

7A: Orthopedic Casting for the Lower Extremity

01 Importance of Casting for the Lower Extremity

02 Anatomical Considerations

03 Lower Extremity Casts - Overview



Unit 7A: Overview

Orthopedic casting for the lower extremity is a fundamental skill in musculoskeletal care, providing stability, immobilization, and support for fractures, soft tissue injuries, and post-surgical recovery. Proper casting techniques not only facilitate optimal healing but also help prevent complications such as pressure sores, skin irritation, and circulation impairment. This section will cover essential casting methods, materials, and application techniques for the foot, ankle, lower leg, knee, and femur. By mastering these principles, practitioners can ensure safe, effective, and patient-centered orthopedic care.

Upon successful completion of these orthopedic modules, students will be able to:

- ✓ Identify the major bony structures, soft tissue components, and neurovascular pathways of the lower extremity.
- ✓ Differentiate between normal and pathological anatomical presentations that may impact casting procedures.
- ✓ Assess the implications of anatomical variations on the selection and application of lower extremity casts.
- ✓ Define the primary objectives of lower extremity casting in orthopedic practice.
- ✓ Compare the indications and contraindications of different casting methods used in lower extremity injuries.
- ✓ List the essential materials and tools required for lower extremity cast application and removal.
- ✓ Explain the step-by-step process of applying and removing various types of lower extremity casts.
- ✓ Perform the proper technique for applying and safely removing a lower extremity cast under supervision.
- ✓ Distinguish between different lower extremity casting techniques and their clinical applications.

Importance of Casting for the Lower Extremity

Orthopedic casting for the lower extremity is a fundamental intervention in the management of fractures, soft tissue injuries, and post-surgical immobilization. The lower extremity consists of complex anatomical structures, including bones, joints, muscles, and ligaments, that play a vital role in weight-bearing and mobility. When an injury occurs, maintaining proper alignment and stability is critical for healing and functional recovery. Casting serves as a non-invasive means of immobilization, allowing for controlled healing while minimizing the risk of complications such as malunion, nonunion, or joint contractures. Additionally, lower extremity casts help reduce pain and inflammation by restricting unnecessary movement at the injury site. Clinicians must consider factors such as the type and severity of the injury, the patient's activity level, and the need for partial or full weight-bearing restrictions when selecting the most appropriate casting method.

Beyond immobilization, casting plays a crucial role in preventing secondary complications associated with musculoskeletal injuries. A properly applied cast ensures adequate support and stability while maintaining circulation and soft tissue integrity. However, improper application, excessive tightness, or prolonged immobilization can lead to severe complications such as pressure ulcers, skin maceration, nerve compression, and deep vein thrombosis (DVT). Special attention must be given to bony prominences, vascular structures, and soft tissue padding to prevent excessive pressure that could compromise skin and neurovascular health. Additionally, clinicians must educate patients on proper cast care, including monitoring for signs of compartment syndrome, infection, or cast loosening. Regular follow-up and cast adjustments, if necessary, are essential to ensure continued effectiveness and prevent complications during the healing process.

The effectiveness of lower extremity casting also extends to its impact on rehabilitation and long-term function. A well-constructed cast allows for safe healing while preserving joint mobility and reducing the risk of muscle atrophy. In cases of prolonged immobilization, weight-bearing restrictions must be carefully managed to prevent muscle deconditioning and loss of proprioception. Additionally, rehabilitation protocols, including gradual weight-bearing progression and range-of-motion exercises, should be incorporated as part of the recovery plan to ensure a smooth transition from immobilization to functional movement. Understanding the biomechanics of the lower extremity and selecting the most appropriate casting technique—such as short leg casts, long leg casts, or walking casts—can significantly impact the patient's recovery trajectory. By mastering best practices in lower extremity casting, healthcare providers can optimize patient outcomes, reduce complications, and enhance the overall success of orthopedic treatment.

Anatomical Considerations of the Lower Extremity

Overview of Lower Extremity Anatomy

The lower extremity is a complex region of the human body that plays a fundamental role in mobility, balance, and weight-bearing activities. This anatomical region consists of multiple interconnected structures, including bones, muscles, ligaments, tendons, and neurovascular components. These elements work in synchrony to facilitate movement, provide structural support, and maintain stability during dynamic and static activities.

The lower extremity is divided into distinct regions: the pelvic girdle, thigh, leg, and foot. The pelvic girdle serves as the foundation, anchoring the lower limbs to the axial skeleton while also transmitting weight from the trunk to the legs. The femur, the longest and strongest bone in the human body, forms the primary framework of the thigh, connecting proximally with the pelvis at the hip joint and distally with the tibia and patella at the knee joint. The tibia, or shinbone, is the primary weight-bearing bone of the lower leg, while the fibula, though smaller, serves as a stabilizer and attachment site for muscles and ligaments.

The foot is an intricate structure composed of the tarsal, metatarsal, and phalangeal bones, forming a highly adaptable and supportive framework. The arches of the foot contribute to shock absorption and energy conservation during gait. Soft tissues, including muscles, ligaments, tendons, and fascia, play an essential role in movement and stabilization. The quadriceps and hamstrings in the thigh, gastrocnemius and soleus in the lower leg, and various intrinsic muscles of the foot all work collectively to enable walking, running, jumping, and other functional activities. Ligaments, such as the anterior cruciate ligament (ACL) in the knee and the deltoid ligament in the ankle, provide stability and restrict excessive motion, preventing injuries.

The neurovascular system of the lower extremity is equally significant. The femoral artery, a continuation of the external iliac artery, supplies oxygenated blood to the leg, branching into the popliteal, anterior tibial, posterior tibial, and peroneal arteries. The venous system, including the great and small saphenous veins, facilitates blood return to the heart. Major nerve structures such as the sciatic nerve, which bifurcates into the tibial and common peroneal nerves, along with the femoral and obturator nerves, provide motor and sensory innervation crucial for movement and sensation.

Anatomy Lower Extremity cont...

Bony Structures

The skeletal framework of the lower extremity is divided into the pelvic girdle, thigh, leg, and foot.

- Pelvic Girdle: Comprised of the ilium, ischium, and pubis, the pelvic girdle provides structural support and weight distribution between the spine and lower limbs.
- Femur: The longest and strongest bone in the body, the femur articulates proximally with the pelvis at the hip joint and distally with the tibia and patella at the knee joint.
- Patella: A sesamoid bone within the quadriceps tendon that enhances the mechanical advantage of the quadriceps muscle group.
- Tibia and Fibula: The tibia, or shinbone, bears the majority of weight, while the fibula provides lateral support and serves as an attachment site for muscles and ligaments.
- Foot Bones: The tarsal bones (including the talus and calcaneus), metatarsals, and phalanges create a rigid yet adaptable structure for weight distribution and movement.

Soft Tissue Structures

The lower extremity consists of essential soft tissues that facilitate movement and stability.

- Muscles: Major muscle groups include the quadriceps and hamstrings in the thigh, the gastrocnemius and soleus in the lower leg, and the intrinsic foot muscles that aid in balance and propulsion.
- Ligaments: These connective tissues stabilize joints, such as the anterior and posterior cruciate ligaments (ACL and PCL) in the knee and the deltoid ligament in the ankle.
- Tendons: The Achilles tendon, patellar tendon, and other structures transmit muscular forces to bones, allowing movement.
- Fascia: The deep fascia of the leg, including the iliotibial band, plays a crucial role in compartmentalization and force distribution.

Neurovascular Structures

The lower extremity is richly supplied by blood vessels and nerves that provide oxygen, nutrients, and sensory-motor control.

- Arteries: The femoral artery (a continuation of the external iliac artery) provides major circulation to the leg, branching into the popliteal, anterior tibial, posterior tibial, and peroneal arteries.
- Veins: The great and small saphenous veins aid in venous return to the heart, alongside deep veins such as the femoral and popliteal veins.
- Nerves: Major nerve structures include the sciatic nerve (which bifurcates into the tibial and common peroneal nerves), femoral nerve, and obturator nerve, all of which contribute to motor and sensory innervation.

Key Anatomical Landmarks for Lower Extremity Casting

Proper casting techniques depend on identifying critical anatomical landmarks to ensure effective immobilization, alignment, and comfort for the patient.

Foot and Ankle

- Medial and Lateral Malleoli: Serve as reference points for ankle positioning.
- Base of the 5th Metatarsal: Critical for evaluating midfoot fractures and ensuring proper foot alignment.
- Navicular Tuberosity: Serves as a reference for medial arch support in casting.

Lower Leg

- Tibial Crest and Anterior Tibial Border: Guides cast application to avoid excessive pressure.
- Fibular Head: Important to consider for preventing peroneal nerve compression.
- Medial and Lateral Tibial Condyles: Key for knee immobilization.

Knee and Thigh

- Patella: Central landmark for knee immobilization and patellar tracking assessment.
- Tibial Tuberosity: Essential for assessing quadriceps function and knee extension alignment.
- Greater Trochanter: Used to ensure hip and femoral alignment during thigh casting.

Types of Lower Extremity Casts and Splints - Overview

(1) Short Leg Cast

A short leg cast (SLC) is a circumferential immobilization device that extends from just below the tibial tuberosity to the metatarsophalangeal joints, leaving the toes exposed. This cast is primarily used to manage fractures, ligamentous injuries, and postoperative immobilization in the lower leg, ankle, and foot (Eiff et al., 2020).

Indications

- Distal tibia and fibula fractures (e.g., nondisplaced distal tibial shaft fractures, isolated fibular fractures).
- Ankle fractures and severe sprains (e.g., lateral malleolus fractures, stable bimalleolar fractures, high-grade ligament sprains).
- Metatarsal and tarsal injuries (e.g., nondisplaced fractures of the metatarsals, Lisfranc injuries).
- Postoperative immobilization following foot or ankle surgery.

Application Steps

1. Patient Preparation: Position the patient supine with the knee slightly flexed and the foot at 90 degrees neutral dorsiflexion to prevent equinus deformity.
2. Padding Application: Apply a layer of stockinette from the toes to just below the knee, followed by multiple layers of cast padding ensuring adequate protection over bony prominences (e.g., malleoli, heel, and anterior tibial crest).
3. Application Fiberglass: Apply a thin layer of plaster or fiberglass casting material circumferentially, molding it for optimal contour and support.
4. Positioning and Molding: Ensure the ankle remains at 90 degrees to maintain neutral alignment while molding the cast.
5. Setting/Drying and Hardening: Allow the cast to dry fully, which takes 10–15 minutes for fiberglass and up to 24 hours for plaster (Eiff et al., 2020).
6. Post-Application Care: Check for adequate circulation, sensation, and motion (CSM) and educate the patient on cast care and warning signs of complications (e.g., pain, swelling, numbness).

Types of Lower Extremity Casts and Splints - Overview

(2) Long Leg Cylinder Cast

A long leg cylinder cast is an extended circumferential cast from the proximal thigh to the ankle, without including the foot. This cast provides rigid support for the knee and adjacent structures while allowing mobility of the foot and ankle (Bucholz et al., 2021).

Indications

- Patella fractures (e.g., nondisplaced transverse fractures).
- Tibial plateau fractures (post-surgical stabilization or conservative management).
- Quadriceps or patellar tendon ruptures (post-surgical immobilization).
- Severe ligamentous knee injuries requiring prolonged immobilization.

Application Steps

1. Positioning: The patient is placed supine with the knee in slight extension (5–10 degrees) to prevent stiffness.
2. Padding Application: Apply stockinette and multiple layers of cast padding, with extra cushioning over the patella, fibular head, and tibial tuberosity.
3. Cast Material Application: Apply fiberglass or plaster in circular layers, ensuring proper molding around the medial and lateral femoral condyles for structural support.
4. Molding and Shaping: Maintain patellar positioning and prevent excessive tightness by ensuring even pressure distribution.
5. Drying and Setting: Allow the material to fully set and harden, which takes approximately 15 minutes for fiberglass and up to 24 hours for plaster (Bucholz et al., 2021).
6. Follow-up Instructions: Educate the patient on weight-bearing restrictions, cast care, and signs of neurovascular compromise (e.g., increased pain, tingling, or swelling).

Types of Lower Extremity Casts and Splints - Overview

(3) Posterior Rigid Splint

A posterior rigid splint is a non-circumferential immobilization device that supports the lower extremity while allowing some degree of swelling. It is commonly used in acute injuries before definitive casting to prevent complications such as compartment syndrome (Eiff et al., 2020).

Indications

- Acute fractures of the tibia, fibula, or ankle (prior to casting).
- Severe ankle sprains (when swelling prevents immediate casting).
- Achilles tendon ruptures (temporary immobilization before surgical intervention).
- Postoperative immobilization in trauma cases.

Application Steps

1. Patient Positioning: Place the patient supine with the knee slightly flexed and the ankle in neutral or plantarflexion (for Achilles injuries).
2. Padding Application: Apply stockinette and cast padding along the posterior lower leg, ensuring thicker layers over bony prominences.
3. Splint Material Preparation: Wet and activate fiberglass or plaster slabs, then apply along the posterior aspect of the leg extending from the proximal calf to the metatarsal heads.
4. Securing the Splint: Wrap the splint with elastic bandages (ACE wrap) from distal to proximal, ensuring moderate compression without restricting circulation.
5. Molding and Positioning: Adjust the ankle angle as necessary, maintaining proper dorsiflexion for ankle injuries or slight plantarflexion for Achilles injuries.
6. Drying and Setting: Allow the splint to set while monitoring for signs of swelling, vascular compromise, or discomfort (Eiff et al., 2020).
7. Patient Education: Instruct the patient on splint care, weight-bearing precautions, and follow-up appointments for re-evaluation or casting.

Conclusion

Lower extremity casts and splints serve as essential tools for immobilizing fractures, ligament injuries, and postoperative conditions. Proper selection and application of each device ensure optimal healing, prevent complications, and facilitate patient recovery. Short leg casts provide immobilization for foot and ankle injuries, long leg cylinder casts stabilize knee injuries, and posterior rigid splints offer temporary support in acute trauma cases. Healthcare providers must adhere to proper casting and splinting techniques to optimize outcomes and prevent complications such as compartment syndrome and cast pressure sores (Bucholz et al., 2021).