

Below-knee cast

Casting Immobilization Series for Primary Care

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The below-knee cast is a circumferential shell of casting material (plaster of Paris or synthetic) that is useful for immobilizing fractures and complex ligamentous injuries of the lower leg, and for maintaining foot position during conservative management of Achilles tendon ruptures. Casting can be a temporizing measure pending definitive fracture fixation.

While many injuries are commonly managed using inflatable boots, the casting technique remains useful in caring for patients who do not have the resources to afford these devices or when such devices are unavailable. Inflatable boots also remain an incompatible solution for some problems (eg, unstable displaced ankle fractures requiring a carefully molded cast to maintain reduction).

Considering a back slab rather than a circumferential cast and ensuring careful application technique to avoid complications are important.

Indications

Injuries potentially appropriate for below-knee cast immobilization include the following:

- fractured malleoli;
- fractured tarsals and metatarsals;
- fractured distal tibia (eg, pilon fracture);
- fractured fibular shaft or neck (occasionally used temporarily for symptom relief but promotes ankle stiffness; beware of associated syndesmosis injury);
- ruptured Achilles tendon (ankle in plantar-flexed position); and
- complex ligamentous ankle injuries.

Conventional below-knee casts are inappropriate for managing proximal tibial shaft injuries, as control of rotational displacement requires immobilizing the knee.¹

Steps for immobilization

Educate the patient and obtain informed consent

- Explain the procedure and obtain informed consent.
- Review the reasons for using this kind of immobilization; the risks, benefits, and possible complications; care of the cast; and further treatment (eg, definitive fixation) and reasons to return (eg, cast wet, unanticipated pain).

Prepare and apply the below-knee cast

- Follow the steps outlined in **Figures 1 to 10**.

Figure 1. Assemble the needed equipment



- Stockinette: used to protect the skin.
- Cotton rolls: used for padding.
- Plaster of Paris (or synthetic) bandages: used to make the cast.
- Bandage scissors: blunt-tipped scissors to cut material without injuring the skin.
- Room-temperature water (not shown): colder water will give more working time and minimize the risk of burning patients with the exothermic reaction of the cast curing, although it will be harder to manipulate the material.
- Underpads (not shown): used to avoid soiling patient's clothing.
- Ideally, an assistant.

Figure 2. Position the patient



- This cast can be applied with the patient supine on the examination table with knee support or sitting with the limb hanging, as pictured.

Figure 3. Identify the landmarks for the cast

- Landmarks are distal to the tibial tuberosity extending proximal to the metatarsophalangeal joints.
- Extending beyond these points will prevent movement of the knee and toes, and cause discomfort, abrasion, and potentially skin breakdown.

Figure 4. Measure, apply, and trim the stockinette

- The stockinette should extend 8 to 10 cm beyond the landmarks.
- Keep the foot close to the intended 90° position to ensure correct length. Cut out wrinkles that cannot be smoothed out.
- Roll the stockinette on as seen in **Figure 2** to limit discomfort.

Figure 5. Apply the padding

- Wrap the cotton roll circumferentially around the leg starting 2 to 3 cm proximal to the tibial tuberosity and rolling distally until the toes are almost covered.
- Keep wrapping the leg, overlapping each previous pass by half until reaching the ankle. Use smaller padding bandages or a "figure of 8" technique to negotiate the 90° angle of the ankle.
- Maintain the desired position of the joint, as repositioning after the padding is applied will create unwanted wrinkles and pressure.
- Additional padding can protect bony prominences.
- Excessive padding prevents optimal molding and injury stabilization.
- Padding should not be constrictive and should extend 2 cm beyond the intended cast edges as a "cuff".
- The padding will form the guide for where the setting plaster will go. Take time to ensure you are happy and, if not, remove and reapply.

Figure 6. Apply the plaster or synthetic bandage



- Open all bandage packets required; it is much harder with wet slippery hands.
- Holding the bandage as you plan to roll it around the limb (with the bulk uppermost), submerge the bandage in water and squeeze out any excess water, maintaining control of the leading edge.
- Roll the wet plaster between the identified landmarks in the same manner as the padding, leaving the “cuff” as described in **Figure 5**.

Figure 7. Turn back the stockinette edges



- Fold back the padding and stockinette to obtain soft edges.
- If there is more than a couple of centimetres of overlap, trim it to prevent difficulty of removal with a cast saw later.

Figure 8. Apply another layer of cast



- Following the same process as with the first layer and taking in the edges of the stockinette, apply further layers of cast material until you are satisfied with the strength.
- As a guide, 4 to 6 layers of plaster or 3 to 4 layers of synthetic material are needed.
- Inform the patient that the cast becomes warm during the hardening process.

Figure 9. Mold the cast



- Smooth the layers of cast together so that they unite as one continuous cast; wetting your hands repeatedly will ensure this.
- Using the palms of your hands and not your fingertips prevents pressure areas; apply molding as needed to correct radiologically confirmed deformities.
- Here, lateral talar shift is reduced by medial pressure on the distal cast while the 90° position is maintained with the clinician's chest.
- For most injuries (except Achilles tendon rupture) a 90° foot position is desirable to minimize the risk of plantar flexion contracture once immobilization is discontinued.
- Ensure anatomic positioning and reduction as required.

Notable points

- Examine the knee and fibular neck and obtain full-length x-ray scans of the fibula if there is clinical suspicion of Maisonneuve injury (proximal fracture of the fibula associated with tears of the distal tibiofibular syndesmosis and interosseous membrane) or avulsion fracture of the base of the fifth metatarsal.
- Elevating the limb is important; dependent positioning causes swelling, pain, and potential compartment syndrome due to the cast.²
- Fracture-dislocation of the ankle is a limb-threatening injury; a closed reduction under procedural sedation should be performed expediently before immobilization.


Potential complications

Alteration to circulation or local nerves can be induced if casting is applied too tightly. Be cognizant of the common peroneal nerve wrapping around the fibular neck.³

Figure 10. The below-knee cast



- Ensure that adequate mobility of the knee joint and toes has been preserved.
- Check for adequate capillary refill compared with the opposite toes.
- Rest the limb on a soft pillow in an elevated position for 24 to 48 hours after application until the cast is completely cured.
- Obtain post-reduction radiographs to confirm position, as clinically indicated.

Skin ulcers can be produced where adequate padding does not protect bony prominences. After casting, always confirm that there is adequate perfusion and active movements, and document a neurovascular examination. 

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Competing interests

None declared

References

1. Court-Brown CM. Fractures of the tibia and fibula. In: Rockwood CA, Green DP, Buchholz RW, editors. *Rockwood and Green's fractures in adults*. 6th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2006. p. 2079-146.
2. LaBella CR. Common acute sports-related lower extremity injuries in children and adolescents. *Clin Pediatr Emerg Med* 2007;8(1):31-42.
3. McRae R, Esser M. *Practical fracture treatment*. 5th ed. London, Engl: Churchill Livingstone; 2008.

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