured extremity.

All efforts should be made to minimize injury swelling. This is best accomplished by using the RICE (rest, ice, compression, and elevation) method after a cast has immobilized the injury.

SELECTION OF CAST SUPPLIES

The width of the cast tape and cast padding is generally determined by the width of the patient's hand (upper extremity) and foot (lower extremity). Pediatric patients generally need smaller sized materials (1-in. to 2-in. cast padding and cast tape) while adult patients need larger sized materials (3-in. to 4-in. cast padding and cast tape).

PRECASTING PROCEDURE

Before applying any cast, an accurate diagnosis should be made by an orthopaedic physician or other qualified health care professional (physician, physician assistant, nurse practitioner) who orders the treatment for the injury.

- A complete neurovascular assessment should be performed before treatment.
- Any wounds should be appropriately covered with a sterile dressing. The sterile dressing should be secured with the use of a rolled gauze.

- For acute fractures, immobilize the joint above (proximal) and below (distal) the fracture when possible.
- Gather all supplies necessary for completion of the cast. It is better to have more supplies than necessary rather than not have enough. This will prevent you from having to leave the patient in order to go get more supplies.
- Explain the treatment to the patient so that they will have a thorough understanding of the casting procedure.

STOCKINETTE

Stockinette generally comes in widths of 1 in., 2 in., 3 in., 4 in., and 6 in. Cut a longer piece of stockinette for a cast instead of one that “just fits” in order to have enough material to flip over the proximal and distal edges. The stockinette should fit snug against the skin but should not be tight. Any wrinkles in the stockinette should be addressed by smoothing them out to prevent unwanted skin irritation.

CAST PADDING

The sized cast padding should be selected and applied to the patient. The cast padding should start distally and proceed proximally. Overlap the first circumference by 100% in order to keep the cast padding from slipping. An overlap of 50% should be used to cover the extremity. The cast padding should be wrapped at a slight angle to prevent gapping in the cast padding. The proximal and distal ends should overlap 100% for three circumferences to ensure a comfortable cuff will be established when turning over the stockinette.

Be sure to evaluate bony prominences (ulnar and radial styloids, olecranon, malleoli, calcaneus) to make sure they are adequately padded. This will prevent the possible formation of pressure sores within the cast.

CASTING PROCEDURE

WATER

Use cool or room-temperature water near 70 degrees for saturating fiberglass. NEVER use hot or warm water! Warm water speeds the setting time and creates a more exotherm reaction that can burn the patient. Cooler water slows the setting time with a lesser exotherm reaction. The technician should never repeatedly use the same water from cast to cast.

PATIENT PROTECTION AND COMFORT

Effort should be made to make the patient comfortable and protected during the casting technique.

The use of a drape will protect the patient from getting excessively wet during the procedure.

PATIENT POSITION

The patient should always be directly in front of the technician during the procedure. This will ensure that the correct anatomical position is monitored and maintained during the application.

EXOTHERM

The patient should be advised that a certain level of exotherm (heat) will be experienced during the setting of the cast. This exotherm will subside once the cast is fully set.

CASTING

Please reference Chapters 3 and 5 to review specific applications for various casts.

CAST TAPE

The cast tape should be applied in the same manner used for the cast padding. When wetting the cast tape, submerge in water at 45 degrees for approximately 3-5 seconds. Allow excess water to drain from material prior to application.

ROLLING

Roll casts with an even distribution of the casting materials for uniform strength, not just with the idea of concentrating too much at the fracture site with weak ends of the cast.

Rub the layers of the cast that you just applied all over to laminate the layers into a solid cast. “Rub it like you love it” should be your motto! This gives the cast its greatest strength, makes it look good, and eliminates wrinkles that can cause pressure sores.

For upper extremity casts, keep the cast narrow in the web space between the thumb and index finger. Keep the palmar crease free to allow for good motion of the fingers.

MOLDING

Once applied, the cast should be well molded to the body in order to maximize strength and increase the patient’s comfort.

Before the casting material sets, be sure to mold the cast for a good anatomical fit. Be patient when molding. Hold and mold. Don’t keep squeezing and letting go, or you will break the setting plaster instead of allowing it to set with your patient and deliberate molding of the cast. Use the palms and heel of your hands to mold as opposed to using your fingers. The use of fingers will leave unwanted indentions.

Use 3-point fixation to mold displaced fractures in long bones to obtain and maintain reduction of the fracture fragments. 3-point fixation is a manual molding technique of casts and splints which can be

COMPARISON OF PLASTER VS. FIBERGLASS FOR SPLINTS AND CASTS

	Plaster	Fiberglass
Cost	lower	higher
Moldability	excellent	average
Strength	average	excellent
Weight	heavier	lighter
Curing period	48–72 hours	under 30 minutes
Radiolucency	poor	good
Water resistance	poor	excellent
Skin complications	easily washes off skin and clothes	gloves are mandatory, resin stains clothes and bonds to skin for days
Allergic reaction	very low	slightly higher
Monovalve	spreads easily	spreads but recoils; needs a wedge to maintain opening

used to obtain and maintain reduction of some displaced fractures. Place one hand on the apex of the fracture, and place your other hand on the opposite side distal to the apex and bring them together to align the fracture fragments. Once the initial layers of the cast or splint are applied, perform the same maneuver on the setting plaster or fiberglass to mold the fracture fragments in place within the cast or splint. This will help to limit the chances of the fracture slipping out of place and losing the reduction. Have a qualified medical professional instruct and supervise your technique until you are competent in this molding skill.

SOFT SPOTS

Evaluate and address soft spots that may occur when applying the cast. Soft spots typically occur around the olecranon and calcaneus and may be addressed by applying an additional roll of cast tape to this area.

POSTAPPLICATION PROCEDURE

Be sure to evaluate the patient's neurovascular status after the completion of the cast. The patient's range of motion of noncasted joints on the injured extremity should also be evaluated to ensure the cast is not limiting the range of motion of those joints.

PATIENT INSTRUCTIONS

The patient should be advised of the basic symptoms of compartment syndrome and instructed to call a physician or visit an emergency room if the following symptoms occur:

- **Pain:** A steady increase of pain out of proportion to the injury. Pain sensation is greater than that experienced at the time of injury.
- **Pressure:** Cast has the sensation of “being too tight.”
- **Paresthesias:** Sensation of tingling, burning or prickling
- **Pulselessness:** Weak or absence of distal pulse
- **Swelling:** Excess swelling below the cast

If any of these symptoms are present, the following steps should be taken:

1. Contact a physician and outline the symptoms. If the provider cannot be reached, proceed to the closest emergency room for evaluation.
2. Elevate the extremity above the level of the heart.
3. The cast may be mono-valved (single longitudinal cut) or bi-valved (double longitudinal cuts) as a first step to address this issue (these techniques are addressed later in this chapter). If this does not eliminate the symptoms, the cast must be removed.

The patient should avoid placing objects (pencils, pens, etc.) into the cast in order to scratch the skin. Avoid getting the cast wet during bathing by wrapping it with plastic. Several commercial products are available to aid in the avoidance of getting the cast wet.

Also instruct the patient (especially pediatric) to avoid using the cast as a weapon. Do not use it to hit other children.

CAST REMOVAL

When removing or splitting casts, an electric cast saw or cast cutter is used. The typical cast saw blade does not move in full circular revolutions. The blade on the saw oscillates, or moves back and forth. When using this oscillating function properly, the blade can gently be applied directly to the skin without cutting the skin. Because of the blade's back and forth movement, it can move the skin back and forth as well without cutting, if the skin is soft and supple and gentle pressure is used. Demonstrating this may ease the apprehension of nervous patients.

The cutting technique is to apply the blade to the cast and gently push it into the cast, and then proceed to cut along the cast in an "up and down" or an "in and out" motion, progressively extending the initial cut into a straight line. To facilitate the "in and out" motion, use the thumb or index finger to stabilize the hand and saw on the cast (see Figure 1.1, Cutting Technique).

Then, cut "in" the cast and use the thumb/finger as a counter force to lift "out." Use this stabilizing technique instead of stabbing at the cast without a controlled counter force. Figures 1.1, 1.2, 1.3, 1.4 use thumb/finger as counterforce. The most dangerous technique is to push the blade into the cast and drag it through the cutting area without regard to the "in-and-out" technique. This negates the intended function of the oscillating blade. NEVER drag the blade through the cast!

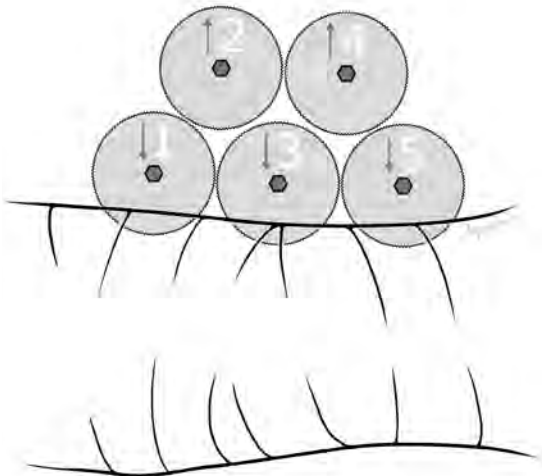


FIGURE 1.1

This illustration demonstrates the up and down or in and out techniques for safely operating the cast saw. NEVER drag the blade across the cast.



FIGURE 1.2

Demonstration of the cast saw grip using the palmar index finger to counterforce.



FIGURE 1.3

Demonstration of the cast saw grip using the thumb for counterforce.



FIGURE 1.4

Demonstration of the cast saw grip using the dorsal index finger for counterforce.

ZIP STICK

A zip stick is a long (typically 2 ft. long by 1 in. wide) piece of plastic that may be inserted into the cast to form a barrier between the patient's skin and the cast blade. This may also ease the patient's apprehension during the removal process.

SPECIAL PRECAUTION

If the blade is used directly over a bony prominence, such as a styloid process or malleolus, it can seriously cut the skin. Cuts can also occur to nails, knuckles, or stretched skin.

Friction between the blade and the cast can cause heat to develop. Keep the friction and heat to a minimum by gently pushing the blade into the cast. Don't be timid about cutting into the cast, thereby allowing the blade to rest on it. This creates more friction and heat. In other words, be slightly aggressive when cutting by carefully pushing the blade into the cast, or increased friction of the blade on the cast can actually burn the patient when the blade gets too hot. If the blade does get too hot from repeated cutting procedures or cutting through an overly thick cast, wipe the blade with an alcohol pad or cool cloth to decrease the heat.

When you are ready to begin your cast cutting procedure, follow these steps:

1. **Position your patient.** Ensure the safety of your patient by having him or her sit in a stable chair without wheels or lie down on an exam table in the case of lightheadedness or fainting. Apply gloves to your hands and drape the patient.
2. **Prepare your patient and earn his/her trust.** Ask the patient if he or she has ever had a cast removed before and if they know what to expect. If it is the first time, reassure the patient about the safety of the saw by turning it on and gently touching it along the relaxed palm of your hand to gain trust. Tell children that the saw might tickle them.
3. **Inspect the cast.** Ask the patient if he or she removed any of the padding from inside the cast. Inspect the cast for damage, sufficient padding on the edges, moisture, or unusual odor. If a patient has removed the cast padding under the cast prior to cast removal, the cast can still be safely removed by sliding a plastic strip or aluminum finger splint under the cast where the cast saw blade would be used. Gently pushing the cast on the opposite side where it will be cut creates a small space between the cast and the skin so the cast can be cut more safely without the skin

touching the blade. Be sure to be very deliberate in using the "in-and-out" cast cutting motion, using a very sensitive cutting technique. Emphasize to the patient that they should not remove the cast padding from casts in the future.

4. **Plan your cuts strategically.** Assess where to make cuts on opposite sides of the cast at its widest part, while avoiding bony prominences. If you are cutting around the ankle of a lower extremity cast, make one full-length cut behind the medial malleolus and into the widest part of the foot, and another full-length cut in front of the lateral malleolus and into the widest part of the foot to facilitate removal. If both cuts are posterior to both malleoli, the anterior half of the cast will not lift off the leg because it is molded behind both malleoli. If someone else bivalved the cast behind both malleoli and you must now remove it, simply cut a triangular-shaped piece around one malleolus so the anterior shell of the cast can freely be lifted off of the leg.
5. **Stabilize the cast and begin cutting.** Once you have determined where to make your cuts, stabilize the cast with one hand and begin cutting from the center of the cast (judging its thickness) and continue cutting to an edge. Then, return to the center and cut to the other end. Turn the extremity and cut the other side. Don't force the blade to cut all the way to the edge of a cast through thick padding and stockinette because it may be difficult for the blade to cut these soft materials. The blade might even "jump off" the edge and onto the adjoining skin.
6. **Release the cast.** Insert the cast spreaders and spread apart the two halves of the cast. The spreaders can break through the cast material under the thick padding and stockinette on the edge. Figures 1.5 and 1.6.

Use scissors to cut the stockinette at each end of the cast. Pull the anterior half of the cast away from the posterior half, then cut the cast padding from end to end with scissors. Stabilize and lift the extremity out of the posterior mold. Be careful not to twist or rotate the injured extremity when lifting. Remove the posterior mold and gently lower the extremity so it can be cleaned and prepared for any other possible procedure like suture/staple removal.

**FIGURE 1.5**

Using the cast spreaders to open the volar side of a short arm cast.

**FIGURE 1.6**

Using the cast spreaders to open the dorsal side of a short arm cast.

Frequently, a cast is removed for evaluation of an injury, so the patient is sent to radiology for imaging. The posterior mold of the split cast can be used with an compression bandage to stabilize and protect the patient if he or she is in pain when the cast is removed. When the patient is in radiology, the compression bandage and splint can be removed, imaging can be obtained, and the patient replaced into the splint and bandage for safe transport back to the cast room. Be sure to order removal of the splint when ordering the images and to have the radiology tech ask for your help if needed to manage the splint removal and reapplication in the radiology area.

SPECIFIC CAST-CUTTING PROCEDURES

MONOVALVE/UNIVALVE

Making a single cut along a full length of a cast is called a monovalve or a univalve. This is done to relieve or to prevent circulatory constriction in a cast where swelling is present or anticipated, like when a fracture reduction takes place. After a monovalve cut is made in the cast, it should gently be spread apart to keep the space open between the edges, creating greater volume in the cast, which allows for better circulation. Plaster casts usually stay open better than fiberglass casts because they are not as strong in the early “green” stage of drying. Commercially available plastic wedges can be inserted into the space of the monovalve to maintain the open space, especially with fiberglass casts. The patient should be instructed to report any problems in circulation or to return if necessary.

BIVALVE

Making two cuts on opposite sides of a cast is called bivalving a cast. Casts are bivalved for many reasons, including the following:

- Immediate removal when a cast is too loose, dirty, broken, has lost its fracture reduction, for evaluation of fracture healing, or when the cast is no longer needed.
- Immediate removal to relieve circulatory constriction or compartment syndrome. All encircling bandages are cut down to the skin and removed to properly assess circulatory and neurological status. The posterior mold may be left on the patient, if possible, to protect the fracture during assessment, but it should be removed if it compromises a thorough evaluation of neurovascular status. It is better to lose a fracture reduction by completely removing the cast for evaluation than to permanently lose the function of a compartment or limb due to Volkman’s Ischemic contracture. Make a neurovascular assessment using the “7 Ps” (pain, pallor, paraesthesia, paralysis, pulselessness, pressure, and puffiness). Immediately report your findings to the attending physician.
- Removal at a later time, such as when a patient’s cast will be bivalved in the clinic, on the hospital ward, or in the ER prior to a visit to the operating room. The cast is minimally

spread open on both sides. The padding and stockinette remain intact. It is wrapped with compression bandages that are removed later in the OR along with the cast. This allows the surgeon to avoid using the cast cutter in the OR so dust is not circulated in the surgical suite prior to the procedure, and it saves time for the OR staff. This delayed removal is also used when a physician orders it post-op or post-fracture reduction instead of a monovalve procedure. It allows for the cast to be loosened or removed if it becomes too tight.

- Immediate removal to convert a cast into a night splint. After a bivalve, both shells are removed. The circumferential padding is completely stripped and replaced with longitudinal strips of padding. Tape the padding over the edges of the shell and insert each shell into a separate stockinette, which is then folded over the end and taped. The patient is placed into the posterior shell first and then covered with the anterior shell. Both are overwrapped with compression bandages and then worn at night to maintain a position usually achieved by serial casting or post clubfoot casting.

When taking an order from the qualified health care professional about bivalving a cast, make sure you understand his/her objectives of treatment, especially when there are concerns about circulatory constriction or compartment syndrome.

WINDOW

A window may be cut into a cast for the following reasons:

- Wound care
- Investigating a complaint like a pressure sore
- Checking a pulse
- Breathing window in a body cast
- Ultrasound bone stimulator

When applying a cast over a wound that will need a window, apply extra 4 x 4 gauze sponges in a stack over the wound to be windowed. With each layer of stockinette, cast padding, and plaster/fiberglass rolls, mold around the contour of the 4 x 4 sponges to clearly outline their location. Apply extra plaster/fiberglass in the area of the cast around the window to make it strong enough to withstand the weakening effect of the window in the cast.

When the cast has set sufficiently and the exotherm has subsided, mark the edges of the window with a pencil, and then cut the window slightly larger than the 4 x 4 sponges. Try cutting the window edges at a 45-degree angle so the window won't fall into the cast later when repositioned. Be sure to cross-cut all the corners of the window for a clean cut that will easily detach the window from the cast without damage to it. Remove the rigid window covering. Carefully lift and cut the padding in the center down to the 4x4 bundle below. Cut the cast padding from the center to the four corners of the window and peel the padding over each edge of the window until the 4 x 4 stack can be removed to expose the wound. Make sure you can visualize the entire wound. Replace the 4 x 4 stack, turn back the cast padding to the center of the window, and always return the rigid window cover to prevent window edema. If the window drops into the cast, a felt pad can be cut and placed over the cast padding and then covered with the rigid cover. Overwrap the window cover with an compression bandage to change the dressing in the future. Cover it with more casting material if the window will not be used again in the future.

OPEN AND CLOSED WEDGING

Casts are wedged to correct for unwanted angulation of long bones, joints, or the spine that have already been casted. There are two types of cast wedging procedures, open and closed.

Open wedge. Open wedge procedures are more common than closed wedge procedures because they are easier to perform. For example, a midshaft fracture of the tibia with varus (lateral) angulation requires a cut about two-thirds around the cast at the level of the fracture on the medial side of the cast. One third of the cast is left uncut on the lateral side of the cast to provide stability for fracture reduction. The medial cut is gently spread open with the spreaders until the fracture is reduced to the anatomical position (see Figure 1.7, Open Wedge). Check the cast padding in the opening to ensure there is acceptable layering of padding without any gaps. Add more padding if necessary. Open wedge procedures require a piece of plastic, cork, wood, or casting material to hold the spread cast open so it can maintain the reduction. Confirm the reduction with X-ray or fluoroscopic images, and then overwrap the wedged section of the cast with more casting material. There are commercially available sets of plastic cast wedges in different sizes for a variety of open wedge reductions.

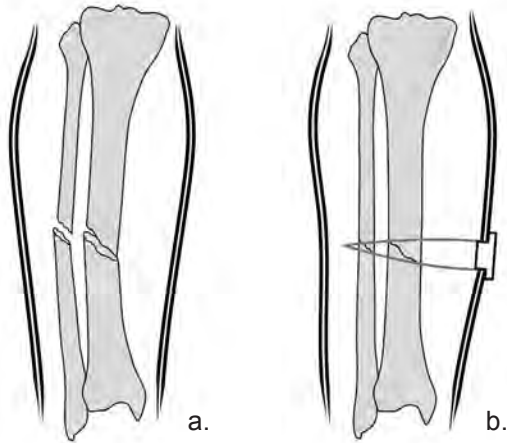


FIGURE 1.7 OPEN WEDGE

- This casted midshaft fracture of the tibia and fibula still has lateral or varus angulation.
- After a cut has been made into the cast at the level of the fracture on the medial side about two-thirds of the way around the cast, the cast is spread open to reduce the fracture and is held with a plastic wedge.

Closed wedge. Closed wedge procedures are less commonly performed than open wedge procedures. To treat a mid-shaft fracture of the tibia with lateral (varus) angulation using the closed wedge technique, you must make a wedge-shaped cut on the lateral side of the cast at the level of the fracture and then remove the cut wedge. The greater the angulation of the fractured leg, the larger the size of the wedge that should be cut out of the cast. Manipulate the cast with a valgus force across the wedge cut in the cast, closing the open wedge (bringing the cut edges of the cast closer together), which should reduce the fracture to the anatomical position. Be very careful when closing the wedge, so you do not pinch the skin and cause a pressure sore (see Figure 1.8 Closed Wedge). Check the cast padding to ensure that there is not an unacceptable amount of bunching, which could also cause a pressure sore. Fix the bunched padding, if necessary. Confirm the reduction with X-ray or fluoroscopic images, and then over wrap the wedged section of the cast with more casting material.

Cast wedging procedures can be very difficult manipulations that obtain reductions in multiple combinations of the AP and mediolateral planes and can compromise soft tissue structures. Cast wedging requires an experienced orthopaedist who will supervise the anesthesia, the reduction, the subsequent interpretation of imaging and neurovascular exam.

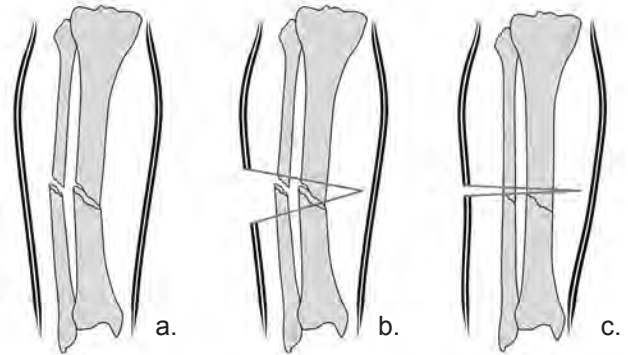


FIGURE 1.8 CLOSED WEDGE

- This casted midshaft fracture of the tibia and fibula still has lateral or varus angulation.
- A section of the cast has been cut away on the lateral side of the cast about two-thirds of the way around the cast.
- The wedge section in the cast is closed, thus reducing the fracture. It is not closed entirely so the skin does not get pinched on the lateral side.

TRIMMING

Casts are trimmed when their edges are too long and/or unpadded. A common area for trimming is in the popliteal area behind the knee of a short leg splint/cast, which has been applied too proximal. The cast should be marked with a pencil about 2 in. below the popliteal crease and then trimmed to create more room to increase knee flexion. Be sure that there is sufficient cast padding on the trimmed edge of the cast/splint. Add more padding as necessary, using the technique described as *petaling* in the next paragraph.

CAST CONVERSION

Cast conversions are performed when a long arm cast is cut down into a short arm cast. This allows the patient to begin moving the elbow and forearm while still protecting a wrist fracture. Long leg casts can also be converted into short leg casts. To make an accurate cut, wrap a piece of string or a tape measure around the cast at the level where the cast should be cut, mark it with a pencil, and then cut around the mark. Bivalve the proximal portion to be removed and take it off. Trim the remaining padding and stockinette so it is about two inches from the edge of the short arm cast. Flip this padding over the edge and secure it with tape, or casting material. If the cast padding on the edge needs to be replaced, then a “petaling” procedure needs to be done. Position the patient so you can comfortably wrap cast

padding around the proximal part of the cast, which has no padding on it. Wrap three or four layers of cast padding around the proximal edge so that half of the padding is on the cast and half of the padding goes over the edge onto the skin. Fold the cast padding that is on the skin so it is now tucked inside the cast and is padding the edge. Use a tongue depressor for tucking the padding inside the cast if your fingers are too big. Add more layers if necessary to make it fit snug. Finish the petaling by overwrapping the cast padding outside the cast with tape, coban, or more fiberglass/plaster.

OTHER IMPORTANT CONSIDERATIONS

- Be sure to read the manufacturer's product guide, which is provided with the cast saw.
- The use of a vacuum system attached to the cast cutter for collecting cast dust when cutting is highly recommended for health and environmental issues. Consider using a mask for your patient and yourself when cutting casts without a vacuum.
- Familiarize yourself with the correct technique in the changing of a dull or damaged cast saw blade. Sharp blades will prolong the life of your cast saw. Dull blades may cause more heat to develop from friction. Inspect blades and change them when dull.
- Practice electrical safety when using cast saws around water buckets.
- After using a cast saw on a patient, move the saw away from areas where the patient or you walk so there is no tripping hazard present.
- Clean the cast saw and blade frequently for good hygiene.
- Change vacuum dust bags/filters on a regular schedule.
- Eye and ear protection (glasses, goggles or a shield, ear plugs) should be considered during the cast removal process.