

ORTHOPEDIC CASTING MANUAL

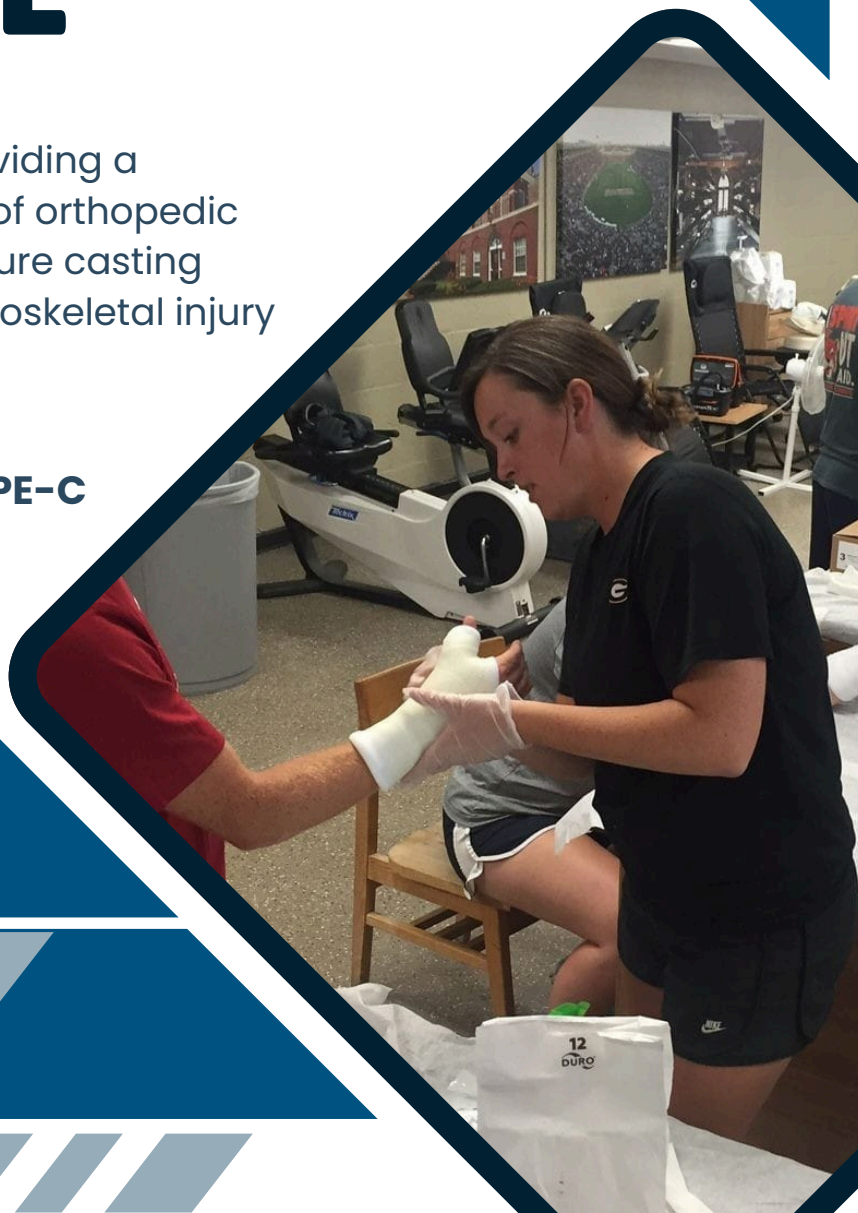
A comprehensive course providing a foundational understanding of orthopedic principles and essential fracture casting methods for effective musculoskeletal injury management


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ORTHOPEDIC CASTING MANUAL

The Orthopedic Casting and Splinting Manual for the Upper and Lower Extremities is an essential resource designed to provide healthcare professionals with a comprehensive guide to the principles and techniques of orthopedic immobilization. Developed by the American Society of Orthopedic Professionals (ASOP), this manual serves as a practical reference for clinicians, including athletic trainers, orthopedic technologists, physician assistants, and other allied health professionals involved in musculoskeletal care.

This manual covers the fundamental and advanced techniques of casting and splinting, ensuring proper application for various orthopedic conditions. It provides step-by-step instructions, supported by high-quality illustrations, audio and video renderings for evidence-based best practices. Readers will gain insights into material selection, patient positioning, and troubleshooting common challenges encountered in immobilization procedures.

Key topics include:

- Basic principles of casting and splinting, including safety considerations
- Application techniques for upper and lower extremity casts and splints
- Specialized casting methods for complex fractures and post-operative care
- Proper fitting, molding, and removal procedures

Emphasizing both precision and patient comfort, the Orthopedic Casting and Splinting Manual is an invaluable guide for clinicians seeking to enhance their skills in orthopedic immobilization. Whether used for training, certification preparation, or clinical practice, this manual upholds the highest standards of orthopedic care established by ASOP.

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SECTION 1

FOUNDATIONS OF ORTHOPEDIC CASTING

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Section I: Foundations of Casting

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UNIT 1:

01 History and evolution of casting

02 Role of the Orthotech in casting

03 Indications and contraindications for casting

Section 1: Foundations of Casting

UNIT 1: Introduction to Casting in Orthopedic Practice

Welcome to the Orthopedic Fracture Casting Techniques course.

This comprehensive course is designed to provide students with a solid foundation in the principles of orthopedics and a thorough understanding of the various fracture casting techniques employed in the management of musculoskeletal injuries. As a medical professional, it is essential to have a strong grasp of orthopedic principles, casting techniques, and the appropriate management of fractures to ensure optimal patient outcomes.

Throughout this course, students will delve into the anatomy and biomechanics of the musculoskeletal system, explore the diagnosis and classification of fractures, and develop practical skills in casting and immobilization techniques. The course will also address essential aspects of patient care, including cast maintenance, complication management, and the role of rehabilitation in achieving functional recovery. With a combination of theoretical knowledge and hands-on practice, students will become proficient in the assessment and management of various orthopedic conditions, enabling them to provide the highest standard of care to their patients.

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

- ✓ Demonstrate a comprehensive understanding of the anatomy and biomechanics of the musculoskeletal system.
- ✓ Identify and classify various types of fractures and orthopedic injuries based on their location, morphology, and etiology.
- ✓ Develop proficiency in the application of appropriate casting techniques for specific fractures and musculoskeletal injuries, including those involving the upper and lower extremities.
- ✓ Implement fundamental principles of orthopedic casting, including anatomic reduction, immobilization, and patient comfort, to ensure optimal healing and functional recovery.
- ✓ Recognize and manage common complications associated with orthopedic casting, such as pressure sores, compartment syndrome, and cast-related skin problems.
- ✓ Provide patients with clear instructions on cast care, including maintenance, hygiene, and strategies to prevent complications.
- ✓ Evaluate the role of rehabilitation and in the recovery process following fracture management with casting techniques.
- ✓ Apply effective communication skills when interacting with patients, their families, and the interdisciplinary healthcare team to ensure coordinated and patient-centered care.
- ✓ Stay current with evolving best practices and advancements in orthopedic casting techniques to continuously improve patient care.
- ✓ Demonstrate professionalism, ethical behavior, and cultural competence in the management of patients with orthopedic injuries.

1.1 History and Evolution of Casting

Casting has evolved significantly from its origins in ancient civilizations to its current advanced forms used in orthopedic practice. Understanding this progression provides valuable context for modern casting techniques and the role of the orthotech in managing injuries.

Orthopedics, derived from the Greek words "orthos" meaning "straight" or "correct" and "paidion" (meaning "child"), is a medical specialty that focuses on the diagnosis, treatment, and prevention of musculoskeletal disorders. Although orthopedic medicine has evolved significantly over time, its historical roots can be traced back to ancient civilizations.

- **Ancient Methods**

- Casting can be traced back to ancient Egypt, where linen bandages and natural resins were used to immobilize fractures. Edwin Smith Papyrus, a surgical document from around 1600 BCE, describes the use of splints to stabilize fractures (Anderson, 2015). Similarly, Hippocrates of ancient Greece, often regarded as the "Father of Medicine," documented methods for fracture reduction and splinting (Galloway et al., 2021).

- **Medieval and Renaissance Developments**

- During the Middle Ages, fracture care involved rudimentary splints made from wood or leather. The Renaissance era brought a deeper understanding of human anatomy through pioneers like Andreas Vesalius, who influenced the treatment of fractures with more anatomically accurate methods (Brown & Parker, 2018).

- **19th Century: The Advent of Modern Casting**

- The term "orthopedics" was first coined by French physician Nicholas Andry in his 1741 book "Orthopaedia, or the Art of Correcting and Preventing Deformities in Children." Andry's work laid the foundation for the modern discipline, emphasizing the importance of correcting musculoskeletal deformities in children to promote healthy development. The introduction of plaster of Paris in the 1800s marked a turning point in fracture care. Invented by Mathijsen, a Dutch military surgeon, plaster casts were lightweight, moldable, and provided rigid immobilization (Robinson, 2020).

- **20th Century to Present: Advanced Materials and Techniques**

- The development of fiberglass casting materials in the mid-20th century further improved the process by offering lightweight, durable, and water-resistant options. Modern innovations, such as breathable cast liners and waterproof materials, continue to enhance patient comfort and outcomes (Smith et al., 2022).

- **1600 BC**
ancient Egyptians were among the first to use splints made from materials like linen and natural resins to immobilize fractures
- **Middle Ages**
Advancements in human anatomy studies enabled fracture management to more anatomically precise
- **19th Century**
Introduction of Plaster of Paris for cast application created lightweight, moldable, and rigid casts
- **20th Century**
Fiberglass offered an immobilization option that was lighter, more durable and water-resistant

The field of orthopedics has a rich history that spans thousands of years, from ancient civilizations to modern surgical advancements. Through the collective efforts of physicians and researchers, the discipline has evolved to provide effective treatments for a wide range of musculoskeletal conditions, significantly improving the quality of life for patients worldwide.

1.2 Role of the Orthotech in Casting

Orthotechs serve a vital function in casting within orthopedic care, especially in sports medicine and clinical practice settings. They are not only responsible for casting

application but also play a vital role in patient education, follow-up care, and interdisciplinary collaboration.

- **Casting Application and Maintenance**

- Orthotechs frequently assist in the management of acute injuries and, under a physician's guidance, apply casts to immobilize fractures or severe sprains. They ensure proper alignment and monitor for complications like pressure sores or circulatory issues (NATA, 2021).

- **Post-Casting Care**

- Monitoring patients for potential complications is a key responsibility. Orthotechs are trained to recognize signs of neurovascular compromise, compartment syndrome, or cast breakage and report such to their supervising physician. They also coordinate with physical therapists to facilitate rehabilitation once the cast is removed (Johnson et al., 2019).

- **Patient Education**

- Educating patients about cast care is essential. Topics include maintaining hygiene, avoiding water exposure for non-waterproof casts, and recognizing warning signs such as increased pain, swelling, or numbness (Smith et al., 2022).

- **Interdisciplinary Collaboration**

- Orthotechs work closely with orthopedic surgeons, primary care physicians, and rehabilitation specialists to develop and implement comprehensive treatment plans, ensuring optimal patient outcomes (NATA, 2021).

1.3 Indications and Contraindications for Casting

Casting is a primary treatment modality for various orthopedic conditions, but its appropriateness depends on the injury type, patient condition, and potential complications.

- **Indications for Casting**

- **Fractures:** Stable fractures, such as those involving the radius, ulna, tibia, or fibula, are commonly treated with casting. Closed, non-displaced fractures respond particularly well to immobilization (Galloway et al., 2021).
- **Soft Tissue Injuries:** Severe ligament sprains or tendon injuries may benefit from immobilization to facilitate healing (Smith et al., 2022).
- **Post-Surgical Immobilization:** Casting protects surgical repairs, such as tendon or ligament reconstructions, during the initial healing phase.
- **Joint Dislocations:** Following reduction, a cast may be applied to stabilize the joint and prevent re-dislocation.

- **Contraindications for Casting**

- **Open Fractures:** Due to the risk of infection, open fractures are typically managed with external fixation or surgical intervention rather than casting (Robinson, 2020).
- **Severe Swelling:** Casting in the presence of significant swelling can lead to complications like compartment syndrome. Initial treatment with splinting is preferred until swelling subsides (Johnson et al., 2019).
- **Infections:** Skin infections or wounds at the site of casting increase the risk of complications and should be resolved before applying a cast.
- **Circumferential Injuries:** Injuries with extensive swelling or circumferential involvement may require splinting for easier monitoring and adjustments.
- **Chronic Conditions:** Patients with diabetes or vascular disease require special consideration due to an increased risk of delayed healing and skin complications (Smith et al., 2022).

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Foundations of Casting in Orthopedics – MP3 Audio

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Unit 2: Principles of Casting [Supplies, Tools & Safety]



1. Types of casting materials (plaster, fiberglass, etc.)
2. Essential tools and equipment
3. Safety considerations and handling techniques

Upon successful completion of this module, students will have a foundational understanding regarding:

- ✓ Overview of casting principles and their importance in fracture management
- ✓ Essential supplies required for effective casting procedures
- ✓ Tools commonly used in the casting process and their specific functions
- ✓ Safety protocols for both patients and practitioners during casting application
- ✓ Different types of casting materials and their applications
- ✓ Techniques for achieving optimal mold and support in various fracture scenarios
- ✓ Maintaining skin integrity and hygiene during the casting process
- ✓ Patient education on cast care and management
- ✓ Potential complications associated with casting and how to mitigate them
- ✓ Best practices for removing casts safely and effectively

2.1 Principles of Casting Supplies, and Tools

Casting materials have evolved significantly, offering a variety of options suited to different clinical needs. The two most commonly used materials are plaster and fiberglass.

- **Plaster of Paris**
 - Plaster has been a cornerstone of casting since the 19th century.
 - **Composition:** Made from calcium sulfate hemihydrate, it hardens upon contact with water due to an exothermic chemical reaction.
 - **Advantages:**
 - Highly moldable, making it ideal for creating precise anatomical contours.
 - Affordable and widely available.
 - Provides a smooth finish, facilitating patient comfort.
 - **Disadvantages:**
 - Heavy and less durable than fiberglass.
 - Non-water-resistant, requiring careful protection in wet environments.
 - Brittle once dried, prone to cracking or crumbling under stress (Smith et al., 2021).
- **Fiberglass**
 - Fiberglass is the modern standard in casting.
 - **Composition:** Woven glass fibers coated in resin, which hardens when exposed to water or air.
 - **Advantages:**
 - Lightweight and extremely durable, making it suitable for active patients.
 - Water-resistant, particularly when paired with waterproof liners.
 - Available in various colors, improving patient compliance and satisfaction.
 - **Disadvantages:**
 - More expensive than plaster.
 - Requires precise handling due to the resin's quick curing process (Johnson & Taylor, 2020).
- **Specialized Casting Materials**
 - Advances in material science have led to innovative casting options, including:
 - **Waterproof Liners:** Allow patients to bathe or swim while wearing the cast.
 - **Breathable Casts:** Reduce heat buildup and moisture retention, enhancing patient comfort.
 - **Biodegradable Casts:** Eco-friendly alternatives designed for temporary immobilization (Brown et al., 2019).

2.2 Essential Tools and Equipment

The application of a cast involves various tools and equipment, each serving a specific purpose:

- **Padding Materials**
 - **Cotton Padding:** Used with plaster casts for cushioning and to prevent skin irritation.
 - **Synthetic Padding:** Compatible with fiberglass casts and water-resistant options.
 - **Stockinette:** A tubular layer applied directly to the skin, providing an additional barrier between the cast and the skin (Galloway et al., 2022).
- **Casting Rolls**
 - **Plaster Rolls:** Used for traditional casts, easily molded to fit anatomical structures.
 - **Fiberglass Rolls:** Stronger and lighter, these rolls are the standard for most modern casts.
- **Cutting and Trimming Tools**
 - **Oscillating Saw:** Essential for safe removal of hardened casts. The saw's oscillating blade cuts through the material without harming the patient's skin.
 - **Cast Scissors:** Used for trimming during application or for splinting.
- **Mixing Tools**
 - **Buckets and Bowls:** Used to moisten casting rolls. Water temperature is critical; warm water accelerates setting time, while cool water slows it.
- **Protective Gear**
 - Gloves, aprons, and masks protect the practitioner from dust, resin, and other materials.

2.3 Safety Considerations

Casting is not without risks. Adhering to safety protocols minimizes complications and enhances patient outcomes.

- **Skin Protection**
 - Ensure adequate padding over bony prominences to prevent pressure sores.
 - Avoid excessive tightness to prevent constriction or compromised blood flow.
- **Application Technique**
 - Use smooth, even layers to avoid ridges or wrinkles, which can cause discomfort or complications.
 - Overlap layers by 50% to ensure strength without adding unnecessary bulk.
- **Monitoring for Complications**
 - Regularly check for signs of neurovascular compromise: changes in skin color, capillary refill time, and temperature.
 - Educate patients to report symptoms such as numbness, tingling, or excessive swelling immediately (Robinson, 2020).
- **Workplace Safety**
 - Ensure adequate ventilation when working with fiberglass materials, as the resin can produce irritating fumes.
 - Dispose of waste materials properly to prevent environmental hazards.
- **Cast Saw Safety Considerations**
 - The oscillating saw is an essential tool for removing hardened casts but requires careful handling to prevent injury:
 - **Operator Training:** Ensure all users are properly trained in the use of the cast saw, including how to angle the blade and adjust pressure appropriately.
 - **Blade Maintenance:** Regularly inspect the saw blade for dullness or damage, as this can reduce efficiency and increase the risk of overheating.
 - **Avoid Excessive Pressure:** Use light, controlled pressure to allow the blade to cut through the cast without generating unnecessary heat that can harm the patient's skin.
 - **Cooling Techniques:** Frequently pause and allow the blade to cool, or use a damp cloth to cool the blade during extended use.
 - **Patient Safety:** Communicate with the patient throughout the procedure to ensure comfort and address any concerns. Remind them to remain still during cast removal to avoid accidental injuries.
- **Patient Education**
 - Instruct patients on cast care, including keeping non-waterproof casts dry, avoiding inserting objects into the cast, and monitoring for complications.
 - Highlight the importance of follow-up appointments to adjust or remove the cast as needed.

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Unit 3.1: Casting Techniques Overview

1. Immobilization of the Affected Area
2. Support for Fracture Healing
3. Protection of the Injured Area
4. Reduction of Swelling and Pain
5. Maintenance of Anatomical Alignment
6. Facilitation of Functional Recovery
7. Psychological Reassurance

Upon successful completion of this module, students will have a foundational understanding regarding:

- ✓ Define the key functional goals of orthopedic casting, including immobilization, protection, alignment, and support for healing.
- ✓ Identify common clinical applications of casting, such as fractures, tendon injuries, and post-surgical immobilization.
- ✓ Explain how casting facilitates fracture healing through callus formation and mineralization.
- ✓ Describe the relationship between proper casting techniques and the prevention of complications like malunion or nerve compromise.
- ✓ Demonstrate the appropriate selection of casting materials and designs based on specific injury types (e.g., hinged vs. rigid casts).
- ✓ Illustrate the role of casts in managing swelling and reducing pain in acute injury scenarios.
- ✓ Differentiate between functional and traditional casts in terms of their application to patient recovery.
- ✓ Assess the effectiveness of casting interventions in maintaining anatomical alignment and promoting long-term biomechanical stability.
- ✓ Understand appropriate casting strategies that optimize healing and minimize complications.

3.1 Functional Goals of Orthopedic Casting

Orthopedic casting is a critical component of fracture management and musculoskeletal care. The primary goal is to promote healing and restore function while minimizing complications. Below are the key functional goals of orthopedic casting:

1. Immobilization of the Affected Area

- **Description:** Casting provides rigid support to immobilize the injured bone, joint, or soft tissue structures, preventing movement at the fracture or injury site.

Purpose:

- Ensures proper alignment of bone fragments for optimal healing.
- Prevents further injury or displacement of the fracture.
- Reduces pain by stabilizing the affected area.

Clinical Application:

- Common in fractures, severe sprains, tendon injuries, and post-surgical recovery.

2. Support for Fracture Healing

- **Description:** Casting stabilizes the bone during the critical phases of fracture healing, allowing the body's natural repair mechanisms to function effectively.

Purpose:

- Facilitates callus formation and mineralization.
- Maintains the position of reduction (if a fracture has been realigned).
- Protects the injury from external forces that could disrupt healing.

Clinical Application:

- Used in both simple and complex fractures, such as long bone fractures or pediatric greenstick fractures.

3. Protection of the Injured Area

- **Description:** By creating a protective barrier, a cast prevents external trauma and contamination of the injury site.

Purpose:

- Guards against infection in cases of closed or healing open wounds.
- Minimizes mechanical stress and shear forces on the injured tissue.

Clinical Application:

- Post-surgical immobilization or in soft tissue injuries like tendon repairs.

4. Reduction of Swelling and Pain

- **Description:** Properly applied casting can help manage swelling by compressing tissues appropriately, without causing vascular or nerve compromise.

Purpose:

- Relieves pain by immobilizing the area and preventing movements that aggravate nociceptors.
- Controls edema, which can reduce secondary complications.

Clinical Application:

- Early application of splints or partial casts in acute injuries to manage swelling before transitioning to full casting.

5. Maintenance of Anatomical Alignment

- **Description:** A cast ensures that bones, joints, and soft tissues remain in their proper anatomical positions.

Purpose:

- Prevents deformities such as malunion or angulation during the healing process.
- Restores biomechanical stability for long-term function.

Clinical Application:

- Essential in managing fractures of weight-bearing bones or joints, like the femur or radius.

6. Facilitation of Functional Recovery

- **Description:** By stabilizing the injury, casting allows the body to focus on healing while maintaining as much function as possible in adjacent structures.

Purpose:

- Encourages safe mobility of non-affected areas through appropriate rehabilitation.
- Prevents atrophy or stiffness in nearby joints with specific designs, such as hinged or functional casts.

Clinical Application:

- Functional casts for certain forearm or lower extremity fractures to allow partial movement while protecting the fracture site.

7. Psychological Reassurance

- **Description:** Casting provides patients with a sense of stability and safety during their recovery process.

Purpose:

- Reduces anxiety related to the fear of reinjury.
- Improves compliance with immobilization requirements.

Clinical Application:

- Particularly important in pediatric and geriatric populations, where confidence in recovery is critical.



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Orthopedic Casting Techniques Overview – MP3 Audio

Unit 3.2: General Guidelines for Extremity Casting

01 Principles of Orthopedic Casting - RECAP

02 Patient Preparation

03 Fiberglass Application

04 Skin Preparation

05 Cast Removal

Upon successful completion of this module, students will be able to:

- ✓ Recall the foundational principles of orthopedic casting, including immobilization, alignment, and fracture protection.
- ✓ Identify the key steps involved in preparing a patient for casting, including medical history review and injury assessment.
- ✓ Review checklist or protocol for patient preparation to standardize best practices.
- ✓ Recall the steps for applying a fiberglass cast, including material handling and layering techniques.
- ✓ Understand the correct application of fiberglass, ensuring proper alignment, tension, and smoothness.
- ✓ Discuss the impact of incorrect fiberglass application on patient outcomes, such as pressure sores.
- ✓ Identify the tools and techniques required for effective skin preparation before casting.
- ✓ Recall the tools and techniques used for cast removal, including the proper use of cast saws.
- ✓ Explain the importance of safety measures to prevent skin injury during cast removal.
- ✓ Recall the step-by-step process for removing a cast while minimizing patient discomfort.
- ✓ Identify risks associated with improper cast removal, such as skin abrasions or patient anxiety.

3.2.1 General Guidelines for Extremity Casting

Orthopedic casting is an essential skill for healthcare professionals who manage fractures and other musculoskeletal injuries. Employing effective casting techniques for the extremities is crucial in ensuring optimal healing and functional recovery. This section will discuss the fundamental principles of orthopedic casting and highlight effective techniques for managing fractures and other injuries of the extremities.

1. Review of Principles of Orthopedic Casting

Orthopedic casting techniques play a critical role in the management of fractures and other musculoskeletal injuries. Adhering to key principles ensures optimal patient outcomes by promoting proper healing, reducing complications, and improving overall patient satisfaction. The following principles are essential for effective orthopedic casting techniques:

- **Accurate diagnosis and assessment:** Begin with a thorough evaluation of the injury using physical examination, patient history, and imaging studies (e.g., X-rays, CT scans, or MRIs) to accurately diagnose the fracture or injury. This information will guide the selection of the most appropriate casting technique.
- **Fracture reduction and alignment:** Properly align the fractured bones before casting to ensure optimal healing and minimize the risk of malunion or nonunion. In some cases, closed reduction may be sufficient, while others may require open reduction and internal fixation before casting.
- **Adequate immobilization:** The cast should immobilize the injured area and provide support to promote healing. Ensure that the cast extends from the joint above the injury to the joint below the injury, effectively stabilizing the fracture site.
- **Anatomic and functional positioning:** Position the affected limb in a functional and anatomically neutral position during casting. This reduces muscle atrophy, joint stiffness, and the risk of developing contractures, ultimately improving the patient's recovery and rehabilitation process.
- **Appropriate padding and pressure distribution:** Apply sufficient padding to protect the skin, nerves, and blood vessels from pressure and irritation caused by the cast material. Ensure even pressure distribution throughout the cast to avoid creating pressure points or compromising circulation.
- **Proper cast material and application:** Choose the appropriate cast material (plaster of Paris or fiberglass) based on the specific needs of the patient and the type of fracture. Apply the cast material evenly and smoothly, using just enough tension to conform to the contours of the extremity without causing excessive pressure.
- **Patient education and follow-up care:** Instruct the patient on proper cast care, including keeping the cast clean and dry, monitoring for signs of infection or complications, and avoiding activities that could damage the cast. Schedule regular follow-up appointments to monitor the patient's progress, address any complications, and adjust the treatment plan as needed.
- **Timely cast removal and rehabilitation:** Remove the cast when the fracture has healed adequately, as determined by clinical assessment and imaging studies. Implement a rehabilitation program tailored to the patient's specific needs to restore strength, range of motion, and function in the affected limb.

By adhering to these principles, healthcare professionals can ensure that orthopedic casting techniques are effective in promoting proper healing, reducing complications, and achieving optimal patient outcomes.

3.2.2 Patient Preparation - General Guidelines

Preparing a patient's skin prior to the application of an orthopedic fracture cast is crucial to ensure proper hygiene, reduce the risk of infection, and provide a comfortable fit. Here are the general steps to prepare the skin before applying a cast:

- **Clean the skin:** Gently clean the area around the fracture site using mild soap and water or an antiseptic solution. This step helps to remove dirt, debris, and bacteria from the skin, reducing the risk of infection.
- **Dry the skin:** Pat the skin dry with a clean towel or gauze. Make sure the skin is completely dry before proceeding, as moisture can interfere with the adhesion of the cast materials and promote the growth of bacteria.
- **Assess the skin:** Examine the skin for any signs of infection, open wounds, or skin irritation. If there are any concerns, consult with the healthcare professional responsible for the patient's care.
- **Apply a skin barrier** (if necessary): In some cases, a skin barrier may be used to protect the skin from irritation or maceration. This could be a moisture barrier cream or spray, which can help prevent skin breakdown caused by prolonged exposure to moisture.
- **Trim or shave hair** (if necessary): Excessive hair in the cast area can cause discomfort, itching, and difficulty removing the cast later. If the patient has a lot of hair in the area, it may be necessary to trim or shave it before applying the cast. Be sure to get the patient's consent before doing so.
- **Position the limb:** Properly position the patient's limb in the desired position for casting. This may involve supporting the limb with pillows, bolsters, or other positioning aids to ensure that it remains stable and comfortable during the casting process.
- Once the patient's skin is clean, dry, and properly assessed, you can proceed with applying the stockinette, padding, and casting material according to the healthcare professional's instructions.

Remember, it's essential to consult with a healthcare professional to ensure proper technique and care for the patient's specific needs.

Points to Ponder

In addition to the previous guidelines, it is essential to remove any jewelry from the affected limb before applying a fiberglass cast to the upper extremity for several reasons:

Swelling: After an injury, it is common for the affected limb to swell. If jewelry is left in place, it may become too tight, constricting blood flow and causing additional pain, discomfort, or even tissue damage.

Pressure points and skin irritation: Jewelry can create pressure points or cause skin irritation when trapped under the cast. This can lead to discomfort, pain, and even pressure sores or skin breakdown, complicating the healing process.

Cast fitting: Jewelry can interfere with the proper fitting and molding of the cast. A well-fitted cast is essential for immobilizing the affected limb and promoting healing. Jewelry may prevent the cast from fitting snugly and providing the necessary support.

Imaging studies: During the course of treatment, the patient may require additional imaging studies, such as X-rays, to monitor the healing process. Metal jewelry can interfere with the quality of these images, making it difficult for healthcare providers to assess the patient's progress accurately.

Cast removal: When it is time to remove the cast, jewelry may complicate the process. If jewelry is trapped beneath the cast, it can be challenging to safely remove the cast without damaging the jewelry or causing injury to the patient.

Removing jewelry from the affected limb prior to the application of a fiberglass cast for the upper extremity helps to ensure patient comfort, proper cast fitting, and effective healing while reducing the risk of complications during the treatment and recovery process.

3.2.3 Materials for Fiberglass Application

Fiberglass orthopedic casts are widely used for immobilizing fractures and providing support to injured limbs. The materials used in the application of a fiberglass cast include the following:

- ✓ **Fiberglass cast tape:** The primary component of a fiberglass cast is the fiberglass cast tape, which is made of woven fiberglass fabric impregnated with a polyurethane resin. The fiberglass fabric provides strength and durability, while the resin hardens when exposed to moisture, allowing the cast to set and maintain its shape. Fiberglass cast tape is available in various widths and colors, allowing for customization according to the patient's needs and preferences.
- ✓ **Padding:** Padding is applied under the fiberglass cast to protect the patient's skin and provide cushioning. Cast padding, such as synthetic or cotton cast padding, is commonly used for this purpose. Another option is a tubular stockinette, which is a stretchy, soft material that can be placed over the limb before the cast padding and fiberglass tape are applied. Padding should be applied smoothly and evenly to prevent pressure points or wrinkles that could irritate the skin.
- ✓ **Gloves:** When applying a fiberglass cast, healthcare providers should wear gloves to protect their hands from the resin and prevent skin irritation. The gloves also ensure a clean application and prevent contamination of the cast materials.
- ✓ **Water:** Water is used to activate the polyurethane resin in the fiberglass cast tape. The healthcare provider will typically dip the fiberglass tape roll in water or use a spray bottle to dampen it. The temperature of the water can affect the working and setting time of the cast; using warmer water will speed up the setting time, while cooler water will slow it down. The water should be clean to prevent contamination and reduce the risk of infection.
- ✓ **Scissors or cast saw:** Scissors or a cast saw may be needed to trim the edges of the cast or remove it once the fracture has healed. Scissors can be used to trim the cast padding and stockinette, while a cast saw is specially designed to remove fiberglass casts without injuring the patient's skin.
- ✓ **Cast spreader:** In some cases, a cast spreader may be used to remove a fiberglass cast. This tool is designed to spread the cast apart after making an initial cut with a cast saw, allowing for safe and efficient removal of the cast without damaging the patient's skin.

These materials, when used in conjunction with proper casting techniques and principles, contribute to the successful application and management of fiberglass orthopedic casts. Fiberglass casts are preferred by many healthcare providers and patients due to their lightweight, durable, and water-resistant properties.



3.2.4 Steps for Cast Removal

Fiberglass orthopedic casts are widely used for immobilizing fractures and providing support to injured limbs. The materials used in the application of a fiberglass cast include the following:

1. Preparation

1.1 Gather Supplies

- Cast saw (oscillating saw specifically designed for cast removal).
- Cast spreader.
- Bandage scissors or cast scissors.
- Protective eyewear (for the provider) and ear protection (for the patient if sensitive).
- Gauze and cleaning materials for the skin.

1.2 Educate the Patient

- Explain the process to the patient to alleviate anxiety.
- Reassure that the cast saw will not cut the skin when used correctly.

1.3 Ensure a Safe Environment

- Position the patient comfortably, ensuring the limb is supported.
- Maintain good lighting and proper ergonomics for the provider.

2. Cutting the Cast

2.1 Identify Cutting Locations

- Mark the cutting sites along the longitudinal axis, usually on the sides of the cast to avoid pressure points.

2.2 Operate the Cast Saw

- Turn on the cast saw and test it to ensure functionality.
- Use the oscillating blade at a 90-degree angle to the cast surface.
- Apply firm but controlled pressure to penetrate the fiberglass without pressing too hard.

2.3 Create Longitudinal Cuts

- Make two parallel cuts along the length of the cast, one on each side.

3.2.4 Steps for Cast Removal cont.

3. Spreading and Removal

3.1 Use the Cast Spreader

- Insert the cast spreader into the cut sections and gently pry open the cast.
- Work slowly to avoid excessive pressure on the underlying tissue.

3.2 Remove the Padding

- Use bandage scissors to carefully cut through the soft inner padding and stockinette.

3.3 Lift the Cast Away

- Remove the cast halves gently, ensuring no sharp edges contact the skin.

4. Post-Removal Care

4.1 Assess the Skin

- Inspect the skin for abrasions, dryness, or irritation.
- Address any areas of concern, such as cleaning the skin or applying moisturizer.

4.2 Advise the Patient

- Discuss the next steps in care, such as rehabilitation exercises or further protection for the limb.
- Reinforce follow-up instructions and answer any patient questions.

4.3 Dispose of the Cast

- Safely discard the cast materials per facility protocols.

5. Documentation

- Record the procedure in the patient's medical record, including any observations of the skin, patient feedback, and post-care instructions. Always bring any questions/concerns to your physician, medical supervisor etc.



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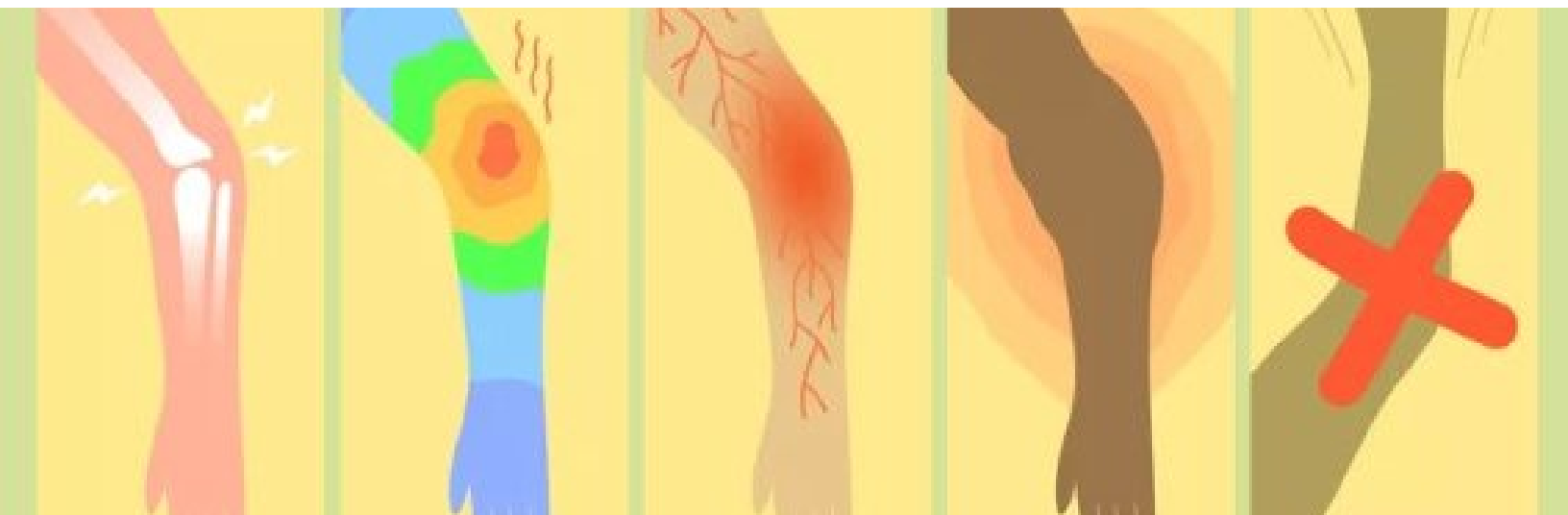
Application and Removal Considerations – MP3 Audio

UNIT 4

1. Cardinal Signs of Inflammation
2. Bones Healing following injury
3. Factors Affecting Bone Injury

4.1: Cardinal Signs of Inflammation

Introduction: Inflammation is a fundamental biological response to tissue injury, infection, or other harmful stimuli. The classic symptoms of inflammation were first described by the Roman medical writer Aulus Cornelius Celsus in the 1st century AD, and they remain critical diagnostic tools in modern healthcare. These signs are essential for understanding the mechanisms of inflammation and guiding effective patient care. In this lecture, we will discuss the five cardinal signs of inflammation and their physiological significance, with references to historical and contemporary medical literature.



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

- ✓ List the cardinal signs of inflammation (redness, heat, swelling, pain, and loss of function).
- ✓ Explain the physiological mechanisms behind each cardinal sign.
- ✓ Recall the stages of bone healing (inflammatory, reparative, and remodeling phases).
- ✓ Describe the cellular and molecular events that occur during each phase of bone healing.
- ✓ Illustrate how clinical interventions, such as immobilization or casting, support the bone healing process.
- ✓ Identify intrinsic (e.g., age, bone density) and extrinsic (e.g., type of trauma, nutritional status) factors affecting bone injury.
- ✓ Explain how specific factors influence the severity and recovery of bone injuries.
- ✓ Recognize potential complications in bone healing based on identified risk factors in a patient case.

4.1 Cardinal Signs of Inflammation

✓ Rubor (Redness)

- ✓ **Physiology:** Redness, or rubor, occurs due to vasodilation, which is the widening of blood vessels in the affected area. This process increases blood flow and is mediated by chemical signals such as histamine, prostaglandins, and bradykinin (Serhan & Levy, 2018). These mediators are released by immune cells like mast cells and macrophages in response to injury or infection.
- ✓ **Clinical Significance:** Increased blood flow delivers immune cells, oxygen, and nutrients necessary for tissue repair. The redness is a visible indicator of increased vascular activity and can help clinicians identify the focal point of inflammation.

✓ Calor (Heat)

- ✓ **Physiology:** Heat in the inflamed area results from the same increased blood flow caused by vasodilation. The temperature rise is localized to the affected tissue and results from the delivery of warm arterial blood.
- ✓ **Protective Role:** Elevated temperature creates an unfavorable environment for pathogens like bacteria and viruses. Additionally, it accelerates the metabolic rate of immune and repair cells, enhancing the healing process (Chovatiya & Medzhitov, 2014).
- ✓ **Clinical Significance:** The warmth is a palpable sign that complements visual redness, offering insight into the intensity of the inflammatory response.

✓ Tumor (Swelling)

- ✓ **Physiology:** Swelling, or tumor, occurs due to increased vascular permeability, allowing plasma, immune cells, and proteins to leak into the extracellular space. This fluid accumulation is driven by inflammatory mediators such as vascular endothelial growth factor (VEGF) and histamine (Abbas et al., 2021).
- ✓ **Protective Role:** Swelling serves to dilute toxins produced by pathogens and provides a medium for immune cells to travel to the injury site.
- ✓ **Clinical Consideration:** Swelling can compress adjacent structures, leading to discomfort or impaired function. However, it is a critical part of the inflammatory response, facilitating healing.

✓ Dolor (Pain)

- ✓ **Physiology:** Pain arises from the sensitization of nociceptors (pain receptors) by inflammatory mediators, such as prostaglandins, bradykinin, and substance P. Additionally, the physical pressure from swelling can activate these receptors (Coulthard et al., 2020).
- ✓ **Purpose:** Pain acts as a protective signal, discouraging movement or further use of the injured area. This rest promotes tissue repair and minimizes the risk of additional damage.
- ✓ **Clinical Perspective:** Understanding the biochemical pathways leading to pain has guided the development of anti-inflammatory and analgesic treatments, such as NSAIDs, which inhibit prostaglandin synthesis.

✓ Functio Laesa (Loss of Function)

- ✓ **Definition:** Loss of function, or functio laesa, occurs when inflammation disrupts the normal activity of the affected tissue.
- ✓ **Mechanisms:** This symptom is often a combination of the other signs. Pain and swelling restrict movement, while the structural integrity of the tissue may be temporarily compromised.
- ✓ **Purpose:** Although inconvenient, loss of function encourages rest, preventing further injury and allowing the healing process to proceed unhindered (Serhan et al., 2020).
- ✓ **Clinical Implication:** Loss of function must be evaluated in the context of the patient's condition. Persistent dysfunction may indicate chronic inflammation or underlying damage that requires intervention.

Conclusion The cardinal signs of inflammation — redness, heat, swelling, pain, and loss of function — are vital diagnostic tools for healthcare professionals. Recognizing these signs and understanding their underlying mechanisms allow clinicians to assess the severity and causes of inflammation accurately. By addressing the root cause of inflammation and supporting the body's healing processes, healthcare providers can optimize patient outcomes.

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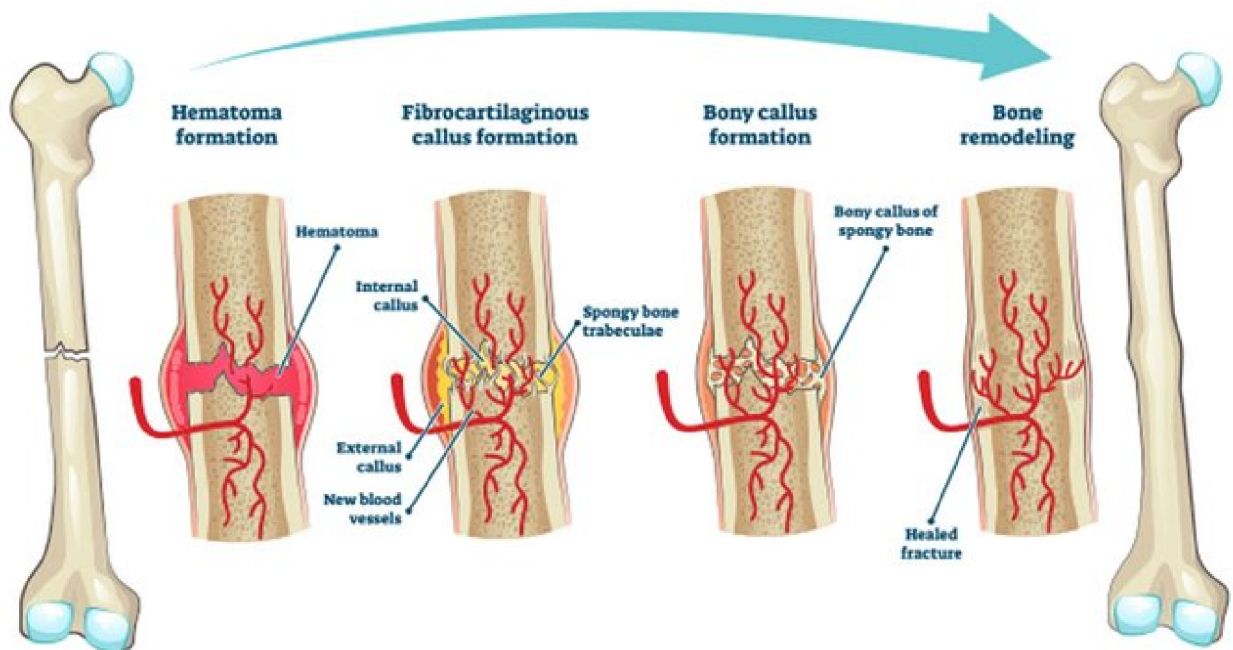
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4.2: Bone Healing Following Injury

Introduction: Bones are essential structures in the human body, serving as the framework for support, protection of vital organs, and facilitation of movement. Despite their strength and resilience, bones are not impervious to injury. Trauma, repetitive stress, or underlying medical conditions can result in fractures, disrupting the integrity of these critical structures. Understanding the bone healing process is essential for healthcare professionals, as it provides the foundation for effective management of fractures and ensures optimal recovery outcomes. Bone healing is a complex, multi-stage process that involves coordinated cellular and molecular events aimed at restoring the bone's original structure and function.

Stages of Bone Healing Bone healing occurs in four overlapping stages: inflammation, soft callus formation, hard callus formation, and remodeling. Each stage is characterized by specific biological processes and cellular activities that contribute to the repair and restoration of the bone.

FRACTURE REPAIR



4.2 Stages of Bone Healing

- 1. Inflammation** The first stage of bone healing begins immediately after injury. Blood vessels at the fracture site rupture, resulting in the formation of a hematoma or blood clot. This hematoma stabilizes the fracture site and creates a provisional matrix for cell migration and repair. Inflammatory cells, such as neutrophils and macrophages, infiltrate the area to clear debris and prevent infection. Additionally, the release of cytokines and growth factors, including tumor necrosis factor-alpha (TNF- α) and vascular endothelial growth factor (VEGF), plays a pivotal role in recruiting mesenchymal stem cells and other cells involved in bone regeneration (Schindeler et al., 2008). The inflammatory phase sets the stage for subsequent healing by creating an environment conducive to repair.
- 2. Soft Callus Formation** The second stage, soft callus formation, involves the activity of chondroblasts, which produce a fibrocartilaginous matrix. This matrix serves as a bridge between the broken bone ends, providing initial stability. The soft callus is primarily composed of collagen and other extracellular matrix components, creating a scaffold for new bone formation. During this phase, angiogenesis, or the growth of new blood vessels, is critical for re-establishing vascular supply to the fracture site. The restoration of blood flow ensures the delivery of nutrients and oxygen required for cellular activity (Marsell & Einhorn, 2011). The soft callus formation phase typically lasts 2-3 weeks, depending on the extent of the injury and individual factors such as age and overall health.
- 3. Hard Callus Formation** As healing progresses, the soft callus is replaced by a hard callus composed of woven bone. This transition is facilitated by osteoblasts, which deposit a mineralized matrix to strengthen the repair site. The hard callus provides increased rigidity and mechanical support, allowing the bone to withstand stress during movement. This phase of healing can last several weeks to months, depending on the severity of the fracture, the patient's nutritional status, and systemic factors like comorbidities (Einhorn & Gerstenfeld, 2015). While the hard callus restores stability, it is mechanically inferior to mature bone, necessitating further remodeling.
- 4. Remodeling** The final stage of bone healing is remodeling, during which the hard callus is transformed into mature lamellar bone. This phase is characterized by the coordinated activity of osteoclasts and osteoblasts. Osteoclasts resorb excess bone tissue, reshaping the callus to restore the bone's original contour. Concurrently, osteoblasts continue to deposit new bone, improving its mechanical properties and strength. Remodeling can take several months to years, depending on the complexity of the fracture and the patient's age and overall health. The end result is a fully restored bone that closely resembles its pre-injury structure and function, both histologically and biomechanically (Claes et al., 2012).

Conclusion Bone

healing is a remarkable biological process involving inflammation, repair, and remodeling. Each stage plays a vital role in restoring the bone's integrity and function. For healthcare professionals, understanding the intricacies of this process is crucial for effective fracture management and patient care. By recognizing the factors that influence bone healing and tailoring interventions accordingly, clinicians can optimize outcomes and support patients on their journey to recovery.

Review - Stages of Bone Healing

The bone healing process can be divided into four overlapping stages: inflammation, soft callus formation, hard callus formation, and remodeling. Each stage is characterized by distinct cellular and molecular events that ultimately lead to the restoration of the bone's structure and function.

Bones are essential structures of the human body, providing support, protection, and facilitating movement. Despite their remarkable strength, bones can sometimes break or fracture due to trauma, repetitive stress, or underlying medical conditions. Understanding the bone healing process is crucial for healthcare professionals and patients alike, as it informs the appropriate management of bone injuries and ensures optimal recovery.

- **INFLAMMATION**

Immediately after a bone injury, the body initiates an inflammatory response. Blood vessels at the fracture site rupture, leading to the formation of a hematoma (a blood clot). The hematoma stabilizes the fracture site and serves as a provisional matrix for the migration of cells involved in bone repair. Inflammatory cells, such as white blood cells, infiltrate the injury site to remove dead tissue and prevent infection. Additionally, cells called cytokines and growth factors are released, which help recruit cells necessary for bone healing.

- **Soft Callus Formation**

During the soft callus formation stage, specialized cells called chondroblasts produce a soft, fibrocartilaginous matrix that bridges the gap between the broken bone ends. This soft callus, composed primarily of collagen, provides initial stability and serves as a scaffold for new bone formation. The soft callus also plays a crucial role in re-establishing the blood supply to the fracture site, as new blood vessels begin to infiltrate the healing tissue.

- **Hard Callus Formation**

As the healing process progresses, the soft callus is gradually replaced by a hard callus made of woven bone. Osteoblasts, the cells responsible for new bone formation, lay down a mineralized matrix that hardens the callus. This hard callus provides increased strength and rigidity to the fracture site, further stabilizing the broken bone ends. The hard callus stage can last several weeks to months, depending on the severity of the injury and individual factors such as age, nutrition, and overall health.

- **Remolding**

The final stage of bone healing is remodeling, during which the hard callus is transformed into mature, lamellar bone. This process is facilitated by osteoclasts, cells that break down and remove excess bone tissue, and osteoblasts, which continue to deposit new bone. Remodeling can take several months to years, depending on the size and complexity of the fracture. The end result is a fully restored bone that closely resembles its pre-injury structure and function.

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4.3 Factors Affecting Bone Healing

Bone healing is influenced by a variety of factors that can either enhance or hinder the process. These factors can be broadly categorized into biological, mechanical, and systemic influences.

I. Biological Factors

A. Age

- Description: Bone healing capacity decreases with age due to reduced cellular activity and slower metabolic rates.
- Impact: Children: Faster healing due to active growth plates and high osteoblastic activity.
- Elderly: Slower healing due to reduced osteoblast function and diminished vascularity.

B. Type and Severity of Fracture

- Description: Complex fractures, such as comminuted or open fractures, take longer to heal than simple, closed fractures.
- Impact: Open fractures: Increased risk of infection and delayed healing.
- Displaced fractures: May require surgical intervention for proper alignment.

C. Vascular Supply

- Description: Adequate blood flow is critical for delivering nutrients, oxygen, and growth factors to the injury site.
- Impact: Poor vascularity (e.g., in scaphoid or femoral neck fractures) can lead to avascular necrosis or delayed healing.

D. Soft Tissue Integrity

- Description: Damage to surrounding soft tissues can impede bone healing by disrupting the vascular supply and creating an inflammatory environment.
- Impact: Severe soft tissue injury increases the risk of infection and complications, delaying the healing process.

E. Bone Quality

- Description: Conditions affecting bone quality, such as osteoporosis, osteopenia, or Paget's disease, impair the structural integrity of bone.
- Impact: Weakened bone structure results in slower healing and higher risk of nonunion.

Conclusion Bone healing is a remarkable biological process involving inflammation, repair, and remodeling. Each stage plays a vital role in restoring the bone's integrity and function. For healthcare professionals, understanding the intricacies of this process is crucial for effective fracture management and patient care. By recognizing the factors that influence bone healing and tailoring interventions accordingly, clinicians can optimize outcomes and support patients on their journey to recovery.

Bone healing is influenced by a variety of factors that can either enhance or hinder the process. These factors can be broadly categorized into biological, mechanical, and systemic influences.

II. Systemic Factors

A. Nutritional Status

- Description: Adequate intake of nutrients, such as calcium, vitamin D, and protein, is crucial for bone repair.
- Impact: Deficiencies in calcium and vitamin D impair mineralization.
- Protein deficiency slows callus formation and collagen synthesis.

B. Hormonal Influences

- Description: Hormones regulate bone metabolism and healing processes.
- Impact: Positive effect: Parathyroid hormone (PTH) stimulates bone remodeling.
- Negative effect: Excessive corticosteroids inhibit osteoblast function and bone formation.

C. Smoking and Alcohol Use

- Description: Tobacco and alcohol negatively affect bone healing by altering cellular and vascular dynamics.
- Impact: - Smoking reduces oxygen delivery and inhibits osteoblastic activity.
- Chronic alcohol consumption disrupts calcium metabolism and osteoblast function.

D. Comorbidities

- Description: Chronic health conditions can delay bone healing.
- Impact: Diabetes mellitus: Impairs vascularity and increases the risk of infection.
- Rheumatoid arthritis: Creates a pro-inflammatory environment that hinders healing.
- Chronic kidney disease: Alters calcium-phosphorus balance, impairing bone strength.

E. Medications

- Description: Certain drugs can influence bone healing.
- Impact: Positive: Bisphosphonates (used in osteoporosis) may improve bone density.
- Negative: NSAIDs and glucocorticoids can delay healing by reducing inflammation necessary for callus formation.

F. Infection

- Description: Infection at the fracture site can severely disrupt healing.
- Impact: Leads to chronic osteomyelitis or delayed union.
- Requires aggressive treatment, including antibiotics and surgical debridement.

III. Mechanical Factors

A. Stability at the Fracture Site

- Description: Mechanical stability is essential for callus formation and proper alignment during healing.
- Impact: Excessive movement: May disrupt callus formation and lead to delayed union or nonunion.
- Optimal fixation (e.g., casts, plates, or external fixation): Enhances stability and supports healing.

B. Type of Immobilization

- Description: Appropriate immobilization techniques ensure proper alignment and minimize movement.
- Impact: Rigid immobilization: Supports primary healing by direct bone remodeling.
- Functional casts or bracing: Allow partial mobility while maintaining stability.

IV. Extrinsic Factors

A. Rehabilitation and Physical Therapy

- Description: Controlled rehabilitation promotes healing by stimulating blood flow and bone remodeling.
- Impact: Early mobilization (within limits): Supports functional recovery.
- Excessive strain: May disrupt the healing process.

B. Environmental Factors - Description: Exposure to sunlight supports vitamin D synthesis, critical for calcium metabolism.

- Impact: Lack of sunlight: May contribute to vitamin D deficiency, impairing bone mineralization.

Conclusion

Various factors can influence the bone healing process, either promoting or hindering recovery. Some factors that promote bone healing include proper immobilization, good nutrition, adequate blood supply, and the absence of infection. Conversely, factors such as smoking, alcohol consumption, certain medications, and underlying medical conditions can negatively impact bone healing. It is essential for patients to follow their healthcare provider's recommendations and maintain a healthy lifestyle to optimize the bone healing process.

The bone healing process is a complex and dynamic sequence of events that involves the interplay of various cells, tissues, and signaling molecules. Through the stages of inflammation, soft callus formation, hard callus formation, and remodeling, the body is able to repair and restore injured bones to their original structure and function. Understanding this process is crucial for the appropriate management of bone injuries and the promotion of optimal patient outcomes.

In conclusion, bone healing is a complex process influenced by a wide range of biological, mechanical, systemic, and extrinsic factors. Understanding these influences is essential for healthcare professionals to develop effective treatment strategies, optimize recovery, and address potential complications. By recognizing and managing these factors, clinicians can enhance the overall success of fracture healing and improve patient outcomes.

Click on or take pic of QR code to review lesson:



Cardinal Signs of Inflammatory Process – MP3 Audio

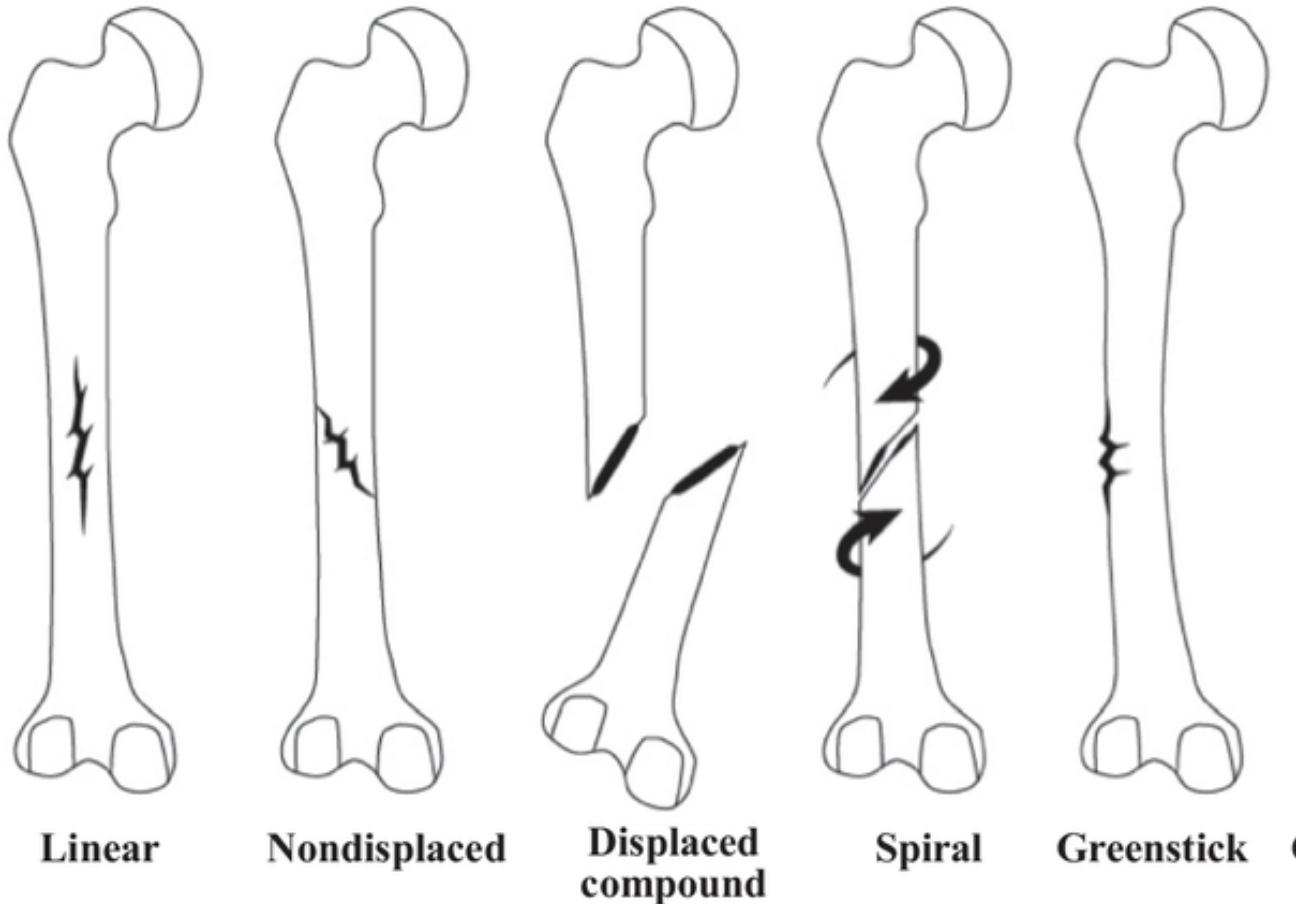
UNIT 5

01 Fracture Classification

02 General Terminology in Orthopedics

5.1: Fracture Classification

Introduction: Fractures represent a common yet complex challenge in musculoskeletal healthcare, requiring a comprehensive understanding of both the injury and the patient's unique needs. Each fracture scenario is distinct, influenced by factors such as the mechanism of injury, the patient's age, bone quality, and overall health. To provide effective care, healthcare professionals must be proficient in fracture terminology, classification systems, and the principles guiding treatment. By understanding the nuances of fracture patterns—ranging from simple stress fractures to complex comminuted injuries—clinicians can tailor interventions that promote healing, restore function, and minimize complications. This discussion will explore key fracture scenarios, terminology, and the decision-making processes essential for patient-centered care, setting the foundation for a deeper dive into effective management strategies.



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

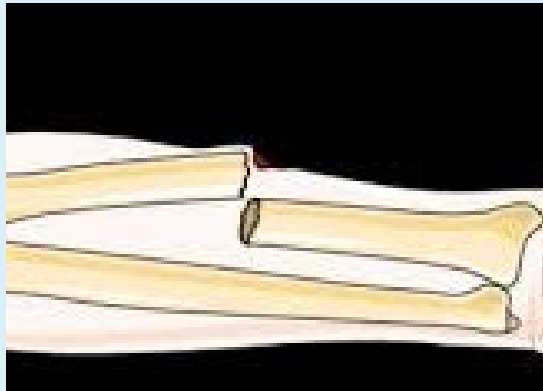
- ✓ Identify the primary types of fractures (e.g., transverse, oblique, spiral, comminuted) and their distinguishing features.
- ✓ Explain the criteria used in fracture classification, such as displacement, angulation, and location.
- ✓ Describe the clinical relevance of fracture classification in guiding treatment decisions.
- ✓ Use fracture classification to support initial treatment plans or referral pathways, per MD guidance.
- ✓ Compare the utility of different fracture classification in specific clinical scenarios.
- ✓ Define key orthopedic terms, including terms related to anatomy (e.g., diaphysis, metaphysis), injury mechanisms (e.g., avulsion, compression), and procedures (e.g., ORIF, external fixation).
- ✓ Recall common abbreviations and their meanings in orthopedic practice.
- ✓ Explain the significance of precise terminology in effective communication among healthcare providers.
- ✓ Illustrate how anatomical and procedural terms are interconnected in describing orthopedic conditions and interventions.
- ✓ Use appropriate orthopedic terminology when documenting patient cases or communicating with colleagues.
- ✓ Match clinical terms with their corresponding definitions and contexts in orthopedic practice.
- ✓ Differentiate between terms with similar meanings but distinct applications, such as subluxation vs. dislocation or cast vs. splint.
- ✓ Appreciate the clarity and accuracy of orthopedic terminology used in patient records or interdisciplinary communication.

Closed (Simple) Fracture



- Definition: A fracture where the bone is broken, but the skin remains intact.
- Mechanism of Injury: Often caused by low-energy trauma, such as a fall or direct blow.

Open (Compound) Fracture



- Definition: A fracture where the broken bone penetrates the skin, creating an open wound.
- Mechanism of Injury: Typically caused by high-energy trauma, such as motor vehicle accidents or gunshot wounds.

Transverse Fracture



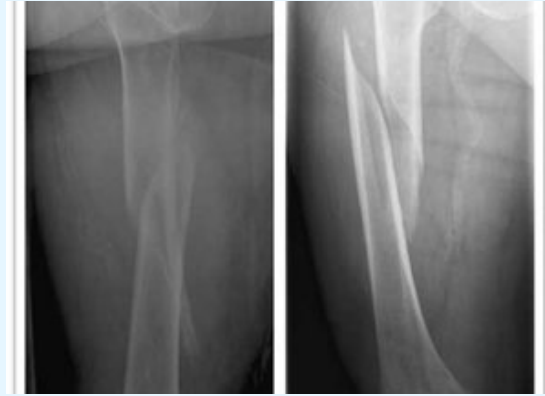
- Definition: A horizontal break across the bone.
- Mechanism of Injury: Direct trauma or repetitive stress.

Oblique Fracture



- Definition: A fracture with an angled line across the bone.
- Mechanism of Injury: Caused by indirect trauma, such as a twisting force or a fall at an angle.

Spiral Fracture



- Definition: A fracture that spirals around the bone, often resembling a corkscrew.
- Mechanism of Injury: Result of rotational or torsional forces, such as twisting injuries during sports.

Comminuted Fracture



- Definition: The bone is shattered into three or more fragments.
- Mechanism of Injury: High-energy trauma, such as vehicle collisions or severe falls.

Segemental Fracture



- Definition: A bone is fractured in two distinct places, creating a segment of bone that is unattached.
- Mechanism of Injury: High-energy trauma..

Greenstick Fracture



- Definition: An incomplete fracture where one side of the bone bends, and the other side breaks.
- Mechanism of Injury: Common in children due to the flexibility of their bones.

Buckle (Torus) Fracture



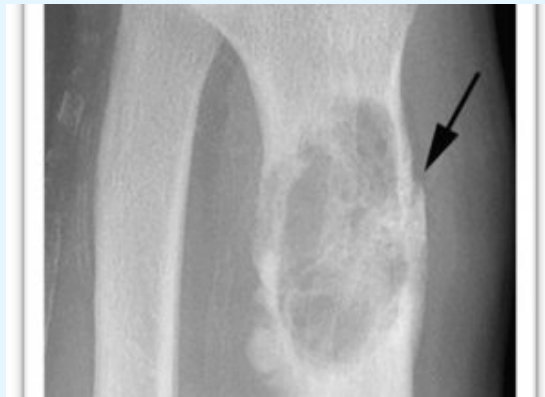
- Definition: A compression fracture where the bone buckles outward.
- Mechanism of Injury: Typically caused by axial loading in children.

Impacted Fracture



- Definition: The broken ends of the bone are driven into each other.
- Mechanism of Injury: Results from compressive forces, such as a fall from height.

Pathologic Fracture



- Definition: A fracture occurring in bone weakened by disease (e.g., osteoporosis, cancer, Paget's disease).
- Mechanism of Injury: Minimal or no trauma.

Stress Fracture



- Definition: A small crack in the bone caused by repetitive stress.
- Mechanism of Injury: Overuse or repetitive loading.

Avulsion Fracture



- Definition: A fragment of bone is pulled away by a tendon or ligament.
- Mechanism of Injury: Sudden forceful contraction or trauma.

Compression Fracture



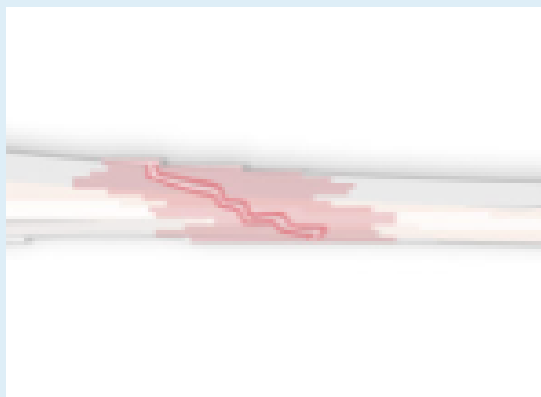
- Definition: A fracture resulting in bone collapse, often in vertebrae.
- Mechanism of Injury: Osteoporotic bones subjected to axial loading.

Displaced Fracture



- Definition: Bone fragments are out of alignment.
- Management: Reduction and surgical fixation.

Non-Displaced Fracture



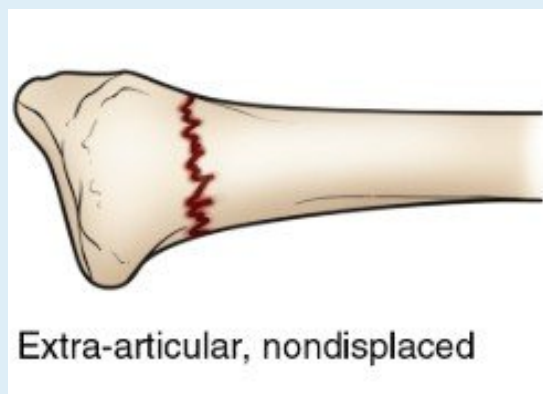
- Definition: Bone fragments remain in alignment.
- Management: Immobilization.

Intra-Articular Fracture



- Definition: The fracture extends into the joint surface.
- Mechanism of Injury: High-energy trauma.

Extra-Articular Fracture



- Definition: The fracture occurs outside the joint capsule.
- Clinical Significance: Easier to manage than intra-articular fractures.

Hairline Fracture



- Definition: A thin, incomplete fracture that may not be visible on initial X-rays.
- Mechanism of Injury: Repetitive stress or minor trauma.

Fatigue Fracture



- Definition: A type of stress fracture caused by abnormal stress on a normal bone.
- Mechanism of Injury: Overuse, especially in weight-bearing bones.

5.2 General Orthopedic Terminology

- **Orthopedics**

The branch of medicine dealing with the correction of deformities or functional impairments of the musculoskeletal system, including bones, joints, muscles, tendons, and ligaments.

- **Musculoskeletal System**

The organ system comprising bones, muscles, cartilage, tendons, ligaments, and connective tissues that support and enable movement.

- **Biomechanics**

The study of the mechanical laws relating to the movement or structure of living organisms, particularly relevant to joint function and load distribution.

- **Fracture**

A break in the continuity of a bone.

- **Osteology**

The study of bones and their structure.

5.2.2 Fracture-Related Terms

- **Closed Fracture**

A fracture where the bone does not break through the skin.

- **Open Fracture**

A fracture where the bone breaks through the skin, increasing infection risk.

- **Greenstick Fracture**

An incomplete fracture common in children, where one side of the bone bends while the other breaks.

- **Comminuted Fracture**

A fracture where the bone is shattered into multiple fragments.

- **Reduction**

The process of realigning a fractured or dislocated bone to its normal anatomical position.

- **Nonunions**

Failure of a fractured bone to heal properly.

- **Malunion**

Healing of a fractured bone in an incorrect anatomical position.

- **Stress Fracture**

A small crack in the bone caused by repetitive stress or overuse.

- **Pathologic Fracture**

A fracture occurring in a bone weakened by disease.

- **Callus**

New bone tissue that forms around a fracture during healing.

5.2.3 Casting & Splinting Terms

- **Cast**

A rigid, external immobilization device used to stabilize fractures or injuries.

- **Splint**

A flexible or rigid device used to support or immobilize a body part temporarily.

- **Plaster of Paris**

A quick-setting material made from calcium sulfate, used historically for orthopedic casting.

- **Fiberglass**

A lightweight, durable material commonly used for modern casts.

- **Bivalve Cast**

A cast that is split into two halves to allow removal and adjustment.

- **Stockinette**

A tubular layer applied to the skin beneath the cast for protection and comfort.

- **Padding**

Material used between the skin and casting material to prevent pressure sores and enhance comfort.

- **Windowing**

The creation of an opening in a cast to access underlying tissues for inspection or treatment.

- **Casting Saw**

A specialized oscillating tool used to safely remove casts.

5.2.4 Bracing Terms

- **Brace**

A device used to support, align, or stabilize a joint or body segment.

- **Orthosis**

A custom-fitted appliance designed to correct or support musculoskeletal function.

- **Spinal Brace**

A brace designed to stabilize or immobilize the spine, often used in scoliosis or post-surgical recovery.

- **Knee Brace**

A brace used to support the knee joint, commonly for ligament injuries or arthritis.

- **Functional Brace**

The process of realigning a fractured or dislocated bone to its normal anatomical position.

- **Hinged Brace**

A brace with mechanical joints to facilitate controlled movement of a limb.

- **Dynamic Splint**

A splint that applies continuous force to improve mobility or correct deformity.

5.2.5 Anatomical Terms

- **Cortex**

The dense, outer layer of bone.

- **Medullary Cavity**

The hollow, inner part of a bone where bone marrow is stored.

- **Articular Cartilage**

The smooth, white tissue that covers the ends of bones in joints, allowing them to move smoothly.

- **Periosteum**

A dense layer of vascular connective tissue enveloping bones, except at joint surfaces.

- **Ligament**

A band of tough connective tissue that connects bones to other bones.

- **Tendon**

A fibrous connective tissue that connects muscles to bones.

- **Synovial Joint**

A type of joint that is surrounded by a fluid-filled capsule, allowing a wide range of motion.

5.2.6 Orthopedic Conditions

- **Arthritis**

Inflammation of one or more joints, causing pain and stiffness.

- **Osteoarthritis**

A degenerative joint disease resulting in cartilage breakdown.

- **Rheumatoid Arthritis**

An autoimmune disease that causes inflammation of the joints.

- **Bursitis**

Inflammation of a bursa, a small fluid-filled sac that reduces friction between tissues

- **Tendonitis**

Inflammation of a tendon, often due to overuse.

- **Scoliosis**

Abnormal lateral curvature of the spine.

- **Kyphosis**

Excessive outward curvature of the spine, leading to a hunched posture.

- **Lordosis**

Excessive inward curvature of the lumbar spine.

- **Osteoporosis**

A condition characterized by weakened bones, increasing fracture risk.

- **Bone Tumor**

An abnormal growth of tissue in the bone, which may be benign or malignant.

5.2.7 Surgical & Treatment Terms

- **Internal Fixation**

The surgical insertion of plates, screws, or rods to stabilize a fracture.

- **External Fixation**

A stabilization technique using pins and a frame outside the body.

- **Arthroscopy**

A minimally invasive procedure using a small camera to visualize and treat joint problems.

- **Osteotomy**

Surgical cutting of a bone to correct deformity.

- **Arthroplasty**

The surgical reconstruction or replacement of a joint.

- **Bone Graft**

Transplantation of bone tissue to aid in healing or repair.

- **Joint Replacement**

Surgical replacement of a damaged joint with a prosthetic implant.

5.2.8 Other Relevant Terms

- **Range of Motion (ROM)**

The degree of movement a joint is capable of performing.

- **Prosthesis**

An artificial device used to replace a missing body part, such as a limb or joint.

- **Rehabilitation**

The process of restoring function and mobility through physical therapy and exercise.

- **Gait Analysis**

The study of a person's walking pattern to identify abnormalities or inefficiencies.

- **Orthopedic Trauma**

Severe injury to the musculoskeletal system requiring urgent care.

Click on or take pic of QR code to review lesson:



Orthopedic Fracture Classification/Types – MP3 Audio



SECTION 2

ORTHOPEDIC CASTING FOR THE UPPER EXTREMITIES

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

- ✓ Identify the major bony structures of the upper extremity and their functional roles in movement and stability.
- ✓ Describe the key soft tissue structures (muscles, tendons, ligaments) involved in upper extremity function.
- ✓ Explain the neurovascular supply of the upper extremity, including the significance of major nerves, arteries, and veins in clinical assessment. (Understanding)
- ✓ Compare and contrast common injuries or conditions affecting bony, soft tissue, and neurovascular structures of the upper extremity. (Analyzing)
- ✓ Describe the fundamental principles of upper extremity casting and immobilization.
- ✓ Explain the indications and contraindications for upper extremity casting in clinical practice.
- ✓ Identify the potential complications associated with improper casting and develop strategies to prevent them.
- ✓ List the essential materials and tools required for upper extremity casting.
- ✓ Demonstrate proper techniques for applying and removing common upper extremity casts.
- ✓ Differentiate between various types of upper extremity casts (e.g., short arm, long arm, thumb spica) and their clinical applications.
- ✓ Understand the step-by-step protocol for safely applying and removing an upper extremity cast, incorporating best practices. (Creating)

Section 1: Foundations of Casting

UNIT 1: Anatomical Considerations

Understanding the anatomy of the upper extremity is fundamental to the effective application of orthopedic casts. This section explores the key anatomical components, including bones, joints, soft tissues, and neurovascular structures, as well as the critical anatomical landmarks necessary for proper casting technique.

Overview of Upper Extremity Anatomy

The upper extremity consists of several key bone groups that provide structural support and facilitate mobility. The shoulder girdle includes the clavicle and scapula, which stabilize the shoulder and allow extensive arm movement. The clavicle is particularly prone to fractures due to its superficial location and role in force transmission, as noted by Rockwood et al. (2010). The scapula, with its acromion, coracoid process, and glenoid cavity, serves as a critical component of the shoulder joint.

The arm contains the humerus, which features distinct anatomical landmarks such as the humeral head, greater and lesser tubercles proximally, and the medial and lateral epicondyles distally. Fractures of the humeral shaft and supracondylar regions are common and must be considered during casting (Stanitski, 2017). The forearm is composed of the radius and ulna, with the radial head articulating proximally at the capitulum and the ulnar olecranon providing the primary point of leverage at the elbow. The distal aspects of the radius and ulna, including their respective styloid processes, are integral to wrist stability (Aro & Koivunen, 1991).

The wrist comprises eight carpal bones—scaphoid, lunate, triquetrum, pisiform, trapezium, trapezoid, capitate, and hamate. Among these, the scaphoid is particularly vulnerable to fractures and avascular necrosis due to its limited blood supply (Gelberman & Menon, 1980). Beyond the wrist, the metacarpals and phalanges form the skeletal framework of the hand. Each digit has three phalanges, except for the thumb, which has two and unique mobility characteristics.

The joints of the upper extremity include the glenohumeral joint at the shoulder, which provides a wide range of motion through its ball-and-socket structure. The elbow's humeroulnar, humeroradial, and proximal radioulnar joints enable hinge and pivot movements essential for arm functionality. At the wrist, the radiocarpal joint's stabilizers, including the scapholunate ligament and triangular fibrocartilage complex (TFCC), are vital for proper articulation and must be supported during immobilization. The hand's metacarpophalangeal (MCP), proximal interphalangeal (PIP), and distal interphalangeal (DIP) joints are essential for dexterity and fine motor skills.

Soft tissues of the upper extremity include muscles, tendons, ligaments, and cartilage. The major muscle groups—deltoid, biceps, triceps, and the flexor-pronator and extensor compartments—are responsible for gross motor movements and stabilization. Tendons, particularly those in the wrist and hand, are susceptible to irritation during immobilization, such as in cases of De Quervain's tenosynovitis. Ligaments, including the ulnar collateral ligament (UCL) and scapholunate ligament, provide critical joint stability. Cartilage and articular surfaces maintain joint congruity, which must be preserved to avoid long-term functional deficits.

1.1 UE Anatomy Landmarks for Casting

Key Anatomical Landmarks for Proper Casting

Accurate identification of anatomical landmarks is critical for ensuring proper cast application. In the shoulder region, the acromion and coracoid processes are palpable markers that guide arm positioning during immobilization. At the elbow, the medial and lateral epicondyles, along with the olecranon process, provide reference points for maintaining correct joint alignment. For the forearm, the ulnar border serves as a guide for padding placement to prevent pressure sores, while the radial styloid indicates the distal extent of immobilization.

In the wrist and hand, the anatomical snuffbox is a crucial landmark for assessing scaphoid injuries, and the thenar and hypothenar eminences ensure functional hand positioning within the cast. Proper identification and preservation of these landmarks are essential to prevent complications and maintain functionality.

Neurovascular Structures to Avoid During Casting

Careful consideration of neurovascular anatomy is necessary to avoid iatrogenic complications. The radial nerve, which wraps around the humerus at the spiral groove, is vulnerable to compression and can result in wrist drop if improperly managed (Stanitski, 2017). The ulnar nerve, located posterior to the medial epicondyle and within Guyon's canal at the wrist, requires adequate padding to prevent "cubital tunnel syndrome." Similarly, the median nerve, which travels through the carpal tunnel, is at risk for compression-related complications, such as carpal tunnel syndrome.

The brachial artery, the main blood supply to the forearm and hand, must remain unobstructed to prevent ischemia. It is particularly susceptible to compression at the elbow and should be monitored for signs of compartment syndrome (Gelberman & Menon, 1980). The radial and ulnar arteries, palpable at the wrist, are essential for maintaining perfusion in the hand. Additionally, care must be taken to avoid constriction of the cephalic and basilic veins and to preserve lymphatic drainage, as these are vital for preventing swelling and venous thrombosis in immobilized areas.

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1.2 Introduction: Purpose and Importance of Casting for the Upper Extremity

Orthopedic casting is a critical intervention for the treatment of a wide range of musculoskeletal conditions affecting the upper extremity. The primary purpose of casting is to immobilize the affected region, thereby providing structural support, reducing pain, promoting tissue healing, and preventing further injury. Casting plays an essential role in the management of fractures, soft tissue injuries, and certain joint dislocations, as it stabilizes the bones and joints in their proper anatomical alignment. This immobilization facilitates natural healing processes while minimizing complications such as malunion, nonunion, or chronic instability (Ricci et al., 2018).

Upper extremity injuries, including fractures of the radius, ulna, humerus, and wrist, are among the most common musculoskeletal injuries treated in clinical practice. Proper casting techniques ensure optimal outcomes by addressing both the mechanical and biological requirements of bone and tissue healing. Mechanically, casts provide external stabilization, maintaining the injured limb in a position conducive to healing while limiting motion that could disrupt the repair process. Biologically, they protect the injury site from external stressors and promote the natural inflammatory and reparative processes critical to recovery (Court-Brown & McQueen, 2016).

Another crucial aspect of casting is its role in reducing the risk of secondary complications. Improperly immobilized fractures or soft tissue injuries can lead to long-term functional impairments, including reduced range of motion, chronic pain, or deformities. For example, in distal radius fractures, maintaining proper alignment and immobilization is critical to preserving wrist function and avoiding complications such as carpal instability or arthritis (Mulders et al., 2019). Effective casting minimizes these risks by ensuring the injured structures remain properly supported throughout the healing process.

In addition to its therapeutic purposes, casting serves an important diagnostic and preventative role. By stabilizing the upper extremity, it allows healthcare providers to assess the patient's recovery progress more effectively. Immobilization can also serve as a protective measure in conditions such as ligament sprains or tendinitis, where restricting movement reduces the risk of exacerbating the injury. Modern advancements in casting materials, such as fiberglass, have improved patient outcomes by offering lightweight, durable, and water-resistant options that enhance comfort and compliance (Bertrand et al., 2018).

Finally, casting for the upper extremity is integral to pediatric and geriatric care, where unique anatomical and physiological factors must be considered. Pediatric patients, for instance, are at higher risk for growth plate injuries, necessitating precise casting techniques to prevent growth disturbances. Conversely, older adults are more prone to osteoporosis-related fractures, requiring additional attention to prevent complications such as skin breakdown or pressure sores (Schmitt et al., 2019). By addressing these diverse patient needs, orthopedic casting remains a cornerstone of effective upper extremity injury management.

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1.3 Upper Extremity Casts - Overview

Orthopedic casts are tailored to address specific injuries of the upper extremity. Each type of cast is designed to provide appropriate immobilization, promote healing, and prevent further damage. The following sections outline the most common types of upper extremity casts, their indications, and the steps for their application.

Short Arm Cast

The short arm cast is one of the most commonly used casts for upper extremity injuries. It extends from just below the elbow to the knuckles, leaving the fingers free.

Indications: Short arm casts are primarily indicated for distal radius fractures, wrist fractures, and other conditions requiring immobilization of the wrist joint without restricting elbow movement. These conditions may include nondisplaced or minimally displaced fractures of the scaphoid, stable metacarpal fractures, and certain soft tissue injuries (Mulders et al., 2019).

Application Steps:

- ✓ Position the wrist in relaxed supination.
- ✓ Apply the casting material (fiberglass or plaster) in layers, starting from the distal end and moving proximally.
- ✓ Mold the cast carefully over bony prominences, such as the radial and ulnar styloid processes, to avoid pressure points.
- ✓ Allow the cast to set fully before providing patient education on care and monitoring.

Contraindications for Casting

- ✓ **Open Fractures:** Due to the risk of infection, open fractures are typically managed with external fixation or surgical intervention rather than casting (Robinson, 2020).
- ✓ **Severe Swelling:** Casting in the presence of significant swelling can lead to complications like compartment syndrome. Initial treatment with splinting is preferred until swelling subsides (Johnson et al., 2019).
- ✓ **Infections:** Skin infections or wounds at the site of casting increase the risk of complications and should be resolved before applying a cast.
- ✓ **Circumferential Injuries:** Injuries with extensive swelling or circumferential involvement may require splinting for easier monitoring and adjustments.
- ✓ **Chronic Conditions:** Patients with diabetes or vascular disease require special consideration due to an increased risk of delayed healing and skin complications (Smith et al., 2022).

Long Arm Cast

The long arm cast provides immobilization from the upper arm to the hand, encompassing the elbow joint. This type of cast restricts forearm rotation and elbow motion.

Indications: Long arm casts are indicated for forearm fractures (e.g., both-bone fractures of the radius and ulna), elbow fractures, and elbow dislocations requiring immobilization. They are also used postoperatively in cases where elbow stability is a concern (Court-Brown & McQueen, 2016).

Application Steps:

1. Position the arm in 90 degrees of elbow flexion, ensuring a neutral forearm position.
2. Apply the stockinette and padding, taking care to cushion bony prominences like the olecranon and epicondyles.
3. Start wrapping the casting material at the hand and progress proximally, covering the elbow and extending to the upper arm.
4. Ensure the cast is molded to maintain the elbow's functional position while providing stability.
5. Check for proper fit and patient comfort, ensuring no areas of excessive pressure.

Thumb Spica Cast

The thumb spica cast is designed to immobilize the thumb and wrist while leaving the fingers free for movement.

Indications: This cast is commonly used for scaphoid fractures, De Quervain's tenosynovitis, and ligamentous injuries of the thumb, such as ulnar collateral ligament tears (Bertrand et al., 2018).

Application Steps:

1. Position the thumb in opposition and slight flexion to preserve function and ensure proper healing alignment.
2. Apply the stockinette and padding, ensuring coverage of the thumb up to the interphalangeal joint.
3. Wrap the casting material around the wrist, hand, and thumb in overlapping layers.
4. Mold the cast carefully around the thenar and hypothenar eminences to maintain thumb position.
5. Verify thumb immobilization while preserving adequate circulation.

Ulnar Gutter Cast

The ulnar gutter cast is specifically designed to immobilize the fourth and fifth digits along with the ulnar side of the hand and wrist.

Indications: This cast is typically used for fractures of the fourth and fifth metacarpals, such as boxer's fractures, and for certain ligamentous injuries (Ricci et al., 2018).

Application Steps:

1. Position the wrist in slight extension and the fourth and fifth metacarpophalangeal (MCP) joints in 70-90 degrees of flexion.
2. Apply the stockinette and padding, focusing on the ulnar border and digits.
3. Wrap the casting material from the mid-forearm down to the distal end of the fourth and fifth fingers, leaving the thumb and other digits free.
4. Mold the cast to ensure proper immobilization of the metacarpal fractures.
5. Check for comfort and functionality, and provide instructions for care.

Sugar Tong Splint

The sugar-tong splint is a versatile immobilization device that encases the forearm and elbow in a U-shaped configuration.

Indications: It is commonly used for temporary stabilization of forearm fractures (e.g., distal radius fractures) and elbow injuries. The splint prevents forearm pronation and supination while allowing for swelling (Court-Brown & McQueen, 2016).

Application Steps:

1. Position the arm with the elbow at 90 degrees and the wrist in neutral.
2. Apply the stockinette and padding from the mid-upper arm to the hand, ensuring full coverage.
3. Place the sugar-tong splint material around the forearm and elbow, extending from the dorsal hand to the volar aspect of the forearm.
4. Secure the splint with an elastic bandage, ensuring it is snug but not overly tight to accommodate swelling.
5. Educate the patient on splint care and signs of complications, such as increased pain or numbness.

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Overview Upper Extremity Casting – MP3 Audio

UNIT 2:

01 Fracture Types in Upper Extremity

02 Short Arm Cast - Application & Removal

03 Long Arm Cast - Application and Removal

04 Thumb Spica Cast - Application and Removal

UNIT 2: Fracture Types for Upper Extremity Casting

Orthopedic casting remains a cornerstone in the management of various fractures, particularly those that require immobilization to promote healing while maintaining functional alignment. This section provides a detailed analysis of specific fracture types commonly treated with casting, addressing clinically relevant anatomy, epidemiological and etiological considerations, clinical characteristics, diagnostic processes, differential diagnoses, and treatment approaches.

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

- ✓ Identify the key anatomical structures of the forearm, wrist, and hand that influence short arm cast application.
- ✓ Explain the importance of positioning and alignment in maintaining proper immobilization.
- ✓ Appreciate the properties of fiberglass materials in terms of strength, drying time, and patient comfort.
- ✓ Select the appropriate material based on the patient's condition and clinical needs.
- ✓ Demonstrate how to achieve optimal immobilization, stability, and comfort while applying a short arm cast.
- ✓ Explain how to balance rigidity and flexibility to allow proper healing while minimizing complications.
- ✓ Describe the preparation process for the skin and apply appropriate padding to prevent pressure points and ensure patient comfort.
- ✓ Demonstrate properly mold the cast to maintain functional position and prevent complications.
- ✓ Ensure correct fit and symmetry to maximize immobilization without causing discomfort.
- ✓ Recognize potential issues such as pressure sores, circulation impairment, and thermal injuries from casting materials.
- ✓ Describe routine and considerations for appropriate follow-up care.

2.1 Fracture Type(s) for Short Arm Cast

Orthopedic casting remains a cornerstone in the management of various fractures, particularly those that require immobilization to promote healing while maintaining functional alignment. This section provides a detailed analysis of specific fracture types commonly treated with casting, addressing clinically relevant anatomy, epidemiological and etiological considerations, clinical characteristics, diagnostic processes, differential diagnoses, and treatment approaches.

Distal Radius Fractures

- ✓ ***Clinically Relevant Anatomy:*** The distal radius is the largest bone of the forearm and articulates with the carpal bones to form the wrist joint. This anatomical structure plays a critical role in wrist motion and load transmission from the hand to the forearm. Key anatomical landmarks include the radial styloid, sigmoid notch, and the volar and dorsal surfaces, which are often the sites of fracture involvement. The integrity of the radioulnar and radiocarpal joints is essential for maintaining wrist function (Court-Brown & McQueen, 2016).
- ✓ ***Epidemiology / Etiology / Mechanism of Injury:*** Distal radius fractures are the most common fractures seen in orthopedic practice, accounting for 18% of all adult fractures. The primary mechanism of injury involves a fall onto an outstretched hand (FOOSH), often occurring in elderly individuals with osteoporotic bone or in young adults exposed to high-energy trauma. Subtypes of distal radius fractures include Colles and Smith fractures, which differ in their mechanism and fracture displacement (Mulders et al., 2019).
- ✓ ***Clinical Characteristics/Presentation:*** Patients with distal radius fractures typically present with localized pain, swelling, and deformity around the wrist. A Colles fracture, caused by a fall onto an extended hand, presents with the characteristic "dinner fork" deformity, where the distal radius is dorsally displaced. Conversely, a Smith fracture, caused by a fall onto a flexed hand, results in volar displacement of the distal radius, producing a "garden spade" deformity. Both fractures may exhibit tenderness, reduced range of motion, and potential neurovascular compromise.
- ✓ ***Fracture Diagnosis Process:*** Radiographic imaging is essential for diagnosing distal radius fractures. Standard views include posteroanterior (PA), lateral, and oblique views, which help evaluate radial height, radial inclination, and volar tilt. Advanced imaging techniques, such as CT scans, are useful for assessing intra-articular extension and complex fracture patterns. Colles fractures often demonstrate dorsal angulation and displacement, while Smith fractures show volar angulation and displacement (Bertrand et al., 2018).
- ✓ ***Differential Diagnosis/Associated Injuries:*** Distal radius fractures can be associated with ulnar styloid fractures, TFCC tears, and ligamentous injuries. Differential diagnoses include scaphoid fractures, lunate dislocations, and carpal instability. It is important to evaluate the patient for concomitant injuries that may require additional intervention.
- ✓ ***Treatment / Management Considerations:*** The treatment of distal radius fractures depends on the stability and displacement of the fracture. Stable, minimally displaced Colles and Smith fractures are managed with closed reduction and immobilization in a short arm cast. The wrist is positioned in slight flexion and ulnar deviation for Colles fractures, while neutral or slight extension is preferred for Smith fractures. Unstable fractures or those with significant displacement often require surgical fixation to restore anatomical alignment and function (Mulders et al., 2019).

2.1.2 Short Arm Cast: Overview

Application Steps:

1. Patient preparation – skin assessment / examination
2. Begin by applying a stockinette and padding to protect the skin and provide comfort.
3. Position the wrist in relaxed supination.
4. Apply the casting material (fiberglass or plaster) in layers, starting from the distal end and moving proximally.
5. Mold the cast carefully over bony prominences, such as the radial and ulnar styloid processes, to avoid pressure points.
6. Allow the cast to set fully before providing patient education on care and monitoring.



2.2 Short Arm Cast (SAC)

Patient Preparation

Preparing a patient's skin prior to the application of an orthopedic fracture cast is crucial to ensure proper hygiene, reduce the risk of infection, and provide a comfortable fit. Here are the general steps to prepare the skin before applying a cast:

- **Removing jewelry from the affected limb prior to the application of a fiberglass cast for the upper extremity helps to ensure patient comfort, proper cast fitting, and effective healing while reducing the risk of complications during the treatment and recovery process.**
- **Clean the skin: Gently clean the area around the fracture site using mild soap and water or an antiseptic solution. This step helps to remove dirt, debris, and bacteria from the skin, reducing the risk of infection.**
- **Dry the skin: Pat the skin dry with a clean towel or gauze. Make sure the skin is completely dry before proceeding, as moisture can interfere with the adhesion of the cast materials and promote the growth of bacteria.**
- **Assess the skin: Examine the skin for any signs of infection, open wounds, or skin irritation. If there are any concerns, consult with the healthcare professional responsible for the patient's care.**
- **Apply a skin barrier (if necessary): In some cases, a skin barrier may be used to protect the skin from irritation or maceration. This could be a moisture barrier cream or spray, which can help prevent skin breakdown caused by prolonged exposure to moisture.**
- **Trim or shave hair (if necessary): Excessive hair in the cast area can cause discomfort, itching, and difficulty removing the cast later. If the patient has a lot of hair in the area, it may be necessary to trim or shave it before applying the cast. Be sure to get the patient's consent before doing so.**
- **Position the limb: Properly position the patient's limb in the desired position for casting. This may involve supporting the limb with pillows, bolsters, or other positioning aids to ensure that it remains stable and comfortable during the casting process.**
- **Once the patient's skin is clean, dry, and properly assessed, you can proceed with applying the stockinette, padding, and casting material according to the healthcare professional's instructions.**

Remember, it's essential to consult with a healthcare professional to ensure proper technique and care for the patient's specific needs.

2.2 Short Arm Cast (SAC) cont ...

Stockinette Application

Applying stockinette and padding correctly is crucial for patient comfort and protection when applying an orthopedic short arm fracture cast. Here is a step-by-step guide on how to apply both the stockinette and padding:

- **Measure the length:** Measure the patient's arm from the wrist to just below the elbow, and then add a few inches to ensure the stockinette covers the entire area that will be immobilized by the cast. The extra length will also allow you to fold the stockinette over the cast edges later.
- **Cut the stockinette:** Cut the stockinette to the appropriate length, taking care to create a clean, even edge.
- **Apply the stockinette:** Slide the stockinette onto the patient's arm, ensuring it is smooth and wrinkle-free. The stockinette should cover the entire area that will be immobilized, extending from the wrist to just below the elbow. Leave the extra length at both ends for folding over the cast edges later. Refer to corresponding video at the end of this lesson for detail instructions on applying the thumb "Gumby".

Padding Application

- **Begin at the wrist:** Start applying the padding at the distal end of the arm (the wrist). This will provide extra cushioning to the most vulnerable areas.
- **Wrap evenly:** Roll the padding evenly around the arm, overlapping each layer by approximately 50% to ensure even pressure distribution and adequate cushioning.
- **Cover bony prominences:** Make sure to pad bony prominences more generously, such as the wrist and the olecranon (the bony tip of the elbow). This helps to prevent pressure points, skin irritation, and discomfort.
- **Smooth out wrinkles:** As you apply the padding, smooth out any wrinkles or folds to ensure a comfortable fit and prevent pressure points.
- **Progress up the arm:** Continue wrapping the padding up the arm, maintaining even pressure and coverage until just 3-4 finger breadths below the elbow. Ensure the padding extends beyond the area that will be immobilized by the cast. Continue back down the arm overlapping half the previous layer and incorporate the flattening the tire technique, per video instruction.
- **Secure the padding:** Once you reach the desired level of padding, trim the padding material and secure it in place by simply applying light pressure on top layer. Tape or tucking the end under the previous layer is not necessary.

By carefully applying both the stockinette and padding, you create a comfortable and protective layer between the patient's skin and the fiberglass cast material. This helps to minimize the risk of skin irritation, pressure sores, and other complications during the healing process.

2.2 Short Arm Cast (SAC) cont ...

Fiberglass Cast Tape Application

Applying the fiberglass cast tape correctly is essential for ensuring a strong, durable, and comfortable orthopedic short arm cast. Here are the steps for effectively applying fiberglass cast tape:

- **Prepare the cast tape:** Open the fiberglass cast tape packages and have them ready for use. Be mindful that exposure to air or moisture will initiate the hardening process of the cast tape.
- **Put on gloves:** Wear gloves to protect your hands from the resin and maintain a clean application.
- **Prepare water:** Fill a basin or container with clean water to activate the polyurethane resin in the fiberglass cast tape. The temperature of the water will affect the working and setting time of the cast, with warmer water speeding up the process and cooler water slowing it down.
- **Dip the fiberglass cast tape:** Take the first roll of fiberglass cast tape and submerge it in the water for a few seconds, ensuring it is fully saturated. Gently squeeze the roll to remove excess water and evenly distribute the resin.
- **Begin at the wrist:** Start applying the fiberglass cast tape at the wrist, which is the distal end of the arm. Hold the roll in one hand and use the other hand to guide and smooth the tape as you wrap it around the limb.
- **Wrap evenly:** Wrap the fiberglass tape evenly around the arm, overlapping each layer by approximately 50% to ensure a strong and stable cast. Maintain an even tension while wrapping to avoid excessive pressure or a loose cast.
- **Cover the padding:** Ensure the fiberglass tape fully covers the underlying padding and stockinette. Be careful not to leave any gaps or exposed padding, as this can compromise the cast's effectiveness.
- **Progress up the arm:** Continue wrapping the fiberglass tape up the arm, maintaining even pressure and coverage until just below the elbow. After your 1-2 turns at top of forearm, fold stockinette back over. You may need to apply a bumper for extra support, per video. Make sure the cast extends from the joint above the injury (3-4 finger breadths below the elbow) to the joint below the injury (the wrist) for proper immobilization.
- **Apply additional layers:** Apply 3-4 layers of fiberglass tape for optimal strength and durability. When adding more layers, change the direction of the wrap to create a crisscross pattern, which increases the stability and rigidity of the cast. Both pinch and a wave as well as the cut technique will be demonstrated on the end of lesson video.
- **Smooth the cast:** While the cast is still wet and malleable, use your hands to gently mold and smooth the fiberglass tape to the contours of the patient's arm. This helps ensure a snug and comfortable fit.
- **Allow the cast to set:** Give the fiberglass cast time to set and harden, which usually takes around 10-15 minutes. Instruct the patient to remain still and avoid moving the affected limb during this time..

By following these steps, you can effectively apply fiberglass cast tape for an orthopedic short arm cast, ensuring a strong, stable, and comfortable cast that promotes healing and patient satisfaction.

2.2.1 Short Arm Cast (SAC) - Removal

Short Arm Cast Removal

Removing a short arm cast with an orthopedic cast cutter requires care and attention to avoid injury. An orthopedic cast cutter, also known as a cast saw, is a specialized tool designed to remove casts by cutting through the hard casting material without injuring the patient's skin. Follow these steps to remove a short arm cast using an orthopedic cast cutter:

- **Prepare the patient and workspace:** Have the patient sit in a comfortable position with their arm supported on a stable surface. Ensure the workspace is well-lit and that you have all the necessary tools, such as the cast cutter, cast spreader, and scissors.
- **Safety measures:** Explain the process to the patient and reassure them that the cast cutter will not harm their skin. The cast cutter works by vibrating at a high frequency, which allows it to cut through the cast material but not the skin. It is normal for the cast cutter to generate some heat and noise during the process, so let the patient know what to expect. Use zip stick if available for additional protection.
- **Begin cutting the cast:** Turn on the cast cutter and start cutting along the length of the cast. Hold the cutter perpendicular to the cast's surface and apply gentle pressure. You can make a cut along the side of the arm, usually following the natural curve between the thumb and the forearm. Be cautious not to press too hard or cut too deep, as this may cause discomfort or injury to the patient.
- **Check for padding:** Periodically stop cutting and check if you've reached the padding layer beneath the cast. The padding will provide an additional layer of protection for the patient's skin.
- **Cut the other side:** Make a similar cut on the opposite side of the cast, ensuring that the two cuts are roughly parallel to one another.
- **Use a cast spreader:** Once both cuts are complete, insert the cast spreader into one of the cuts and gently spread the edges apart. This will help to break any remaining connections between the cast pieces and create enough space to safely remove the cast.
- **Remove the cast:** Carefully lift the cast pieces away from the patient's arm, making sure not to pull or tug on the skin. If needed, use scissors to cut through the padding and stockinette underneath the cast.
- **Inspect the skin:** After the cast is removed, examine the patient's skin for any signs of irritation, infection, or injury. Encourage the patient to gently move their fingers and wrist to regain mobility.

Remember that cast removal should be performed by a healthcare professional or someone trained in cast removal to ensure the safety and well-being of the patient.

Click on or take pic of QR code to review lesson:



Short Arm Cast Application – MP3 Audio



Short Arm Cast Padding - Video



Short Arm Cast Application - Video



Short Arm Cast Removal - Video



2.3 Long Arm Cast: Introduction

The long arm cast is a commonly used immobilization device in orthopedic practice, designed to stabilize fractures of the upper extremity involving the elbow, proximal radius or ulna, and midshaft of these bones. Below, we discuss fracture types commonly managed with a long arm cast, including their clinical presentation, anatomy, and management considerations.

2.3.1 Fracture Type(s) for Long Arm Cast

Supracondylar Humerus Fractures

- ✓ Clinically Relevant Anatomy: The distal humerus comprises the medial and lateral condyles, the olecranon fossa, and the supracondylar region. The brachial artery and median nerve traverse the cubital fossa near the supracondylar region, making them vulnerable in these fractures.
- ✓ Epidemiological/Etiology/Mechanism of Injury: Supracondylar fractures account for approximately 60% of elbow fractures in children under 15 years old (Rasool, 2020).
- ✓ Mechanism: These fractures typically result from a fall on an outstretched hand (FOOSH) with the elbow hyperextended, leading to compression or shear forces on the supracondylar region.
- ✓ Clinical Characteristics/Presentation: Severe pain, swelling, and deformity at the elbow; Limited or absent elbow flexion/extension., possible neurovascular compromise indicated by pallor, pulselessness, or paresthesia.
- ✓ Fracture Diagnosis Process: Imaging: Anteroposterior (AP) and lateral radiographs of the elbow are diagnostic. A "posterior fat pad sign" suggests occult fractures.
- ✓ Clinical Tests: Neurovascular assessment for radial, median, and ulnar nerve function.
- ✓ Differential Diagnosis/Associated Injuries: Elbow dislocation; Intercondylar fractures
- ✓ Treatment/Management Considerations: Closed reduction and immobilization in a long arm cast with the elbow flexed to 90 degrees if neurovascular status permits; Post-reduction radiographs to confirm alignment; Regular monitoring for compartment syndrome.



2.3.1 Fracture Type(s) cont ...

Olecranon Fractures

- ✓ Clinically Relevant Anatomy: the olecranon is part of the proximal ulna, forming the bony prominence of the elbow. It serves as the insertion point for the triceps brachii tendon and articulates with the trochlea of the humerus.
- ✓ Epidemiological/Etiology/Mechanism of Injury: Olecranon fractures are more common in adults and account for approximately 10% of upper extremity fractures (Horneff & Kane, 2020).
- ✓ Mechanism: Direct trauma (e.g., a fall onto the elbow) or indirect trauma through triceps contraction during a fall.
- ✓ Clinical Characteristics/Presentation: Localized swelling and tenderness over the olecranon ; inability to actively extend the elbow due to triceps disruption; Pain exacerbated by elbow movement.
- ✓ Fracture Diagnosis Process: Imaging: AP and lateral elbow radiographs typically reveal the fracture and its displacement.
- ✓ Clinical Tests: Assessment of ulnar nerve function due to its proximity.
- ✓ Differential Diagnosis/Associated Injuries: Radial head fractures; Distal humerus fractures; Elbow dislocations.
- ✓ Treatment/Management Considerations: Nondisplaced fractures: Long arm cast with the elbow at 45-90 degrees of flexion to avoid triceps tension; Displaced fractures: Often require surgical fixation.



2.3.1 Fracture Type(s) cont ...

Radial Head Fractures

- ✓ Clinically Relevant Anatomy: The radial head articulates with the capitellum of the humerus and the radial notch of the ulna. This structure is integral to forearm pronation and supination.
- ✓ Epidemiological/Etiology/Mechanism of Injury: Radial head and neck fractures are the most common fractures of the elbow in adults, comprising about 20% of elbow fractures (Mason, 2021). Most result from a FOOSH injury with the forearm in pronation, transferring force to the radial head.
- ✓ Clinical Characteristics/Presentation: Lateral elbow pain and swelling; Pain aggravated by forearm pronation, supination, and elbow flexion; Mechanical block to motion may indicate a displaced fracture.
- ✓ Fracture Diagnosis Process: Imaging: AP and lateral elbow radiographs, possibly with oblique views. Computed tomography (CT) may aid in complex cases.
- ✓ Clinical Tests: Palpation of the lateral elbow for tenderness over the radial head.
- ✓ Differential Diagnosis/Associated Injuries: Olecranon fractures; Elbow dislocations; Coronoid process fractures.
- ✓ Treatment/Management Considerations: Nondisplaced or minimally displaced fractures: Long arm cast with the elbow at 90 degrees and the forearm in neutral rotation; Displaced or comminuted fractures: Surgical intervention may be required.



2.3.1 Fracture Type(s) cont ...

Midshaft Radius and Ulna Fractures

- ✓ Clinically Relevant Anatomy: The radius and ulna form the forearm's osseous framework and are connected by the interosseous membrane, which transfers force and maintains alignment.
- ✓ Epidemiological/Etiology/Mechanism of Injury: Most common in pediatric and adolescent populations but can occur in adults; High-energy trauma such as falls, direct blows, or sports-related injuries.
- ✓ Clinical Characteristics/Presentation: Forearm deformity, swelling, and ecchymosis; Pain and tenderness along the radius and ulna shafts; Reduced pronation and supination.
- ✓ Fracture Diagnosis Process: Imaging: AP and lateral forearm radiographs;
- ✓ Clinical Tests: Evaluation of neurovascular function due to proximity to the radial and ulnar nerves.
- ✓ Differential Diagnosis/Associated Injuries: Isolated radius or ulna fractures; Compartment syndrome; Associated elbow or wrist fractures.
- ✓ Treatment/Management Considerations: Nondisplaced fractures: Long arm cast with neutral forearm position; Displaced fractures: Surgical fixation is usually required.



2.3.1 Fracture Type(s) cont ...

Galeazzi Fractures

- ✓ Clinically Relevant Anatomy: the distal third of the radius and distal radioulnar joint (DRUJ) injury. The DRUJ stabilizes forearm rotation.
- ✓ Epidemiological/Etiology/Mechanism of Injury: Epidemiology: More common in adolescents and young adults.
- ✓ Mechanism: FOOSH injury with the forearm in pronation.
- ✓ Clinical Characteristics/Presentation: Swelling and deformity over the distal forearm; Tenderness at the wrist and limited forearm rotation; Instability or subluxation of the DRUJ.
- ✓ Fracture Diagnosis Process: Imaging: AP and lateral forearm radiographs with attention to the DRUJ alignment.
- ✓ Clinical Tests: Assessment of DRUJ stability under fluoroscopy if necessary.
- ✓ Differential Diagnosis/Associated Injuries: Isolated distal radius fractures; Distal ulna fractures; Ligamentous injuries of the wrist;
- ✓ Treatment/Management Considerations: Nondisplaced fractures: Long arm cast with forearm in supination; Displaced fractures or DRUJ instability: Surgical fixation required.



2.3.1 Fracture Type(s) cont ...

Monteggia Fractures

- ✓ Clinically Relevant Anatomy: a proximal ulna fracture with radial head dislocation. The interosseous membrane maintains the relationship between the radius and ulna.
- ✓ Epidemiological/Etiology/Mechanism of Injury: Epidemiology: Rare but often seen in pediatric populations.
- ✓ Mechanism: FOOSH injuries combined with pronation or hyperextension forces.
- ✓ Clinical Characteristics/Presentation: Forearm deformity with tenderness over the ulna; Limited forearm rotation and elbow extension; Radial head prominence may be palpable.
- ✓ Fracture Diagnosis Process: Imaging: AP and lateral radiographs of the forearm, elbow, and wrist. Look for radial head alignment with the capitellum.
- ✓ Clinical Tests: Evaluate radial nerve function.
- ✓ Differential Diagnosis/Associated Injuries: Isolated radial head dislocation; Galeazzi fractures (distal radial fracture with radioulnar joint disruption); Nerve injuries (posterior interosseous nerve).
- ✓ Treatment/Management Considerations: Closed reduction and immobilization in a long arm cast with the forearm in supination; Monitor for any displacement, which may require surgical intervention.



2.4 Long Arm Cast

Patient Preparation

Preparing a patient's skin prior to the application of an orthopedic fracture cast is crucial to ensure proper hygiene, reduce the risk of infection, and provide a comfortable fit. Here are the general steps to prepare the skin before applying a cast:

- **Removing jewelry from the affected limb prior to the application of a fiberglass cast for the upper extremity helps to ensure patient comfort, proper cast fitting, and effective healing while reducing the risk of complications during the treatment and recovery process.**
- **Clean the skin: Gently clean the area around the fracture site using mild soap and water or an antiseptic solution. This step helps to remove dirt, debris, and bacteria from the skin, reducing the risk of infection.**
- **Dry the skin: Pat the skin dry with a clean towel or gauze. Make sure the skin is completely dry before proceeding, as moisture can interfere with the adhesion of the cast materials and promote the growth of bacteria.**
- **Assess the skin: Examine the skin for any signs of infection, open wounds, or skin irritation. If there are any concerns, consult with the healthcare professional responsible for the patient's care.**
- **Apply a skin barrier (if necessary): In some cases, a skin barrier may be used to protect the skin from irritation or maceration. This could be a moisture barrier cream or spray, which can help prevent skin breakdown caused by prolonged exposure to moisture.**
- **Trim or shave hair (if necessary): Excessive hair in the cast area can cause discomfort, itching, and difficulty removing the cast later. If the patient has a lot of hair in the area, it may be necessary to trim or shave it before applying the cast. Be sure to get the patient's consent before doing so.**
- **Position the limb: Properly position the patient's limb in the desired position for casting. This may involve supporting the limb with pillows, bolsters, or other positioning aids to ensure that it remains stable and comfortable during the casting process.**
- **Once the patient's skin is clean, dry, and properly assessed, you can proceed with applying the stockinette, padding, and casting material according to the healthcare professional's instructions.**

Remember, it's essential to consult with a healthcare professional to ensure proper technique and care for the patient's specific needs.

2.4 Long Arm Cast cont ...

Stockinette Application

Applying a stockinette and padding correctly is crucial for patient comfort and protection. Here is a step-by-step guide on how to apply both the stockinette and padding:

- **Prepare the materials:** Gather the necessary materials, including a stockinette, scissors, and cast padding.
- **Measure the stockinette:** Measure the length of the patient's arm from the base of the hand to the axilla, and add a few extra inches to allow for folding at the top and bottom. Cut the stockinette to the appropriate length.
- **Position the stockinette:** Slide the stockinette over the patient's arm so that it covers the entire length of the limb. Make sure that the stockinette is not too loose or too tight.
- **Fold the top of the stockinette:** Fold the top of the stockinette down towards the patient's hand, leaving a few inches of excess material at the top. This will create a cuff that will protect the skin from the cast material.
- **Fold the bottom of the stockinette:** Fold the bottom of the stockinette up towards the patient's axilla, leaving a few inches of excess material at the bottom.
- **Smooth the stockinette:** Smooth out any wrinkles or folds in the stockinette to ensure a comfortable and snug fit.

Padding Application

- **Apply the first layer:** Start at the base of the hand and wrap the first layer of cast padding over the stockinette, making sure to cover the entire limb. The padding should overlap $\frac{1}{2}$ with each turn to ensure a smooth and even surface.
- **Apply the second layer:** Once the first layer is in place, apply a second layer of cast padding in the same manner. The second layer should overlap the first layer by approximately half of its width.
- **Continue adding layers:** Depending on the severity of the injury and the physician's instructions, additional layers of cast padding may be needed. Apply each layer in the same manner as the first two, making sure to cover the entire limb.
- **Smooth out any wrinkles:** As you apply each layer of cast padding, make sure to smooth out any wrinkles or folds to ensure a comfortable fit. Wrinkles or folds can cause discomfort and may even lead to pressure sores.
- **Check for proper fit:** After applying the cast padding, check to ensure that it is not too tight or too loose. The padding should provide cushioning and protection for the limb, but should not constrict blood flow or cause discomfort.

Overall, applying cast padding over the stockinette in a long arm orthopedic cast is an important step in protecting the patient's skin and ensuring a comfortable fit. It is important to follow the physician's instructions carefully.

2.4 Long Arm Cast cont ...

Fiberglass Cast Tape Application

Applying the fiberglass cast tape correctly is essential for ensuring a strong, durable, and comfortable orthopedic long arm cast. Here are the steps for effectively applying fiberglass cast tape:

- **Prepare fiberglass tape:** Put on gloves to protect your hands. The exact number of rolls will depend on the size of the patient's arm and the desired thickness of the cast.
- **Dip fiberglass tape:** Fully submerge a roll of fiberglass tape in lukewarm water for a few seconds to activate the resin. Squeeze the roll gently to remove excess water.
- **Apply fiberglass tape:** Start wrapping the fiberglass tape in the same manner as the short arm cast as well as applying fiberglass around the wrist - cut technique or fan fold" at the wrist
- **Focus on positioning the elbow slightly above 90 degrees** as the arm will migrate slightly to 90 degrees in final fiberglass application.
- **Start with your next roll of fiberglass tape on the proximal end of your short arm cast and continue with figure 8** approached around the elbow. Cove the cast tape along the antecubital space - as demonstrated in the lesson video and continue to work your way towards the shoulder. Overlap each layer by 50% for uniform thickness. Make sure the tape lies smoothly without any wrinkles or air pockets.
- **Mold the cast (per video):** As you apply the fiberglass tape, use your hands to mold and shape the cast around the arm. Apply gentle pressure to ensure a snug fit without causing discomfort. Ensure the elbow is immobilized at an appropriate angle, usually around 90 degrees.
- **Final molding:** Once you have reached the desired thickness, smooth the outer surface of the cast using your hands or a gloved palm. This will help set the cast and make it more comfortable for the patient. Use the demonstrated molding technique from the instructional video for upper arm.
- **Cast setting:** Allow the fiberglass cast to harden, which usually takes around 10-15 minutes. The cast will feel warm as it hardens, which is normal.
- **Inspect the cast:** Once the cast is set, check for any sharp edges, pressure points, or skin irritation. Trim or smooth any rough edges as necessary. Ensure proper circulation by checking the patient's capillary refill time and ensuring they can move their fingers without difficulty.
- **Provide aftercare instructions:** Explain to the patient how to care for their cast, including keeping it dry, avoiding direct pressure on the cast, and reporting any signs of infection or discomfort.

By following these steps, you can effectively apply fiberglass cast tape for an orthopedic short arm cast, ensuring a strong, stable, and comfortable cast that promotes healing and patient satisfaction.

2.4.1 Long Arm Cast (SAC) - Removal

Long Arm Cast Removal

Follow these steps to remove a short arm cast using an orthopedic cast cutter:

- **Explain the process:** Inform the patient about the cast removal process, emphasizing that the cast saw will make noise and may feel warm but will not cut their skin.
- **Position the patient:** Have the patient sit or lie down in a comfortable position, ensuring their arm is well-supported throughout the process.
- **Cast saw safety:** Put on protective eyewear and ensure the cast saw is in good working condition before using it. Double-check that the blade is sharp and properly attached.
- **Cutting the cast:** Begin by cutting the cast longitudinally on each side, taking care to avoid direct contact with the patient's skin. Apply gentle pressure and use a steady, back-and-forth motion. Do not force the blade or attempt to cut through the padding in one pass. The cast saw is designed to cut through the rigid outer layer without cutting the padding underneath.
- **Scissor insertion:** Once the cast is cut on both sides, gently insert the blunt-nosed cast scissors or a spreader between the padding and the patient's skin, keeping the blade parallel to the skin. This will protect the patient's skin while you cut through the padding.
- **Cut the padding:** Carefully cut the padding along the same lines you cut the outer layer of the cast. Be cautious not to nick or cut the patient's skin.
- **Cast spreading:** Using a cast spreader, gently pry apart the two halves of the cast. If necessary, use additional cutting or spreading to ensure the cast can be removed without causing discomfort to the patient.
- **Remove the cast:** Carefully lift the two halves of the cast away from the patient's arm, taking care not to cause any sudden movements or excessive pressure on the healing fracture.
- **Remove the padding and stockinet:** Gently peel back the padding and stockinet, being cautious of any sensitive or tender areas on the patient's skin.
- **Skin inspection:** Examine the patient's skin for any signs of infection, pressure sores, or other issues that may require medical attention. Look for redness, swelling, discharge, or foul odor. Additionally, assess the patient's range of motion and strength in their arm and fingers.
- **Clean the area:** Gently cleanse the patient's skin with warm water and mild soap, and pat dry. Apply moisturizing lotion if the skin is dry or irritated.
- **Follow-up care:** Per MD instructions.

Click on or take pic of QR code to review lesson:



Long Arm Cast Application – MP3 Audio



Long Arm Cast Application - Video

2.5 Thumb Spica Arm Cast: Intro

The thumb spica cast is a versatile immobilization technique primarily used to stabilize fractures and soft tissue injuries involving the thumb and adjacent structures. This type of cast extends from the proximal forearm to the distal interphalangeal joint of the thumb, ensuring adequate immobilization while preserving circulation and minimizing functional limitations post-healing. Below are detailed descriptions of common fractures managed using a thumb spica cast.





Scaphoid Fracture

2.5.1 Fracture Type(s) for Thumb Spica Cast

Scaphoid Fractures

- ✓ **Clinical Relevant Anatomy:** The scaphoid is a small carpal bone situated on the radial side of the wrist, bridging the distal and proximal carpal rows. It plays a critical role in wrist stability and motion. The blood supply to the scaphoid, primarily from the radial artery, is retrograde, increasing the risk of avascular necrosis, particularly in proximal pole fractures.
- ✓ **Epidemiology / Etiology / Mechanism of Injury:** Scaphoid fractures account for approximately 60%-70% of carpal bone fractures (Adams et al., 2020). They often result from a fall on an outstretched hand (FOOSH), with the wrist hyperextended and radially deviated.
- ✓ **Clinical Characteristics / Presentation:** Patients typically present with pain and tenderness in the anatomical snuffbox, swelling, and reduced wrist range of motion. Pain exacerbates with axial loading of the thumb or wrist extension.
- ✓ **Fracture Diagnosis Process:** Diagnosis is made through clinical examination and imaging. Radiographs (posteroanterior, lateral, and scaphoid views) are the first step. If initial imaging is inconclusive, advanced modalities such as MRI or CT scan can confirm the diagnosis and assess displacement.
- ✓ **Differential Diagnosis / Associated Injuries:** Distal radius fracture; Triangular fibrocartilage complex (TFCC) injury; Lunate dislocation
- ✓ **Treatment / Management Considerations:** Non-displaced scaphoid fractures are treated with a thumb spica cast for 6-12 weeks, depending on the location of the fracture. Displaced or proximal pole fractures often require surgical fixation.

2.5.1 Fracture Type(s) for Thumb Spica Cast

First Metacarpal Fractures (Bennett's and Rolando's Fractures)

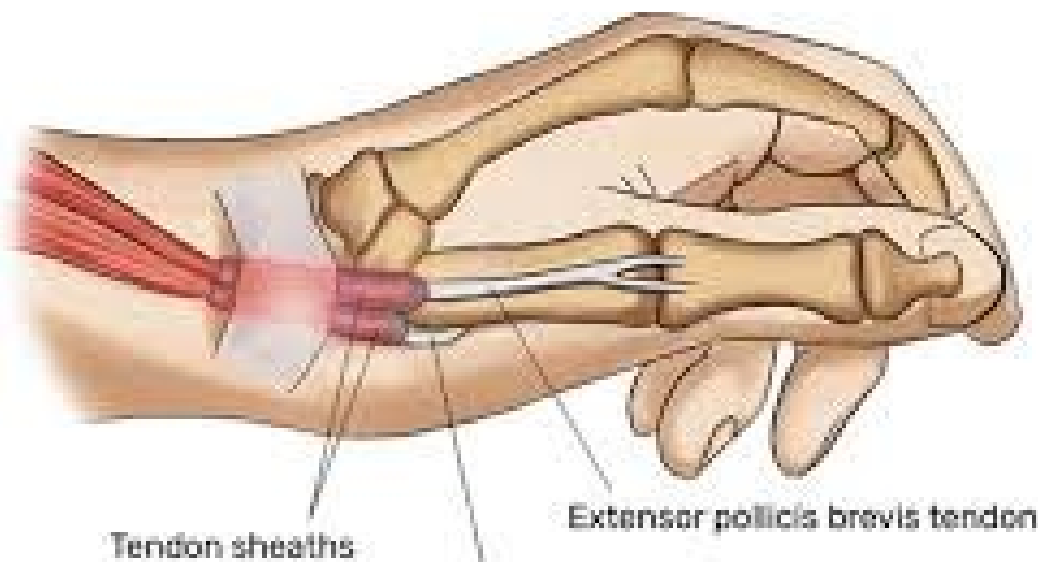
- ✓ Clinical Relevant Anatomy: the first metacarpal forms the thumb's base and articulates with the trapezium, allowing for a wide range of thumb movements. Stability is provided by the ulnar collateral ligament, volar plate, and dorsal capsule.
- ✓ Epidemiology / Etiology / Mechanism of Injury:
 - ✓ Bennett's fracture (a single intra-articular fracture-dislocation) and Rolando's fracture (a comminuted intra-articular fracture) are common in younger, active populations. These injuries typically result from axial loading or direct trauma during sports or falls.
- ✓ Clinical Characteristics / Presentation: Patients report pain, swelling, and deformity at the thumb base. Movement, particularly pinching and grasping, is markedly painful. Visible shortening or angulation may be present.
- ✓ Fracture Diagnosis Process: Radiographs confirm the fracture pattern, with Bennett's fractures showing a triangular fragment attached to the trapezium and Rolando's fractures displaying a Y- or T-shaped comminuted pattern.
- ✓ Differential Diagnosis / Associated Injuries: Gamekeeper's or skier's thumb (ulnar collateral ligament tear); Carpometacarpal joint dislocations
- ✓ Treatment / Management Considerations: Non-displaced fractures may be immobilized in a thumb spica cast for 4-6 weeks. Displaced or unstable fractures usually require open reduction and internal fixation.



2.5.1 Fracture Type(s) for Thumb Spica Cast

DeQuervain's Tenosynovitis (Soft Tissue Injury)

- ✓ Clinical Relevant Anatomy: This condition involves inflammation of the tendons in the first dorsal compartment (abductor pollicis longus and extensor pollicis brevis) and their synovial sheath.
- ✓ Epidemiology / Etiology / Mechanism of Injury: De Quervain's tenosynovitis is common in repetitive strain injuries due to overuse or direct trauma. It often affects individuals performing repetitive wrist and thumb motions.
- ✓ Clinical Characteristics / Presentation: Patients present with pain and swelling over the radial styloid, worsened by thumb movements or ulnar deviation of the wrist. The Finkelstein test reproduces symptoms.
- ✓ Fracture Diagnosis Process: This condition is primarily diagnosed clinically. Imaging may be used to exclude underlying fractures or arthritis.
- ✓ Differential Diagnosis / Associated Injuries:
 - ✓ Intersection syndrome
 - ✓ Scaphoid fracture
 - ✓ Radial styloid fracture
- ✓ Treatment / Management Considerations: A thumb spica splint or cast may be used for immobilization to reduce inflammation. Conservative treatment includes NSAIDs, physical therapy, and corticosteroid injections. Surgical intervention is considered in refractory cases.



2.5.1 Fracture Type(s) for Thumb Spica Cast

Ulnar Collateral Ligament (UCL) Injuries of the Thumb

- ✓ Clinical Relevant Anatomy: The UCL stabilizes the thumb's metacarpophalangeal joint, preventing excessive valgus stress. Injury to this ligament is commonly referred to as "skier's thumb."
- ✓ Epidemiology / Etiology / Mechanism of Injury: UCL injuries are often caused by forceful thumb abduction, such as during a fall while holding a ski pole. Chronic cases are termed "gamekeeper's thumb" due to repetitive stress.
- ✓ Clinical Characteristics / Presentation: Patients present with pain, swelling, and ecchymosis at the thumb's base. Valgus stress testing reveals joint laxity.
- ✓ Fracture Diagnosis Process: Diagnosis is clinical, with stress radiographs used to assess associated avulsion fractures.
- ✓ Differential Diagnosis / Associated Injuries: Stener lesion (displaced ligament entrapment); First metacarpal fracture
- ✓ Treatment / Management Considerations: Partial tears are treated conservatively with a thumb spica cast for 4-6 weeks. Complete tears or Stener lesions require surgical repair.



2.6 Thumb Spica Cast

Patient Preparation

Preparing a patient's skin prior to the application of an orthopedic fracture cast is crucial to ensure proper hygiene, reduce the risk of infection, and provide a comfortable fit. Here are the general steps to prepare the skin before applying a cast:

- **Removing jewelry from the affected limb prior to the application of a fiberglass cast for the upper extremity helps to ensure patient comfort, proper cast fitting, and effective healing while reducing the risk of complications during the treatment and recovery process.**
- **Clean the skin: Gently clean the area around the fracture site using mild soap and water or an antiseptic solution. This step helps to remove dirt, debris, and bacteria from the skin, reducing the risk of infection.**
- **Dry the skin: Pat the skin dry with a clean towel or gauze. Make sure the skin is completely dry before proceeding, as moisture can interfere with the adhesion of the cast materials and promote the growth of bacteria.**
- **Assess the skin: Examine the skin for any signs of infection, open wounds, or skin irritation. If there are any concerns, consult with the healthcare professional responsible for the patient's care.**
- **Apply a skin barrier (if necessary): In some cases, a skin barrier may be used to protect the skin from irritation or maceration. This could be a moisture barrier cream or spray, which can help prevent skin breakdown caused by prolonged exposure to moisture.**
- **Trim or shave hair (if necessary): Excessive hair in the cast area can cause discomfort, itching, and difficulty removing the cast later. If the patient has a lot of hair in the area, it may be necessary to trim or shave it before applying the cast. Be sure to get the patient's consent before doing so.**
- **Position the limb: Properly position the patient's limb in the desired position for casting. This may involve supporting the limb with pillows, bolsters, or other positioning aids to ensure that it remains stable and comfortable during the casting process.**
- **Once the patient's skin is clean, dry, and properly assessed, you can proceed with applying the stockinette, padding, and casting material according to the healthcare professional's instructions.**

Remember, it's essential to consult with a healthcare professional to ensure proper technique and care for the patient's specific needs.

2.6 Thumb Spica Cast cont ...

Stockinette Application

- **Measure the stockinette:** Measure the length required for the stockinette, which should cover the patient's arm from the upper arm to the base of the thumb. Make sure you have enough material to fold back at the edges to create a neat finish.
- **Cut the stockinette:** Cut the stockinette to the measured length, ensuring it's wide enough to fit comfortably around the patient's arm without excessive stretching.
- **Position the patient:** Have the patient sit or lie down in a comfortable position with their arm well-supported and elevated. The fingers should be slightly flexed, and the thumb should be in a functional position (slightly abducted and extended).
- **Apply the stockinette:** Slide the stockinette over the patient's hand and up their arm, ensuring it covers the entire area where the cast will be applied. Smooth out any wrinkles or folds.
- **Create a thumb hole:** Locate the base of the thumb and carefully cut a small hole in the stockinette for the thumb to fit through. Make sure the hole is snug but not too tight, to avoid constriction or discomfort.
- **Fit the thumb:** Gently guide the patient's thumb through the hole, ensuring the stockinette covers the base of the thumb and the thumb-forefinger web space without any wrinkles or folds. The stockinette should provide a smooth, comfortable layer between the skin and the cast padding. Refer to video for detailed instructions.

Padding Application

- **Apply padding to the thumb:** Begin applying the cast padding (cotton or synthetic) around the patient's thumb, starting at the tip and working your way towards the base. Ensure adequate padding to prevent pressure sores, especially at the thumb's base and the thumb-forefinger web space.
- **Apply padding to the wrist and forearm:** Start wrapping the padding around the wrist, overlapping each layer by 50% for uniform thickness. Continue up the forearm, ensuring the padding lies smoothly without wrinkles or folds. Apply extra padding around bony prominences as needed.

2.6 Thumb Spica Cast cont ...

Fiberglass Cast Tape Application

- **Preparation:** Put on gloves to protect your hands from the fiberglass resin. Gather all necessary materials, including fiberglass casting tape, a bucket of lukewarm water, and scissors.
- **Dip the fiberglass tape:** Fully submerge a roll of fiberglass tape in the lukewarm water for a few seconds to activate the resin. Squeeze the roll gently to remove excess water.
- **Apply fiberglass tape to the thumb:** Start wrapping the fiberglass tape around the base of the thumb, working your way up towards the tip. Overlap each layer by 50% for uniform thickness. Ensure the tape lies smoothly without any wrinkles or air pockets. This is similar to the padding technique previously described.
- **Apply fiberglass tape to the hand:** Once the thumb is covered, begin wrapping the tape around the patient's hand, making sure to cover the thumb-forefinger web space. Continue overlapping each layer by 50% to maintain uniform thickness.
- **Apply fiberglass tape to the wrist and forearm - similar to the short arm cast previous demonstrated:** Start wrapping the tape around the wrist and work your way up the forearm. Overlap each layer by 50% for even thickness. Make sure the tape lies smoothly without any wrinkles or air pockets.
- **Mold the cast:** As you apply the fiberglass tape, use your hands to mold and shape the cast around the thumb, hand, wrist, and forearm. Apply gentle pressure to ensure a snug fit without causing discomfort. Ensure the thumb is immobilized in a functional position (slightly abducted and extended).
- **Apply additional layers:** Apply additional layers of fiberglass tape to reinforce the cast and ensure adequate immobilization. Keep dipping, wrapping, and molding the cast tape as needed.
- **Final molding:** Once you have reached the desired thickness, smooth the outer surface of the cast using your hands or a gloved palm. This will help set the cast and make it more comfortable for the patient.
- **Cast setting:** Allow the fiberglass cast to harden, which usually takes around 10-15 minutes. The cast will feel warm as it hardens, which is normal.
- **Inspect the cast:** Once the cast is set, check for any sharp edges, pressure points, or skin irritation. Trim or smooth any rough edges as necessary. Ensure proper circulation by checking the patient's capillary refill time and ensuring they can move their fingers without difficulty.
- **Provide aftercare instructions:** Explain to the patient how to care for their cast, including keeping it dry, avoiding direct pressure on the cast, and reporting any signs of infection or discomfort.

Remember to monitor the patient's condition and follow up as needed to ensure proper healing and prevent complications.

2.6.1 Thumb Spica Cast - Removal

Thumb Spica Cast Removal

Removing a thumb spica fiberglass cast requires careful handling to prevent injury to the patient. Here's a step-by-step guide on how to remove the cast using a cast saw, scissors, and a cast spreader, along with skin considerations after the cast is removed:

- **Explain the process:** Inform the patient about the cast removal process, emphasizing that the cast saw will make noise and may feel warm but will not cut their skin.
- **Position the patient:** Have the patient sit or lie down in a comfortable position, ensuring their arm, wrist, and thumb are well-supported throughout the process.
- **Cast saw safety:** Put on protective eyewear and ensure the cast saw is in good working condition before using it. Double-check that the blade is sharp and properly attached.
- **Cutting the cast:** Begin by cutting the cast longitudinally along the sides of the thumb, hand, wrist, and forearm. Take care to avoid direct contact with the patient's skin. Apply gentle pressure and use a steady, back-and-forth motion. Do not force the blade or attempt to cut through the padding in one pass. The cast saw is designed to cut through the rigid outer layer without cutting the padding underneath.
- **Scissor insertion:** Once the cast is cut on both sides, gently insert the blunt-nosed cast scissors or a spreader between the padding and the patient's skin, keeping the blade parallel to the skin. This will protect the patient's skin while you cut through the padding.
- **Cut the padding:** Carefully cut the padding along the same lines you cut the outer layer of the cast. Be cautious not to nick or cut the patient's skin.
- **Cast spreading:** Using a cast spreader, gently pry apart the two halves of the cast. If necessary, use additional cutting or spreading to ensure the cast can be removed without causing discomfort to the patient.
- **Remove the cast:** Carefully lift the two halves of the cast away from the patient's arm, taking care not to cause any sudden movements or excessive pressure on the healing injury.
- **Remove the padding and stockinet:** Gently peel back the padding and stockinet, being cautious of any sensitive or tender areas on the patient's skin.
- **Skin inspection:** Examine the patient's skin for any signs of infection, pressure sores, or other issues that may require medical attention. Look for redness, swelling, discharge, or foul odor. Additionally, assess the patient's range of motion and strength in their arm, wrist, and fingers.
- **Clean the area:** Gently cleanse the patient's skin with warm water and mild soap, and pat dry. Apply moisturizing lotion if the skin is dry or irritated.
- **Follow-up care:** Based on the patient's recovery progress and physician's instructions, provide appropriate follow-up care, such as range of motion exercises, physical therapy, or the application of a new cast or brace.

Click on or take pic of QR code for an audio review of this lesson:



Thumb Spica Cast Application – MP3 Audio



Thumb Spica Cast Application - Application



Thumb Spica Cast Removal - Video



SECTION 3

ORTHOPEDIC CASTING FOR THE LOWER EXTREMITIES

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UNIT 3: 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.

Introduction: Purpose and 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.

3.1 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.

3.2 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).

3.2 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).

3.2 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).

3.3 Short Leg Cast



3.3.1 Fracture Type(s) for Short Leg Cast

Short leg casts (SLCs) are widely used in orthopedic practice for immobilizing fractures of the distal tibia, fibula, ankle, and foot. These fractures often occur due to trauma, falls, or sports-related injuries and require precise diagnosis and management to ensure proper healing. This section explores distal tibia fractures, isolated fibular fractures, ankle fractures, metatarsal fractures, and Lisfranc injuries, detailing their clinical anatomy, epidemiology, mechanism of injury, clinical characteristics, diagnostic process, differential diagnoses, and treatment considerations.

Distal Tibia Fractures

- ✓ ***Clinical Relevant Anatomy:*** The tibia, or shinbone, is the primary weight-bearing bone of the lower leg and plays a crucial role in lower extremity biomechanics. The distal tibial metaphysis transitions from the dense cortical bone of the shaft to the more porous cancellous bone near the ankle joint, making it more susceptible to fractures. The medial malleolus, which extends from the distal tibia, forms a critical stabilizing component of the ankle joint. Additionally, the posterior tibial artery and nerve pass closely along the posterior aspect of the tibia, making vascular and neurological compromise a concern in tibial fractures (Moore et al., 2020).
- ✓ ***Epidemiology / Etiology / Mechanism of Injury:*** Distal tibial fractures comprise approximately 7-10% of all tibial fractures, with a bimodal age distribution. Younger individuals commonly sustain these fractures through high-energy trauma, such as motor vehicle accidents, sports injuries, or falls from height. In contrast, older adults often experience low-energy fragility fractures due to osteoporosis and falls (Court-Brown et al., 2021). The mechanism of injury varies but often involves axial loading, torsional forces, or direct impact. High-energy fractures are frequently comminuted or intra-articular, while low-energy fractures tend to be simple transverse or oblique fractures.
- ✓ ***Clinical Characteristics / Presentation:*** Patients with distal tibial fractures typically present with significant localized pain, swelling, and bruising over the lower leg and ankle. Depending on the severity, they may have an obvious deformity in displaced fractures or minimal swelling in hairline fractures. Weight-bearing is often painful or impossible, and patients may report numbness or tingling if neurovascular structures are affected. Compartment syndrome is a rare but critical complication in high-impact fractures, requiring immediate assessment.
- ✓ ***Fracture Diagnosis Process:*** Assess for tenderness along the tibia, particularly near the medial malleolus; Evaluate skin integrity to rule out open fractures; Perform a neurovascular examination, checking for capillary refill, dorsalis pedis and posterior tibial pulses, and sensation in the foot.
- ✓ ***Imaging Studies:*** (1) X-ray (AP, lateral, oblique views) is the first-line imaging modality to confirm the fracture pattern; (2) CT scan may be necessary for complex fractures with suspected intra-articular extension.
- ✓ ***Differential Diagnosis / Associated Injuries:*** Ankle sprains (can mimic pain at the distal tibia); Stress fractures (particularly in athletes with chronic lower leg pain); Talus fractures (can coexist with distal tibial fractures); Maisonneuve fractures (high fibular fractures associated with syndesmosis injuries)
- ✓ ***Treatment / Management Considerations:*** For nondisplaced fractures, an SLC is applied for 6–8 weeks, with non-weight-bearing status for the first few weeks, followed by progressive weight-bearing. If the fracture is displaced, closed reduction is performed before casting. Surgical fixation (intramedullary nailing or plating) is considered for unstable fractures, open fractures, or those involving the articular surface (Bucholz et al., 2021).

3.3.2 Fracture Type(s) for Short Leg Cast

Isolated Fibular Fractures

- ✓ Clinical Relevant Anatomy: The fibula is a non-weight-bearing bone, running parallel to the tibia and playing a key role in ankle stability and lateral leg muscle attachment. It provides attachment for the peroneus longus and brevis muscles, which contribute to ankle eversion. Additionally, the interosseous membrane connects the fibula to the tibia, offering further support (Moore et al., 2020).
- ✓ Epidemiology / Etiology / Mechanism of Injury: Fibular fractures account for 15% of lower extremity fractures, commonly occurring due to inversion injuries, direct trauma, or rotational forces. These injuries are frequently seen in athletes, particularly runners and soccer players, due to repetitive stress on the fibula.
- ✓ Clinical Characteristics / Presentation: Localized pain and swelling over the lateral lower leg; Possible ecchymosis and tenderness along the fibula; Intact weight-bearing ability if isolated; Minimal deformity unless displaced
- ✓ Fracture Diagnosis Process: (1) X-ray (AP, lateral, and mortise views) to confirm the location and pattern; (2) MRI if syndesmotic injury or ligamentous instability is suspected.
- ✓ Differential Diagnosis / Associated Injuries: High-grade ankle sprains (lateral ligament damage mimicking fibular fractures); Syndesmotic injuries (damage to the tibiofibular syndesmosis); Maisonneuve fractures (proximal fibula fracture with syndesmotic disruption)
- ✓ Treatment / Management Considerations: For nondisplaced fractures, an SLC is applied for 4–6 weeks, allowing early weight-bearing. Displaced fractures may require closed reduction or surgical fixation, particularly if ankle stability is compromised (Bucholz et al., 2021).

3.3.3 Fracture Type(s) for Short Leg Cast

Ankle Fractures

- ✓ Clinical Relevant Anatomy: The ankle joint consists of the tibia, fibula, and talus, with stabilizing ligaments including the anterior talofibular, calcaneofibular, and deltoid ligaments. The syndesmosis, a fibrous joint between the tibia and fibula, is critical for stability (Moore et al., 2020).
- ✓ Epidemiology / Etiology / Mechanism of Injury: Ankle fractures represent 9% of all fractures, affecting young athletes and elderly individuals. Common mechanisms include: (1) Inversion injuries → Lateral malleolus fractures; (2) Eversion injuries → Medial malleolus fractures; (3) Torsional forces → Bimalleolar fractures
- ✓ Clinical Characteristics / Presentation: Pain, swelling, and bruising localized at the ankle; Difficulty bearing weight; Instability in ligamentous injuries
- ✓ Fracture Diagnosis Process: (1) X-ray (AP, lateral, mortise views) for fracture classification; (2) Ottawa Ankle Rules to determine imaging necessity
- ✓ Treatment / Management Considerations: Stable fractures are treated with SLC for 6 weeks, while unstable fractures require ORIF (Bucholz et al., 2021).

3.3.4 Fracture Type(s) for Short Leg Cast

Metatarsal Fractures

- ✓ **Clinical Relevant Anatomy:** The metatarsals are five long bones located in the midfoot, connecting the tarsal bones to the phalanges. They play a critical role in weight-bearing, balance, and propulsion during walking and running. The first metatarsal is the thickest and strongest, bearing the most weight, while the fifth metatarsal is more susceptible to avulsion fractures due to its attachment to the peroneus brevis tendon (Moore et al., 2020). Blood supply to the metatarsals is primarily derived from the dorsalis pedis and plantar arteries, with the nutrient arteries supplying the midshaft. Insufficient vascularization, particularly at the proximal fifth metatarsal (Jones fracture site), can impair healing.
- ✓ **Epidemiology / Etiology / Mechanism of Injury:** Metatarsal fractures are among the most common foot fractures, accounting for approximately 35% of all foot fractures (Court-Brown et al., 2021). The fifth metatarsal is the most frequently fractured, often due to twisting injuries, direct trauma, or stress-related overuse; (1) high-energy trauma (e.g., falls, dropping heavy objects on the foot) can lead to displaced fractures; (2) Repetitive stress in athletes and military personnel causes stress fractures, commonly seen in the second and third metatarsals (March fractures); (3) Twisting or inversion injuries often cause fifth metatarsal avulsion fractures due to the pull of the peroneus brevis tendon.
- ✓ **Clinical Characteristics / Presentation:** Pain and swelling over the dorsum of the foot; Difficulty walking or bearing weight, especially with first and fifth metatarsal fractures; Localized tenderness, often at the fracture site; Ecchymosis (bruising) around the midfoot or lateral border of the foot (especially in Jones fractures).
- ✓ **Fracture Diagnosis Process:** Physical Examination: (1) Palpation to localize pain along each metatarsal; (2) Assess for midfoot instability if Lisfranc injury is suspected; (3) Check for capillary refill and sensation to rule out neurovascular compromise.
- ✓ **Imaging Studies:** (1) X-ray (AP, lateral, oblique views) to assess for fracture type and displacement; (2) MRI or bone scan in suspected stress fractures, where initial X-rays may be negative; (3) CT scan if intra-articular extension is suspected.
- ✓ **Differential Diagnosis / Associated Injuries:** Lisfranc injury (midfoot instability must be ruled out); Soft tissue injuries or ligamentous sprains mimicking fractures; Sesamoid fractures (common near the first metatarsal head).
- ✓ **Treatment / Management Considerations:** (1) Nondisplaced fractures: Managed with an SLC or walking boot for 4–6 weeks with progressive weight-bearing; (2) Stress fractures: Require activity modification and protective immobilization for 6–8 weeks; (3) Displaced fractures: May require closed reduction before casting; (4) Jones fractures (proximal fifth metatarsal fractures with high risk of nonunion) may require operative fixation (Bucholz et al., 2021).

3.3.5 Fracture Type(s) for Short Leg Cast

Lisfranc Fractures

- ✓ Clinical Relevant Anatomy: The Lisfranc joint complex is a critical stabilizing structure of the midfoot, consisting of the tarsometatarsal (TMT) joints, the Lisfranc ligament (between the medial cuneiform and second metatarsal base), and the supporting joint capsule. This structure maintains the medial longitudinal arch and allows for force distribution during ambulation. The Lisfranc ligament is relatively weak, making it susceptible to dislocation or fracture with excessive midfoot stress (Moore et al., 2020).
- ✓ Epidemiology / Etiology / Mechanism of Injury: Lisfranc injuries are relatively rare, occurring in 1 out of 55,000 fractures annually, but they are often missed, leading to chronic instability if untreated (Eiff et al., 2020). These injuries typically occur due to high-energy trauma (e.g., motor vehicle collisions, falls from height, or crush injuries) but can also be seen in low-energy twisting injuries, especially in athletes (e.g., football, gymnastics, horseback riding).
- ✓ Clinical Characteristics / Presentation: (1) Midfoot pain, swelling, and bruising, particularly along the plantar surface; Inability to bear weight due to pain; (2) Pain with passive forefoot abduction or dorsiflexion (Lisfranc stress test); (3) "Fleck sign" on X-ray – a small avulsion fragment at the base of the second metatarsal indicating ligamentous injury.
- ✓ Fracture Diagnosis Process / Physical Examination: Tenderness along the midfoot, especially at the TMT joint complex; Assess for instability by applying dorsal-plantar stress to the forefoot.
- ✓ Imaging Studies: (1) Weight-bearing X-rays (AP, lateral, oblique views) to assess for TMT diastasis >2mm; (2) CT scan if subtle fractures or dislocations are suspected; (3) MRI to evaluate for Lisfranc ligamentous disruption.
- ✓ Differential Diagnosis / Associated Injuries: Metatarsal fractures (isolated vs. Lisfranc instability); Midfoot sprains (without ligamentous rupture); Navicular or cuneiform fractures.
- ✓ Treatment / Management Considerations: (1) Stable Lisfranc injuries (without diastasis): Managed with SLC for 6–8 weeks with non-weight-bearing for 6 weeks; (2) Unstable injuries (>2 mm diastasis): Require surgical fixation with screws or plates to prevent chronic midfoot instability and arthritis; (3) Post-immobilization rehabilitation: Progressive weight-bearing and midfoot strengthening exercises for 3–6 months post-injury (Bucholz et al., 2021).

3.3.6 Conclusion

Short leg casts (SLCs) remain a fundamental treatment modality for managing stable fractures of the distal tibia, fibula, ankle, and foot, providing essential immobilization to promote optimal healing while minimizing complications. Their application is particularly beneficial for non-displaced fractures and fractures with minimal instability, where external support is sufficient to allow the natural bone remodeling process to occur without the need for surgical fixation. In addition to immobilization, SLCs help to reduce pain, swelling, and movement-related discomfort, facilitating early recovery and functional rehabilitation.

Fracture management is not solely dependent on casting, as accurate diagnosis, classification, and patient-specific considerations play a critical role in determining treatment outcomes. Understanding the biomechanics and anatomical significance of the affected bones is crucial in selecting the appropriate immobilization strategy. For example, metatarsal stress fractures require modified weight-bearing approaches, while fifth metatarsal Jones fractures often require closer monitoring due to poor vascular supply and the potential risk of nonunion. Similarly, Lisfranc injuries, although potentially treated conservatively in stable cases, may lead to chronic midfoot instability and post-traumatic arthritis if misdiagnosed or inadequately managed.

Moreover, the role of early detection and proper imaging cannot be overstated in fracture management. Conventional X-ray imaging remains the first-line diagnostic tool, but in cases of subtle fractures or suspected ligamentous injuries (e.g., Lisfranc sprains or occult fractures), additional imaging modalities such as CT scans and MRIs are invaluable in determining the extent of the injury and guiding treatment decisions. Failure to accurately diagnose and classify fractures may lead to prolonged disability, malunion, or functional impairments, which can significantly impact an individual's mobility and quality of life.

The physician's decision to treat a fracture conservatively or surgically is guided by several factors, including fracture displacement, stability, alignment, and soft tissue involvement. While SLCs provide sufficient stabilization for many injuries, they are not suitable for all fracture types, particularly those with significant displacement, intra-articular extension, or syndesmotic disruption. In these cases, surgical intervention with open reduction and internal fixation (ORIF) may be necessary to restore anatomic alignment and joint stability, preventing long-term complications such as post-traumatic osteoarthritis, chronic pain, and functional limitations.

Beyond immobilization, rehabilitation and post-cast care are essential components of the recovery process. Prolonged immobilization can lead to muscle atrophy, joint stiffness, and decreased range of motion, necessitating progressive rehabilitation protocols focusing on strength restoration, proprioceptive training, and gradual weight-bearing progression. Patient education is also vital, emphasizing proper cast care, monitoring for complications (e.g., swelling, numbness, or skin irritation), and adherence to weight-bearing restrictions to ensure optimal healing.

In conclusion, short leg casts play a pivotal role in orthopedic fracture management, but their effectiveness depends on appropriate patient selection, accurate diagnosis, and comprehensive follow-up care. As advancements in fracture treatment and imaging techniques continue to evolve, the focus remains on optimizing outcomes through evidence-based clinical decision-making. A multidisciplinary approach, incorporating orthopedic specialists, athletic trainers, physical therapists, and patient-centered rehabilitation strategies, is key to ensuring that individuals with lower extremity fractures regain full functional mobility and long-term musculoskeletal health.

3.4 Short Leg Cast: Overview

Application Steps:

1. Patient preparation – skin assessment / examination
2. Begin by applying a stockinette and padding to protect the skin and provide comfort.
3. Position the hip / ankle 90/90 on cast stand.
4. Apply the casting material (fiberglass or plaster) in layers, starting from the distal end toes and moving proximally.
5. Mold the cast carefully over bony prominences, such as the medial / lateral malleolus, Achilles and tibial tubercle.
6. Allow the cast to set fully before providing patient education on care and monitoring.



3.4.1 Short Leg Cast

Patient Preparation

Proper patient and skin preparation is essential to ensure optimal cast fit, patient comfort, and skin integrity. Here are the general steps to prepare the skin before applying a cast:

- **Verify Physician's Orders:** Confirm the type of cast needed, any special positioning requirements, and whether weight-bearing status is partial, non-weight-bearing, or full weight-bearing.
- **Assess Patient Condition:** Check for contraindications such as open wounds, infections, or significant edema; Evaluate neurovascular status (circulation, sensation, movement) of the affected limb and document findings before cast application.
- **Position the Patient:** Seat the patient comfortably with the affected leg supported at the knee and ankle; Ensure the foot is in a neutral (90-degree) position to prevent equinus deformity.
- **Skin Preparation:** Inspect the skin for abrasions, blisters, or irritation; Clean the skin with an antiseptic solution if necessary; Dry thoroughly before proceeding.
- **Protect Bony Prominences:** Identify pressure-prone areas (e.g., malleoli, Achilles tendon, tibial crest, metatarsal heads); If necessary, apply extra padding (foam or felt) to these areas.

Remember, it's essential to consult with a healthcare professional to ensure proper technique and care for the patient's specific needs.

3.4.1 Short Leg Cast cont ...

Stockinette Application

Applying stockinette and padding correctly is crucial for patient comfort and protection when applying an orthopedic short leg cast. Here is a step-by-step guide on how to apply both the stockinette and padding:

- **Select the Correct Size:** Choose a stockinette size appropriate for the patient's leg circumference.
- **Apply the Stockinette:** Slide the stockinette over the foot and leg, extending approximately 2 inches beyond the intended cast borders (to be folded later).
- **Ensure Smooth Application:** Avoid wrinkles or tight folds to prevent skin irritation.
- **Trim Excess Length:** Ensure 2 inches remain beyond the cast margins to allow for later folding over the padding.

Padding Application

- **Start Distally (at the Toes):** Begin wrapping just below the metatarsal heads to avoid over-tightening at the toes.
- **Wrap Evenly around ankle complex:** Use the entire roll to cover ankle with 50% overlap to ensure full coverage without excessive bulk.
- **Maintain Neutral Foot Position:** Hold the foot in a 90-degree dorsiflexed position as you wrap.
- **Provide Extra Padding Over Bony Areas:** Add additional layers over the malleoli, tibial crest, heel, and Achilles tendon, as needed.
- **Apply another roll starting at previous layer above malleoli to connect ankle complex with lower leg.** Continue up the lower leg to tibial tubercle and return back down to ankle.
- **The above techniques can be viewed on video at the end of this lesson.**

By carefully applying both the stockinette and padding, you create a comfortable and protective layer between the patient's skin and the fiberglass cast material. This helps to minimize the risk of skin irritation, pressure sores, and other complications during the healing process.

3.4.1 Short Leg Cast cont ...

Fiberglass Cast Tape Application

Applying the fiberglass cast tape correctly is essential for ensuring a strong, durable, and comfortable orthopedic short leg cast. Here are the steps for effectively applying fiberglass cast tape:

- Typically, 3-inch or 4-inch fiberglass rolls are used for short leg casts. Padding technique will be replicated with fiberglass application.
- Prepare the First Roll: Open and submerge the fiberglass roll in room temperature water for 1-2 seconds (excessively wet tape can weaken the cast); Gently squeeze out excess water.
- Apply the First Layer: Begin wrapping distally near the toes, leaving the toes exposed; Maintain 50% overlap, ensuring uniform coverage.
- Mold/Cove Cast While Wrapping: Keep the foot in a neutral position (90 degrees) to prevent plantar flexion deformity; Avoid excessive tension while wrapping to prevent pressure points. Use entire first roll on ankle complex, as indicated above.
- Connect Ankle to Lower Leg: Apply 2nd roll with an anchor turn and connect ankle complex and continue wrapping up to the upper third of the tibia, finishing near tibial tubercle; or as directed by MD/DO; Apply 2-3 layers for adequate support.
- Fold Stockinette Over the Cast Edges: Turn back the excess stockinette over the padding to create smooth, soft edges.
- Final Fiberglass Layer: Apply final layers of fiberglass to secure the folded stockinette and smooth the cast edges.
- Mold and Contour the Cast: Use your hands to mold the cast gently while it sets (approximately 5-7 minutes); Ensure the plantar arch mold, Achilles and tibial molds are applied.
- Monitor Setting Time: The cast will be fully hardened within 20-30 minutes, but weight-bearing (if allowed) should be delayed until full cure (~24 hours).
- Check for Proper Fit: Perform a final neurovascular check: Capillary refill; Sensation; Toe movement
- Ask the patient if they feel any tightness, discomfort, or pressure spots.
- Always have physician review/evaluate cast prior to patient departure from office

By following these steps, you can effectively apply fiberglass cast tape for an orthopedic short leg cast, ensuring a strong, stable, and comfortable cast that promotes healing and patient satisfaction.

3.4.1 Short Leg Cast - Removal

Short Arm Cast Removal

Removing a short arm cast with an orthopedic cast cutter requires care and attention to avoid injury. An orthopedic cast cutter, also known as a cast saw, is a specialized tool designed to remove casts by cutting through the hard casting material without injuring the patient's skin. Follow these steps to remove a short arm cast using an orthopedic cast cutter:

- **Prepare the patient and workspace:** Have the patient sit in a comfortable position with their arm supported on a stable surface. Ensure the workspace is well-lit and that you have all the necessary tools, such as the cast cutter, cast spreader, and scissors.
- **Safety measures:** Explain the process to the patient and reassure them that the cast cutter will not harm their skin. The cast cutter works by vibrating at a high frequency, which allows it to cut through the cast material but not the skin. It is normal for the cast cutter to generate some heat and noise during the process, so let the patient know what to expect. Use zip stick if available for additional protection.
- **Begin cutting the cast:** Turn on the cast cutter and start cutting along the length of the cast. Hold the cutter perpendicular to the cast's surface and apply gentle pressure. You can make a cut along the side of the arm, usually following the natural curve between the thumb and the forearm. Be cautious not to press too hard or cut too deep, as this may cause discomfort or injury to the patient.
- **Check for padding:** Periodically stop cutting and check if you've reached the padding layer beneath the cast. The padding will provide an additional layer of protection for the patient's skin.
- **Cut the other side:** Make a similar cut on the opposite side of the cast, ensuring that the two cuts are roughly parallel to one another.
- **Use a cast spreader:** Once both cuts are complete, insert the cast spreader into one of the cuts and gently spread the edges apart. This will help to break any remaining connections between the cast pieces and create enough space to safely remove the cast.
- **Remove the cast:** Carefully lift the cast pieces away from the patient's arm, making sure not to pull or tug on the skin. If needed, use scissors to cut through the padding and stockinette underneath the cast.
- **Inspect the skin:** After the cast is removed, examine the patient's skin for any signs of irritation, infection, or injury. Encourage the patient to gently move their fingers and wrist to regain mobility.

Remember that cast removal should be performed by a healthcare professional or someone trained in cast removal to ensure the safety and well-being of the patient.

3.4.2 Short Leg Cast - Conclusion

Short Arm Cast Removal

The Short Leg Cast is an essential orthopedic technique for immobilizing fractures, sprains, and post-surgical conditions of the lower extremity. Ensuring proper application, molding, and patient education is critical for optimal healing and patient comfort.

Key Takeaways:

- ✔ Maintain proper foot positioning during application.
- ✔ Ensure adequate padding over bony areas.
- ✔ Perform neurovascular checks before and after casting.
- ✔ Provide clear weight-bearing and care instructions.

By following these guidelines, clinicians can ensure safe, effective, and comfortable short leg cast applications for their patients.

Click on or take pic of QR code to review lesson:



Short Leg Cast Application – MP3 Audio



Short Leg Cast Set Up - Video



Short Leg Cast Application - Video



Short Leg Cast Removal - Video

3.5 Long Leg Cast

A long leg cylinder cast (LLCC) is a circumferential immobilization device extending from the **proximal thigh to just above the ankle**, leaving the foot free. It is used primarily to stabilize injuries that require immobilization of the knee joint while allowing some degree of ankle mobility. Common indications include:

- **Patella fractures** (nondisplaced or minimally displaced fractures requiring immobilization)
- **Tibial plateau fractures** (stable fractures that do not require surgical fixation)
- **Quadriceps tendon ruptures** (postoperative immobilization following repair)
- **Patellar tendon ruptures** (postoperative management)
- **Severe knee ligament injuries** requiring prolonged immobilization (e.g., high-grade medial collateral ligament (MCL) injuries)



3.5.1 Anatomical & Injury Considerations

Clinically Relevant Anatomy:

The knee joint is a complex hinge joint involving the **distal femur, proximal tibia, and patella**, stabilized by **ligaments, cartilage, and surrounding musculature**. The patella functions as a mechanical pulley for the **quadriceps muscle**, allowing efficient knee extension. The **quadriceps and patellar tendons** play a crucial role in stabilizing the knee joint. Additionally, the **tibial plateau serves as the weight-bearing surface**, and fractures in this region can significantly impact **knee stability and mobility**. Neurovascular structures, including the **popliteal artery, peroneal nerve, and tibial nerve**, must be assessed when managing knee fractures to prevent complications such as **vascular injury or nerve damage** (Moore et al., 2020).

Epidemiology / Etiology / Mechanism of Injury

- *Patella Fractures:* Account for 1% of all skeletal fractures and are commonly seen in direct impact trauma (e.g., falls, dashboard injuries in motor vehicle accidents) (Court-Brown et al., 2021).
- *Tibial Plateau Fractures:* Represent 1% of all fractures but make up 55% of all tibial fractures, often occurring due to axial loading with valgus or varus forces, commonly seen in pedestrian vs. car accidents, skiing injuries, or high-energy falls.
- *Quadriceps/Patellar Tendon Ruptures:* These injuries frequently occur in middle-aged males engaging in sports and are associated with sudden eccentric contraction of the quadriceps (e.g., landing from a jump or a forceful knee extension) (Buchholz et al., 2021).
- *Severe Knee Ligament Injuries:* High-grade MCL and multi-ligamentous injuries often result from sports-related trauma, valgus stress, or hyperextension forces.

3.5.2 Clinical Characteristics

Clinical Characteristics / Presentation

Patella Fractures

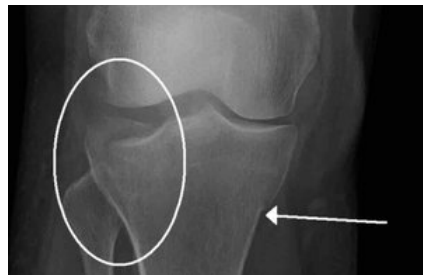
- ✓ Pain and swelling over the anterior knee
- ✓ Inability to actively extend the knee if extensor mechanism is disrupted
- ✓ Palpable gap in displaced fractures
- ✓ Hemarthrosis (knee effusion)

Tibial Plateau Fractures

- ✓ Pain and swelling localized to the proximal tibia
- ✓ Inability to bear weight
- ✓ Joint effusion and possible valgus/varus deformity
- ✓ Possible ligamentous instability if associated soft tissue injury

Quadriceps / Patellar Tendon Ruptures

- ✓ Inability to extend the knee actively
- ✓ Patella alta (high-riding patella) in patellar tendon rupture
- ✓ Palpable defect above or below the patella
- ✓ Significant pain with attempted knee extension



3.5.3 Clinical Diagnosis Review ...

Fracture Diagnosis Process

1. Physical Examination

- Palpation for tenderness, deformity, and effusion
- Assess knee extension function (critical for determining extensor mechanism integrity)
- Check neurovascular status, particularly for popliteal artery injury in tibial plateau fractures

2. Imaging Studies

- X-ray (AP, lateral, sunrise views for patella fractures; AP, lateral, oblique views for tibial plateau fractures)
- CT scan for complex tibial plateau fractures
- MRI for suspected ligamentous injuries or occult tendon ruptures

Differential Diagnosis / Associated Injuries

- Knee dislocations (can be mistaken for tibial plateau fractures)
- Meniscal tears (often co-exist with tibial plateau fractures)
- Femoral condyle fractures (may present similarly to tibial plateau injuries)
- Severe patellofemoral osteoarthritis (mimicking pain from patellar fractures)

Treatment / Management Considerations

Non-Surgical Management (Long Leg Cylinder Cast Indications)

- Stable, nondisplaced patella fractures → LLCC for 4–6 weeks with gradual range of motion exercises after 3–4 weeks.
- Minimally displaced tibial plateau fractures → LLCC for 6 weeks, followed by partial weight-bearing with a hinged knee brace.
- Postoperative care for tendon repairs (quadriceps/patellar tendon ruptures) → LLCC in extension for 4–6 weeks, with progressive mobilization.
- Severe ligamentous injuries (high-grade MCL injuries requiring immobilization) → LLCC with restricted weight-bearing until ligamentous healing occurs.

Surgical Considerations (Cases Not Suitable for LLCC Alone)

- Displaced fractures of the patella or tibial plateau require open reduction and internal fixation (ORIF).
- Complex tibial plateau fractures involving joint depression may require surgical elevation and fixation.
- Complete extensor mechanism disruption (patellar/quad tendon rupture with retraction) mandates surgical repair with early immobilization in LLCC.

3.5.3 Conclusion

Fracture Diagnosis Process

A long leg cylinder cast plays an essential role in stabilizing knee and proximal tibia fractures that do not require immediate surgical intervention. By maintaining knee extension and limiting motion, an LLCC facilitates healing while reducing pain, preventing deformity, and minimizing complications. Proper patient selection, early imaging, and rehabilitation planning are critical in ensuring optimal recovery and functional outcomes. While LLCC remains a mainstay in conservative orthopedic management, it is imperative to monitor fracture stability, assess for associated ligamentous or vascular injuries, and ensure gradual return to mobility post-immobilization. As advancements in orthopedic surgery and rehabilitation continue to evolve, the role of early functional movement post-casting is becoming increasingly recognized in achieving the best possible outcomes.

References

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- Court-Brown, C. M., Rimmer, S., Prakash, U., & McQueen, M. M. (2021). *Epidemiology of adult fractures* (2nd ed.). Elsevier.
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3.5.4 Long Leg Cast

Patient Preparation

Preparing a patient's skin prior to the application of an orthopedic fracture cast is crucial to ensure proper hygiene, reduce the risk of infection, and provide a comfortable fit. Here are the general steps to prepare the skin before applying a cast:

- **Removing jewelry from the affected limb prior to the application of a fiberglass cast for the lower extremity helps to ensure patient comfort, proper cast fitting, and effective healing while reducing the risk of complications during the treatment and recovery process.**
- **Clean the skin: Gently clean the area around the fracture site using mild soap and water or an antiseptic solution. This step helps to remove dirt, debris, and bacteria from the skin, reducing the risk of infection.**
- **Dry the skin: Pat the skin dry with a clean towel or gauze. Make sure the skin is completely dry before proceeding, as moisture can interfere with the adhesion of the cast materials and promote the growth of bacteria.**
- **Assess the skin: Examine the skin for any signs of infection, open wounds, or skin irritation. If there are any concerns, consult with the healthcare professional responsible for the patient's care.**
- **Apply a skin barrier (if necessary): In some cases, a skin barrier may be used to protect the skin from irritation or maceration. This could be a moisture barrier cream or spray, which can help prevent skin breakdown caused by prolonged exposure to moisture.**
- **If the patient has excessive hair, trim lightly with clippers (avoid shaving, as micro-abrasions can lead to irritation or infection). Be sure to get the patient's consent before doing so.**
- **Position the limb: Properly position the patient's limb in the desired position for casting: (1) Place the patient in a supine position on an examination table or specialized casting table; (2) Ensure the injured leg is fully supported on a padded surface, with the knee in slight flexion (~5-10 degrees). This helps maintain joint positioning and prevents undue stiffness after cast removal; (3) the ankle should be in a neutral position (to prevent foot drop).**
- **Once the patient's skin is clean, dry, and properly assessed, you can proceed with applying the stockinette, padding, and casting material according to the healthcare professional's instructions.**

Remember, it's essential to consult with a healthcare professional to ensure proper technique and care for the patient's specific needs.

3.5.4 Long Leg Cast cont ...

Stockinette Application

Applying a stockinette and padding correctly is crucial for patient comfort and protection. Here is a step-by-step guide on how to apply both the stockinette and padding:

- **Prepare the materials:** Gather the necessary materials, including a stockinette, scissors, and cast padding.
- **Choose a 4 inch wide stockinette,** ensuring it is wide enough to cover the entire leg without excessive bunching.
- **Measure the stockinette:** Measure a length of stockinette that extends at least 2-3 inches beyond the anticipated proximal (thigh) and distal (lower leg) cast edges. Cut the stockinette to the appropriate length.
- **Position the stockinette:** Slide the stockinette over the leg, making sure it reaches from just below the groin to just above the ankle joint.
- **Smooth out any wrinkles or folds to avoid pressure points inside the cast.**
- **Leave extra length at both the proximal and distal ends to be folded over after padding and fiberglass application.**

Padding Application

- **Choose 4-inch wide padding rolls based on the size of the patient's limb.** Apply the first section around the upper thigh - wrap the padding circumferentially from proximal to distal, maintaining a 50% overlap with each pass to ensure uniform coverage.
- **For the next roll, continue over the knee joint and provide additional layers around the patella and tibial tuberosity to prevent pressure sores.**
- **Pad bony prominences thoroughly:** (1) Patella: Apply extra padding to distribute pressure; (2) Fibular head: This area is prone to nerve compression (watch for signs of common peroneal nerve compression); (3) Tibial tuberosity & lateral condyles: Reinforce with additional layers to prevent discomfort.
- **Extend padding distally to just above the ankle, stopping 2 inches above the malleoli (to prevent excessive bulk near the ankle joint).**
- **Smooth out any wrinkles:** As you apply each layer of cast padding, make sure to smooth out any wrinkles or folds to ensure a comfortable fit. Wrinkles or folds can cause discomfort and may even lead to pressure sores.
- **Check for proper fit:** After applying the cast padding, check to ensure that it is not too tight or too loose. The padding should provide cushioning and protection for the limb, but should not constrict blood flow or cause discomfort.

3.5.4 Long Leg Cast cont ...

Fiberglass Cast Tape Application

Applying the fiberglass cast tape correctly is essential for ensuring a strong, durable, and comfortable orthopedic long arm cast. Here are the steps for effectively applying fiberglass cast tape:

- **Prepare fiberglass tape:** Put on gloves to protect your hands. The exact number of rolls will depend on the size of the patient's arm and the desired thickness of the cast.
- **Select 4- or 5-inch fiberglass rolls** (typically 3-5 rolls are needed, depending on patient size).
- **Dip fiberglass tape:** Fully submerge a roll of fiberglass tape in lukewarm water for a few seconds to activate the resin. Squeeze the roll gently to remove excess water.
- **Apply fiberglass tape:** 1. Begin proximally at the thigh and wrap circumferentially, ensuring even tension without excessive pressure - per video crating the thigh cylinder with first roll; 2. Use a 50% overlap technique to maintain strength and uniformity.
- **With the next roll, continue to cover the knee smoothly, avoiding creases. Reinforce by applying 1-2 extra layers over the patella.**
- **Grab another roll and continue wrapping distally, stopping just above the ankle.**
- **Mold the cast (per video):** As you apply the fiberglass tape, use your hands to mold and shape the cast around the leg. Apply gentle pressure to ensure a snug fit without causing discomfort.
- **Final molding:** Once you have reached the desired thickness, smooth the outer surface of the cast using your hands or a gloved palm. This will help set the cast and make it more comfortable for the patient. Use the demonstrated molding technique for the upper thigh from the instructional video for upper arm.
- **Cast setting:** Allow the fiberglass cast to harden, which usually takes around 10-15 minutes. The cast will feel warm as it hardens, which is normal.
- **Inspect the cast:** Once the cast is set, check for any sharp edges, pressure points, or skin irritation. Trim or smooth any rough edges as necessary. Ensure proper circulation by checking the patient's capillary refill time and ensuring they can move their fingers without difficulty.
- **Provide aftercare instructions:** Explain to the patient how to care for their cast, including keeping it dry, avoiding direct pressure on the cast, and reporting any signs of infection or discomfort.

By following these steps, you can effectively apply fiberglass cast tape for an orthopedic short arm cast, ensuring a strong, stable, and comfortable cast that promotes healing and patient satisfaction.

3.5.4 Long Leg Cast - Removal

Long Arm Cast Removal

Follow these steps to remove a short arm cast using an orthopedic cast cutter:

- **Explain the process:** Inform the patient about the cast removal process, emphasizing that the cast saw will make noise and may feel warm but will not cut their skin.
- **Position the patient:** Have the patient lie down in a comfortable position, ensuring their arm is well-supported throughout the process.
- **Cast saw safety:** Put on protective eyewear and ensure the cast saw is in good working condition before using it. Double-check that the blade is sharp and properly attached.
- **Cutting the cast:** Begin by cutting the cast longitudinally on each side, taking care to avoid direct contact with the patient's skin. Apply gentle pressure and use a steady, back-and-forth motion. Do not force the blade or attempt to cut through the padding in one pass. The cast saw is designed to cut through the rigid outer layer without cutting the padding underneath.
- **Use the cast saw -** Apply gentle, controlled pressure and Move the saw in a back-and-forth motion to prevent heat buildup.
- **Scissor insertion:** Once the cast is cut on both sides, gently insert the blunt-nosed cast scissors or a spreader between the padding and the patient's skin, keeping the blade parallel to the skin. This will protect the patient's skin while you cut through the padding.
- **Cut the padding:** Carefully cut the padding along the same lines you cut the outer layer of the cast. Be cautious not to nick or cut the patient's skin.
- **Cast spreading:** Using a cast spreader, gently pry apart the two halves of the cast. If necessary, use additional cutting or spreading to ensure the cast can be removed without causing discomfort to the patient.
- **Remove the cast:** Carefully lift the two halves of the cast away from the patient's arm, taking care not to cause any sudden movements or excessive pressure on the healing fracture.
- **Remove the padding and stockinette:** Gently peel back the padding and stockinet, being cautious of any sensitive or tender areas on the patient's skin.
- **Skin inspection:** Examine the patient's skin for any signs of infection, pressure sores, or other issues that may require medical attention. Look for redness, swelling, discharge, or foul odor. Additionally, assess the patient's range of motion and strength in their arm and fingers.
- **Clean the area:** Gently cleanse the patient's skin with warm water and mild soap, and pat dry. Apply moisturizing lotion if the skin is dry or irritated.
- **Follow-up care:** Per MD instructions.

Click on or take pic of QR code to review lesson:



Long Leg Cast Application – Video

3.6 Posterior Rigid Splint: Intro

A posterior rigid splint is a **non-circumferential immobilization** device used primarily in acute settings for **temporary stabilization** of lower extremity injuries. Common indications include:

- **Acute fractures of the tibia, fibula, or ankle** before definitive casting
- **Severe ankle sprains** with extensive soft tissue damage
- **Achilles tendon ruptures** requiring immobilization in plantarflexion
- **Postoperative immobilization** for foot and ankle surgery
- **Management of severe lower leg contusions** with swelling risk



3.6.1 Anatomical & Injury Considerations

Clinically Relevant Anatomy:

The posterior rigid splint primarily **stabilizes the lower leg**, ankle, and foot, providing **support while allowing room for swelling**. The device immobilizes the affected limb along the posterior aspect, from just below the knee to the metatarsal heads, leaving the **anterior leg and dorsum of the foot exposed**. Key anatomical structures involved include the **gastrocnemius-soleus complex**, Achilles tendon, tibia, fibula, and associated neurovascular structures such as the **posterior tibial artery and tibial nerve** (Moore et al., 2020).

Epidemiology / Etiology / Mechanism of Injury

- **Tibia and fibula fractures:** High-energy trauma such as motor vehicle accidents, sports injuries, or falls from height can lead to acute fractures that require splinting before definitive treatment.
- **Severe ankle sprains:** Ligamentous injuries involving high-grade sprains (ATFL, CFL, deltoid ligament tears) often benefit from temporary immobilization to reduce swelling and pain.
- **Achilles tendon ruptures:** Sudden eccentric loading of the Achilles tendon, common in middle-aged recreational athletes, can result in a rupture requiring immediate plantarflexion positioning for healing (Bucholz et al., 2021).

3.6.2 Clinical Characteristics

Clinical Characteristics / Presentation

- ✓ Pain and swelling localized to the injured region
- ✓ Deformity (if displaced fractures are present)
- ✓ Inability to bear weight in lower leg fractures or Achilles tendon ruptures
- ✓ Instability in ligamentous injuries
- ✓ Neurovascular assessment is crucial to rule out compartment syndrome

Fracture Diagnosis Process

1. Physical Examination

- Assess for deformity, swelling, and bruising
- Palpate for bony tenderness and soft tissue injury
- Check distal neurovascular function (capillary refill, pulses, and sensation)

2. Imaging Studies

- X-ray (AP, lateral, oblique views of the lower leg, ankle, or foot)
- Ultrasound for Achilles tendon rupture
- MRI if ligamentous or soft tissue injuries are suspected

Differential Diagnosis / Associated Injuries

- Compartment syndrome (can develop after tibial fractures)
- Tendon injuries (Achilles rupture vs. severe strain)
- Lisfranc injuries (midfoot instability)
- Severe ankle sprains with syndesmotic involvement

Treatment / Management Considerations

- Temporary immobilization with a posterior rigid splint for acute fractures or severe soft tissue injuries before definitive treatment.
- Achilles tendon rupture → Immobilization in 20-30 degrees of plantarflexion before orthopedic referral.
- Severe ankle sprains → Splinting with non-weight-bearing status for 1-2 weeks, followed by progressive rehabilitation.
- Postoperative immobilization → Used to protect surgical repairs while allowing swelling to subside.

Conclusion

The posterior rigid splint serves as an essential temporary immobilization tool for managing acute lower extremity injuries. Unlike circumferential casts, it allows for swelling accommodation while providing adequate stability. Early application, proper positioning, and careful monitoring are essential to prevent complications, including compartment syndrome and neurovascular compromise. Once swelling subsides, patients are transitioned to definitive treatment, which may include casting, functional bracing, or surgical intervention, depending on the severity of the injury. Proper patient education on weight-bearing restrictions and follow-up care ensures optimal outcomes and minimizes long-term complications.

3.6.3 Posterior Rigid Splint

Patient Preparation

Preparing a patient's skin prior to the application of an orthopedic splinting is crucial to ensure proper hygiene, reduce the risk of infection, and provide a comfortable fit. Here are the general steps to prepare the skin before applying a cast:

- **Removing jewelry from the affected limb prior to the application of a fiberglass splint for the lower extremity helps to ensure patient comfort, proper fitting, and effective healing while reducing the risk of complications during the treatment and recovery process.**
- **Evaluate the affected limb for deformity, swelling, and neurovascular status (capillary refill, pulse, sensation, and movement).**
- **Per MD/DO, confirm the need for a posterior rigid splint based on the injury type (e.g., fractures, sprains, soft tissue injuries).**
- **Explain the Procedure: Inform the patient about the procedure, expected duration, and potential discomfort.**
- **Position the limb: Properly position the patient's limb in the desired position for splinting - place the patient in a seated or supine position for comfort and stability.**
- **Inspect and Prepare the Skin: Check for open wounds, abrasions, or lacerations; dress any wounds with sterile gauze if necessary; Ensure the skin is clean and dry before applying the splint; Avoid applying splints directly over areas of swelling or pressure points to prevent skin breakdown.**

Remember, it's essential to consult with a healthcare professional to ensure proper technique and care for the patient's specific needs.

3.6.3 Posterior Rigid Splint cont ...

Stockinette Application

A stockinette provides a protective barrier between the skin and padding materials, preventing irritation.

- Choose a stockinette width appropriate for the limb (typically 2–4 inches for extremity splints). Measure the stockinette:
- Measure the length required for the stockinette - Cut the stockinette approximately 2–3 inches longer than the anticipated splint length to allow for secure tucking.
- Apply the stockinette: Slide the stockinette over the patient's foot/ankle and up their lower leg, ensuring it covers the entire area where the splint will be applied. Smooth out any wrinkles or folds.

Padding Application

Padding protects the skin and provides cushioning to prevent pressure sores.

- Use soft, orthopedic padding (cotton or synthetic) for comfort and shock absorption.
- Apply the Padding: (1) Start at the foot/toes and wrap circumferentially in an overlapping pattern (50% overlap) to ensure full coverage to the desired proximal end; (2) Extend the padding 2–3 inches beyond the expected splint length; (3) Ensure additional padding over bony prominences (e.g., ulnar styloid, olecranon) to prevent pressure sores.
- Secure the Padding: (1) Smooth out wrinkles to prevent pressure points; (2) Ensure a snug, but not overly tight, application to allow for mild swelling.

3.6.3 Posterior Rigid Splint cont ...

Fiberglass Cast Tape Application

- **Preparation:** • Pre-fabricated splinting material; Elastic bandage (Ace wrap or cohesive bandage); Scissors; Bucket with cool water (if fiberglass splint requires activation); Protective gloves; Trauma shears (if trimming is needed)
- **Check Patient Position:** Have the patient lie supine with the lower leg elevated and supported; Maintain the ankle at a neutral position (90° dorsiflexion), unless contraindicated due to swelling or pain.
- **Prepare the Splinting Material: Fiberglass:** Activate by dipping in cool water for 2–5 seconds, then gently squeeze out excess water; Cut the splint long enough to extend from just below the knee to the metatarsal heads (leaving the toes exposed).
- **Apply the Splint:** Position the splint posteriorly along the lower leg, from just below the knee to the foot; Ensure good contact with the limb while maintaining neutral ankle positioning; Avoid excessive compression to prevent pressure sores.
- **Secure the Splint with an Elastic Bandage:** Begin wrapping the Ace wrap distal to proximal (from foot to calf); Apply firm but not constrictive pressure to secure the splint; Check for puckering or tight spots and adjust as needed.
- **Key Considerations & Tips**
 - ✔ Use adequate padding to avoid skin injury.
 - ✔ Ensure the ankle is in neutral position unless contraindicated.
 - ✔ Do not wrap too tightly—allow room for swelling.
 - ✔ Avoid excessive water activation for fiberglass to prevent heat burns.
 - ✔ Always perform a final neurovascular check before discharging the patient.

Remember to monitor the patient's condition and coordinate the necessary referral / follow up as needed to ensure proper healing and prevent complications.

3.6.3 Posterior Rigid Splint - Removal

The removal of a pre-fabricated splint must be done carefully to prevent patient discomfort, soft tissue injury, or damage to healing structures. Below is a step-by-step guide to safely removing the splint.

- **Explain the process:** Inform the patient about the splint removal process.
- **Position the patient:** Have the patient sit or lie down in a comfortable position, ensuring their leg is well-supported throughout the process.
- **Gather Supplies:** Trauma shears or bandage scissors; Splint spreader (optional, if applicable); Gloves; Towel or drape (to contain debris).
- **Assess the Limb Before Removal:** Check the patient's pain level before starting; Assess for any signs of skin irritation, pressure sores, or swelling; Confirm that removal is appropriate (as per physician's orders or follow-up instructions).
- **Cut the Elastic Bandage:** Start at the proximal (upper) end of the splint and carefully cut down toward the foot using trauma shears; Avoid cutting too close to the skin—keep shears parallel to the limb to prevent accidental injury; If the bandage is tight, gently pull it away from the skin while cutting.
- **Remove the Padding & Stockinette:** Once the elastic bandage is removed, unroll the padding (Webriil) carefully; Cut and remove the stockinette in a similar fashion; If padding adheres to the skin due to sweating or swelling, moisten with warm water for easier removal.
- **Remove the Splint Material:** If the splint is still adhering to the skin, slide a gloved hand underneath and gently lift it away.

3.6.3 Posterior Rigid Splint - Post-Removal Care

- **Inspect the Skin:** Check for redness, pressure sores, blisters, or abrasions; Assess for swelling or signs of circulatory compromise; Assess Neurovascular Status; Check capillary refill, sensation, pulses, and movement to ensure proper circulation.
- **Clean the Skin:** If needed, clean the skin with mild soap and warm water to remove any debris; Apply moisturizer if the skin is dry or irritated.
- **Next Steps (based on physician orders):**
 - (1) If the splint was for temporary immobilization, provide further instructions on casting, bracing, or additional care;
 - (2) If the splint is being replaced or adjusted, ensure the new splint or cast is applied promptly to maintain immobilization;
 - (3) Educate the patient on any post-removal symptoms to monitor (e.g., pain, swelling, or weakness).
- **Key Considerations & Tips**
 - ✔ Use blunt-tip trauma shears to avoid injury while cutting the bandage and stockinette.
 - ✔ If the splint is tight, remove it gradually and allow for periodic patient feedback.
 - ✔ Always check circulation and sensation before & after removal.
 - ✔ If the patient experiences increased pain or discomfort, stop and reassess before proceeding.

Conclusion

The application and removal of pre-fabricated lower leg splints are essential skills in orthopedic and emergency care, ensuring proper immobilization while minimizing complications. Mastering this technique requires attention to proper positioning, padding, and secure application to provide stability and comfort for the patient. Equally important is the safe and systematic removal of the splint, prioritizing patient safety, skin integrity, and neurovascular assessment. By following these step-by-step procedures, healthcare professionals can ensure effective injury management, reduce the risk of complications, and optimize patient outcomes. Consistent practice and adherence to best practices will help students gain confidence in applying and removing lower leg splints in clinical settings.

Click on or take pic of QR code to review lesson:



Posterior Rigid Splint Application – MP3 Audio

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