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ORTHOPEDIC SPLINTING MANUAL

A comprehensive course providing a foundational understanding of orthopedic principles and essential splinting methods

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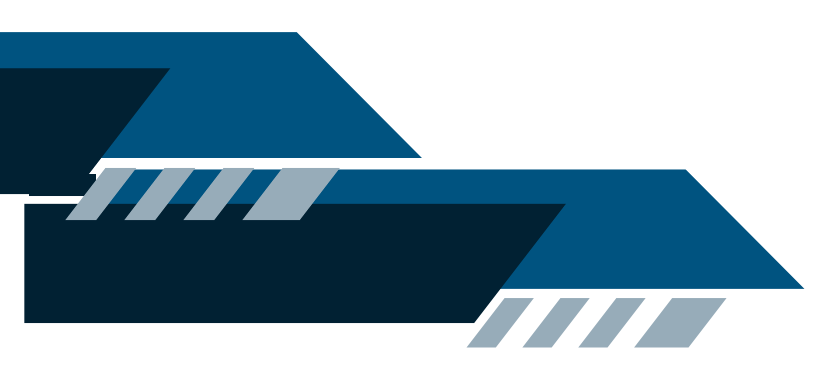
ORTHOPEDIC SPLINTING MANUAL

The Orthopedic 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



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Section I: Foundations of Orthopedic Splinting

Chapter 1: Introduction to Orthopedic Splinting

History and Evolution of Splinting

Orthopedic splinting has a long and storied history that spans centuries, evolving from rudimentary forms of immobilization into sophisticated, evidence-based interventions essential to musculoskeletal care. The primary function of a splint —immobilization of an injured or structurally compromised anatomical region— has remained consistent, but the materials, methods, and theoretical underpinnings have advanced considerably with medical and technological progress.

Ancient Origins

The origins of splinting can be traced back to ancient civilizations where early attempts at immobilization were based on practical necessity rather than scientific understanding. Archaeological evidence suggests that the ancient Egyptians used wooden sticks, linen, and hardened resins to immobilize fractured limbs (Rogers & Smith, 2015). Inscriptions found in tombs indicate that healers used splints constructed from bark, palm fiber, and cloth. These methods, though primitive, reflect an early appreciation for the role of immobilization in healing broken bones.

Similarly, in ancient Greece and Rome, Hippocrates, often referred to as the "*father of medicine*""," advocated for the alignment and immobilization of fractures using wooden splints, bandages, and waxed linen (Browner et al., 2014). His observations laid foundational concepts for fracture care, including anatomical reduction, stabilization, and prevention of deformity.

Medieval and Renaissance Advancements

During the medieval period, the evolution of splinting stagnated due to limited scientific advancement and heavy reliance on herbal remedies and spiritual healing. However, the Renaissance ushered in renewed anatomical exploration and innovation. Ambroise Paré, a French military surgeon in the 16th century, significantly advanced trauma care, including the design of more refined splints made of leather, iron, and padded wooden slats. His contributions emphasized both mechanical support and the importance of patient comfort (Hughes, 2008).

Industrial Era and the Birth of Modern Orthopedics

The 18th and 19th centuries saw tremendous advancements in the understanding of musculoskeletal injuries and the materials used for immobilization. The industrial revolution enabled the mass production of metals and molded materials. It was during this era that the discipline of orthopedics formally emerged in Europe. The word “orthopaedics,” derived from the Greek *orthos* (straight) and *paideia* (child-rearing), was coined by Nicolas Andry in 1741, initially to describe the correction of spinal deformities in children (Andry, 1741/2005).

The invention of plaster of Paris revolutionized orthopedic immobilization. Used widely during the American Civil War and World War I, plaster allowed for customized molding around the limb and provided excellent immobilization for fractures. Surgeons such as Hugh Owen Thomas and later his nephew, Sir Robert Jones, introduced standardized fracture management protocols involving splints and braces, some of which form the basis of contemporary splint designs (Peltier, 1990).

Modern Era and Technological Integration

In the late 20th and early 21st centuries, splinting evolved rapidly with the integration of lightweight, durable materials such as fiberglass and thermoplastics. Fiberglass became preferred in many settings due to its superior strength-to-weight ratio, radiolucency, faster curing time, and lower risk of thermal injury compared to plaster (Bledsoe et al., 2017).

Furthermore, technological advancements now permit the design and production of custom splints using 3D scanning and printing, particularly for pediatric or complex anatomical cases (Telfer et al., 2012). Additionally, advances in understanding tissue biomechanics, neurovascular protection, and pressure distribution have resulted in evidence-based splinting protocols that reduce complications and improve outcomes.

Today’s orthopedic technologists and clinicians apply these techniques in diverse settings—from high-acuity trauma centers to outpatient rehabilitation clinics—using skills grounded in both historical precedent and modern science.

Clinical Integration and the Art of Immobilization

Immobilization is both a science and an art—grounded in the foundational principles of anatomy, biomechanics, and tissue healing, yet shaped by the clinician's ability to interpret the individual needs of each patient. The effective use of splinting requires far more than technical skill; it demands critical thinking, adaptability, and vigilance. The ability to identify appropriate indications for splinting, recognize when to defer or modify immobilization due to contraindications, and clearly define the goals of therapy is what separates the competent practitioner from the exceptional one.

Each decision to apply a splint carries with it a responsibility to assess neurovascular status, consider the phase of healing, weigh mechanical demands, and anticipate functional outcomes. A poorly timed or improperly applied splint can cause complications ranging from pressure ulcers to compartment syndrome or loss of joint mobility, while a well-chosen and expertly executed splint can reduce pain, facilitate healing, and preserve independence.

As healthcare continues to emphasize value-based, outcome-driven care, orthopedic technologists, athletic trainers, and emergency clinicians must approach immobilization with a framework that is both evidence-based and responsive to the individual clinical context. Splinting is not a passive restraint; it is an active therapeutic strategy designed to protect, guide, and enable recovery.

This chapter reinforces the foundational truth: immobilization, when applied thoughtfully and with purpose, enhances healing, protects the patient, and restores function—fulfilling the very goals at the heart of musculoskeletal care.

Conclusion

The evolution of splinting reflects the broader trajectory of medical advancement—moving from empirical trial and error to evidence-based practice. Understanding the history of orthopedic splinting is more than an academic exercise; it provides a deeper appreciation of its clinical rationale, underscores the importance of ongoing innovation, and reinforces the responsibility of today's healthcare providers to apply techniques that are both safe and effective.

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Splinting vs. Casting: Principles and Distinctions

Orthopedic immobilization is a foundational element in the treatment of musculoskeletal injuries. While both splints and casts serve the purpose of stabilizing injured tissues, the principles guiding their selection, application, and clinical use differ significantly. Understanding these distinctions is critical for clinicians and orthopedic technologists to ensure optimal patient outcomes, minimize complications, and align with evidence-based practice.

Core Purposes of Immobilization

The primary objectives of both splints and casts include:

- Preventing further injury or deformity
- Alleviating pain by reducing movement
- Promoting proper anatomical alignment
- Facilitating healing of bones, soft tissues, or joints
- Providing support during functional recovery or rehabilitation

Despite these shared goals, splints and casts differ markedly in their **construction, indications, flexibility, adjustability, and risk profile**.

Definition and Characteristics

Characteristic	Splint	Cast
Design	Non-circumferential	Circumferential
Rigidity	Partial—allows for soft-tissue expansion	Complete—fixed rigidity
Material	Fiberglass, plaster, thermoplastics (applied only to one aspect of limb)	Plaster or fiberglass encircling the limb
Setting Time	Rapid (especially fiberglass)	Slightly longer (plaster sets more slowly)
Adjustability	Removable or modifiable	Not easily modified once hardened
Use Duration	Temporary or interim	Long-term immobilization

Principles and Clinical Application

Splinting Principles

Splints are typically **non-circumferential**, applied to one side of the limb and secured with padding and elastic or gauze wraps. This design allows room for **soft tissue swelling**, making splints the preferred initial immobilization technique in the acute or inflammatory phase of injury—particularly in the emergency room or immediately post-injury (Tintinalli et al., 2020). Splints reduce the risk of **compartment syndrome**, pressure sores, or neurovascular compromise, especially in high-risk patients.

Common indications for splinting include:

1. Acute fractures awaiting definitive orthopedic follow-up
2. Severe soft tissue injuries
3. Tendon or ligament injuries
4. Post-reduction stabilization of dislocations
5. Temporary immobilization in the preoperative or postoperative phase

Because splints are adjustable and often removable, they are also ideal for serial examinations and reassessments of swelling, pain, and vascular status.

Casting Principles

Casts are **circumferential** and provide **rigid, total immobilization**. Once applied and hardened, they are not easily adjusted, and they carry a higher risk of complications related to compression. As such, casting is reserved for cases where **swelling has stabilized** and more **definitive, long-term immobilization** is appropriate—typically several days to a week after injury, depending on the degree of trauma and soft tissue involvement.

Casts are generally indicated for:

- Stable, reduced fractures requiring prolonged immobilization
- Postoperative immobilization following fracture fixation or ligament repair
- Conditions requiring consistent immobilization, such as congenital deformities or chronic instability

While more durable and protective, casts require careful neurovascular monitoring, particularly within the first 48 hours post-application. Modern casting materials such as fiberglass have replaced plaster in many settings due to reduced weight, durability, and radiolucency, although plaster still provides superior molding capabilities for complex anatomical contours.

Risk-Benefit Analysis and Clinical Decision-Making

The decision to apply a splint versus a cast should be based on:

- **Stage of healing** (acute, subacute, chronic)
- **Extent of soft tissue injury**
- **Need for monitoring** (e.g., frequent neurovascular checks)
- **Patient compliance and lifestyle**
- **Anatomic site and type of injury**

Clinicians must weigh the flexibility and safety of splints against the rigidity and protection of casts. For example, a displaced distal radius fracture may initially be splinted in a sugar-tong configuration to accommodate swelling, followed by a circumferential short arm cast 5–7 days later once swelling resolves.

Proper application of either device depends on comprehensive patient assessment, anatomical knowledge, and skillful technique. Training in both splinting and casting is an essential competency for orthopedic technologists and emergency care providers.

Conclusion

Though splints and casts are both integral tools in orthopedic care, their mechanical principles, indications, and clinical implications differ significantly. A nuanced understanding of these distinctions enables clinicians to select the most appropriate immobilization strategy based on patient presentation, injury characteristics, and risk factors. In many cases, splinting serves as a bridge to casting, reinforcing the need for adaptable and patient-centered care in musculoskeletal management.

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Chapter 2: Indications, Contraindications, and Goals of Splinting

Indications, Contraindications, and Goals of Splinting

Indications, Contraindications, and Goals of Splinting

Orthopedic splinting is not merely a mechanical task—it is a critical, patient-centered clinical decision grounded in anatomical, physiological, and pathological understanding. In emergency departments, urgent care clinics, outpatient orthopedic practices, and surgical recovery settings, splinting is frequently one of the first and most impactful interventions performed. Whether stabilizing an acute fracture, managing postoperative healing, or supporting a chronic musculoskeletal condition, the decision to immobilize must be made with precision and an awareness of the broader implications for recovery and function.

This chapter aims to provide a comprehensive and evidence-informed exploration of the clinical rationale for immobilization. It begins by identifying the full range of indications for splinting, supported by a review of the pathophysiological mechanisms that make immobilization therapeutic. It then addresses contraindications to splinting—conditions in which immobilization may cause harm or delay more appropriate interventions—requiring the clinician to critically assess when not to immobilize or when to alter technique. Finally, the chapter concludes with a deep dive into the goals of immobilization, examining the biomechanical, functional, protective, and psychological benefits that an expertly applied splint provides.

By understanding the indications, contraindications, and goals of splinting in a unified framework, orthopedic technologists and healthcare professionals are equipped to make nuanced clinical judgments. Immobilization is not a standalone treatment—it is a bridge to healing, a protective measure, and, when applied appropriately, a powerful contributor to long-term functional success.

Section A: Indications for Immobilization

<u>**Contraindications can be divided into two categories:**</u>

Immobilization is a foundational strategy in orthopedic care that aims to support injured tissues, limit motion, alleviate pain, and facilitate biological healing. In both emergency and elective settings, splinting is often the initial step in musculoskeletal stabilization, particularly when soft tissue swelling, neurovascular monitoring, or transport are concerns. The clinical indications for splinting are varied and span both traumatic and non-traumatic pathologies. This section provides an exhaustive review of conditions warranting orthopedic immobilization, with emphasis on the pathophysiology, goals of care, and clinical rationale.

I. Acute Fractures

Fractures represent one of the most common and well-established indications for immobilization. Proper stabilization limits micromotion at the fracture site, which in turn:

- Reduces pain and reflex muscle spasm
- Minimizes the risk of further displacement or angulation
- Protects neurovascular structures
- Allows periosteal and endosteal callus formation to initiate uninterrupted

Commonly splinted fracture types include:

- Distal radius/ulna → Volar or sugar-tong splint
- Metacarpals or phalanges → Ulnar or radial gutter splints
- Ankle and foot fractures → Posterior ankle and stirrup splints
- Humeral shaft or elbow fractures → Long arm posterior splint

In emergency care, splinting also permits accommodation of post-injury edema—a key consideration in fractures with extensive soft tissue involvement or blunt trauma (Tintinalli et al., 2020).

II. Joint Dislocations and Subluxations

Post-reduction immobilization of a joint is critical to:

- Maintain proper joint alignment
- Prevent re-dislocation
- Allow capsuloligamentous healing
- Minimize pain and inflammation

Examples include:

- Anterior shoulder dislocation → Shoulder immobilizer or sling and swathe
- Patellar dislocation → Knee immobilizer or posterior knee splint
- Elbow dislocation → Long arm posterior splint in flexion

Immobilization duration varies by joint and recurrence risk. For example, first-time anterior shoulder dislocations in young athletes may warrant up to three weeks of immobilization followed by controlled rehabilitation, whereas older adults may require a shorter duration due to stiffness risk (McRae & Esser, 2016).

III. Ligamentous Injuries and Sprains

Ligament sprains—graded I to III based on severity—are frequent indications for temporary immobilization to reduce stress on healing fibers, limit inflammation, and promote early mobilization once acute symptoms resolve.

Common scenarios:

- Ankle inversion sprains (Grade II–III) → Stirrup splint or CAM walker
- Thumb UCL tear (“skier’s thumb”) → Thumb spica splint
- Knee MCL injury → Knee immobilizer (initial) with progression to functional brace

Immobilization should balance protection and prevention of joint stiffness or muscle atrophy. Typically, ligament injuries are immobilized for 1–3 weeks before transitioning to early rehabilitation with a hinged or functional brace.

IV. Tendon Injuries and Repairs

Tendons are delicate structures prone to elongation or rupture without proper protection. Immobilization is crucial in both conservative and post-surgical tendon injury management.

Clinical examples:

- **Extensor tendon lacerations** (zones I–VII) → Static splints that preserve length-tension relationships
- **Flexor tendon repairs** → Dorsal blocking splints to prevent rupture from active extension
- **Mallet finger** → Continuous DIP extension splinting for 6–8 weeks

Each tendon injury requires positioning that reduces tension at the repair site. Inadequate immobilization may lead to gapping, scar adherence, or functional deficits (Zlotolow et al., 2013).

V. Postoperative Immobilization

After surgical intervention involving bones, joints, tendons, or ligaments, immobilization helps:

- Protect surgical hardware or suture lines
- Allow soft tissue healing and graft integration
- Maintain specific positioning critical to functional outcomes (e.g., elbow at 90°)
- Reduce swelling and postoperative discomfort

Procedures such as open reduction internal fixation (ORIF), ligament reconstructions, and tendon transfers often require postoperative splinting ranging from temporary immobilizers to custom-molded orthoses depending on the surgeon’s protocol.

VI. Soft Tissue Trauma

Significant soft tissue injuries such as deep contusions, hematomas, and crush injuries may benefit from immobilization to:

- Reduce mechanical stress and secondary injury
- Prevent muscular contraction that worsens bleeding or swelling
- Improve patient comfort

Splinting in a position of function or rest helps preserve range of motion and muscle alignment while tissues recover.

VII. Infections and Inflammatory Conditions

Although immobilization is not curative for infections, it plays a supportive role in reducing the systemic and local inflammatory burden in conditions such as:

- Septic arthritis
- Cellulitis with joint involvement
- Tenosynovitis

Resting the joint through splinting minimizes inflammatory cytokine release triggered by mechanical stress, relieves pain, and enhances compliance with antibiotic therapy (Weber & Bae, 2018).

VIII. Neurological and Neurovascular Indications

Neurological impairments may result in spasticity, flaccidity, or sensory loss. Splinting in such cases prevents secondary complications including:

- Joint contractures and Muscle shortening
- Malalignment of flaccid limbs
- Pressure sores due to poor proprioception

Examples:

- Radial nerve palsy → Dynamic extension splint
- Cerebral palsy or stroke → Resting hand splints to preserve neutral positioning and function

  These patients may require customized orthoses and regular reassessment by a multidisciplinary team (Braddom et al., 2021).

IX. Overuse Syndromes and Chronic Disorders

Splinting also has a role in managing non-traumatic conditions. It limits repetitive motion and provides localized rest in cases of:

- **Carpal tunnel syndrome** → Neutral wrist splint (especially during sleep)
- **De Quervain's tenosynovitis** → Thumb spica splint
- **Lateral epicondylitis** → Counterforce bracing or wrist cock-up splint

Such devices are often used intermittently and in conjunction with physical therapy, ergonomic corrections, or corticosteroid injections.

X. Emergency and Transport Indications

In the prehospital and emergency department environment, splints provide temporary immobilization during:

- EMS transport
- Field stabilization in athletic or combat settings
- Pain control before definitive management

Proper splinting at the time of injury is shown to reduce further tissue damage and lower the risk of compartment syndrome in fractures involving long bones (PHTLS, 2020).

Conclusion

The indications for splinting are extensive and encompass a wide array of orthopedic, neurologic, infectious, and soft tissue conditions, ranging from acute traumatic injuries to chronic overuse syndromes and complex postoperative needs. Splinting is not a one-size-fits-all solution; rather, it is a strategic, targeted intervention that must be tailored to the specific anatomical site, injury mechanism, tissue involved, and phase of healing. Clinical judgment is paramount in guiding not only the decision to immobilize but also determining the optimal timing, material selection, anatomical positioning, and duration of splint use.

An in-depth understanding of the underlying pathophysiology behind each indication enables clinicians to implement splinting in a way that truly complements the body's natural healing processes. Immobilization should be viewed not merely as a passive measure, but as an active therapeutic tool that can reduce inflammation, stabilize joint mechanics, optimize blood flow, and prevent secondary complications such as deformity, nerve compression, or chronic dysfunction.

Moreover, the application of splints must always be accompanied by a comprehensive clinical assessment that includes evaluation of neurovascular status, mechanism of injury, patient comorbidities, functional limitations, and psychosocial considerations. The orthopedic technologist or clinician must also remain vigilant about potential downstream consequences of improper immobilization—including joint stiffness, muscle atrophy, skin breakdown, or delayed union of fractures—by balancing protection with the eventual need for mobilization and rehabilitation.

As such, competency in splinting extends beyond technical proficiency; it demands critical thinking, interdisciplinary communication, and a patient-centered mindset. In emergency departments, urgent care settings, and orthopedic clinics, those applying splints must function as both skilled practitioners and thoughtful clinical decision-makers. When properly executed, splinting not only protects injured tissues but actively promotes recovery, restores function, and enhances the overall quality of orthopedic care.

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Section B: Contraindications to Splinting

While splinting remains an essential and versatile tool in musculoskeletal management, it is not universally appropriate in all clinical scenarios. There are specific conditions and circumstances in which splinting is either contraindicated outright, requires significant caution, or must be delayed or adapted. These contraindications are typically informed by the risk of iatrogenic harm, including skin breakdown, neurovascular compromise, infection propagation, and missed or delayed
diagnosis of emergent conditions.

- Absolute Contraindications – Conditions where splinting is inappropriate or potentially harmful unless life- or limb-saving measures are concurrently taken
- Relative Contraindications – Scenarios in which splinting may be performed with modifications or under specific precautions

Each contraindication must be weighed against the risks of non-immobilization, emphasizing that immobilization is a clinical judgment—not a reflex.

I. Absolute Contraindications to Splinting

1. Open Fractures Prior to Proper Wound Management

Open fractures pose a significant infection risk due to the direct communication between the external environment and the bone. Splinting before proper wound assessment and irrigation can result in:

- Entrapment of foreign material within the wound bed
- Impaired access for surgical debridement
- Compression of viable soft tissue around necrotic debris
- Development of deep infection, including osteomyelitis, which has long-term functional consequences

Clinical action: Apply sterile dressing only. Immobilize the limb minimally for transport (e.g., padded board) and avoid circumferential wrapping over the wound until debridement and surgical intervention have occurred.

2. Compartment Syndrome or High-Risk Limb Swelling

Compartment syndrome is a limb-threatening emergency caused by increased pressure within a fascial compartment, leading to impaired perfusion and irreversible ischemia. The danger with splinting is twofold:

- Tight circumferential wraps or rigid splints may elevate intra-compartmental pressure
- Immobilization may mask progressive symptoms such as increasing pain or neurologic changes

Clinical markers: Pain out of proportion, pain with passive stretch, tense compartments, paresthesia, and pallor are early signs. Pulses may still be present initially and are not a reliable exclusion criterion.

Clinical action: Maintain limb at heart level; do not elevate or compress. Avoid splinting until compartment syndrome is ruled out or fasciotomy is performed.

3. Absent or Severely Compromised Distal Circulation

When a limb presents with diminished or absent pulses, delayed capillary refill, or a cool, cyanotic appearance, applying a splint **before restoring alignment or performing emergent reduction** can worsen ischemia or obscure ongoing vascular deterioration.

Example scenarios:

- Displaced supracondylar humerus fracture compressing the brachial artery
- Dislocated knee compromising popliteal artery flow

Delay in intervention beyond 6–8 hours may result in permanent neurovascular damage and limb loss.

Clinical action: Immediate reduction or vascular consult. Splint only after perfusion is reestablished or stabilized.

II. Relative Contraindications to Splinting (Requires Modification or Monitoring)

1. Severe Soft Tissue Damage Overlying the Splinting Site

Contusions, degloving injuries, lacerations, and avulsions represent compromised dermal and subdermal tissue. Applying pressure with a splint can:

- Exacerbate soft tissue necrosis
- Disrupt capillary beds and lymphatic drainage
- Mask wound drainage or necrotic progression

Adaptations:

- Avoid rigid contact with the injured area; pad liberally
- Use off-loading splint designs
- Apply positioning techniques with foam support or elevation
- Delay rigid splinting until tissue integrity improves

2. Infected Limbs or Septic Joints

Active infection around joints or soft tissues (e.g., cellulitis, septic arthritis, or necrotizing fasciitis) may worsen under immobilization:

- Heat and moisture retention may accelerate bacterial proliferation
- Compression may impair local blood flow and limit antibiotic delivery
- Pain may be aggravated by splint-induced pressure

Exceptions: In cases like septic arthritis, **gentle immobilization for pain relief** may be indicated, but must be monitored closely.

Precautions:

- Use breathable padding, avoid occlusive wraps
- Remove splint frequently to inspect skin
- Coordinate immobilization with infectious disease and surgical teams

3. Rapidly Progressive Edema (Post-Trauma or Reperfusion)

Injuries to highly vascularized areas such as the leg, forearm, or hand often swell considerably in the first 24–72 hours. This edema can lead to:

- Skin tension and blistering beneath the splint
- Nerve compression (e.g., ulnar or peroneal neuropathies)
- Vascular compromise due to wrap-induced compression

Clinical modification:

- Apply **non-circumferential splints** (e.g., posterior slab with loose wrap)
- Use ample padding
- Recheck neurovascular status every 2 hours for the first 12–24 hours
- Elevate limb to promote venous return and reduce fluid accumulation

4. Patient Factors: Claustrophobia, Psychiatric Conditions / Sensory Disorders

Patients with anxiety, PTSD, autism spectrum disorder, or cognitive impairment may become highly distressed or noncompliant with immobilization. Rigid or bulky splints may trigger panic or behavioral agitation, leading to:

- Splint removal or destruction
- Increased pain perception
- Trauma-related regression or combativeness (especially in pediatric or geriatric populations)

Management strategies:

- Offer clear, empathetic explanation of procedures
- Involve caregivers and provide visual cues (splinting dolls, photos)
- Use soft immobilizers when possible
- In rare cases, mild anxiolytics or conscious sedation may be warranted for splint tolerance

5. Contact Allergies to Splinting Materials

Allergic contact dermatitis may occur in reaction to:

- Fiberglass resin
- Neoprene or latex
- Stockinette adhesives
- Polyurethane foam or elastic wraps

Signs include: Erythema, pruritus, vesicles, and sloughing at the skin-contact points.

Prevention:

- Ask about previous reactions
- Use hypoallergenic alternatives (cotton stockinette, silicone liners)
- Apply a protective barrier or secondary wrap before splint contact

6. Poor Patient Compliance or Unsafe Home Environment

Splints lose their therapeutic benefit if patients fail to:

- Maintain correct positioning
- Return for follow-up care
- Avoid wetting or modifying the device

Patients with active substance use disorder, homelessness, dementia, or language barriers may not safely manage a splint independently.

Solutions:

- Involve social work or case management
- Educate family/caregivers on splint use and monitoring

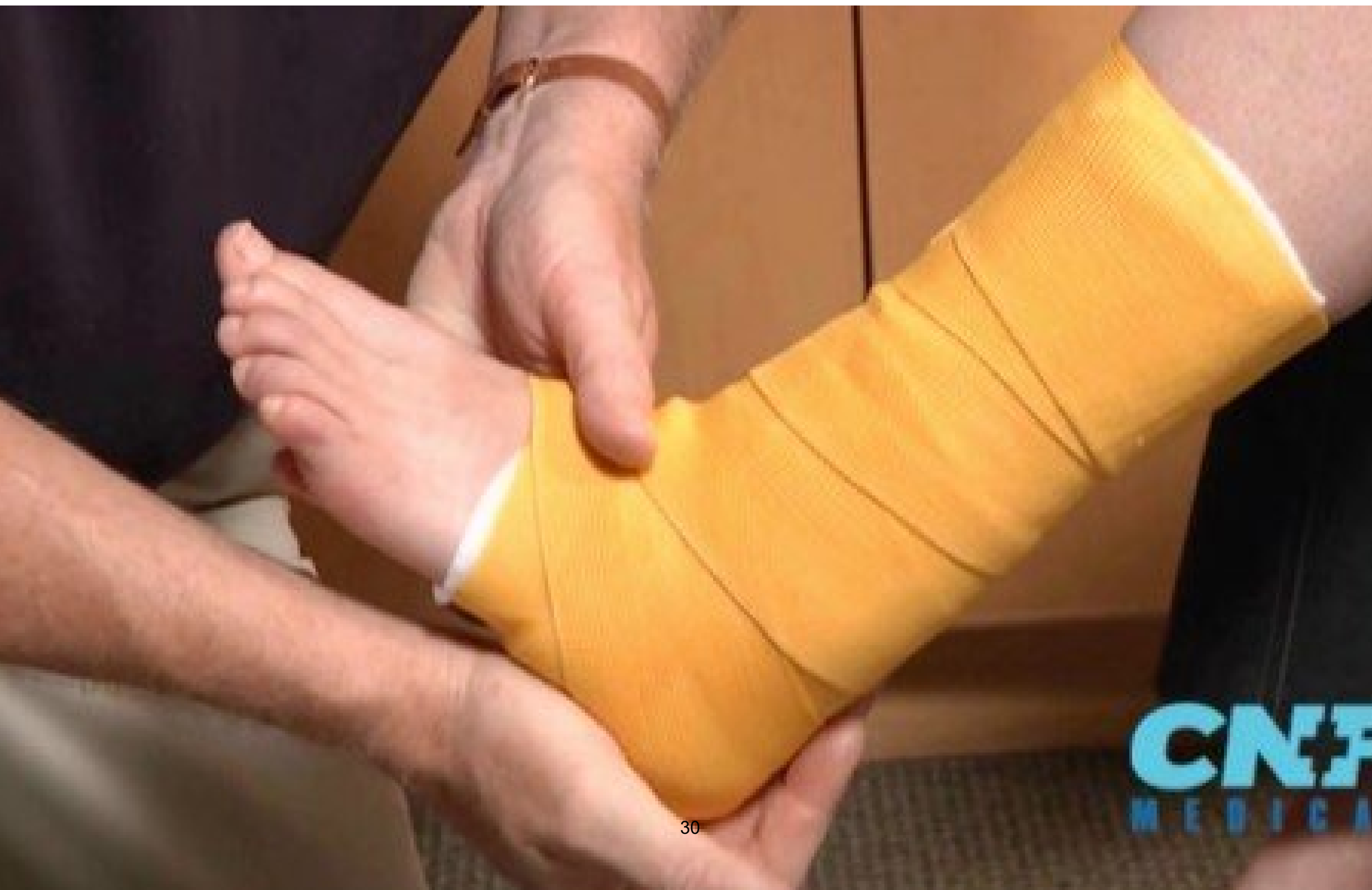
Use protective casts or removeable braces with alarm tags in high-risk cases

III. Environmental or Operational Constraints

In certain field or mass-casualty settings, splinting decisions must balance:

- Transport safety (bulky splints may impair EMS extrication)
- Limited resources (may require improvised splints with minimal stabilization)
- Prolonged travel times (require easily adjustable or removable devices)

Best practices: Use modular or soft splints that stabilize the limb without restricting emergency access or visibility.



Conclusion

Contraindications to splinting are as critical to patient safety as the indications for its use. Improperly applied or ill-timed immobilization can lead to limb-threatening complications, masked emergencies, patient distress, and medicolegal exposure. Orthopedic technologists, emergency clinicians, and casting professionals must therefore be vigilant in evaluating not only the injury, but the entire clinical context—including tissue condition, vascular integrity, cognitive capacity, and environmental circumstances.

When a contraindication exists, the clinician must consider alternative immobilization strategies, defer splinting until stabilization is achieved, or modify standard protocols to protect the patient. Mastery of these decision-making principles ensures that splinting remains a therapeutic ally, not a source of avoidable harm.

Section C: Goals of Immobilization

Immobilization is one of the foundational therapeutic interventions in musculoskeletal care. Its primary purpose is to **stabilize injured or vulnerable anatomical structures** while enabling the body's intrinsic healing mechanisms to function without interruption or re-injury. Proper immobilization is not simply about preventing motion—it is a carefully executed intervention that supports **anatomical alignment, tissue repair, functional preservation, and pain control.**

Understanding the goals of immobilization allows orthopedic technologists, emergency clinicians, and allied healthcare professionals to tailor each splinting intervention to the unique needs of the patient and the nature of the injury. Immobilization must be guided by both **physiological principles and practical considerations**, ensuring that treatment enhances—not impedes—recovery.

I. Promote Healing by Limiting Pathological Movement

At the core of immobilization is the prevention of pathological motion at the site of injury. This is especially critical in:

- **Fractures**, where even micro-movements at the fracture line can disrupt hematoma formation, delay callus development, or result in nonunion.
- **Ligamentous injuries**, where excess strain on injured fibers can lead to lengthening, scarring, or recurrent instability.
- **Tendon repairs**, which require precise control of tension to prevent rupture or adhesion formation.

  By eliminating abnormal movement, splinting **preserves the integrity of newly forming tissue matrices,** allowing for uninterrupted cellular repair processes such as collagen deposition, angiogenesis, and osteogenesis (Braddom et al., 2021).

II. Protect Anatomical Structures from Further Injury

Immobilization creates a **controlled biomechanical environment** that shields the injured area from external forces, unintended patient movement, and weight-bearing stress. This goal is particularly vital in:

- **Joint dislocations**, where stabilization prevents redislocation
- **Open injuries,** where splinting can minimize soft tissue shearing
- **Nerve entrapment syndromes**, such as carpal tunnel syndrome, where neutral positioning reduces mechanical compression

The **biomechanical benefit** of splinting is not just static protection—it also **alters load transmission**, offloading certain anatomical planes while preserving the function of uninvolved segments. For instance, a thumb spica splint immobilizes the first metacarpophalangeal (MCP) joint while preserving digital flexion and wrist function.

III. Facilitate Proper Anatomical Alignment

Maintaining or restoring anatomical alignment is critical in preventing **malunion, joint dysfunction, and post-traumatic deformit**y. Immobilization achieves this by:

- Holding bones in a reduced or nearly reduced position
- Supporting joints in a **position of function or resting position**
- Preventing contractures through gentle extension or flexion as indicated

Proper alignment **reduces compensatory muscular tension**, improves vascular drainage, and facilitates more effective tissue healing under appropriate stress gradients. For example, splinting a wrist in slight extension maximizes flexor tendon function and prevents shortening of the volar structures during immobilization (Zlotolow et al., 2013).

IV. Minimize Pain and Inflammation

Pain reduction is one of the most immediate and observable goals of splinting. Immobilization reduces pain by:

- **Restricting movement** that triggers nociceptive signaling
- **Stabilizing fractures**, thereby reducing muscle spasm and periosteal irritation
- **Allowing rest to inflamed structures**, such as in overuse syndromes (e.g., tendinitis)

By decreasing mechanical irritation, splints help **break the pain-spasm-pain cycle**, particularly in acute trauma and in conditions involving sensitive periarticular structures. Reduced pain facilitates deeper breathing, improved sleep, and better participation in therapy.

V. Preserve Function and Prevent Secondary Complications

Immobilization should always aim to **preserve long-term function** and limit iatrogenic harm. Goals include:

- Preventing **joint stiffness** by immobilizing in functional positions
- Avoiding **muscle atrophy** and disuse by minimizing unnecessary immobilization duration
- Protecting **neurovascular structures** by reducing edema and compression
- Preventing **skin breakdown** by using well-padded, properly applied materials

In the upper extremity, hand-based splints should preserve thumb opposition and metacarpophalangeal flexion, while lower extremity immobilization should consider safe weight-bearing transitions or assistive device compatibility.

Example: Immobilizing the ankle in **neutral dorsiflexion** ensures proper Achilles tendon length and prevents equinus contracture—a common issue with plantarflexion-positioned splints left on too long.

VI. Provide Psychological and Behavioral Benefits

In addition to physical benefits, immobilization can offer significant **psychological reassurance** to patients. Stabilizing a painful or unstable limb can:

- Reduce anxiety about movement or reinjury
- Increase patient trust in the care process
- Improve compliance with activity restrictions

For pediatric patients, geriatric populations, or individuals with developmental disorders, a well-applied splint can also serve as a **behavioral cue** to protect the limb and reduce inadvertent strain during daily activities.

VII. Facilitate Safe Transport and Continuity of Care

In emergency or prehospital care settings, one of the primary goals of splinting is to:

- Prevent **worsening of injuries during transit**
- Reduce the risk of hemorrhage or neurovascular compromise in route
- Enable diagnostic imaging by providing basic stabilization

Additionally, temporary splints serve as a **bridge to definitive care**, maintaining anatomical integrity until further surgical or orthopedic interventions can be safely performed.

VIII. Support Rehabilitation Planning and Gradual Mobilization

Immobilization sets the stage for **progressive rehabilitation** by first protecting injured structures, then **transitioning to dynamic or removable splints** as healing progresses. Modern splinting strategies often involve:

- **Phased immobilization**, gradually restoring range of motion
- **Hybrid orthoses**, allowing joint mobilization while protecting healing tissues
- Use of **night splints or removable braces** during functional recovery

In cases like flexor tendon repair or ligamentous reconstruction, splints are part of **protocol-driven rehabilitation**, where early passive or active motion is introduced under controlled conditions (Strickland, 2005).

Conclusion

The goals of immobilization are far-reaching and multidimensional, encompassing **biological, biomechanical, functional, and psychosocial domains** of healing. Immobilization is not simply a static intervention—it is a dynamic clinical strategy that, when employed with expertise and intention, promotes healing while minimizing the risk of secondary complications. The orthopedic technologist and clinician must understand that every immobilization decision has **short-term consequences** for comfort and tissue stability, and **long-term implications** for function, independence, and quality of life.

When used appropriately, splinting achieves multiple critical outcomes:

- **Reduces pathological motion:** Injured tissues—whether bone, ligament, tendon, or joint capsule—require mechanical stillness to initiate organized healing. Immobilization limits micromovement that could disrupt cellular repair processes, displace fracture fragments, or elongate torn ligaments. Controlled positioning minimizes pain-inducing mechanical stress and preserves joint congruity.

- **Supports tissue healing**: Immobilization creates a **biologically favorable microenvironment** by reducing inflammation, protecting granulating tissue, and preventing reinjury. For example, stabilizing a joint in a neutral or functional position supports tendon gliding and prevents collagen fiber disorganization, allowing the body's reparative processes to proceed efficiently.

- **Prevents deformity:** Without proper immobilization, patients are at risk of malunion, contracture, and joint subluxation—particularly when injury involves muscle imbalance, neurovascular compromise, or open wounds. By preserving anatomical alignment during healing, splints prevent structural complications that can significantly impair long-term mobility and hand function.

- **Alleviates pain:** Immobilization interrupts the cycle of pain, spasm, and inflammation. Mechanical support reduces stimulation of nociceptors, especially in fractures and soft tissue injuries. Furthermore, immobilization reduces muscle guarding and provides psychological reassurance, which further contributes to subjective pain reduction.

- **Preserves function:** Immobilization is not about eliminating motion across the entire limb—it is about protecting injured segments while preserving function in adjacent joints and uninvolved structures. Proper splint design maintains critical positions (e.g., wrist extension, MCP flexion, ankle neutral), which reduces the risk of long-term stiffness, loss of dexterity, or impaired ambulation.

- **Facilitates transition to rehabilitation:** Immobilization is often the **first phase in a comprehensive recovery continuum**. It creates the stability necessary to progress to active range of motion, strengthening, and functional retraining. Thoughtful splinting may also evolve into dynamic orthotic use, activity-specific bracing, or structured withdrawal as healing milestones are reached.

For these goals to be realized, orthopedic technologists and clinicians must approach splinting with **deliberate clinical reasoning and patient-specific customization**. Splints should never be applied as a routine or generalized intervention. Every splint must reflect:

- The **nature and phase of the injury**
- The **expected healing timeline**
- The **functional demands** of the patient
- The **psychosocial factors** that influence compliance and recovery

Ultimately, the purpose of splinting is not merely to immobilize—but to **protect, guide, and empower healing**. The true success of immobilization lies not in the rigidity of the device, but in the precision and purpose with which it is applied. The expert clinician balances the competing needs of **stability and mobility, healing and independence**, creating an environment in which the patient can recover fully, safely, and functionally.

References

Though splints and casts are both integral tools in orthopedic care, their mechanical principles, indications, and clinical implications differ significantly. A nuanced understanding of these distinctions enables clinicians to select the most appropriate immobilization strategy based on patient presentation, injury characteristics, and risk factors. In many cases, splinting serves as a bridge to casting, reinforcing the need for adaptable and patient-centered care in musculoskeletal management.

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Chapter 3: Materials and Tools in Splinting

Materials/Supplies Selection and Equipment Safety Considerations

Section A: Plaster, Fiberglass, and Thermoplastics

Advanced Material Selection in Orthopedic Immobilization

The splinting material selected for immobilization must meet the anatomical, mechanical, and clinical needs of the injury while also addressing patient comfort, healing timelines, cost efficiency, and environmental demands. The three most commonly used categories of materials—plaster of Paris, fiberglass, and thermoplastics—each offer distinct advantages and limitations in orthopedic immobilization. A thorough understanding of their composition, physical behavior, application protocols, and clinical indications is critical for selecting the optimal material for each scenario.

I. Plaster of Paris

Chemical Composition and Reaction

Plaster of Paris is made from calcium sulfate hemihydrate ($CaSO_4 \cdot \frac{1}{2}H_2O$), derived by heating gypsum to remove water. When combined with water, it undergoes an exothermic hydration reaction to form calcium sulfate dihydrate ($CaSO_4 \cdot 2H_2O$), producing heat and a rigid crystalline structure. This setting reaction is temperature-sensitive and time-dependent.

Reaction: $CaSO_4 \cdot \frac{1}{2}H_2O + 1\frac{1}{2}H_2O \rightarrow CaSO_4 \cdot 2H_2O$ + heat

Mechanical Properties:

- **Malleability:** Superior—conforms easily to contours and bony prominences
- **Setting Time:** Initial set in 3–5 minutes; full strength in 24–72 hours
- **Strength:** High compressive strength when fully dry; lower tensile strength
- **Weight:** Significantly heavier than fiberglass
- **Radiodensity:** Radiopaque—can obscure subtle fracture lines
- **Exothermic:** Risk of thermal burns with thick layers, minimal padding, or hot water activation

Clinical Advantages:

Plaster remains the **material of choice for high-precision molding**, particularly in:

- **Hand, wrist, and forearm splints** where anatomical detail is critical
- **Postoperative applications** where edema control and tissue contouring are essential
- **Custom-molded** posterior slabs, sugar-tong splints, and bivalved casts
- **Serial casting in pediatrics** (e.g., for clubfoot or spastic contractures)

It is ideal for early-stage management of unstable or high-risk injuries, where swelling and the need for adjustment require a material that molds and bivalves easily.

Safety Considerations:

- Always use **lukewarm water (~20–25°C)** to prevent accelerated reaction and burns
- Apply **adequate padding,** especially over bony landmarks (e.g., olecranon, malleoli)
- Limit **layer thickness (8–12 layers typical);** excess material traps heat
- Advise patients that full curing takes **24–72 hours** and to avoid weight-bearing or getting the splint wet

Clinical Limitations:

- **Not water-resistant**—susceptible to breakdown with moisture
- Brittle if dropped or struck after drying
- **Dust particles** from trimming may be irritating; use appropriate PPE
- Can be messy and labor-intensive, requiring skilled handling

II. Fiberglass

Fiberglass consists of woven glass fibers impregnated with polyurethane resin, which hardens upon exposure to air and water. It is typically packaged in sealed rolls and activated with room-temperature water.

Mechanical Properties:

- Setting Time: 3–5 minutes; functional hardness in ~20 minutes
- Weight: Lightweight—roughly ⅓ the weight of plaster
- Strength: Superior tensile and flexural strength
- Durability: Resistant to cracking and fracture; supports limited weight-bearing
- Radiolucency: Permits clear radiographic evaluation of fracture healing
- Water Resistance: Cured fiberglass is water-resistant, though inner padding must still be protected

Clinical Advantages:

Fiberglass has become the preferred material in long-term immobilization, especially in:

- Lower extremity splints (e.g., stirrup, posterior short leg)
- Fractures requiring durable, low-bulk support (e.g., tibial shaft, humeral fractures)
- Outpatient care, where quick setting time and patient convenience are prioritized
- Pediatric fractures—less weight and more colorful options encourage compliance

It is also ideal for frequent radiographic monitoring, given its radiolucency and compatibility with MRI/CT imaging (depending on resin type).

Safety & Application Notes:

- Minimal exothermic risk, but still requires skin protection
- Use vinyl gloves to prevent resin adherence during application
- Trimming generates airborne glass dust—use respirator and vacuum system
- Must be properly stored—resin activation degrades with humidity and shelf-life

Clinical Limitations:

- Less moldable—poor conformation around sharp curves or fine anatomy
- May require more pre-molding and careful hand positioning
- Costlier than plaster, particularly in high-volume use
- Resin smell and vapors may irritate sensitive patients or staff

II. Thermoplastics

Material Composition:
Thermoplastics used in splinting are typically **low-temperature heat-sensitive polymers**, such as:

- Polycaprolactone (e.g., Aquaplast™, Orfit™, Polyform™)
- Polyethylene derivatives
- EVA ethylene-vinyl acetate) composites

These materials become pliable at **135–160°F (57–71°C)**, and are reusable upon reheating. They are available in **perforated and solid sheets**, varying in thickness (1/8", 1/16", etc.), rigidity, and memory.

Mechanical and Handling Properties:

- **Highly conformable** when heated; return to rigid state in ~5–10 minutes
- **Re-moldable** multiple times without structural degradation
- **Smooth edges** can be shaped without cutting or grinding
- **Low weight and bulk**; breathable and well-tolerated for long-term wear

Clinical Applications:
Thermoplastics are standard in:

- **Custom hand and wrist orthoses** for neuromuscular or post-traumatic rehab
- **Resting hand splints** to prevent contractures in patients with spasticity or hemiplegia
- **Static-progressive or dynamic splints** for joint mobilization
- **Pediatric orthoses**, especially for children with cerebral palsy or developmental disorders

These splints are often created collaboratively between orthopedic technologists and occupational or physical therapists, and frequently incorporated into rehabilitation regimens post-fracture, tendon repair, or nerve decompression (Michlovitz et al., 2014).

Safety and Handling:

- Requires **splint pan or water bath** set to target temperature
- **Protect skin** during molding; confirm tolerance with therapists
- Always test moldability before application; overheated thermoplastic may deform
- Once cooled, may be **trimmed and perforated** to enhance comfort and ventilation

Clinical Limitations:

- **Not indicated for acute trauma** or weight-bearing scenarios
- Cannot provide rigid fixation needed in fractures or joint dislocations
- Requires more **fabrication time and patient cooperation**
- **Material cost and reusability** make it best suited for rehab and sub-acute care

Clinical Selection Considerations

Criterion	Plaster	Fiberglass	Thermoplastics
Conformability	Best	Moderate	Excellent (custom)
Application Speed	Moderate-Slow	Fast	Moderate (requires heating)
Strength	Moderate-High (fragile)	High	Low-Moderate
Radiolucency	Low	High	High
Reusability	No	No	Yes
Cost	Low	Moderate	High
Best Use Case	Acute trauma, complex anatomy	Long-term casting, outpatient	Rehab, orthotics, neurosplints
Setting/Curing Reaction	Exothermic hydration	Resin polymerization	Heat-activated molding

Conclusion

A deep understanding of plaster, fiberglass, and thermoplastics allows clinicians to approach splint fabrication not as a rote procedure, but as a clinical art form rooted in biomechanical science and patient-specific strategy. These materials are tools—not just for immobilization, but for recovery. Selecting the right one means balancing anatomical accuracy, therapeutic need, patient comfort, and timing across the spectrum of injury care.

Clinicians must master the properties, handling characteristics, indications, and limitations of each material type. Whether molding a forearm slab with plaster, applying a fiberglass stirrup in a trauma bay, or crafting a dynamic thermoplastic splint in an outpatient rehab clinic, the skilled orthopedic technologist must apply evidence-based rationale, anatomical insight, and professional craftsmanship to each splint created.

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Section B: Padding, Stockinette and Fasteners

Essential Soft Components for Safe and Effective Immobilization

While rigid splinting materials provide the external support necessary to immobilize injured structures, the **internal components**—specifically **padding, stockinette, and fasteners**—are equally critical in ensuring a safe, effective, and comfortable application. These soft materials serve as the **interface between the skin and the immobilizer**, playing a vital role in **pressure distribution, moisture management, thermal protection, and skin integrity preservation**.

Understanding the properties, functions, and application techniques of these components is essential for orthopedic technologists and clinicians. Incorrect use or omission can lead to **iatrogenic injury**, including pressure ulcers, compartment syndrome, skin maceration, or delayed healing.

I. Stockinette

Overview and Composition

Stockinette is a soft, tubular stretch fabric placed directly over the patient's skin before padding and rigid material are applied. It is typically made from **cotton, polyester, rayon, or blended fibers** and is available in multiple widths (commonly 1″–6″) to accommodate different limb circumferences. Some stockinette is/are available in **antimicrobial, hypoallergenic, or self-adhesive** varieties to reduce skin irritation and improve adherence to underlying padding.

Function:

- **Creates a smooth skin-barrier foundation** to prevent friction and chafing
- **Reduces skin irritation** from direct contact with plaster, fiberglass, or resin
- **Accommodates swelling** due to its stretchable, tubular design
- **Improves patient comfort** and reduces odor retention by wicking moisture

In pediatric and long-term applications, stockinette with **printed patterns may help increase compliance and reduce anxiety.**

Application Considerations:

- Stockinette should extend **2–3 inches beyond each end** of the splint or cast to allow for folding back over the edges, creating a soft finished border
- Avoid wrinkles or twisting during application—these can cause **skin shearing or pressure ridges** beneath rigid layers
- For areas prone to movement (e.g., elbow, ankle), consider using **bias-cut stockinette** to enhance conformity
- In patients with **fragile skin** or allergy risk, use **latex-free and hypoallergenic stockinette**

II. Cast and Splint Padding

Composition and Variants

Cast and splint padding is a **critical intermediary layer** between the patient's skin and the rigid splinting material. It serves not only to protect soft tissue but also to regulate heat, wick moisture, and mitigate the risk of pressure injuries. The type of padding selected must consider the **anatomical region, injury characteristics, patient skin integrity, and anticipated swelling**.

1. Cotton Padding (Orthopedic Cotton Roll)

- Composed of **100% non-woven cotton fibers**, this padding is highly absorbent and traditionally used with plaster of Paris applications.
- Offers **excellent conformability** and cushioning around joints and bony prominences.
- **Highly compressive** over time, which may reduce effectiveness in long-term immobilization.
- Drawbacks include **poor moisture resistance**, risk of **maceration**, and **slow drying** time.

2. Synthetic Padding (Polyester or Polypropylene)

- Constructed from **non-woven polyester fibers**, often thermally bonded to maintain loft and springiness.
- Compatible with both **fiberglass and plaster**, though typically paired with fiberglass.
- **Features include:**

1. **Water resistance** (does not absorb water easily)
2. **Higher memory**, maintaining thickness under pressure
3. **Smooth, uniform application** for consistent pressure distribution

- May create **more friction during application** and require experienced handling to prevent rolling or slippage.

3. Waterproof Padding (Hydrophobic Foam-Lined Polyester)

- Designed for **water-tolerant casts**, particularly in pediatric or athletic populations.
- Lined with a **closed-cell polyethylene foam** core surrounded by hydrophobic synthetic wrap.
- Allows for **showering or swimming** once the cast material has fully set.
- Not suitable in high-risk wounds, infections, or fragile skin conditions due to **reduced breathability**.

4. Adhesive-Backed Padding

- Found in **prefabricated splints and post-operative bracing systems**.
- Made from **foam, silicone, or synthetic fiber** mats with pressure-sensitive adhesives on one side.
- Allows for **easy placement** and repositioning during fabrication.
- Useful in customizing **thermoplastic splints, orthoses, or post-op braces** for targeted off-loading.

5. Specialty Padding (Gel Inserts, Pressure-Offloading Cushions)

- Includes v**iscoelastic gel pads, custom-molded foam** wedges, or silicone ring pads.
- Used in:
    - Neuropathic foot care (e.g., diabetic ulcers)
    - Post-operative tendon or ligament repairs
    - Pressure injury prevention in immobilized or insensate patients

Functions:

- **Prevents pressure injury** over bony prominences (e.g., malleoli, olecranon, radial styloid)
- **Acts as a thermal insulator**, especially during the exothermic reaction of plaster setting
- **Manages mild swelling**, accommodating volume changes in early post-trauma phases
- **Reduces skin maceration** by absorbing perspiration or wound exudate (if used with precautions)

Application Techniques:

- Apply in **uniform layers** with 30–50% overlap to ensure even pressure distribution
- **Use extra padding** over vulnerable areas or surgical sites
- Avoid excessive padding, which can cause **loss of immobilization** effectiveness or slipping of the splint
- Tension should be light; stretching the padding during application **may cause a tourniquet effect**

Clinical Tip: In high-risk patients (e.g., elderly, diabetic, or neuropathic), additional attention should be given to pressure relief and skin inspection.

III. Fasteners and Retention Materials

Types of Fasteners

1. Elastic Bandages (e.g., Ace™ Wrap)

- Made from a blend of **cotton, polyester, and latex or synthetic rubber fibers**, elastic bandages provide graduated compression and adjustability.
- Typically used in a **spiral or figure-eight pattern**, extending distal to proximal.
- Available in multiple widths (2″–6″) and lengths.

Advantages:

- **Reusable** and adjustable
- Allows limb swelling to expand without tourniquet effect

Caution:

- **Risk of circulatory compromise** if applied under tension or if swelling increases
- May loosen with activity or over time

2. Self-Adherent Wrap (e.g., Coban™)

- Non-woven elastic wrap with **self-bonding cohesive properties**, eliminating the need for clips or tape.
- Provides light compression; sticks only to itself, not to skin or fabric.
- Ideal for **short-term immobilization**, pediatric use, or post-surgical dressing reinforcement.

Caution:

- **Easy to over-tighten**, especially on small limbs or fingers
- Can be difficult to monitor skin condition beneath the wrap

3. Hook-and-Loop Straps (Velcro®)

- Consist of **nylon or polyester loop fabric** and a hook strip withadhesive or sewn base.

Common in:

- Custom thermoplastic splints
- Removable braces
- Functional orthoses

Advantages:

- **Highly adjustable**, ideal for long-term or rehab use
- Facilitates patient independence in donning/doffing

Caution:

- **Requires secure anchoring** (glued, riveted, or sewn into splint)
- May collect debris or lose adhesion over time with repeated use

4. Adhesive Tapes (Surgical or Casting Tape)

Includes:

- **Zinc oxide medical tape**: High-adhesion, breathable
- **Rigid cloth or waterproof tape**: Durable for athletic use
- **Fiberglass cast tape as a secondary** wrap: Used to reinforce splint

Applications:

- Securing overwrap in field or emergency settings
- **Supplementing elastic bandages** when added stability is needed

Limitations:

- **Non-reusable**
- **May irritate sensitive skin**
- Difficult for patients with limited dexterity to remove or adjust

Functions:

- Maintain splint position and prevent migration or loosening
- Permit **reversible immobilization** for re-evaluation or swelling assessment
- Allow for **adjustable compression**, useful in conditions with fluctuating edema
- Enable **early mobilization protocols**, particularly in rehabilitation splints

Application Considerations:

- Bandages should be applied with **consistent, light compression**, spiraling from distal to proximal
- Avoid creating **pressure ridges** or circumferential constriction—risk of **vascular compromise**
- If using **self-adherent wrap**, ensure that it is not applied under tension, especially in neurovascularly vulnerable limbs
- Velcro straps must be **anchored securel**y to thermoplastics or fabric splints using rivets, glue, or stitching to ensure durability

Pediatric and Geriatric Considerations

Patients at the extremes of age require specific modifications and heightened awareness when selecting and applying soft materials and fasteners.

Pediatric Considerations:

- **Anatomical differences**: Smaller limb girth and softer tissue require thinner padding and more precise material trimming.
- **Higher sweat production**: Use moisture-wicking padding (e.g., synthetic over cotton).
- **Skin fragility**: Children's skin is more sensitive to adhesives and shear forces—avoid aggressive tape use.
- **Behavioral unpredictability**:
  - Young children may remove wraps or splints impulsively.
  - Consider adhesive-backed padding and extra overwrap to reduce tampering.
- **Engagement**: Use colored stockinette or themed patterns to reduce anxiety and encourage cooperation.

Geriatric Considerations

- **Thinned epidermis and reduced dermal elasticity** make elderly skin prone to tears, bruising, and pressure injury.
- **Comorbidities** such as peripheral vascular disease, diabetes, or neuropathy demand enhanced padding and frequent neurovascular checks.
- **Reduced mobility and dexterity**:
  - Select **larger loop or strap systems** to allow easier manipulation.
  - Avoid wraps that require fine motor control.
- **Cognitive impairments**: Dementia or delirium can lead to confusion or agitation, making compliance difficult. Simplify the design and provide caregiver instruction.

Clinical Tip: In both populations, consider applying **pressure-relief padding over prominences** (e.g., heels, ulnar styloid, olecranon) and routinely assess for **early skin compromise** beneath wraps or straps.

Clinical Pearls for Integration

- Layering sequence matters: Improper order (e.g., padding directly on skin) may increase friction and reduce effectiveness
- Secure edge rolling: Folding stockinette and padding back over splint ends creates a “soft border” that protects skin from abrasive fiberglass or plaster edges
- Check circulation post-application: Every splint should be followed by neurovascular reassessment—particularly if swelling is present or fasteners are tight
- Instruct patients on how to re-wrap or adjust bandages, and when to seek help if swelling or pain increases
- In post-operative care, use breathable padding and antimicrobial liners to reduce risk of skin breakdown or infection beneath the immobilizer

Conclusion

While rigid materials provide the structure of an orthopedic splint, the true interface between the patient and the device is determined by the soft components: stockinette, padding, and fasteners. These materials safeguard the skin, distribute pressure, accommodate anatomical irregularities, and support patient comfort and compliance. A well-constructed splint is only as good as the quality and placement of its internal layers.

Mastery of these components requires attention to detail, anatomical awareness, and an understanding of individual patient risk factors. Poorly applied padding or constrictive wraps may lead to complications such as pressure ulcers, cast syndrome, circulatory obstruction, or splint migration. Conversely, thoughtful use of stockinette, well-padded layers, and properly secured fasteners can turn a simple immobilization into a high-functioning therapeutic intervention that promotes healing and protects quality of life.

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Section C: Application Equipment & Safety Tools

Essential Instruments for Efficient, Safe, and Professional Splint Fabrication

Orthopedic splint application requires more than just immobilization materials. To ensure precise, hygienic, and safe splint fabrication, clinicians must have access to a comprehensive and well-maintained **set of application equipment and protective tools**. These instruments support the accuracy of splint construction, protect both the patient and provider, and allow for efficient workflow in high-paced environments such as emergency departments, orthopedic clinics, and rehabilitation centers.

Understanding each tool's purpose, handling technique, sterilization requirements, and potential hazards is essential to reduce complications and promote best practices in musculoskeletal care.

I. Cutting and Shaping Tools

1. Bandage Scissors (Lister or Utility Scissors)

- Designed with a blunted tip to allow safe cutting of stockinette, elastic wraps, and padding near the skin.
- Curved blade prevents puncturing of the patient's skin during removal.
- Sterilizable
  stainless steel preferred for reusable instruments; disposable plastic variants may be used in high-contamination settings.

Clinical Tip: Always position the flat side against the skin when removing dressings or splints.

2. Cast Shears (Trauma Shears)

- Heavy-duty scissors designed for trimming plaster or fiberglass rolls before hardening.
- Feature serrated blades and extra leverage handles for cutting thick, rigid materials.

Not to be confused with cast cutters—these are for pre-set material cutting or reshaping during fabrication.

3. Thermoplastic Scissors or Heat Shears

- Specially reinforced blades for cutting thermoplastics while warm.
- Designed to reduce cracking or jagged edges that may irritate the skin.
- Some have angled blades to assist with contour shaping.

4. Cast Cutter (Oscillating Saw)

- Used not for splints, but for removal of circumferential casts.
- Oscillates in a side-to-side motion, which cuts rigid material but stops against soft tissue.
- Requires training and caution to avoid heat or friction burns, especially over bony prominences.
- Equipped with a dust collection system and must be paired with a cast spreader.

II. Heating Equipment for Thermoplastics

1. Splint Pan (Hydrocollator or Thermoplastic Water Bath)

- Maintains water temperature between 135–160°F (57–71°C) to activate thermoplastic sheets.
- Should include a thermometer, safety drain, and insulated body.
- Water must be changed and sanitized daily to prevent contamination.
- Always test plastic temperature on the forearm before applying to patient to avoid burns.

2. Heat Gun

- High-velocity tool delivering focused heat for:
  - Spot molding
  - Reheating splint edges
  - Attaching hook-and-loop straps
- Operates at variable heat settings (250–1,100°F) and should be used at a safe distance of 6–12 inches from thermoplastic to avoid warping or scorching.
- Always unplug and cool between uses.

III. Water Activation and Handling Tools

1. Water Bucket (for plaster or fiberglass activation)

- Non-metallic container with a capacity of 2–4 liters for activating cast rolls.
- Clean, room-temperature water (~20–25°C) recommended for plaster to avoid rapid setting and burns.
- Squeeze excess water from roll gently—do not twist or wring, as this may

2. Towels and Drapes

- Used to protect patient skin, clothing, and exam tables from water, resin, and padding debris.
- Absorbent cloth towels are preferred; however, disposable underpads are often used in high-volume settings.
- Keep dry towels nearby to blot excess moisture and improve grip during molding.

IV. Personal Protective Equipment (PPE)

1. Gloves

- **Vinyl or nitrile gloves** required when handling fiberglass or resin-based materials.
- Prevents skin exposure to uncured chemicals that may cause irritation or dermatitis.
- Should be replaced when contaminated, torn, or heavily coated with resin.

2. Eye Protection

- Safety goggles or face shields advised when:
    - Trimming hardened fiberglass or plaster
    - Operating oscillating saws
    - Using cast saws or sanding equipment
- Protects from airborne particulate matter and resin fragments.

3. Respiratory Protection

- **N95 respirators or surgical masks** recommended during:
  - Fiberglass cutting
  - Thermoplastic trimming
  - Dust-producing procedures

- Must comply with **OSHA guidelines** in facilities using powered cutting equipment.

4. Aprons or Gowns

- Worn to protect the provider's clothing and prevent contamination during splinting or casting.
- Disposable or autoclavable options available.

V. Measuring and Marking Instruments

1. Measuring Tape (Flexible)

- Used to assess:
  - Limb circumference
  - Stockinette and padding length
  - Thermoplastic sheet sizing
- Must be **sanitized between uses** or disposable when appropriate.

2. Skin Markers

- Non-toxic, waterproof markers are used to:
  - Outline anatomical landmarks (e.g., bony prominences, tendon paths)
  - Pre-mark trim lines on thermoplastic sheets
- Always check for **allergies or sensitivities** to marker dyes in pediatric or dermatologically sensitive patients.

VI. Supportive Tools and Fixture

1. Molding Aids (Foam Blocks, Pillows, Positioning Wedges)

- Used to position limbs in **functional or resting posture** during hardening.
- Especially useful for:
- Posterior elbow splints
- Long leg or sugar-tong splints
- Night splints for foot drop or hand contractures

2. Limb Elevation Devices

- Include **sling systems, foam wedges, or adjustable bolsters** to reduce swelling and protect during drying.
- May be left in place post-procedure to assist with post-application elevation.

VII. Disinfection and Safety Maintenance Protocols

- Clean and disinfect **cutting tools, scissors, and splint pans** daily using hospital-grade disinfectants.
- Inspect **splint pan thermostats and heat gun cords** weekly for safety compliance.
- Maintain **log of equipment calibration**, including cast saw blade replacement and pan temperature accuracy.
- Store **fiberglass and thermoplastic sheets in sealed containers**, away from heat or
humidity to prevent degradation.

Conclusion

Splinting is a technically demanding skill that depends as much on the quality of tools as it does on anatomical knowledge or material selection. From cutting instruments to splint pans, every piece of equipment plays a role in patient safety, splint integrity, and clinical efficiency. Mastery of splinting requires fluency not only in application technique but also in tool selection, handling, and sterilization.

An orthopedic technologist or clinician must treat the splinting station as a mini-surgical environment—organized, clean, calibrated, and equipped for precision. The deliberate use of proper tools and protective equipment ensures that every splint applied is safe, secure, and positioned for optimal healing.

Refer to Appendix A: Splint Cart Setup Checklist and Daily Cleaning Protocols

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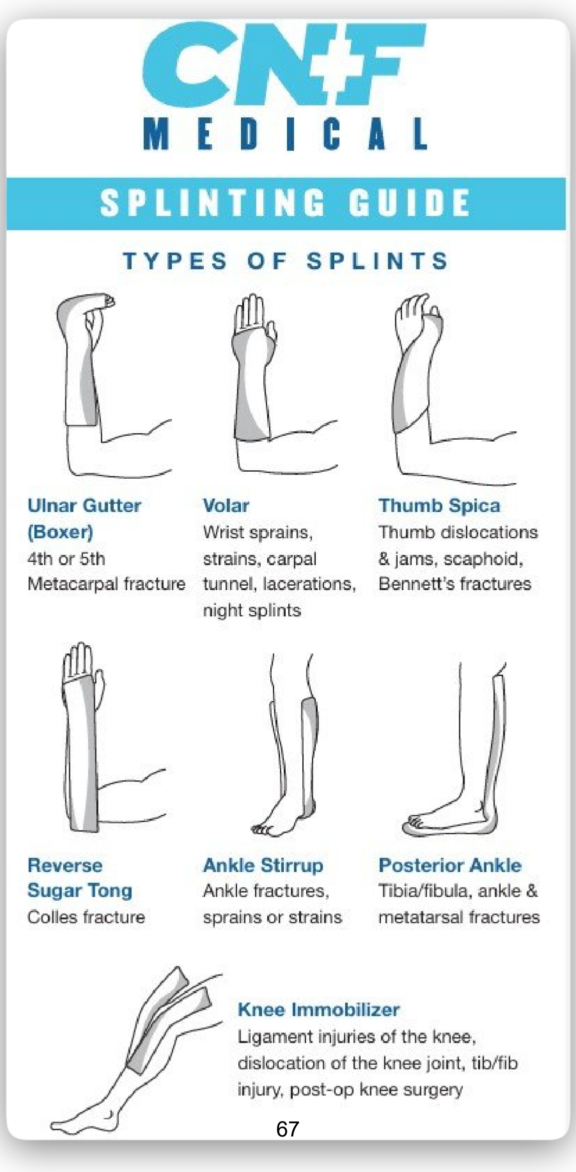
Chapter 4: Biomechanics and Anatomy in Immobilization

Materials/Supplies Selection and Equipment Safety Considerations



Section A: Functional Positioning Principles

Functional positioning refers to the deliberate placement of a limb or joint during immobilization to optimize healing, preserve anatomical integrity, and prevent long-term complications. Unlike arbitrary positioning, functional positioning is rooted in biomechanics, anatomical resting postures, and the preservation of tendon length, joint motion, and muscular balance. Proper positioning minimizes deforming forces, reduces pain, prevents contractures, and enables efficient return to function once the splint is removed.

I. The Scientific Basis of Functional Position

Functional positioning draws on foundational principles of anatomy, kinesiology, and the physiological demands of tissue repair. The concept involves placing the limb in a position that minimizes pathologic motion while maximizing the potential for tendon gliding, joint preservation, and patient comfort.

- **Resting Muscle-Tendon Tension:** Muscles and tendons operate optimally at certain lengths. Immobilization in shortened positions can lead to adaptive shortening and fibrosis, while excessive stretch may cause strain or delayed healing.
- **Capsular and Ligamentous Integrity:** Joint capsules and collateral ligaments are highly susceptible to contracture if immobilized in non-anatomic positions. Functional positioning ensures the preservation of ligament length and joint space.
- **Biomechanical Load Control:** Proper alignment distributes axial, shear, and rotational forces evenly across an injured limb, reducing the risk of secondary dislocation, malunion, or delayed un

II. Foundational Functional Positions by Region

- Each body region has a recognized “position of function” and/or “position of safety” that reflects optimal joint preservation and biomechanical alignment during splinting. These are summarized below:

Region	Position of Function	Rationale
Hand/Wrist	Wrist 20–30° extension, MCPs 60–70° flexion, IPs full extension, thumb in palmar abduction	Preserves collateral ligament length, optimizes grip strength, minimizes stiffness
Elbow	Flexion at 90°, forearm neutral or slightly supinated	Protects neurovascular bundle, supports flexor/extensor balance
Shoulder	Adduction and internal rotation in sling	Minimizes tension on capsule and rotator cuff
Ankle	90° neutral dorsiflexion	Prevents equinus deformity and Achilles tendon shortening
Knee	Full extension or slight flexion (10–15°)	Maintains posterior capsule length and quad tension
Digits	Flexed posture as if holding a can	Moderate
Best Use Case	Acute trauma, complex anatomy	Long-term casting, outpatient
Setting/Curing Reaction	Exothermic hydration	Maintains tendon length, avoids extensor/flexor imbalance

III. Position of Function vs. Position of Safety

- **Position of Function:** A posture that preserves biomechanical readiness for activity. Often used in chronic conditions, post-recovery bracing, or custom orthoses. Emphasizes long-term usability and task efficiency.

- **Position of Safety** (a.k.a. Intrinsic Plus Position): Primarily used in acute trauma or postoperative care. Protects joint and ligamentous structures from contracture or collapse. Particularly essential in hand splinting to preserve MCP collateral ligament length.

IV. Deforming Forces and Positioning Countermeasures

Fractures and soft tissue injuries are often subject to muscle-induced deforming forces. Functional positioning should oppose these forces:

- **Distal radius fractures:** Muscles pull into radial deviation and dorsal angulation → Position in slight flexion and ulnar deviation.
- **Proximal humerus fractures:** Deltoid and pectoralis major pull into internal rotation → Sling with slight external rotation pad.
- Gastrocnemius pulls foot into dorsiflexion → Splint in plantarflexion

V. Special Populations and Modifications

- **Pediatrics:** Consider growth plates and compliance. Avoid forceful positioning; use comfort-based modifications with visual reinforcement.
- **Geriatrics:** Account for osteopenia, skin fragility, and contracture risk. Add padding and adjust angles to reduce pressure.
- N**eurologically impaired patients:** Prevent spastic patterns by avoiding positions that trigger hypertonicity (e.g., excessive flexion in hemiplegic limbs).

VI. Common Pitfalls in Functional Positioning

- Immobilizing MCPs in extension → Leads to claw hand deformity
- Ankle splinted in plantarflexion >2 weeks → Risk of equinus contracture
- Elbow hyperextension → Triceps tightening, cubital tunnel compression
- Thumb immobilized in adduction → Loss of opposition function

Conclusion

Functional positioning is not a procedural afterthought—it is a core therapeutic decision that shapes the outcome of immobilization. By understanding anatomical relationships, joint mechanics, and the physiological needs of healing tissue, orthopedic technologists can apply splints that truly protect and preserve limb function. The deliberate use of biomechanically informed positioning improves healing, reduces complications, and sets the stage for effective rehabilitation.

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Section B: Regional Anatomy and Surface Landmarks for Splinting

Palpation Precision and Anatomical Accuracy in Immobilization

Accurate identification of anatomical landmarks is fundamental to the safe, effective, and biomechanically appropriate application of orthopedic splints. This section expands on the essential regional surface anatomy relevant to splinting, providing clinical context, palpation strategies, and essential anatomical variations that may influence splint placement. Special attention is given to avoiding nerve compression, vascular compromise, and malalignment during splint construction and application.

I. Shoulder and Upper Arm

- **Acromion Process:** Posterior-lateral scapular extension; critical for positioning shoulder immobilizers.
- **Clavicle:** Easily palpable from sternoclavicular joint to acromioclavicular joint; common site for fractures.
- **Coracoid Process:** Anterior shoulder prominence; pain on palpation suggests anterior dislocation or labral injury.
- **Greater Tuberosity of Humerus:** Lateral prominence of proximal humerus; tenderness here indicates rotator cuff pathology.
- **Deltoid Insertion (Deltoid Tuberosity):** Midshaft humerus; avoid excessive compression from splinting

II. Wrist and Hand

- **Radial and Ulnar Styloid Processes:** Anchor sites for wrist alignment and support.
- **Anatomical Snuffbox** (Scaphoid): Tender in scaphoid fracture; always assess in wrist trauma.
- **Pisiform and Hook of Hamate:** Palpable volarly; landmarks for ulnar border and carpal tunnel margins.
- **Metacarpophalangeal (MCP) Joints:** Ensure MCPs are flexed in intrinsic-plus position to preserve ligament length.
- **Thenar and Hypothenar Eminences:** Must be supported to maintain grip biomechanics.
- **Flexor Tendon Zones:** Volar hand and fingers; injury-specific splint modifications needed in zones I–V.

III. Pelvis and Hip

- **Anterior Superior Iliac Spine (ASIS):** Major landmark for pelvic brace alignment.
- **Greater Trochanter:** Lateral thigh bulge; pad to prevent pressure injury in lateral decubitus positioning.
- **Pubic Symphysis:** Palpable in trauma; important in assessing pelvic instability.
- **Ischial Tuberosity:** Must be relieved in seated splints or prolonged sling use to avoid ulceration.

IV. Knee and Thigh

- **Patella:** Central anterior knee; ensure no direct splint pressure to avoid chondromalacia.
- **Medial and Lateral Femoral Epicondyles:** Distal thigh prominences; used to guide hinged brace placement.
- **Tibial Tuberosity**: Inferior to patella; insertion site of patellar tendon.
- **Pes Anserine Bursa** (Medial Tibia): Tender in overuse injuries; avoid excessive medial strap tension.

VII. Foot and Toes

- **Base of the Fifth Metatarsal:** Common avulsion site; include in splint for inversion sprains.
- **Navicular Tuberosity:** Medial prominence; supports arch when splinting.
- **Calcaneus:** Heel bone; offload in posterior splints to avoid pressure ulcers.
- **Metatarsophalangeal (MTP) Joints**: Maintain dorsiflexion for walking boot compatibility.
- **Plantar Fascia Insertion:** Calcaneal base; splinting to relieve plantar fasciitis tension.

Conclusion

Mastery of regional surface anatomy and palpation landmarks is essential for any orthopedic technologist tasked with designing and applying immobilization devices. These landmarks not only guide precise splint contouring and alignment, but also safeguard critical neurovascular structures and maintain biomechanical function. Failure to recognize key anatomical reference points may result in improper stabilization, pressure injuries, or compromised healing. Through deliberate and practiced palpation, clinicians can ensure that each splint fulfills its therapeutic goal—whether to stabilize a fracture, protect soft tissues, or preserve joint motion. A strong anatomical foundation is thus not optional but integral to the art and science of orthopedic splinting.

Section C: Neurovascular Considerations in Splinting

Safeguarding Peripheral Integrity through Anatomical Knowlege and Clinical Precision

Neurovascular compromise is one of the most serious risks associated with improper splint application. The orthopedic technologist must possess a refined understanding of **peripheral nerve anatomy, vascular flow pathways, and the dynamic interactions** between limb position, pressure, and swelling. Splints that are too tight, poorly padded, or anatomically misaligned may induce **nerve entrapment syndromes, vascular occlusion**, or precipitate **acute compartment syndrome**—a surgical emergency with permanent consequences. Protecting the limb's functional viability requires more than technical skill—it demands **proactive design, accurate anatomical palpation, and frequent neurovascular monitoring** throughout the immobilization period.

I. Core Neurovascular Concepts in Splinting

1. Nerve Compression vs. Tension Injuries

- **Compression neuropathy** arises when external force is applied over a superficial nerve course (e.g., ulnar nerve at elbow).
- **Tension-related neuropathy** occurs when a splint immobilizes a joint in extreme flexion or extension, placing stretch on peripheral nerves (e.g., wrist hyperflexion and median nerve tension).

2. Vascular Flow Interruption

- Arterial compression reduces **oxygenated blood supply**, risking ischemia and tissue necrosis.
- Venous compression leads to **congestion and swellin**g, which can increase compartment pressures and initiate a vicious cycle.

3. Compartment Syndrome and Pressure Dynamics

- Compartment syndrome develops when **intramuscular pressures** exceed capillary perfusion pressure. It can develop under a circumferential or overly rigid splint, particularly in settings of trauma, soft tissue injury, or anticoagulant use.

  Warning Signs Include: Increasing pain despite immobilization, tight compartments on palpation, pain with passive stretch, and paresthesia—often before pulselessness is noted.

II. Peripheral Nerve and Artery Mapping by Region

A. Upper Extremity

Location	Nerves at Risk	Vascular Structures	Splinting Implications
Elbow	Ulnar (posteromedial), Radial (posterolateral), Median (anterior)	Brachial artery	Pad medial and lateral epicondyles; avoid cubital tunnel compression
Forearm	Median, Ulnar	Ulnar, Radial arteries	Use forearm troughs with soft inner surface; avoid tight circumferential wraps
Wrist	Median (carpal tunnel), Ulnar (Guyon's canal)	Radial and ulnar arteries	Neutral to slight extension positioning; avoid excessive volar flexion
Hand	Digital nerves	Palmar/digital arteries	Splint in functional or safe hand position; leave fingertips exposed for circulation checks

II. Peripheral Nerve and Artery Mapping by Region cont

A. Lower Extremity

Location	Nerves at Risk	Vascular Structures	Splinting Implications
Knee	Peroneal (fibular head), Tibial (popliteal fossa)	Popliteal artery	Avoid posterior pressure behind the knee; pad fibular neck
Ankle	Tibial (posterior to medial malleolus), Superficial peroneal (lateral foot)	Posterior tibial, Dorsalis pedis	Ankle splints must not compress malleoli; elevate post-application
Foot	Medial/Lateral plantar nerves	Plantar arch	Offload calcaneus and metatarsal heads; pad arch supports

III. High-Risk Clinical Situations

1. Crush Injuries and Soft Tissue Swelling

- High likelihood of **delayed compartment syndrome**
- Use **bivalved splints** or **non-circumferential posterior splints**
- Monitor neurovascular status every **1–2 hours** for 24 hours post-injury

2. Anticoagulated or Bleeding-Prone Patients

- At risk of **hematoma formation** within compartments
- Splints should be applied loosely and monitored more frequently

3. Post-operative Immobilization

- Incisions may track near nerves or arteries
- Always coordinate with surgeon for **splint tension and placement zones**

4. Pediatric Patients

- Nerves and vessels are more superficial
- Swelling changes rapidly—**recheck frequently**
- Avoid overcorrection in growing bones that may impinge on physis or lead to entrapment

5. Geriatric Patients

- Thinned skin, reduced perfusion capacity
- Higher risk of **pressure ulcers and ischemic injury**
- Consider using **pneumatic padding systems** or memory foam where possible

IV. Protocol for Neurovascular Assessment

Before and After Splint Application

1. **Sensation Testing**

- Light touch (cotton or monofilament)
- Pinprick (safety pin or sterile needle)
- Median, radial, ulnar dermatomes of the hand; peroneal and tibial distributions in the foot

2. **Motor Function Assessment**

- Thumb opposition (median), finger abduction (ulnar), wrist/finger extension (radial)
- Ankle dorsiflexion (peroneal), toe flexion (tibial)

3. **Circulation Evaluation**

- Capillary refill (<2 seconds)
- Palpation of distal pulses
- Observation of color and skin temperature

Document all findings in the medical record before and after immobilization.
Use neurovascular assessment forms or standardized checklists.

V. Red Flags and Emergency Response

If the following symptoms develop post-splinting, **remove or loosen the splint immediately** and escalate care:

- Numbness or tingling that progresses
- Inability to move the digits or toes
- Dusky, cold, or mottled skin
- Severe, unrelenting pain
- Absent distal pulses or cap refill >3 seconds

Emergency Protocol: Notify attending provider or surgeon. Prepare for potential compartment pressure measurement or surgical decompression (fasciotomy).

VI. Design Techniques for Neurovascular Preservation

- Use **three-point pressure systems** over deformities to avoid circumferential compression
- Never allow rigid splint edges to rest over **bony prominences or nerve courses**
- Leave **fingertips and toes exposed** for rapid reassessment
- Instruct patients/caregivers on warning signs and **provide written return precautions**

Conclusion

- The process of orthopedic splinting must transcend mechanical immobilization and embody a thorough understanding of the limb's intricate neurovascular architecture. Peripheral nerves and vascular structures are not just passive tissues adjacent to the splint—they are **dynamic, vulnerable conduits** responsible for sensation, movement, and tissue viability. When compromised, the consequences can be devastating: **irreversible nerve injury, limb ischemia, compartment syndrome, and functional disability**. Therefore, a failure to incorporate neurovascular considerations into every phase of splinting—assessment, application, and follow-up—is not merely a technical oversight but a breach of clinical responsibility.

- A successful splint must reflect the clinician's comprehensive awareness of anatomy, biomechanical forces, and physiological responses to injury and healing. This requires consistent **pre- and post-splint neurovascular evaluations**, strategic pressure redistribution, and adaptive design tailored to the individual's age, body habitus, injury mechanism, and comorbid conditions.

- Clinicians must also maintain a high index of suspicion and act promptly when **red flag symptoms** arise—pain out of proportion to injury, pulselessness, pallor, paresthesia, and paralysis. Splinting, when executed with anatomical precision and vigilant follow-through, becomes a therapeutic extension of the clinician's duty to protect, preserve, and promote healing.

- In the hands of a skilled orthopedic technologist or clinician, the splint is not just a device—it is a **protective interface** between injury and recovery, and a critical safeguard against the silent threat of neurovascular compromise.

Chapter 5: Infection Control and Patient Safety

Section A: Sterile vs. Clean Technique

Maintaining Procedural Integrity in Splinting Environment

I. Introduction

Infection control is a critical pillar of patient safety in orthopedic care, particularly during splinting procedures, where broken skin, open wounds, or surgical incisions may coexist with immobilization needs. The selection and implementation of either **sterile technique** or **clean technique** must be guided by the **clinical context**, **patient risk factors**, and **institutional protocol**. Misapplication of these techniques can lead to serious complications such as **local wound infection**, **cellulitis**, **osteomyelitis**, or **nosocomial transmission** of drug-resistant organisms.

Understanding the differences between sterile and clean technique is essential for orthopedic technologists working in **emergency departments**, **surgical clinics**, **orthopedic offices**, and **rehabilitation units**.

II. Definitions and Key Differences

Characteristic	Sterile Technique	Clean Technique
Goal	Eliminate all microorganisms (pathogenic and non)	Reduce number and spread of microorganisms
Use Case	Invasive procedures, open wounds, surgical interventions	Non-invasive procedures, intact skin
Environment	Controlled (e.g., OR, sterile field)	Outpatient, bedside, or field settings
Examples in Orthopedics	Dressing surgical wounds, applying splints to open fractures	Applying a volar wrist splint to an unbroken forearm
Required Supplies	Sterile gloves, gowns, drapes, instruments, antiseptics	Non-sterile gloves, clean table, hand hygiene

III. Indications for Each Technique in Splinting

A. Sterile Technique Required When:

- Applying a splint over an **open wound**, **fresh surgical site**, or **external fixation**.
- Managing **post-operative immobilization** after fracture reduction or joint replacement.
- Dressing changes involving **sutures**, **drains**, or **skin grafts**.
- Preparing for **emergency surgical transfer** in open fracture management.

Example: A long leg posterior splint placed over a surgically debrided tibial wound must use sterile gloves, sterile padding, and sterile draping of the limb.

B. Clean Technique Appropriate When:

- Immobilizing **closed fractures**, **sprains**, or **soft tissue injuries** with intact skin.
- Applying splints during **initial outpatient care** or field evaluation.
- Teaching patients how to **re-wrap or re-apply splint padding** at home.

Example: A thumb spica splint applied for De Quervain's tenosynovitis in a walk-in clinic is safely performed using clean technique.

Refer to Appendix C for Comparison Chart

IV. Key Steps of Each Technique

Sterile Technique:

01 Perform surgical hand scrub or antiseptic hand rub.

02 Don sterile gloves, mask, and gown (if necessary).

03 Open sterile field using sterile drape.

04 Clean wound or incision site using sterile saline or antiseptic.

05 Apply dressing and splint without contaminating the field.

06 Dispose of all biohazard materials in accordance with policy.

Clean Technique:

01 Perform hand hygiene (soap and water or alcohol-based rub).

02 Wear clean, non-sterile gloves.

03 Disinfect work surface and instruments.

04 Use clean supplies that have not been sterilized (e.g., pre-packaged splint rolls).

05 Apply splint avoiding contact with wounds or sterile dressings.

V. Rationale and Clinical Importance

Preventing Infection in High-Risk Patients

- Immunocompromised individuals (e.g., transplant patients, diabetics)
- Elderly patients with thin, fragile skin
- Children with skin breakdown from repetitive taping or straps

Avoiding Cross-Contamination

- Orthopedic clinics must maintain strict protocol to prevent the spread of **MRSA**, **VRE**, or **Clostridioides difficile**, especially between shared casting rooms.

Protecting Healthcare Workers

- Proper PPE (personal protective equipment) use during sterile procedures reduces exposure to **bloodborne pathogens** and **aerosolized particles**.

VI. Common Errors to Avoid

Characteristic	Sterile Technique	Clean Technique
Using clean gloves on a wound with exposed bone	Osteomyelitis risk	Default to sterile if tissue integrity is compromised
Use Touching sterile supplies with non-sterile hands	Field contamination	Re-prepare the sterile field immediately
Using same gloves between patients	Cross-contamination	Change gloves and sanitize hands every encounter
Reusing wrapping or padding from open packages	Introduction of pathogens	Use only single-use or freshly opened materials

VII. Institutional Guidelines and OSHA Considerations

Facilities should adhere to:

- **CDC Standard Precautions**
- **OSHA Bloodborne Pathogen Standard**
- **WHO Hand Hygiene Guidelines**
- **Facility Infection Control Committees** for approved protocols

Providers should be educated in **PPE donning/doffing**, **sharps safety**, and **disposal of contaminated materials**.

VIII. Conclusion

The ability to distinguish between sterile and clean technique is fundamental to orthopedic splinting practice. Each technique carries a specific set of requirements, indications, and safety expectations. While clean technique is sufficient for the majority of routine splint applications, sterile technique must be implemented when the risk of infection is elevated or when dealing with compromised tissue barriers.

The orthopedic technologist is not simply a technician but a **protector of patient safety** and a **gatekeeper of infection control standards**. Judicious application of these techniques ensures not only optimal healing outcomes but also institutional compliance and patient trust in orthopedic care environments.

Section B: Personal Protective Equipment (PPE) in Splinting Procedures

Ensuring Provider and Patient Safety in the Orthopedic Setting

I. Introduction

Personal protective equipment (PPE) forms a critical barrier between healthcare workers and potentially infectious materials, chemicals, or biohazards encountered during orthopedic splinting. From **exposure to blood or bodily fluids** to **airborne particles created during cast sawing**, PPE serves to prevent the transmission of infectious agents and ensure regulatory compliance with **OSHA**, **CDC**, and **institutional infection control policies**.

Orthopedic technologists must not only select PPE appropriately but also don, doff, and dispose of it properly. Improper PPE usage can result in contamination, personal harm, or nosocomial transmission—particularly dangerous in settings involving high-risk patients or open injuries.

II. Core PPE Components Used in Splinting

PPE Item	Purpose	Examples in Splinting
Gloves	Barrier protection for hands against bodily fluids and chemicals	Applying padding, molding splints, dressing wounds
Gown or Apron	Protect clothing and skin from contamination	Re-prepare the sterile field immediately
Eye Protection (goggles/face shield)	Prevent splashes from entering mucous membranes	During cast removal, cast sawing, or irrigating wounds
Mask/Respirator	Barrier for droplet or aerosol exposure	Required during high-dust activities (e.g., sanding thermoplastics, sawing fiberglass)
Hair Cover/Head Cap	Prevent contamination in sterile procedures	Sterile splint applications in the OR or surgical recovery rooms

III. Levels of PPE Use Based on Splinting Environment

A. Routine Splinting (Clean, Closed Injuries)

- Non-sterile gloves
- Eye protection (optional unless risk of splash)
- Disposable gown (optional, based on splinting material used)

B. High-Risk or Contaminated Cases

- Sterile or non-sterile gloves (depending on wound status)
- Fluid-resistant gown or disposable apron
- Eye protection and surgical mask
- Proper hand hygiene before and after

C. Splinting in the Operating Room or Over Surgical Sites

- Sterile gloves and sterile gown
- Mask, eye protection, and hair cover
- Strict adherence to sterile field protocol

D. Aerosol-Generating or Dust-Generating Activities

- Eye protection with side shields or face shield
- Fit-tested **N95 respirator** or **PAPR** (Powered Air-Purifying Respirator)
- Long-sleeved protective gowns or aprons
- Vacuum-assisted dust collection system for fiberglass/cast removal

Note: Dust from sawing fiberglass casts is **not only respiratory irritant**, but may contain particles linked to **dermatitis** and **asthma exacerbation**. Always use vacuum-assisted systems and proper masks.

IV. Donning and Doffing PPE

Proper donning and doffing are as critical as PPE use itself. Contamination often occurs during **removal**, particularly when gloves or gowns are handled incorrectly.

Donning Sequence (Clean Setting)

01 **Perform hand hygiene**

02 **Don gown (if used)**

03 **Put on mask or respirator**

04 **Apply eye protection**

05 **Put on gloves last**

Doffing Sequence

01 Remove gloves (turn inside out)

02 Remove gown by unfastening ties and rolling inward

03 Remove eye protection (avoid touching front)

04 Remove mask/respirator (handle straps only)

05 Perform hand hygiene immediately

V. Regulatory and Institutional Guidelines

Healthcare workers involved in splinting must comply with the following:

- **OSHA Bloodborne Pathogen Standard (29 CFR 1910.1030)**
- **CDC Core Infection Prevention and Control Practices**
- **NIOSH Respiratory Protection Standards**
- **Institutional protocols** for PPE conservation and appropriate disposal

Facilities should offer **annual PPE training**, **fit-testing for respirators**, and **easy access to replacement supplies** in splinting areas.

VI. PPE and Environmental Safety Considerations

- Dispose of PPE in designated biohazard bins.
- Do not reuse single-use gloves or gowns.
- Launder reusable gowns or aprons according to facility guidelines.
- Replace masks or eye shields that become wet or visibly soiled.
- Avoid using splinting materials that produce excessive dust without proper environmental controls.

VII. Pediatric and Geriatric Considerations

Pediatric Patients

- May become anxious when clinicians are wearing full PPE.
- Use verbal reassurance and demonstrate PPE use in child-friendly terms.

Geriatric Patients

- Ensure proper communication while masked; use clear face shields when possible.
- Watch for balance issues when donning PPE during bedside applications.

VIII. Conclusion

The consistent and correct use of PPE in orthopedic splinting is essential to safeguarding both the patient and the provider. Whether managing a closed ankle sprain or applying a splint over a surgically debrided limb, appropriate PPE choices reflect professional standards of care and institutional integrity. Beyond personal protection, PPE serves as a visible commitment to infection control, environmental safety, and the ethical imperative to do no harm.

The orthopedic technologist must view PPE not as a regulatory burden, but as a core competency—one that supports confident, competent, and contamination-free patient care.

Refer to Appendix D for additional details

Section C: Environmental Controls in Splinting Rooms

Optimizing Safety, Sanitation, and Compliance in Orthopedic Immobilization Spaces

I. Introduction

Environmental control is a critical, yet often overlooked, component of infection prevention in orthopedic settings. The splinting room—whether in a hospital, urgent care, or outpatient clinic—serves as a **procedural space** that must meet hygiene, airflow, material containment, and equipment decontamination standards. A poorly maintained environment not only increases the risk of **cross-contamination** but also threatens **staff safety**, contributes to **nosocomial infections**, and may violate local and federal regulatory standards.

Proper **ventilation**, **cleaning protocols**, **storage practices**, and **material handling** must be part of daily routines, institutional policies, and orientation for orthopedic technologists.

II. Design and Layout of Splinting Rooms

A well-designed splint room minimizes infection risks and supports workflow efficiency. Recommendations include:

- **Non-porous, cleanable flooring and wall surfaces** (e.g., vinyl, tile, or painted drywall with antimicrobial coating)
- **Sinks with hands-free controls** for handwashing
- **Separate “clean” and “dirty” zones**, including designated biohazard disposal areas
- **Well-ventilated workstations** with airflow away from sterile supply areas
- **Adequate lighting** for precise procedures and safe PPE use

Note: The CDC recommends a minimum of **6 air changes per hour (ACH)** for outpatient procedural areas (CDC, 2020).

III. Surface and Equipment Sanitation Protocols

Proper sanitation protocols reduce the environmental burden of pathogens such as **MRSA**, **C. difficile**, **Pseudomonas aeruginosa**, and **fungal spores**.

Item/Surface	Cleaning Frequency	Recommended Disinfectants
Treatment Tables	After each patient	EPA-registered hospital-grade disinfectants
Splinting carts	Daily and after spills	Quaternary ammonium, bleach-based wipes
Cast saws/tools	After each use	Alcohol-based wipes or sterilization
Flooring	Daily	Mopped with disinfectant detergent solution
Door handles/light switches	Twice daily minimum	Disinfectant wipes

Caution: Do not use alcohol-only cleaners on visible soiling or biohazard material.

IV. Airborne and Particulate Control

A. Fiberglass and Plaster Dust

Dust generated during splint trimming, cast sawing, or thermoplastic shaping poses respiratory and dermal hazards. Control strategies include:

- **High-efficiency particulate air (HEPA) vacuum systems** attached to cast saws
- Use of **negative pressure workstations** for trimming
- Wearing **N95 masks or PAPR systems** during high-dust procedures
- Regular filter changes and maintenance logs for vacuum devices

B. Fume and Odor Control

Some thermoplastic and adhesive products release **volatile organic compounds (VOCs)**. Ventilation must meet OSHA standards:

- Minimum **10 ACH for odor-generating procedures**
- Avoid procedures in non-ventilated rooms without HVAC return/exhaust flow

V. Storage of Splinting Supplies

Improper supply storage leads to contamination, waste, and regulatory violations.

- Store splinting rolls (plaster/fiberglass) in **sealed, moisture-controlled bins**
- Use **first-in, first-out (FIFO)** inventory rotation
- Separate **sterile** from **non-sterile** supplies
- Label all materials with **expiration dates**
- Avoid stacking materials near **floor or sink level**

Example: Thermoplastics stored under open sinks or beside dirty cast saws risk both water and microbial contamination.

VI. Linen, Laundry, and Sharps Protocols

- **Used linens** must be placed in closed, marked laundry bins and not re-used between patients.
- **Sharps containers** must be present and mounted at arm height.
- Remove **broken scissors, needles, or blades** immediately from the splint area.

VII. Daily Environmental Safety Checklist

Each splinting station should maintain a **posted checklist** with the following:

- ◻ Handwashing supplies stocked
- ◻ PPE available and accessible
- ◻ Clean work surface prior to start of day
- ◻ Splinting materials checked for damage/expiration
- ◻ HEPA vacuum system functional
- ◻ Biohazard bin emptied and disinfected
- ◻ Floors mopped and debris removed

Regular audits and staff sign-offs should be enforced weekly or per shift.

VIII. Staff Training and Safety Culture

Creating a culture of infection control means ensuring that:

- All staff receive **annual infection control and PPE training**
- New hires are oriented to room-specific safety protocols
- Incident reporting is encouraged when breaches occur
- Managers support **non-punitive correction** and continual improvement

IX. Conclusion

Environmental control is not ancillary—it is foundational to safe orthopedic care. Splinting rooms function as high-frequency procedural areas where minor lapses in cleanliness or airflow can cause major patient harm. A vigilant, evidence-based approach to room design, sanitation, airflow, and material storage reflects not only best practice but also **institutional integrity and patient trust**. Orthopedic technologists are frontline stewards of this environment and must treat every surface, supply, and breath of air as a potential interface for infection prevention.

Refer to Appendix E for additional details

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Section D: Waste Management and Biohazard Disposal in Splinting Practice

Minimizing Risk Through Proper Handling of Clinical Waste

I. Introduction

Orthopedic splinting generates a variety of waste products, including **contaminated dressings**, **chemical-laden casting materials**, **biohazardous sharps**, and **dust-producing debris**. Improper disposal of these materials poses risks to both healthcare personnel and patients, including **cross-infection**, **occupational injury**, and **environmental contamination**. This section provides clear, evidence-based standards for managing and disposing of waste materials in orthopedic splinting environments, in compliance with **OSHA**, **EPA**, and **state health department regulations**.

II. Categories of Waste Generated in Splinting

Proper sanitation protocols reduce the environmental burden of pathogens such as **MRSA**, **C. difficile**, **Pseudomonas aeruginosa**, and **fungal spores**.

Waste Type	Examples	Disposal Requirements
Biohazardous Waste	Blood-soaked padding, wound dressings, contaminated gloves	Red biohazard bags and labeled containers
Sharps	Scalpel blades, scissors tips, used needles or suture cutters	Quaternary ammonium, bleach-based wipes
Chemical Waste	Excess plaster slurry, monomer resins, solvent-soaked gauze	Dispose per SDS/MSDS protocol; may require hazardous waste pickup
General Medical Waste	Used stockinette, plaster backing, fiberglass sheeting	Non-biohazard medical trash bins
Dust and Particulate Matter	Fiberglass or thermoplastic debris from trimming	Vacuum-assisted collection with HEPA filtration

III. Biohazard and Sharps Disposal Protocols

A. Biohazard Disposal

- Place all items **visibly saturated with blood, pus, or bodily fluids** into **leak-proof red bags** clearly labeled “Biohazard.”
- Keep bags in **covered, foot-operated containers** located in the splint room.
- Bags should be replaced **daily** or **when ¾ full**, and removed to designated facility biohazard holding areas.
- Double-bag if outside contamination is suspected.

B. Sharps Disposal

- All scalpel blades, contaminated scissors, broken applicator tips, and needles must be placed **immediately** into **FDA-approved sharps containers**.
- Sharps containers should be:
  - **Mounted at arm level**
  - **Labeled clearly**
  - **Replaced when ¾ full**
- Never overfill, recap, bend, or hand-carry sharps.

Regulatory Note: OSHA mandates immediate disposal of sharps and prohibits recapping without mechanical assistance (OSHA, 2023).

IV. Disposal of Plaster and Fiberglass Waste

A. Plaster Slurry:

- Allow unused plaster to **fully harden** before disposal.
- Never pour unset plaster down sinks—it can solidify in plumbing.
- Dispose of set plaster in regular trash unless visibly contaminated.

B. Fiberglass Dust:

- Collect dust using **HEPA-filtered vacuum** systems during trimming or cast removal.
- Clean vacuum filters per manufacturer instructions.
- Dispose of used fiberglass in sealed trash bags if uncontaminated; use biohazard disposal if blood-soaked.

V. Chemical Waste Considerations

- **Thermoplastics, solvents, and adhesives** may release volatile organic compounds (VOCs) or irritants.
- Dispose of gauze soaked in monomers or resin hardeners per **MSDS/SDS** guidelines.
- Store open chemical containers in **fume-hood ventilated** spaces.
- Train staff in **spill response protocols** for chemical splinting agents.

VI. Linen and Laundry Containment

- All used linens must be placed in **leak-proof, labeled laundry bins**.
- Do not re-use drapes or padding between patients.
- Separate clean linen from treatment surfaces.
- Launder linen per institutional guidelines with **thermal disinfection cycles**.

VII. Documentation and Incident Reporting

- Maintain **waste logs** for biohazard and sharps disposal (as per facility policy).
- Report any sharps injuries, exposure to fluids, or improper disposal using **Occupational Exposure Incident Reports**.
- Periodic audits and **staff re-education** are essential to compliance and safety.

VIII. Pediatric and Home Care Disposal Considerations

- Educate caregivers on **proper home disposal** of used dressings, particularly in fracture or wound follow-up care.
- Use **child-safe sharps containers** in pediatric orthopedic clinics.
- Supply patients with **biohazard baggies** when sending home post-surgical splints or contaminated wraps.

IX. Conclusion

Effective waste management in splinting environments is more than a housekeeping concern—it is a **core element of infection control and staff safety**. Clinicians and orthopedic technologists must remain vigilant in categorizing waste, disposing of materials using designated pathways, and reinforcing protocol adherence. In doing so, they protect not only themselves and their patients, but also support institutional compliance with OSHA, EPA, and local infection control standards.

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Chapter 6: Patient Communication and Education in Splinting

Section A: Foundations of Therapeutic Communication

Empowering Patients through Compassionate, Clear, and Culturally Competent Interaction

I. Importance of Patient-Centered Communication in Orthopedics

In orthopedic care, effective communication is not merely a soft skill—it is a clinical imperative. The splinting process, though often perceived as a mechanical intervention, is deeply personal to the patient. Patients may present with pain, functional impairment, emotional distress, or fear, all of which require sensitivity and tailored information. **Patient-centered communication** enhances understanding, reduces anxiety, and fosters collaborative decision-making. It contributes significantly to patient satisfaction, adherence to splint care instructions, and ultimately, clinical outcomes (O'Hagan et al., 2014).

In splinting scenarios—especially acute or post-operative settings—patients may be unfamiliar with immobilization devices, uncertain about recovery expectations, or apprehensive about pain and restriction. The orthopedic technologist or clinician plays a pivotal role in **explaining the purpose, process, and expectations** in terms the patient can understand and recall. When done well, communication not only informs but reassures, equipping patients to become active participants in their recovery.

II. Verbal vs. Non-Verbal Communication During Splinting

Orthopedic technologists must balance **verbal explanation** with **non-verbal cues** to effectively guide the patient through the splinting procedure. Verbal communication should be clear, concise, and free of medical jargon. Phrases like “We’re going to stabilize your wrist with a lightweight support to promote healing and reduce pain” are more effective than technical language such as “This volar splint will immobilize your distal radius in neutral dorsiflexion.”

Tone, pace, and word choice must be adapted to the patient’s emotional and cognitive state. For example, pediatric patients benefit from storytelling or distraction techniques, while elderly patients may require slower, more deliberate explanations due to hearing or processing limitations.

Non-verbal communication includes eye contact, posture, facial expression, and the physical touch involved in splint application. A clinician's body language can convey empathy or impatience, attentiveness or distraction. Maintaining gentle, deliberate hand movements while positioning or molding a splint, for example, can communicate calm competence and build trust. Even seemingly minor gestures—such as offering a blanket or adjusting the exam table—demonstrate attentiveness to the patient’s comfort and dignity.

III. Building Trust, Reducing Anxiety, and Promoting Compliance

The success of a splint relies not only on technical accuracy but on patient cooperation and follow-through. Many patients harbor anxiety about being immobilized, losing independence, or suffering complications like pressure sores or nerve compression. If trust is not established early, patients may resist positioning, interfere with their splint post-procedure, or disregard home care instructions.

To build trust:

- **Introduce yourself clearly**, explain your role, and ask permission before touching or adjusting body parts.
- Provide **step-by-step narration** during the procedure.
- Offer **reassurance**, such as “You may feel warmth during the hardening of this material, but it won’t burn your skin.”
- Validate the patient’s concerns while redirecting anxiety: “It’s normal to feel a bit unsure; I’ll walk you through everything and make sure you’re comfortable.”

Promoting compliance also involves addressing the **“why”** behind instructions. Telling a patient not to get their splint wet is more effective when paired with an explanation like, “If this padding gets wet, it can cause skin irritation and breakdown, which may delay your healing.”

IV. Cultural Sensitivity and Health Literacy Considerations

A patient's background—including language, religion, cultural norms, and literacy level—can shape their understanding, expectations, and comfort with splinting procedures. Clinicians must engage with **cultural humility**, seeking to understand the patient's worldview rather than imposing assumptions. For example:

- Some patients may be reluctant to undress or expose certain limbs due to modesty concerns.
- Others may prefer to have a family member present or may need gender-concordant providers.
- Beliefs about healing, touch, or medical authority may influence how information is received or followed.

In addition, **health literacy** must be assessed in every patient encounter. Studies show that nearly 9 out of 10 adults in the U.S. struggle to understand and use routine health information (U.S. Department of Health and Human Services, 2010). Therefore:

- Use **plain language** and avoid acronyms.
- Provide written handouts at or below a 6th-grade reading level.
- Employ **visual aids** and **demonstrations** when possible.
- Confirm understanding through **teach-back techniques** (e.g., "Can you show me how you'll elevate your arm at home?").

V. Conclusion

Foundational communication principles in orthopedic splinting are not adjunctive to care—they are integral to successful treatment. Through the mindful use of language, gestures, and listening, clinicians foster cooperation, alleviate distress, and guide patients through what is often a confusing or painful episode. Patient-centered communication, when culturally attuned and literacy-aware, not only strengthens the clinician-patient relationship but also promotes healing, safety, and satisfaction. In every splint applied lies an opportunity for compassion and connection.

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Section B: Educating the Patient About the Splinting Process

Fostering Understanding, Engagement, and Informed Consent

I. The Role of Patient Education in Procedural Success

Before applying any orthopedic splint, clinicians have an ethical and clinical obligation to ensure that the patient **understands the purpose, procedure, and implications** of the intervention. Informed education is not simply procedural consent—it is an opportunity to engage the patient in their own healing process, address misconceptions, and promote safe outcomes. Studies consistently show that patients who receive clear, tailored education are more likely to adhere to treatment plans, attend follow-up appointments, and avoid preventable complications (Kessels, 2003).

In splinting, where immobilization can affect mobility, work, hygiene, and comfort, a lack of pre-application explanation may result in patient noncompliance, anxiety, or even litigation. Proper education transforms the procedure from a passive experience into a **collaborative therapeutic event**.

II. Explaining the Procedure: Indications, Goals, and Materials

Patients should receive a concise but thorough explanation of why a splint is necessary and how it will function:

- **Indication**: “We’re applying a splint to support your fractured wrist and reduce pain while the bone heals.”
- **Goal**: “The splint will help keep your bones aligned and prevent further damage while your body repairs itself.”
- **Expected outcome**: “With the splint in place, most patients begin to notice decreased pain and swelling within a few days.”

Clinicians should also show or describe the **materials** being used—whether plaster, fiberglass, or thermoplastic—and explain what to expect during application (e.g., warmth, drying time, pressure points). For instance:

“You’ll feel this material get warm—that’s normal and part of the setting process. It won’t burn, but let me know if anything feels too hot or tight.”

In cases of complex splints (e.g., sugar tong, long arm posterior), diagrams or 3D models can help demystify the process.

III. Addressing Common Concerns and Misconceptions

Patients often harbor unspoken questions or fears about splints, including:

- **Will it hurt?**
- **Will I be able to move my fingers?**
- **Can I take it off at home?**
- **Will this interfere with bathing, driving, or work?**

Clinicians should **proactively address** these concerns:

- “The splint should never cause pain or numbness—if that happens, call us right away.”
- “Yes, you’ll still be able to move your fingers to help with circulation and prevent stiffness.”
- “This splint is not removable, so please don’t try to adjust it at home without contacting us.”

Avoiding passive or dismissive statements such as “You’ll be fine” helps maintain patient confidence and clarity.

IV. Tailoring Communication to Patient Populations

Pediatric Patients

Children require a **developmentally appropriate** explanation using simple, concrete language:

- "This is your superhero arm shield—it's going to help your bone grow back strong."
- Offer choices when possible: "Would you like the red wrap or the blue one?"

Utilizing distraction, story metaphors, or medical play (e.g., letting them touch the wrap) can reduce fear and improve cooperation.

Geriatric Patients

Older adults may have sensory impairments or cognitive decline. Speak slowly, maintain eye contact, and confirm understanding through repetition or demonstration. Include caregivers in all instructions when applicable.

Cognitively Impaired or Anxious Patients

Use **visual supports**, **simple one-step instructions**, and reassurance. Avoid overwhelming them with excessive detail. Empathy and repetition are key.

V. Incorporating Multimedia and Demonstrations

Incorporating **visual tools** into patient education can significantly enhance understanding. Consider the following:

- Diagrams of splint anatomy
- Short videos of splint care
- Handheld models to show how the splint will function
- Sample splints the patient can touch or observe prior to placement

If a patient has doubts or hesitations, a short **demonstration on a limb model** or even allowing them to see the material in its flexible state can alleviate anxiety.

VI. Ensuring Comprehension: Teach-Back Method

To confirm understanding, the **teach-back** method is recommended:

“Can you show me how you’re going to keep your splint dry when you shower?”“What signs would you watch for that might mean the splint is too tight?”

If the patient is unable to answer, clarify the information and repeat the explanation. This method not only validates understanding but also improves recall and compliance (Ha Dinh et al., 2016).

VII. Documentation of Education

Every patient education session must be documented in the medical record:

- Time, content, and method of education
- Patient’s response and understanding
- Materials provided (e.g., handout, demonstration)
- Use of interpreter or caregiver presence

Example note:

“Patient educated on short arm splint purpose, materials, and care instructions. Demonstrated understanding via teach-back. Provided illustrated handout. Wife present and verbalized comprehension.”

Documentation protects the provider and reinforces clinical accountability.

VIII. Conclusion

Educating the patient about the splinting process transforms a passive procedure into an active partnership. Through effective explanation, demonstration, and validation of understanding, clinicians empower patients to care for their injury and avoid complications. Whether through words, visuals, or hands-on instruction, education is a clinical intervention in itself—one that supports healing and fosters trust.

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Section C: Home Care Instructions for Splinted Patients

Promoting Healing, Safety, and Patient Independence Post-Procedure

I. The Importance of Discharge Education

Once a splint is applied, the responsibility of maintaining its integrity and monitoring potential complications shifts largely to the patient or caregiver. Without proper discharge education, even a well-applied splint can lead to preventable complications, including pressure ulcers, skin maceration, joint stiffness, or neurovascular compromise. Therefore, **comprehensive, clear, and accessible home care instructions** are a critical extension of procedural care.

Clinicians must deliver both **verbal and written instructions**, tailored to the patient's literacy level and functional abilities, to promote safe splint management and avoid unnecessary emergency visits or poor outcomes (Titler, 2008).

II. Keeping the Splint Clean and Dry

Moisture can compromise padding materials, weaken structural elements (especially plaster), and promote **bacterial growth**, increasing the risk for skin breakdown and infection.

Key Instructions:

- "Keep your splint completely dry at all times."
- "Cover it with a plastic bag or cast cover when showering—do not submerge."
- "Do not use a hair dryer or heater to dry a wet splint."

Instruct patients to report **any dampness, odor, or itching**, which could indicate trapped moisture or bacterial overgrowth. Recommend replacement of the splint if it becomes saturated.

III. Elevation, Icing, and Edema Management

Swelling is common post-injury or post-splinting, and must be managed effectively to prevent increased compartment pressure or discomfort.

Instructional Tips:

- “Elevate your limb above the level of your heart as much as possible during the first 48–72 hours.”
- “Apply ice packs to the sides of the splint—never directly on top, and be sure the splint stays dry.”
- “Gently wiggle your fingers or toes every hour while awake to promote circulation.”

Also educate on **signs of excessive swelling**, such as increasing pain, numbness, or tightness, which require immediate medical attention.

IV. Activity and Mobility Considerations

Patients must be made aware of their **functional limitations** to avoid falls, re-injury, or improper use of the splinted limb.

Instructions May Include:

- "Do not bear weight through a splinted leg unless instructed otherwise."
- "Do not drive if your splint affects your leg, wrist, or dominant hand."
- "Avoid lifting anything heavier than a few pounds with the affected arm."
- "Do not attempt to adjust or remove the splint at home."

Advise patients to adapt their environment temporarily:

- Install bath rails or non-slip mats
- Use assistive devices (slings, crutches, walkers) properly
- Consider temporary work or school modifications

V. Safe Sleeping and Dressing Practices

Daily activities such as dressing or sleeping can pose risks if the splint is not considered.

Sleeping Guidelines:

- "Keep the splinted limb elevated on pillows at night."
- "Avoid sleeping on the splinted side."
- "Use a body pillow to prevent rolling onto your splint."

Clothing Tips:

- Choose loose-fitting clothes with wide sleeves or pant legs
- Use slip-on shoes or sandals if foot is splinted
- Consider adaptive dressing tools for limited arm mobility

VI. Environmental Safety and Fall Prevention

Patients recovering with lower extremity splints or balance disturbances require reminders about home safety:

- Clear pathways and remove rugs or tripping hazards
- Avoid stairs unless necessary and supported
- Use night lights to reduce fall risk during nocturnal toileting
- Enlist help for errands, transfers, or high surfaces

Instruct caregivers, especially for pediatric or elderly patients, to observe for **hazardous behaviors** like tampering with the splint or attempting unsupervised ambulation

VII. Common Red Flags and When to Call

Patients must understand that **early identification of complications** is essential to avoid serious outcomes such as compartment syndrome, infection, or deep vein thrombosis (DVT).

Instruct patients to call immediately if they notice:

- Numbness, tingling, or burning
- Blue, pale, or cold fingers or toes
- Inability to move fingers or toes
- Excessive or increasing pain not relieved by rest or elevation
- Foul odor or discharge from the splint
- Splint feels too tight or too loose
- Fever or chills

Include **emergency contact numbers and a follow-up appointment reminder** on written instructions.

VIII. Use of Written Handouts and Visual Aids

Every patient should receive a **take-home sheet** that includes:

- Clear bulleted instructions
- Photos or diagrams (e.g., elevation angle, cover method)
- A checklist of “Do’s and Don’ts”
- Contact info for the orthopedic or urgent care clinic

These can be laminated, translated, or provided digitally based on patient preference. Written instructions reduce reliance on memory during a potentially stressful discharge (Kessels, 2003).

IX. Conclusion

Patient recovery from orthopedic injuries depends not only on the application of splints but also on the **behavior, understanding, and environment** of the patient after leaving the healthcare setting. High-quality, patient-centered home care instructions are a fundamental component of splinting practice. Clinicians must educate with clarity, compassion, and cultural awareness to empower patients toward safe recovery.

Refer to Appendix F: Splint Home Care Instructions: Patient Checklist

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Section D: Communication with Family or Caregivers

Integrating Support Systems for Safer and More Effective Splinting Outcomes

I. The Importance of Family and Caregiver Involvement

For many patients—particularly **children, older adults, individuals with cognitive or physical impairments, or those with language barriers**—splint care is not managed alone. Family members and caregivers often play a central role in ensuring proper limb positioning, monitoring for complications, maintaining hygiene, and facilitating follow-up care.

Effective caregiver communication is not optional in these cases; it is a **clinical requirement** for safe, home-based recovery (Bullock et al., 2019). Splint failure or complications often occur when caregivers are excluded from discharge education or provided information that is too technical, brief, or inaccessible

II. When to Include Caregivers in Communication

The healthcare provider must determine when the presence or involvement of a caregiver is essential:

- **Pediatric patients** (especially under age 12)
- **Elderly patients** living alone or with mobility/cognitive impairments
- **Post-operative patients** under sedation or pain management
- **Non-English-speaking patients** or those with low health literacy
- **Any patient who expresses concern** about managing care alone

HIPAA regulations allow for caregiver involvement in care conversations when consent is granted by the patient or when the caregiver is legally authorized to act on the patient's behalf.

✅ *Clinician Tip: Always ask, "Is there someone you'd like us to include in your discharge instructions?"*

III. Core Topics to Address with Caregivers

Caregiver conversations should include all patient-facing education **plus supplemental guidance** on assisting and monitoring:

A. Assisting with Daily Splint Care

- How to check circulation: "Can you touch their fingers daily to make sure they're warm and pink?"
- How to help with bathing: "Please use a waterproof cover every time they shower."
- When to elevate the limb and how to support positioning with pillows

B. Observation for Red Flags

- Teaching caregivers to assess for swelling, discoloration, or change in behavior (e.g., child avoiding use of limb)
- Providing written and visual aids to assist with daily checks

C. Reinforcing Activity Restrictions

- Ensuring understanding of lifting/weight-bearing limitations
- Supervising children who may run, jump, or tamper with their splint
- Reminders not to adjust or remove the splint at home

D. Managing Psychosocial Impact

- Helping children adapt emotionally: "Let them decorate the splint if it's safe."
- Supporting elderly patients who fear losing independence
- Encouraging caregivers to report signs of depression or agitation due to immobilization

IV. Best Practices for Clear Caregiver Communication

Effective caregiver communication requires:

- **Plain language**: Avoid medical jargon. Say “arm support” instead of “volar orthosis.”
- **Written handouts**: Provide care instructions in easy-to-follow formats
- **Teach-back method**: “Can you show me how you would check their fingers for swelling?”
- **Demonstration**: Physically show positioning, elevation techniques, or splint checking
- **Language services**: Use professional interpreters if needed—never rely on children to translate clinical information

🎯 *Goal: Caregivers leave with confidence, not confusion.*

V. Tools and Aids to Support Caregiver Understanding

Include caregiver-specific handouts such as:

- Splint care checklist
- Red flag symptom charts
- Daily care logs for multi-shift households
- Tips for children or dementia patients

Consider digital resources:

- QR codes linking to video demonstrations
- Email follow-up with PDF instructions
- Short SMS follow-ups reminding caregivers of care steps

VI. Conclusion

Caregiver involvement in splinting extends the reach of the clinician and enhances patient safety. By educating and empowering family members or designated caregivers, healthcare providers help ensure continuity of care, reduce preventable complications, and improve emotional support for the patient. Communication must be deliberate, inclusive, and compassionate—adapting to the unique needs of both patient and caregiver. A well-informed caregiver is not just a helper; they are an essential partner in the therapeutic alliance.

Refer to Appendix G: Red Flag Symptom Checklist for Patients with Splints

Section E: Documentation of Patient Education

Ensuring Accountability, Legal Protection, and Continuity of Care

I. The Purpose of Documentation in Patient Education

Accurate and thorough documentation of patient education is an essential component of clinical care in orthopedic splinting. It:

- Confirms that informed consent was obtained.
- Demonstrates that safety, risks, and aftercare were explained.
- Serves as a **legal safeguard** for the provider and institution.
- Facilitates **continuity of care** among multidisciplinary teams.
- Enables quality improvement and auditing for patient satisfaction and outcomes.

Failure to document patient education may compromise patient safety and expose clinicians to legal risk, particularly in cases involving complications or noncompliance (Ha & Longnecker, 2010).

II. Core Elements of Education Documentation

Documentation should be **factual, specific, and standardized**. The following components should be included in every splinting case:

A. Content of Education Provided

- Diagnosis and reason for splint
- Overview of the splinting procedure (type, material, placement)
- Home care instructions (elevation, hygiene, activity restrictions)
- Red flag symptom review
- Emergency contact and follow-up plan

B. Method of Education

- Verbal instruction
- Written handout or checklist (specify title/version)
- Video, poster, or diagram shown
- Demonstration (on patient or model limb)
- Use of teach-back or repeat demonstration

C. Patient Response

- Verbalized understanding
- Demonstrated proper care or awareness of symptoms
- Stated concerns or questions
- Need for re-education or clarification

D. Additional Considerations

- Language used (e.g., English, Spanish)
- Interpreter services utilized (name and credential if possible)
- Caregiver present during education (name and relationship)
- Education adapted for literacy, age, or disability (e.g., simplified, pictorial)

III. Sample Documentation Templates

Example 1 (Adult outpatient):

“Patient educated on splinting rationale, application steps, and aftercare. Provided verbal and written instructions for keeping splint dry, elevating limb, activity restrictions, and signs of neurovascular compromise. Patient successfully performed teach-back on red flag symptoms. Written splint care sheet (v3) given. No questions. Follow-up visit scheduled.”

Example 2 (Pediatric inpatient):

“Mother present during splint application. Pediatric patient (age 7) and caregiver educated using simplified language and visual chart. Discussed hygiene, limb elevation, activity limits. Provided child-friendly splint care guide and waterproof shower cover. Caregiver verbalized understanding and agreed to monitor for swelling, discoloration, and discomfort. Education documented in EHR.”

IV. Best Practices for Legal and Clinical Safety

- **Use objective language**: Avoid vague terms like "seemed to understand." Instead use "verbalized understanding" or "demonstrated ability to..."
- **Time and date all entries**.
- **Avoid abbreviations** unless approved in the facility's documentation policy.
- **Be consistent** in terminology used across forms, instructions, and chart notes.

If using an **electronic health record (EHR)**, be sure to:

- Select the correct procedural education template.
- Customize dropdowns to reflect specific patient needs.
- Upload copies of handouts or record version numbers.

V. Regulatory and Institutional Standards

Documentation practices should conform to guidelines from:

- **The Joint Commission** (TJC): Requires patient education to be documented as part of clinical care.
- **Centers for Medicare & Medicaid Services (CMS)**: Mandates patient rights to information and participation.
- **Institutional Policy**: Adhere to specific formats or required language outlined by the orthopedic or rehab service line.

VI. Conclusion

Documenting patient education in orthopedic splinting is more than an administrative task—it is a clinical, ethical, and legal imperative. Accurate records reinforce patient safety, support team communication, and uphold the standards of care. Every splinting episode must include a corresponding, well-documented education note that reflects not just what was taught—but how it was understood.

Refer to Appendix F: Splint Home Care Instructions: Patient Checklist

References

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Joint Commission. (2023). *Comprehensive Accreditation Manual for Hospitals: The Official Handbook*. Oakbrook Terrace, IL: The Joint Commission.

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Chapter 7: Upper Extremity Splinting Techniques

Introduction

The upper extremity comprises a complex interplay of joints, musculature, tendons, and neurovascular structures that allow for an extraordinary range of motion, dexterity, and strength. Because of this anatomical and functional complexity, immobilization of the upper limb demands meticulous attention to biomechanical alignment, soft tissue preservation, and neurovascular protection. Splinting of the upper extremity is a cornerstone of conservative orthopedic management for a wide array of injuries and conditions—ranging from acute fractures, dislocations, and tendon lacerations to overuse syndromes and nerve entrapments.

Each splint must be tailored to the anatomical region involved, the specific pathology being addressed, and the functional needs of the patient. Whether immobilizing a fractured metacarpal, stabilizing a flexor tendon repair, or decompressing the median nerve in carpal tunnel syndrome, the goal of upper extremity splinting is not simply immobilization, but therapeutic positioning. This includes preserving ligament and tendon lengths, minimizing the risk of contracture, and maintaining hand function during the healing process. Moreover, the unique demands of the dominant versus non-dominant limb, patient occupation, and lifestyle must be considered in both the design and counseling phases of splint application.

This chapter provides a comprehensive guide to upper extremity splinting techniques, organized anatomically from the wrist and hand to the shoulder. Each technique is presented in a standardized format covering clinical indications, positioning principles, materials, application steps, patient education, complications to avoid, and visual references. Through the structured mastery of these techniques, orthopedic technologists and clinicians can ensure safe, effective, and functionally mindful splinting across the entire upper limb.

Volar Wrist Splint (Cock-up Splint) Technique Guide

Indications: Wrist sprains/strains, Carpal tunnel syndrome

- Measure and size accordingly
- Stretch the ends
- Apply cool water and towel out
- Pull relax and roll bandage with 50-50 coverage
- Hold and mold with palms only
- Position as prescribed by physician
- Check for capillary refill

Indications

- **Tendinopathies:** Extensor carpi radialis brevis/longus irritation (tennis elbow) or flexor carpi radialis issues where wrist rest reduces strain.
- **Post-cast rehabilitation:** Used after cast removal to ease the transition to full motion without overloading healing structures.
- **Neurological dysfunction:** Radial nerve palsy (“wrist drop”) where wrist extension splinting restores function and prevents over-stretching of extensor tendons.
- **Post-operative tendon repair:** Maintains wrist positioning to reduce tension on sutured structures, especially flexor tendons.
- **Arthritic flare control:** Common in rheumatoid arthritis to stabilize painful, inflamed joints and reduce morning stiffness.

📌 *Key Rationale:* Wrist immobilization decreases muscle activity in the flexor and extensor groups, reducing pain and inflammation while protecting healing tissues (Magee, 2019).

Contraindications

- **Marked edema or compartment risk:** Avoid initial application in significantly swollen limbs without first applying a circumferential compression wrap or edema management.
- **Unstable or angulated distal radius fractures:** Requires circumferential immobilization or reduction before splint use.
- **Skin maceration or burn over volar forearm:** Moisture can exacerbate breakdown; consider offloading or alternative splint designs.
- **Severe carpal instability (e.g., lunotriquetral dissociation):** These require more specific orthopedic intervention than simple volar splinting.

2. Surface Landmarks and Positioning

Critical Anatomical Landmarks

- **Radial styloid:** Lateral wrist prominence; overpadding reduces risk of pressure necrosis.
- **Ulnar styloid:** Avoid direct contact with fiberglass edge; this site is prone to ulceration.
- **Palmar crease:** Stay proximal to allow full MCP flexion and grip maintenance.
- **Thenar eminence and carpal tunnel zone:** Must remain uncompressed to avoid exacerbating nerve compression syndromes.

Joint Positioning Biomechanics

- **Wrist extension (20–30°):** Optimizes grip strength by elongating finger flexor tendons to a biomechanically efficient resting length (Nordin & Frankel, 2020).
- **MCPs unrestricted:** Critical for preserving lumbrical muscle function and preventing claw hand in long-term splinting.

🧠 *Teaching Tip:* Demonstrate how full MCP flexion becomes impaired if the distal edge of the splint encroaches past the distal palmar crease.

3. Materials Checklist

- **2–3″ stockinette**: Choose breathable, latex-free if possible to reduce skin irritation.
- **Padding** (Weberil, synthetic cast padding): Minimum 2 layers; focus on bony prominences. For fragile skin (elderly/pediatric), consider 3–4 layers.
- **Splinting material**:
  - **Plaster**: Better moldability, faster set time, heavier, warmer during curing.
  - **Fiberglass**: Lightweight, water-resistant, excellent durability.
- **Room-temperature water basin**: Avoid warm water as it accelerates set time, reducing working time and increasing risk of improper molding.
- **Elastic bandage**: Should provide compression without circulatory compromise—avoid overlap exceeding 50%.
- **Scissors & gloves**: Always wear gloves when handling fiberglass to prevent resin skin exposure.

4. Step-by-Step Application

Preparation

- Position patient seated upright with arm supported on a towel or splinting board.
- Confirm limb is clean and dry. Inspect for wounds, edema, or deformity.
- **Measure** from the metacarpal heads to ~2 inches distal to the cubital fossa (volar side).

Application

1. Apply stockinette from mid-hand to mid-forearm, leaving slack to fold back for clean edges.
2. Add 2–3 layers of padding. Overlap evenly and avoid wrinkling to prevent pressure points.
3. Submerge fiberglass splinting roll in room temp water for 5–10 seconds (plaster: 3–5 seconds).
4. Gently wring out excess water. Lay splint over volar forearm, molding it into slight concavity to match arm contour.
5. Re-check wrist extension: Aim for 20–30°, using a goniometer if needed.
6. Fold back stockinette and padding to cushion edges before applying elastic wrap.
7. Secure elastic wrap from hand toward elbow with moderate pressure—no more than 50% stretch.
8. Recheck:
    1. Finger mobility
    2. Capillary refill (<2 sec)
    3. Absence of edge pressure at styloids

⚠️ *Clinical Caution:* If wrist drops into flexion or if MCPs are covered, the splint must be removed and reapplied.

5. Post-Application Instructions

Patient Education:

- Keep the splint dry and elevated for the next 48–72 hours.
- Do not remove or alter the splint unless advised.
- Perform **finger ROM exercises** hourly (flexion/extension, finger spreads).
- Inspect fingertips for color, warmth, or swelling.
- **Avoid driving** or operating machinery with a splinted dominant hand.

Provider Follow-Up:

- Schedule recheck in 3–5 days for swelling reassessment or definitive casting.
- Consider reassessment earlier in high-risk populations (diabetics, elderly, anticoagulated).

6. Complications to Avoid

Complication	Mechanism	Prevention
Median nerve compression	Splint too distal, tight wrap	Avoid compressing carpal tunnel zone
Ulnar styloid ulceration	Poor padding or splint overlap	Pad generously and avoid direct splint edge over styloid
MCP stiffness	Splint crosses palmar crease	Terminate just proximal to MCPs
Skin maceration	Moisture, sweat, inadequate ventilation	Educate on drying protocol and use breathable stockinette
Tendon adhesion post-injury	Immobilization in flexed wrist	Maintain extension and initiate gentle ROM when appropriate

Sugar-Tong Forearm Splint

Indications: Colles' fracture, Forearm fracture

- Measure and size accordingly
- Stretch the ends
- Apply cool water and towel out
- Pull relax and roll bandage with 50-50 coverage
- Hold and mold with palms only
- Position as prescribed by physician
- Measure up to the palm or crease
- Pinch and fold gap in splint away from the ulnar nerve

1. Indications & Contraindications

Indications

- **Distal radius and/or ulna fractures** (both displaced and nondisplaced)
- **Post-reduction support** of forearm fractures before casting
- **Forearm shaft fractures** (when combined with posterior splint)
- **Severe wrist sprains** with instability
- **Initial immobilization** in high-energy wrist trauma with swelling risk
- **Protection during transport** to surgery or definitive casting
- **Preventing pronation/supination** in post-operative patients (e.g., after ORIF)

💡 *Clinical Insight:* The sugar-tong configuration immobilizes both the wrist and forearm while allowing for swelling, making it ideal in acute fracture care (Hoppenfeld & Murthy, 2013).

Contraindications

- Open fractures with exposed bone or severe soft tissue compromise
- Circumferential lacerations or burns in the splint path
- High-risk for compartment syndrome—requires vigilant monitoring
- Midshaft fractures requiring circumferential cast or internal fixation
- Patients unable to report sensory changes (use with caution)

2. Surface Landmarks and Positioning

Anatomical Landmarks

- **Elbow epicondyles** (medial/lateral)
- **Olecranon process**
- **Radial and ulnar styloids**
- **Metacarpal heads** (avoid covering MCP joints)
- **Mid-forearm muscular belly** for compression concerns

Functional Positioning

- **Elbow:** Flexed to 90°
- **Forearm:** Neutral (thumb up)
- **Wrist:** Neutral to slight extension (0–20°)
- **Fingers:** Free for active motion (instruct patient to exercise them hourly)

🧠 *Pearl:* This splint prevents **pronation and supination** by crossing the elbow joint and curving from dorsum of the hand to the olecranon—essential in managing radius and ulna injuries.

3. Materials Checklist

- Gloves
- **Stockinette** (2–3 inch): from knuckles to upper arm
- **Padding** (cast padding): 2–3 layers, focus on olecranon, styloids, and bony prominences
- **Fiberglass or plaster splinting material**, approx. 30–36 inches long (adult forearm)
- Room-temp **water basin**
- **Elastic bandage wrap** (3–4 inch)
- Bandage scissors
- Optional: **arm sling**, cold pack

4. Step-by-Step Application

Preparation

1. Explain the procedure to the patient and confirm informed consent.
2. Position the arm with elbow at 90°, forearm in neutral rotation, wrist in slight extension.
3. Measure from MCP knuckles dorsally, around the elbow, to volar MCPs.

Application

1. Apply stockinette from mid-hand to above the elbow (approx. mid-biceps).
2. Wrap 2–3 layers of cast padding evenly along the entire splint path, emphasizing olecranon and styloids.
3. Wet fiberglass or plaster roll; wring out excess water.
4. Lay the splint dorsally across MCP joints, around the elbow, and return volarly to the palm.
5. Mold gently along the forearm's natural curvature, ensuring snug fit but avoiding tight compression.
6. Fold stockinette and padding at edges for skin protection.
7. Secure with elastic wrap in spiral fashion, overlapping 50%. Begin at hand, wrap to upper arm.
8. Place arm in sling if needed.

⚠️ *Monitor during curing:* Warn of warmth with plaster; support splint until rigid.

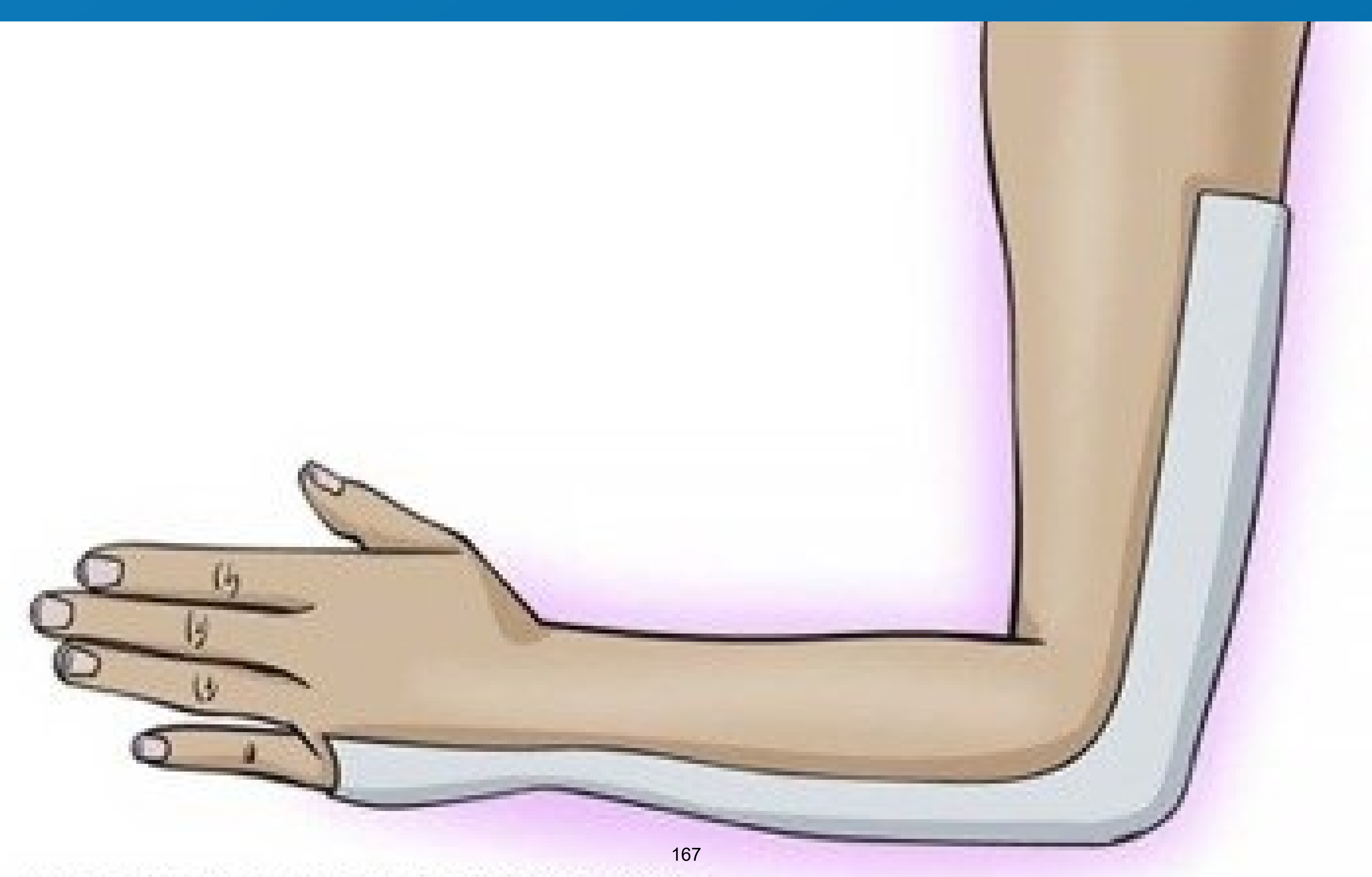
5. Post-Application Instructions

- Elevate the arm above heart level for 48 hours to reduce swelling.
- Keep the splint dry. Protect with a cover when bathing.
- Perform frequent **finger range of motion exercises** to prevent stiffness.
- Inspect fingers hourly: color, sensation, capillary refill.
- **Do not insert objects** to relieve itching.
- Watch for swelling above the elastic wrap or numbness in fingers.
- Return for re-evaluation in 3–7 days for casting or clinical reassessment.

6. Complications to Avoid

Complication	Cause	Prevention
Compartment syndrome	Constriction from wrap or progressive swelling	Avoid tight wrapping; pad generously; instruct on red flags
Ulnar nerve entrapment	Poor positioning or compression at elbow	Proper elbow padding and neutral alignment
Skin breakdown over styloid processes	Inadequate padding	Double padding over radial/ulnar styloids
Excessive movement of fracture	Incorrect mold or loose wrap	Confirm fit and immobilization before discharge
Finger stiffness	Patient inactivity	Instruct finger flexion/extension every hour

Long Arm Posterior Splint



Indications

- **Distal humerus fractures (nondisplaced or post-reduction)**
- **Radial head and neck fractures**
- **Proximal and mid-shaft forearm fractures (combined with sugar-tong splint for complete immobilization)**
- **Elbow dislocations (post-reduction)**
- **Severe ligamentous injuries of the elbow (MCL, LCL complex)**
- **Olecranon fractures**
- **Post-operative elbow immobilization**
- **Soft tissue trauma to the elbow or proximal forearm**

💡 ***Clinical Insight:*** **The long arm posterior splint provides elbow immobilization while allowing accommodation for swelling. It spans from the upper arm to the hand, stabilizing both elbow flexion/extension and forearm rotation.**

Contraindications

- **Open fractures or contaminated wounds not yet debrided**
- **Suspected or evolving compartment syndrome**
- **Severely displaced fractures requiring operative fixation**
- **Fractures necessitating complete circumferential immobilization (requires conversion to cast)**
- **Uncontrolled swelling requiring only sling and observation**

2. Surface Landmarks and Positioning

Anatomical Landmarks

- Olecranon process
- Medial and lateral epicondyles
- Radial head
- Wrist crease and MCP joints
- Acromion and deltoid insertion (upper splint limit)

Functional Positioning

- Elbow: Flexed to 90°
- Forearm: Neutral rotation (thumb up)
- Wrist: Slight extension (20–30°)
- Hand: Neutral, MCPs free for movement

🧠 *Biomechanical Note:* This positioning allows for optimal alignment of the elbow's carrying angle, and functional forearm tension, while avoiding over-stretching of healing structures (Norkin & Levangie, 2016).

3. Materials Checklist

- **Nonsterile gloves**
- **Stockinette (2–3 inch): From hand to mid-humerus**
- **Padding (Webril or cast padding): 2–3 layers, with extra at olecranon and epicondyles**
- **Fiberglass or plaster splint roll: ~4-inch width, 22–24 inches long (adult)**
- **Elastic bandage (3–4 inch)**
- **Water basin (if plaster)**
- **Bandage scissors**
- **Optional: sling, shoulder immobilizer**

4. Step-by-Step Application

Preparation

1. **Explain procedure and obtain informed consent.**
2. **Seat patient or position supine with arm flexed at 90° across chest or on pillow.**
3. **Measure splint length: mid-palm → posterior elbow → mid-humerus.**

Application

1. **Apply stockinette, ensuring coverage from hand to above elbow.**
2. **Apply 2–3 layers of padding along same area, with extra over the olecranon, wrist, and bony prominences.**
3. **Activate splinting material and lay posteriorly from MCPs to mid-humerus.**
4. **Mold over the olecranon, elbow, and humerus while maintaining elbow at 90°.**
5. **Ensure wrist remains in extension and forearm is neutral.**
6. **Wrap elastic bandage starting at wrist, progressing to proximal arm with even pressure.**
7. **Hold in position until set (~5–10 minutes depending on material).**

⚠️ ***Key Safety Note:*** **Never fully circumferentially encase a swollen arm. Leave volar and dorsal skin accessible for neurovascular checks.**

5. Post-Application Instructions

- **Keep elevated and immobilized for first 48 hours.**
- **Do not remove splint or unwrap bandages.**
- **Perform regular neurovascular checks: sensation, movement of fingers, capillary refill.**
- **Observe for pain increase, finger color changes, or numbness.**
- **Return in 3–7 days for reassessment, potential conversion to cast, or orthopedic referral.**
- **Keep splint dry and covered when bathing.**
- **Avoid lifting, pushing, or shoulder motion.**

6. Complications to Avoid

Complication	Cause	Prevention
Ulnar nerve compression	Elbow hyperflexion or tight padding	Ensure elbow at 90°, pad medial condyle
Pressure ulcers	Inadequate padding over olecranon	Double padding at pressure points
Volar skin necrosis	Circumferential wrapping with swelling	Never apply circumferential hard splints
Joint stiffness	Excessive immobilization duration	Use only as indicated, re-evaluate regularly
Missed compartment syndrome	Poor monitoring	Educate on red flags and inspect fingers hourly

Thumb Spica Splint

Indications: Navicular/Scaphoid fracture,
Ulnar collateral ligament sprain

- Measure and size accordingly
- Reseal foil
- Stretch the ends
- Apply cool water and towel out
- Pull relax and roll bandage with 50-50 coverage
- Hold and mold with palms only
- Position as prescribed by physician
- Make V cut at distal end of fiberglass
- Slight spiral around the dorsal side
- Maintain position of functioning by holding rolled bandage
- Check capillary refill

Indications

- **Scaphoid fractures** (non-displaced or suspected)
- **Thumb metacarpal fractures** (especially Bennett or Rolando fractures)
- **Ulnar collateral ligament (UCL) injury** of the thumb (Skier's/Gamekeeper's thumb)
- **First carpometacarpal (CMC) joint arthritis**
- **De Quervain's tenosynovitis**
- **Post-operative or post-injection immobilization** of thumb or wrist
- **Ligamentous sprains** of the thumb MCP or CMC joints
- **Soft tissue injuries** requiring joint protection and rest

💡 *Clinical Insight:* Immobilizing both the thumb and wrist prevents stress transmission to the injured structure—especially important for scaphoid healing and UCL stabilization (Brinker & O'Connor, 2021).

Contraindications

- **Open wounds or infection** in the thumb/wrist area without adequate dressing accommodation
- **Displaced or unstable fractures** requiring surgical intervention or rigid immobilization
- **Compartment syndrome or uncontrolled swelling**—requires temporary soft support or close monitoring
- **Severe deformity or neurovascular compromise** needing urgent reduction

2. Surface Landmarks and Positioning

Anatomical Landmarks

- **Radial and ulnar styloids**
- **Thenar eminence**
- **Anatomical snuffbox** (between extensor pollicis longus and brevis)
- **Thumb MCP and IP joints**
- **First metacarpal shaft**
- **Scaphoid tubercle** (palpated distal to radial styloid)

Functional Positioning

- **Wrist**: 20–30° extension
- **Thumb**: Positioned in abduction, mid-opposition
- **Thumb MCP joint**: Slight flexion (5–10°)
- **Thumb IP joint**: Free if injury permits (immobilized for distal injuries)

🧠 *Biomechanical Rationale:* This position supports the thumb's functional grip while unloading injured ligaments or bones. Immobilizing the CMC joint in abduction stabilizes both radial and ulnar structures (Norkin & Levangie, 2016).

3. Materials Checklist

- Exam gloves
- **Stockinette** (2–3 inch): From fingertips to mid-forearm
- **Padding**: 2–3 layers of Webril or equivalent
- **Precut fiberglass or plaster splinting material**: 8–10 inches, width based on hand size
- Optional: thumb gusset or pre-molded thumb piece
- **Water basin** (room temp)
- **Elastic bandage** (2 or 3 inch)
- **Bandage scissors**
- Optional: sling, instructional handout

4. Step-by-Step Application

Preparation

1. Explain procedure and obtain informed consent.
2. Position patient: forearm supported, wrist extended 20–30°, thumb in abduction and mid-opposition.
3. Measure and cut splinting material from mid-forearm to thumb tip, curving around thenar eminence.

Application

1. Apply stockinette and padding. Ensure padding between thumb and index web space and around radial styloid.
2. Wet and wring out fiberglass or plaster roll.
3. Lay splint volarly along forearm, wrapping around radial wrist and thumb to mimic a "hockey stick" or "L-shape" configuration.
4. Mold material snugly around thumb and wrist. Maintain positioning while splint cures.
5. Fold back excess padding and stockinette to cushion edges.
6. Secure with elastic bandage—start distally and wrap to proximal forearm.

⚠️ *Ensure that MCP joint is covered but not hyperextended. Allow thumb IP to remain free unless stabilization of that joint is needed.*

5. Post-Application Instructions

- Keep dry and elevated for 48 hours.
- Perform finger ROM exercises hourly.
- Do not use thumb or grip with the splinted hand.
- Monitor for swelling, pain, numbness, or tightness.
- Avoid driving or strenuous activity until cleared.
- Follow up in 5–7 days for imaging, cast conversion, or clinical reassessment.

6. Complications to Avoid

Complication	Cause	Prevention
Pressure ulcers at radial styloid	Inadequate padding	Pad generously over bony prominences
Median nerve compression	Over-tight wrap or improper wrist angle	Keep neutral wrist alignment and monitor circulation
Loss of thumb function	Incorrect thumb positioning	Position in functional abduction/opposition
Thumb MCP stiffness	IP joint included unnecessarily	Leave IP free unless clinically indicated
Poor fracture healing	Insufficient immobilization of CMC and scaphoid	Extend splint proximally and secure wrist joint

Ulnar Gutter Splint

Indications

- **Fractures of the 4th and/or 5th metacarpals** (e.g., Boxer's fracture)
- **Proximal phalanx fractures** of the ring and small fingers
- **Post-reduction immobilization** of displaced ulnar-sided hand injuries
- **UCL injuries of the 5th MCP joint**
- **Soft tissue trauma** to the ulnar side of the hand or fingers
- **Post-operative protection** following ulnar-sided tendon or ligament repairs

💡 *Clinical Note:* The ulnar gutter splint is highly effective in maintaining proper alignment of the 4th and 5th digits in the intrinsic-plus position, preventing shortening or rotational deformities that compromise grip strength and finger cascade (Brinker & O'Connor, 2021).

Contraindications

- **Open fractures** with contamination or requiring surgical debridement
- **Severely displaced or angulated fractures** requiring closed or open reduction
- **Compartment syndrome** or evolving ischemia
- **Injuries involving the 2nd or 3rd digits** (would require radial gutter or alternate support)
- **Severe hand edema** that risks vascular compromise without ongoing monitoring

2. Surface Landmarks and Positioning

Anatomical Landmarks

- **Ulnar styloid**
- **5th metacarpal and MCP joint**
- **4th MCP and PIP joints**
- **Olecranon** (used for elbow positioning)
- **Metacarpal heads** (palpate to ensure no overlap or MCP hyperextension)

Functional Positioning

- **Wrist**: 20–30° extension
- **MCP joints (4th and 5th)**: 70–90° flexion (intrinsic-plus position)
- **PIP and DIP joints**: Full extension
- **Elbow**: Flexed to 90°, if including forearm

🧠 *Biomechanical Rationale:* MCP flexion preserves collateral ligament length, reducing long-term joint stiffness. Wrist extension and finger alignment maintain natural tendon tension and prevent rotational deformity of healing metacarpals (Norkin & Levangie, 2016).

3. Materials Checklist

- Protective gloves
- **Stockinette** (2–3 inch): from fingertips to mid-forearm
- **Padding**: 2–3 layers, extra around ulnar styloid and MCP joints
- **Fiberglass or plaster splinting material**: ~8–10 inches (cut to ulnar half of forearm/hand)
- **Water basin** (room temperature)
- **Elastic bandage** (2–3 inch)
- Bandage scissors
- Optional: sling or finger trap traction device (if needed)

4. Step-by-Step Application

Preparation

1. Explain the procedure and obtain consent.
2. Position patient with elbow flexed at 90°, wrist slightly extended, and fingers in intrinsic-plus position.
3. Measure splint length from the ulnar mid-forearm, around the 5th MCP joint, ending at the distal phalanges of the 4th and 5th digits.

Application

1. Apply stockinette to encompass hand and forearm.
2. Pad entire splint path, paying attention to bony prominences—especially ulnar styloid and MCP heads.
3. Activate fiberglass or plaster roll, then wring and lay it along the **ulnar border of the hand and forearm**, extending from mid-forearm to the distal interphalangeal joints (DIPs) of 4th and 5th fingers.
4. Mold the splint to contour the ulnar side of the forearm and dorsum/volar hand, ensuring 4th and 5th fingers are held together in natural cascade.
5. Use elastic bandage to secure, wrapping from fingers to mid-forearm with 50% overlap.
6. Hold in position until material is cured and firm.

⚠️ *Key Technique Tip:* Ensure fingers are not rotated or scissored. Use buddy taping or cotton roll between fingers to maintain alignment if needed.

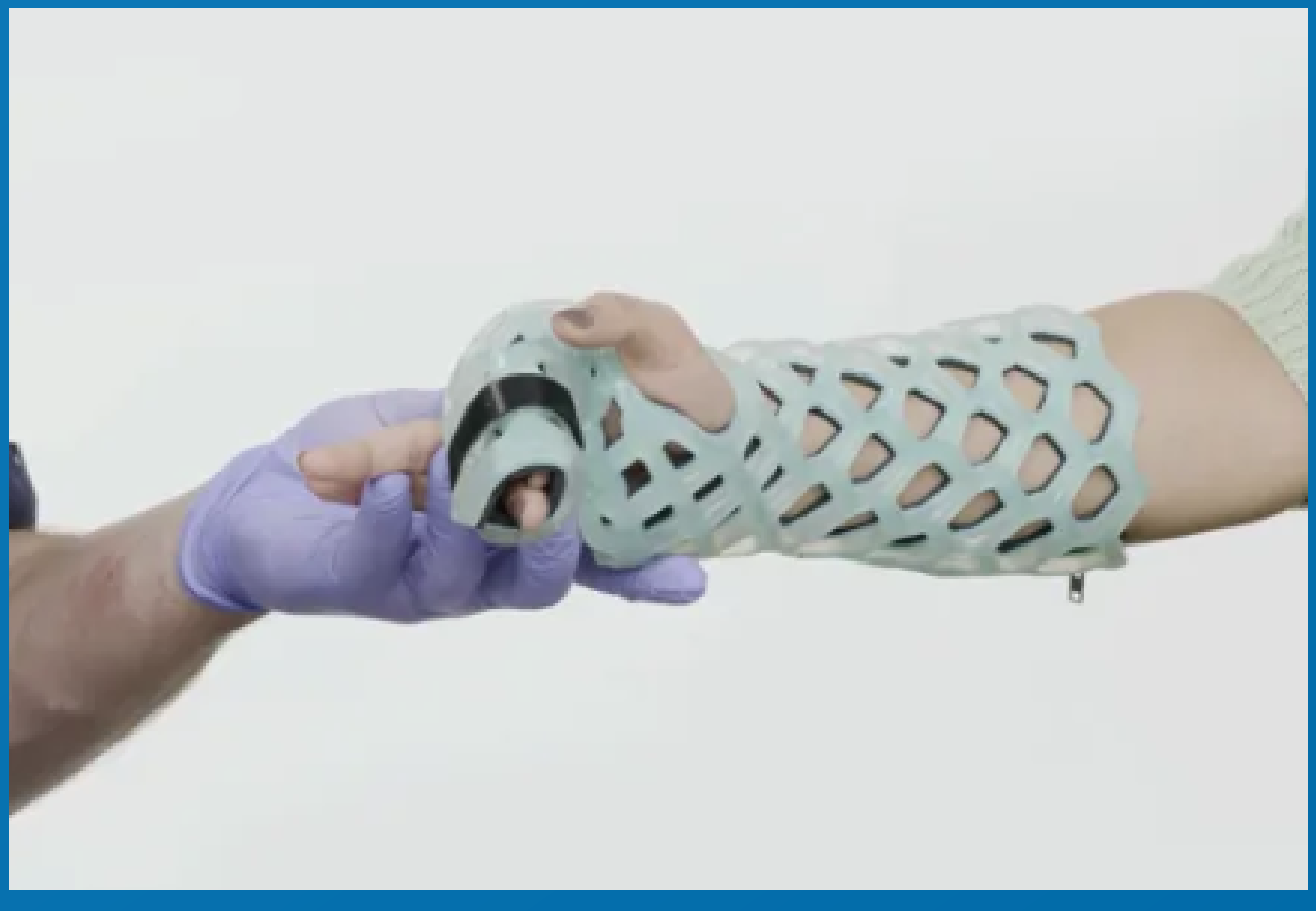
5. Post-Application Instructions

- Elevate limb for 48 hours to minimize swelling.
- Instruct on hourly finger ROM (excluding immobilized digits).
- Keep splint dry. Do not tamper with bandage layers or insert items inside.
- Inspect for color changes, numbness, or worsening pain.
- Advise patient to return in 5–7 days for reassessment or conversion to full cast.
- Avoid gripping, lifting, or manipulating objects with the splinted hand.

6. Complications to Avoid

Complication	Cause	Prevention
Rotational deformity	Poor finger positioning or splint molding	Visual inspection for parallel digit alignment before curing
Ulnar nerve compression	Tight wrap over ulnar groove	Adequate padding and avoiding direct pressure over elbow
MCP joint stiffness	Failure to maintain flexion	Reinforce intrinsic-plus positioning with finger molding
Skin breakdown at styloid	Rigid splint edge or poor padding	Round and pad edges, especially distally
Finger maceration	Excess moisture or insufficient ventilation	Educate on splint hygiene and frequent monitoring

Radial Gutter Splint



Indications

- **Fractures of the 2nd and 3rd metacarpals** (e.g., non-displaced shaft or neck fractures)
- **Proximal phalanx fractures** of the index and middle fingers
- **Stable soft tissue injuries** involving the radial digits
- **Ligamentous sprains or dislocations** at MCP or PIP joints of the 2nd and 3rd fingers
- **Post-reduction immobilization** of index/middle digit dislocations
- **Post-operative protection** of tendon repairs in radial digits

💡 *Clinical Insight:* The radial gutter splint maintains the index and middle fingers in the intrinsic-plus position, offloading tension on healing fractures or tendons while preserving natural hand alignment for function (Brinker & O'Connor, 2021).

Contraindications

- **Open fractures** requiring surgical debridement
- **Severely displaced fractures** with malrotation or shortening
- **Multi-digit fractures** involving ring or small fingers (consider ulnar or volar alternatives)
- **Uncontrolled swelling**—may need initial soft immobilization
- **Compartment syndrome** or ischemic hand—requires immediate surgical attention

2. Surface Landmarks and Positioning

Anatomical Landmarks

- **Radial styloid**
- **2nd and 3rd metacarpals and MCP joints**
- **Phalanges of index and middle fingers**
- **Thenar eminence and anatomical snuffbox**
- **Wrist crease and mid-forearm**

Functional Positioning

- **Wrist**: 20–30° extension
- **MCP joints (2nd and 3rd)**: 70–90° flexion (intrinsic-plus position)
- **PIP and DIP joints**: Full extension
- **Forearm**: Neutral rotation
- **Thumb**: Free (not immobilized in this splint)

🧠 *Biomechanical Principle:* The intrinsic-plus position preserves collateral ligament length and hand arch integrity, reducing long-term stiffness and functional loss (Norkin & Levangie, 2016).

3. Materials Checklist

- Gloves
- **Stockinette** (2–3 inch): from fingertips to mid-forearm
- **Padding** (Webril or equivalent): 2–3 layers, extra over metacarpal heads and wrist
- **Fiberglass or plaster splinting material**: 8–10 inches, tailored to index/middle fingers and radial forearm
- **Elastic bandage** (2–3 inch)
- Water basin (if using plaster)
- Bandage scissors
- Optional: finger spacer (e.g., gauze roll or foam pad)

4. Step-by-Step Application

Preparation

1. Obtain patient consent and explain the procedure.
2. Position elbow at 90°, forearm neutral, wrist extended, and index/middle fingers flexed at MCPs.
3. Measure splint from mid-forearm → along radial aspect → extending to distal phalanges of index and middle fingers.

Application

1. Apply stockinette and padding to cover forearm and radial digits.
2. Double-pad around MCP joints and radial styloid.
3. Wet and prepare splinting material. Lay from mid-forearm up the radial wrist, continuing along the dorsum and volar surfaces of the 2nd and 3rd fingers.
4. Mold to maintain MCP flexion and ensure proper contour to hand curves.
5. Secure with elastic bandage—begin at fingers and spiral up to mid-forearm.
6. Place cotton roll or foam between index and middle fingers to avoid pressure or skin breakdown.

⚠️ *Important:* Ensure the thumb is entirely free and fingers are aligned without rotation.

5. Post-Application Instructions

- Keep hand elevated above heart level for 24–48 hours.
- Perform gentle ROM exercises of unaffected digits and shoulder.
- Monitor for signs of compromised circulation: increased pain, color change, numbness, or tingling.
- Keep splint clean and dry. Do not attempt to adjust or remove.
- Follow up in 5–7 days for imaging, cast conversion, or orthopedic evaluation.
- Avoid lifting or grasping objects with the splinted hand.

6. Complications to Avoid

Complication	Cause	Prevention
Rotational deformity	Poor finger alignment during molding	Visually inspect finger alignment in cascade before curing
Skin breakdown at MCPs	Rigid splint edges or pressure points	Pad over MCPs generously and smooth splint edges
Loss of thumb motion	Incorrect splint length or wrapping	Ensure thumb remains completely free
Joint stiffness	Improper MCP angle or prolonged immobilization	Use intrinsic-plus positioning and monitor duration
Nerve compression	Overly tight wrap or insufficient padding	Avoid circumferential compression and reassess frequently

Shoulder Immobilizer

Indications

- **Glenohumeral dislocations** (anterior or posterior) following closed reduction
- **Proximal humerus fractures**
- **Clavicle fractures** requiring adjunct support
- **Rotator cuff injuries or repairs**
- **Acromioclavicular (AC) joint separations**
- **Post-operative immobilization** (e.g., arthroscopy, rotator cuff repair)
- **Shoulder instability syndromes** (acute or chronic)
- **Soft tissue injuries** to deltoid, biceps, or labrum

💡 *Clinical Note:* Shoulder immobilizers are superior to simple slings for limiting shoulder abduction, external rotation, and distal arm motion—protecting healing tissues while reducing dislocation recurrence risk (Brinker & O'Connor, 2021).

Contraindications

- **Open fractures or wounds** over the shoulder girdle requiring surgical access
- **Compartment syndrome of upper arm**
- **Active infection** in the axillary region or proximal humerus
- **Neurological compromise** requiring ongoing monitoring of shoulder/upper arm motion
- **Massive swelling** where circumferential compression could worsen vascular flow

2. Surface Landmarks and Positioning

Anatomical Landmarks

- **Acromion process**
- **Clavicle and sternoclavicular joints**
- **Deltoid insertion**
- **Axillary fold and scapular spine**
- **Olecranon and ulnar border of forearm** (for forearm strap alignment)

Functional Positioning

- **Elbow**: Flexed to 90°
- **Forearm**: Across abdomen in neutral rotation
- **Shoulder**: Adducted and internally rotated
- **Hand**: Slightly above elbow to facilitate venous return

🧠 *Biomechanical Rationale:* Immobilization in adduction and internal rotation offloads stress from the anterior capsule and rotator cuff while optimizing comfort and preventing dependent edema (Norkin & Levangie, 2016).

3. Materials Checklist

- Nonsterile gloves (if inspecting wounds)
- Commercial shoulder immobilizer kit (includes:
  - Waist belt
  - Arm cradle/forearm sling
  - Optional: shoulder strap or pillow abduction wedge)
- Optional: Stockinette sleeve (to reduce axillary friction)
- Padding or gauze for bony prominences
- Scissors and skin-friendly tape (if custom adjustments needed)

4. Step-by-Step Application

Preparation

1. Explain purpose and obtain informed consent.
2. Confirm reduction (if post-reduction use), inspect skin for abrasions or wounds.
3. Position arm at side, elbow flexed, forearm across abdomen, hand elevated slightly above elbow.

Application

1. Wrap **waist belt** around patient's lower ribs/abdomen and secure with hook-and-loop closure. Ensure it is snug but not restrictive to breathing.
2. Slide **forearm cradle** under the injured arm with elbow flush against the side.
3. Attach forearm cradle to waist belt at multiple contact points (usually Velcro).
4. If included, secure **shoulder strap** over contralateral shoulder and attach to lateral forearm cradle for upward support.
5. Check for symmetrical support, and ensure hand is elevated relative to elbow.

⚠️ *Important:* Elbow must not hang below waistline—risk of traction and dependent edema. Avoid axillary compression with padding as needed.

5. Post-Application Instructions

- Leave immobilizer in place unless instructed otherwise by a physician.
- Remove only for hygiene, wound care, or passive exercises (if cleared).
- Elevate hand when seated or resting to prevent swelling.
- Avoid lifting, pushing, or rotating the injured shoulder.
- Inspect axillary area daily for signs of skin irritation, maceration, or ulceration.
- Return for urgent care if experiencing numbness, tingling, increased pain, or discoloration of the hand or fingers.
- Follow-up with orthopedic or physical therapy provider as scheduled.

6. Complications to Avoid

Complication	Cause	Prevention
Axillary skin breakdown	Friction or moisture buildup	Use padding and encourage skin inspection
Elbow traction injury	Poorly positioned sling	Ensure elbow is supported flush to side
Rotator cuff stress	Arm not immobilized in adduction	Maintain arm tightly to chest with cradle
Hand/finger swelling	Dependent hand position	Keep hand slightly above elbow
Pressure sores over acromion or clavicle	Over-tightened strap or hard splint edges	Use gauze or foam pads under contact points

Chapter 8: Lower Extremity Splinting Techniques

Introduction

Lower extremity splinting represents a cornerstone of orthopedic and emergency musculoskeletal care. Injuries to the hip, thigh, knee, leg, ankle, and foot are not only common but often require immediate stabilization to minimize pain, prevent further injury, and initiate healing. From tibial shaft fractures to complex ankle sprains, the clinician's ability to immobilize the lower extremity correctly can significantly influence patient outcomes—ranging from acute pain relief to long-term functional recovery.

Compared to the upper limb, the lower extremity is biomechanically distinct: it bears weight, drives locomotion, and contains longer lever arms with greater kinetic energy during trauma. As such, splinting in this region must carefully consider load transmission, joint alignment, rotational control, and tissue protection. For instance, immobilizing the ankle at 90 degrees is crucial to prevent equinus deformity, while improper alignment at the knee can lead to valgus or varus stress across healing fractures.

Lower extremity splinting also poses practical challenges. It typically requires more materials, greater limb stabilization, and often two clinicians to apply effectively. Furthermore, neurovascular risk zones—such as the peroneal nerve at the fibular neck or the dorsalis pedis artery over the midfoot—must be protected with precise padding and periodic monitoring. The clinician must also account for swelling, compartment syndrome risk, and the need to offload pressure points such as the heel, Achilles tendon, or malleoli.

This chapter outlines the most common and clinically essential lower extremity splints used in orthopedic clinics, urgent care centers, and emergency departments. For each splinting technique, detailed protocols will include indications, contraindications, surface landmarking, materials checklists, application steps, post-procedure guidance, and complication avoidance strategies. Where applicable, visual diagrams and procedural illustrations will further guide the learner or practicing technologist in mastering these vital immobilization skills.

Posterior Ankle Splint (Short Leg Posterior Slab)

Indications: Severe ankle sprain/strain, Metatarsal fractures, Distal tib/fib fracture, Achilles tendon tear

- Measure and size accordingly
- Stretch the ends
- Apply cool water and towel out
- Pull relax and roll bandage with 50-50 coverage
- Hold and mold with palms only
- Position as prescribed by physician
- Pad bony prominences
- Remove tape before discharge

1. Indications & Contraindications

Indications

- **Unimalleolar and bimalleolar ankle fractures** (nondisplaced or post-reduction)
- **Metatarsal fractures**
- **Severe ankle sprains**
- **Talar or calcaneal fractures**
- **Foot dislocations** (e.g., Lisfranc injuries)
- **Achilles tendon ruptures**
- **Post-operative immobilization**
- **Soft tissue trauma** of the ankle or hindfoot

💡 *Clinical Insight:* This splint provides temporary posterior-lateral stability and allows for swelling while minimizing pressure across the anterior tibia and dorsum of the foot (Brinker & O'Connor, 2021).

Contraindications

- **Open fractures** without surgical debridement
- **Active compartment syndrome** (may obscure swelling)
- **Circumferential casting need** (i.e., unstable fractures once swelling subsides)
- **Deep vein thrombosis** or **peripheral vascular disease** requiring dynamic circulation monitoring
- **Massive soft tissue swelling**—Jones compression may be preferred initially

2. Surface Landmarks and Positioning

Anatomical Landmarks

- **Tibial crest**
- **Medial and lateral malleoli**
- **Achilles tendon**
- **Calcaneus**
- **Metatarsal heads and toes**

Functional Positioning

- **Ankle**: 90° dorsiflexion (neutral)
- **Knee**: Slight flexion (15–20°) with support under knee
- **Toes**: Exposed and in neutral alignment

🧠 *Biomechanical Rationale:* Dorsiflexion to neutral minimizes Achilles tendon shortening and prevents plantarflexion contracture. Padding must protect bony prominences such as the malleoli and heel (Norkin & Levangie, 2016).

3. Materials Checklist

- Nonsterile gloves
- **Stockinette** (2–3 inch): From toes to just below the knee
- **Padding** (Webril or cast padding): 2–3 layers with extra around malleoli and heel
- **Plaster or fiberglass splint material**: 4–6 inches wide, length: heel → mid-calf (approx. 10–15 layers)
- **Elastic bandage** (3–4 inch)
- Water basin (for plaster)
- Bandage scissors
- Optional: pillow, triangle wedge, or posterior foot support

4. Step-by-Step Application

Preparation

1. Explain procedure, verify laterality and obtain informed consent.
2. Seat patient with leg extended and foot supported in neutral.
3. Measure splint length from plantar metatarsal heads around the heel up to ~2 inches below the popliteal fossa.

Application

1. Apply stockinette to cover from toes to upper calf, cutting small V-shaped relief at heel if needed.
2. Wrap cast padding in 2–3 layers over same area, adding extra at:
    1. Malleoli
    2. Heel (to prevent ulceration)
    3. Dorsum of foot (to prevent tenting of splint edges)
3. Soak splinting material (if plaster), wring out excess, and allow to briefly set.
4. Lay splint along **posterior aspect of leg** from metatarsal heads, under heel, up to posterior calf.
5. Gently mold the splint around:
    1. **Heel cup**
    2. **Achilles**
    3. **Calf contour**
6. Maintain **90° dorsiflexion** and leg neutrality throughout.
7. Secure with an **elastic bandage**, wrapping from foot → calf with even tension. Avoid restricting blood flow.

⚠️ *Key Tip:* Elevate heel off surface until splint hardens (~8–10 minutes). Do not wrap splint circumferentially to avoid creating a cast.

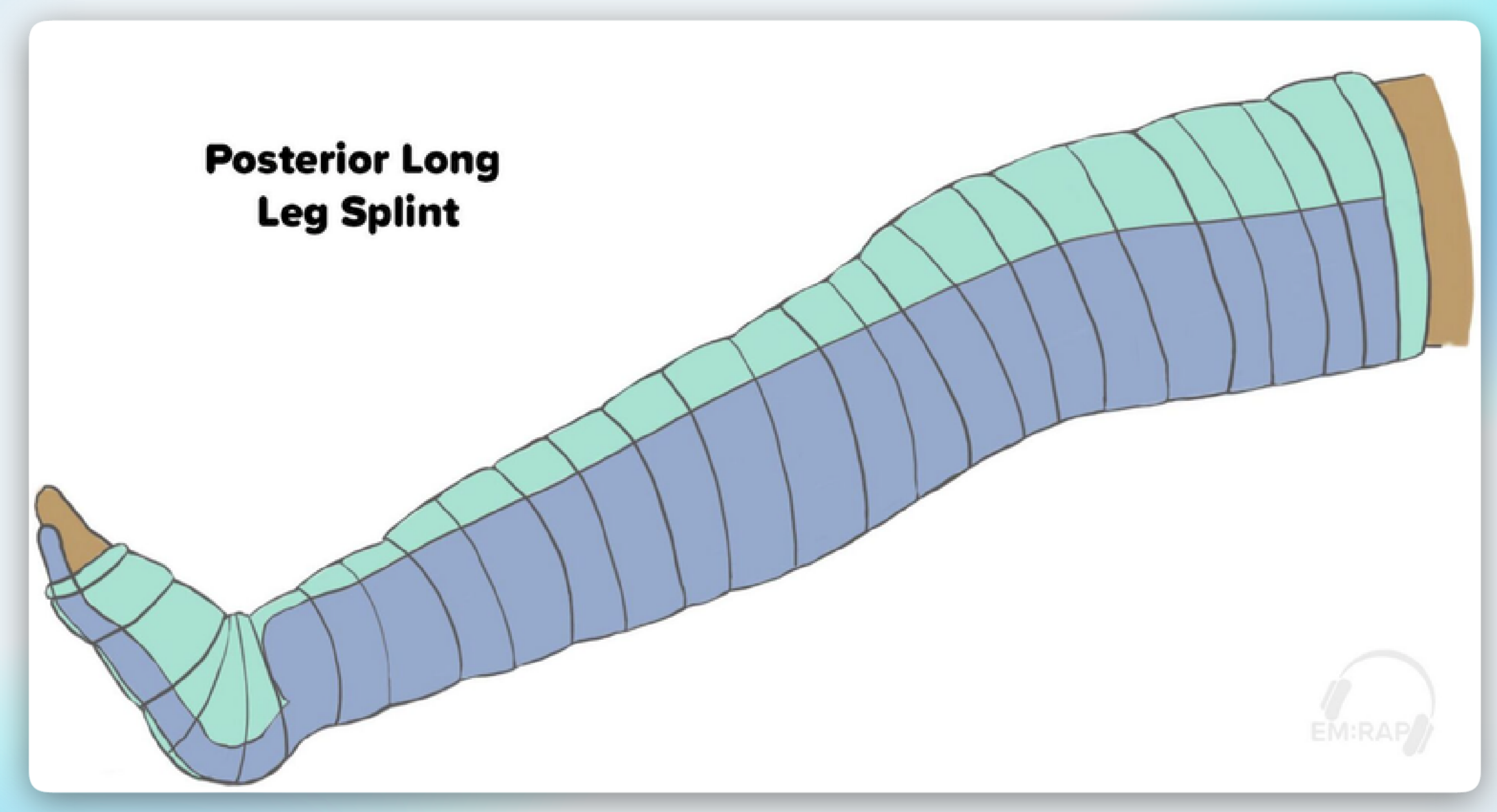
5. Post-Application Instructions

- Keep limb **elevated above heart level** for 24–48 hours.
- Do not walk on splint unless otherwise directed (non-weightbearing unless CAM boot used).
- Inspect toes frequently for:
  - **Color change**
  - **Temperature**
  - **Capillary refill**
  - **Swelling**
  - **Movement/sensation**
- Keep dry and clean—cover with plastic if needed during hygiene.
- Return immediately if:
  - Pain increases
  - Numbness or tingling occurs
  - Toes become cold, blue, or immobile
- **Follow-up** in 5–7 days for fracture reassessment, X-rays, and possible cast application.

6. Complications to Avoid

Complication	Cause	Prevention
Heel pressure ulcer	Insufficient padding, heel resting on bed	Double pad heel and float it during curing
Nerve compression	Tight elastic wrap or improper dorsiflexion	Check capillary refill, avoid circumferential pressure
Plantarflexion contracture	Poor positioning during curing	Maintain 90° dorsiflexion until set
Compartment syndrome	Inadequate monitoring of swelling	Keep splint non-circumferential and reassess neurovascular status
Skin maceration or breakdown	Moisture, friction	Keep splint dry and inspect regularly

Stirrup Ankle Splint



1. Indications & Contraindications

Indications

- **Lateral or medial malleolus fractures**
- **Severe ankle sprains or ligamentous injuries**
- **Post-reduction support of ankle dislocations**
- **Bimalleolar or trimalleolar ankle fractures (with posterior slab)**
- **Talar or calcaneal fractures** requiring rotational control
- **Subtalar joint instability**
- **Initial immobilization for open reduction internal fixation (ORIF) planning**

💡 *Clinical Insight:* The stirrup ankle splint offers **medial-lateral stability** and **rotational control** superior to a posterior slab alone, particularly in unstable ankle fractures (Brinker & O'Connor, 2021).

Contraindications

- **Open wounds** or infected soft tissues around the ankle
- **Gross deformity unreduced**
- **Compartment syndrome** or vascular compromise—requires emergency intervention
- **Circumferential swelling with neurovascular concern** (splint may mask worsening symptoms)
- **Need for circumferential immobilization** (e.g., post-surgical casting phase)

2. Surface Landmarks and Positioning

Anatomical Landmarks

- **Medial and lateral malleoli**
- **Base of the 5th metatarsal**
- **Calcaneus**
- **Achilles tendon**
- **Tibial shaft**

Functional Positioning

- **Ankle**: At 90° dorsiflexion (neutral)
- **Foot**: Aligned straight with tibial axis
- **Knee**: Slightly flexed (~15°) for patient comfort
- **Toes**: Exposed, visible for neurovascular checks

🧠 *Biomechanical Principle:* A stirrup maintains ankle neutral and provides **valgus/varus** control while allowing for swelling—ideal during acute injury phases (Norkin & Levangie, 2016).

3. Materials Checklist

- Gloves
- **Stockinette** (2–3 inch): From toes to just below the knee
- **Cast padding** (Webril): 2–3 layers, with extra at malleoli, heel, and Achilles
- **Fiberglass or plaster splinting material**: 4–6 inches wide, ~12–16 inches long (length varies based on patient size)
- **Elastic bandage** (3–4 inch): for securement
- Water basin (if using plaster)
- Scissors
- Pillow or bolster for leg support

4. Step-by-Step Application

Preparation

1. Explain procedure and obtain consent.
2. Position patient supine with leg extended and foot over edge of table or resting on bolster.
3. Ensure ankle is in **neutral dorsiflexion** with foot aligned.

Application

1. Apply stockinette, then 2–3 layers of padding—add extra to:
   1. Malleoli
   2. Heel and Achilles
   3. Lateral base of the 5th metatarsal
2. Measure and prepare splinting material:
   1. Start just above lateral malleolus → under heel → up to just above medial malleolus.
3. Activate (if plaster), remove excess water, and place **from one medial tibial border → under heel → to lateral tibial border**.
4. Gently mold around:
   1. Medial and lateral malleoli
   2. Heel cup
   3. Distal tibia contours
5. Wrap snugly with an elastic bandage in **distal to proximal** fashion, avoiding excessive compression.
6. Elevate leg on pillow and maintain ankle at 90° until splint hardens.

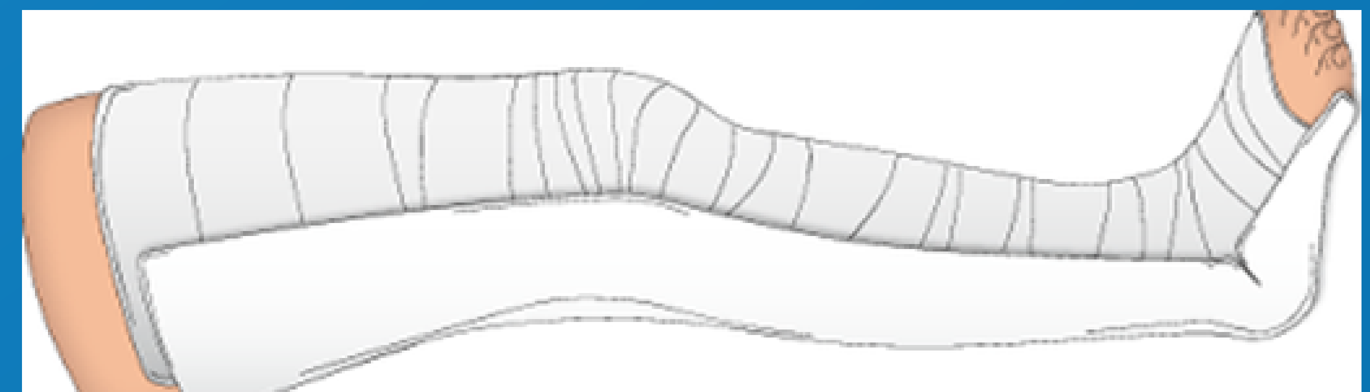
⚠️ *Tip:* The stirrup splint **does not extend to posterior calf**—do not use as posterior slab unless combined.

5. Post-Application Instructions

- **Elevate leg** to heart level or higher for first 24–48 hours.
- Keep **splint dry** and **do not bear weight** unless directed by orthopedic team.
- Check **capillary refill**, toe color, warmth, and sensation multiple times daily.
- Avoid tight socks or restrictive clothing around ankle.
- Return to care immediately if:
  - Toes become cold, blue, or numb
  - Pain worsens or swelling increases
  - Splint becomes wet or damaged

6. Complications to Avoid

Complication	Cause	Prevention
Pressure sores over malleoli	Inadequate padding	Add extra Webril at bony prominences
Loss of ankle neutral	Poor positioning during molding	Maintain 90° dorsiflexion until cure
Neurovascular compromise	Too-tight elastic wrap	Use 2-finger test and observe toes
Foot drop position	Excess plantarflexion	Position ankle in strict neutral
Skin maceration	Moisture under splint	Educate patient on dry care and covering



Long Leg Posterior Splint

1. Indications & Contraindications

Indications

- **Tibial shaft fractures** (nondisplaced or post-reduction)
- **Distal femur fractures**
- **Patellar fractures**
- **Knee dislocations** (post-reduction)
- **Ligamentous injuries** (ACL, PCL, MCL, LCL) in acute phase
- **Meniscal tears** requiring immobilization
- **Quadriceps or patellar tendon ruptures**
- **Post-operative immobilization of the knee or proximal tibia/fibula**

💡 *Clinical Insight:* This splint provides full immobilization from mid-thigh to ankle, protecting both the knee joint and tibia/fibula while allowing for swelling, making it ideal for early injury management (Brinker & O'Connor, 2021).

Contraindications

- **Compartment syndrome** (risk of obscuring swelling)
- **Open wounds requiring frequent inspection**
- **Circumferential swelling with neurovascular risk**
- **Unstable femoral shaft fractures requiring traction or ORIF**
- **Severe obesity or edema that may limit splint support and retention**

2. Surface Landmarks and Positioning

Anatomical Landmarks

- **Mid-thigh (proximal femur)**
- **Patella**
- **Tibial tuberosity**
- **Medial and lateral femoral/tibial condyles**
- **Malleoli**
- **Calcaneus and heel**

Functional Positioning

- **Knee**: 20–30° flexion (to reduce tension on posterior capsule and accommodate swelling)
- **Ankle**: 90° dorsiflexion (neutral position)
- **Hip**: Slight external rotation and support under thigh
- **Toes**: Fully visible, straight, and warm

🧠 *Biomechanical Rationale:* Gentle knee flexion improves comfort and helps avoid excessive posterior tension while keeping extensor mechanism protected (Norkin & Levangie, 2016).

3. Materials Checklist

- Gloves
- **Stockinette**: Toes to mid-thigh (~4–6 inch)
- **Cast padding/Webril**: 2–3 layers, with extra at malleoli, heel, patella, and popliteal fossa
- **Splinting material (plaster or fiberglass)**: 6–8 inch wide, 12–15 layers, cut to reach from heel to mid-thigh
- **Elastic bandage** (4–6 inch): For securement
- Water basin (for plaster)
- Scissors
- Pillow or foam wedge to support leg in flexion

4. Step-by-Step Application

Preparation

1. Explain procedure and confirm injury site.
2. Position patient supine, leg extended with knee slightly flexed (~20°) over a pillow or wedge.
3. Measure splint length from metatarsal heads → under heel → posterior calf and thigh → ~2 inches below gluteal crease.

Application

1. Apply stockinette from toes to mid-thigh; relieve tension at heel with a small "V" notch if needed.
2. Wrap Webril padding in 2–3 uniform layers, adding additional rolls at:
    1. **Heel**
    2. **Malleoli**
    3. **Popliteal fossa**
    4. **Patella**
    5. **Anterior tibia (shin)**
3. Prepare and activate splinting material; wring and fold if using plaster.
4. Lay splint **posteriorly**, starting at the **metatarsals**, cupping around heel, and continuing up to **mid-thigh**.
5. Mold carefully to:
    1. **Heel contour**
    2. **Calf**
    3. **Posterior knee**
    4. **Posterior thigh**
6. Secure splint with an **elastic bandage**, starting distal to proximal, ensuring even tension.
7. Hold ankle in **neutral dorsiflexion** and **knee flexion at 20–30°** until the splint hardens.

5. Post-Application Instructions

- **Do not bear weight** unless directed (use crutches or walker as needed).
- **Elevate leg** at or above heart level for 24–72 hours to reduce swelling.
- **Monitor toes** for color, temperature, movement, and sensation.
- Keep splint **dry**—cover during bathing and avoid submersion.
- Reposition patient periodically to reduce risk of pressure ulcers at heel and sacrum.
- Return for urgent reassessment if:
    - Numbness, tingling, or increasing pain
    - Blue, cold, or pale toes
    - Wet or damaged splint

📆 Follow-up typically within 5–7 days for repeat X-rays, swelling reassessment, and possible cast conversion.

6. Complications to Avoid

Complication	Cause	Prevention
Heel ulceration	Inadequate padding; prolonged pressure	
Neurovascular compromise	Tight wrap or swelling	
Anterior shin abrasions	Pressure from tight anterior wrap	
Popliteal pressure sores	Molded splint into posterior knee too tightly	
Excessive plantarflexion	Improper ankle positioning	

Chapter 9: Specialty & Pediatric Splints

Introduction

Introduction Pediatric and specialty splinting require a distinct clinical approach, informed by the unique anatomical, physiological, and behavioral characteristics of growing children and medically complex patients. Unlike adult populations, pediatric patients are in a continuous state of musculoskeletal development, with open physes (growth plates), more cartilaginous skeletal structures, and heightened tissue plasticity. These features not only influence fracture patterns but also alter how immobilization must be applied to ensure both efficacy and safety. Additionally, pediatric splinting intersects with developmental psychology, requiring tailored communication, behavioral strategies, and caregiver engagement to achieve compliance and therapeutic success.

Beyond age-related anatomy, this chapter also addresses splinting adaptations required in specialty populations—such as children with neurodevelopmental disorders, sensory integration challenges, or congenital limb differences. These patients often require modifications in technique, materials, and environment to reduce anxiety and support cooperation during immobilization procedures. For instance, tactile sensitivities, impaired expressive communication, or heightened reactivity to pain may necessitate nontraditional splinting workflows.

The successful application of pediatric or specialty splints extends beyond technical execution—it requires interdisciplinary awareness, family-centered care, and vigilant monitoring. Parents and caregivers must be empowered with education to recognize red flag symptoms, promote skin integrity, and maintain positioning. When done correctly, splinting in these populations not only stabilizes musculoskeletal injuries but also contributes to the child's overall comfort, trust in care, and long-term functional recovery. This chapter explores these considerations in depth, equipping the orthopedic technologist or clinician with evidence-based strategies for delivering safe, effective, and developmentally informed splint care.

Section 1:

Anatomical Growth Considerations and Physeal Protection

Children are not merely “small adults” when it comes to musculoskeletal anatomy and orthopedic management. Pediatric bones are actively growing, more porous, less mineralized, and possess a greater cartilaginous composition than adult bones. One of the most clinically significant distinctions is the presence of open growth plates, or physes, which serve as the primary centers of longitudinal bone development. These cartilaginous zones are biomechanically weaker than adjacent bone and are uniquely vulnerable to injury. Splinting in pediatric patients must account for these anatomical realities to avoid iatrogenic damage, growth disturbances, or deformity.

I. Growth Plate Anatomy and Physiology:

The physis is a multilayered, cartilaginous structure situated between the metaphysis and epiphysis of long bones. It is composed of five histologic zones:
1) Reserve (resting) zone

2) Proliferative zone

3) Hypertrophic zone

4) Calcification zone

5) Ossification zone

Each zone contributes to the regulated growth and elongation of bones. The hypertrophic and proliferative zones are particularly susceptible to shear and compressive forces—types of mechanical stress that splints must mitigate during immobilization. Clinical Note: Damage to the physis during splinting—either through poor positioning or inadequate padding—can lead to physeal arrest, resulting in premature closure, limb-length discrepancy, or angular deformity.

II. Age-Based Skeletal Development Considerations

• **Infants and Toddlers (0–3 years):** Epiphyses are largely cartilaginous; radiographs may not show complete joint surfaces. Splints should avoid placing rigid force across joints with visible deformity but no bony fracture on imaging.
• **Preschool to Early Childhood (3–8 years):** Rapid longitudinal bone growth occurs. Splint contact with the physis should be minimal and well-padded.
• **Late Childhood to Adolescence (9–16 years):** Physes begin to close in a distal-to-proximal and gender-dependent pattern (earlier in females). Injury to closing physes can create partial growth arrests and angular deformities.

III. Common Growth Plate Locations and Splinting Implications

Bone	Growth Plate Location	Implications for Splinting
Radius	Distal	Avoid excessive dorsiflexion/volar flexion in wrist splints
Ulna	Distal	Ulnar gutter must not impinge distal ulna or styloid
Humerus	Proximal and distal	Pad both epicondyles and greater tuberosity
Femur	Proximal and distal	Long leg splints should avoid posterior thigh compression
Tibia	Proximal and distal	Malleoli and tibial tubercle require padding
Fibula	Proximal and distal	Watch for peroneal nerve compression near fibular head
Metacarpals/Metatarsals	Base and head	Use flexible materials and avoid direct splint compression

IV. Salter-Harris Fractures and Immobilization

The Salter-Harris classification system helps describe the location and severity of physeal injuries: Type I: Fracture through physis only – often radiographically occult. Type II: Through physis and metaphysis – most common. Type III: Through physis and epiphysis – intra-articular. Type IV: Across metaphysis, physis, and epiphysis – risk of growth arrest. Type V: Crush injury of physis – least common but most serious. Management Tip: Types I and II may be treated conservatively with splints or casts; Types III–V often require orthopedic consultation and surgical evaluation due to risk of deformity.

V. Biomechanical Considerations for Physeal-Safe Splinting

• Avoid longitudinal pressure or torsional forces across growth plates. • Use extra padding at all physis-adjacent prominences (e.g., tibial tuberosity, distal radius). • In growing children, materials should accommodate tissue expansion and swelling, especially in the first 48 hours post-injury. • Choose low-temperature thermoplastics when possible for younger children, especially in hand/finger splints, to allow for more flexible control and easier adjustment. • When splinting across a joint containing an open physis, maintain neutral positioning to reduce mechanical strain.

VI. Imaging and Reassessment

Radiographs should be obtained both before and after splinting, especially in suspected physeal injury. Because some growth plate injuries are radiolucent, maintain a high index of suspicion when there is focal tenderness over the physis despite normal imaging or when swelling or joint effusion is disproportionate to clinical findings. Children with suspected or known physeal involvement should be reassessed within 5–7 days for alignment, healing progress, and potential need for orthopedic referral or conversion to a cast.

VII. Case Example: Distal Tibial Physeal Injury

A 12-year-old male soccer player presents with ankle pain after eversion injury. X-rays reveal a Salter-Harris II fracture of the distal tibia. The plan includes: Stirrup + posterior slab combination; heavy padding over medial/lateral malleoli and Achilles tendon; 90° ankle positioning; recheck in 3–5 days with repeat radiographs.

Conclusion

Proper splinting in pediatric patients hinges on understanding the physiology and vulnerability of growing bones. Growth plates demand careful protection from mechanical stress, compression, or improper alignment. A thorough knowledge of skeletal maturity patterns, splinting biomechanics, and age-specific adaptations enables clinicians to provide safe, effective immobilization while safeguarding the long-term development of the musculoskeletal system. Pediatric splinting is not just an orthopedic task—it is a precise act of developmental protection.

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Section 2:

Behavioral and Sensory Integration Adaptations

Successfully splinting pediatric and neurodiverse patients requires more than anatomical knowledge—it demands behavioral insight, sensory awareness, and flexible clinical technique. Many children, particularly those with autism spectrum disorder (ASD), attention-deficit/hyperactivity disorder (ADHD), sensory processing disorders (SPD), or cognitive developmental delays, may experience fear, anxiety, or physical discomfort during immobilization. Without appropriate behavioral adaptations, these patients may resist treatment, remove their splint prematurely, or experience psychological trauma. This section outlines clinical strategies to foster cooperation, build trust, and accommodate the individual needs of pediatric patients.

I. Understanding Pediatric Behavioral Responses

Pediatric patients interpret clinical procedures through the lens of developmental stage, previous experiences, and emotional maturity. A one-size-fits-all approach often fails to meet the needs of diverse pediatric populations.

Age Group	Common Reactions	Communication Tips
Toddlers (1–3 yrs)	Separation anxiety, fear of strangers, physical resistance	Use simple, reassuring phrases and involve caregivers
Preschool (3–5 yrs)	Imagination-driven fears, attention span limits	Offer choices (e.g., bandage color), use distraction toys
School Age (6–11 yrs)	Fear of pain, need for autonomy, peer awareness	Explain the purpose of splinting, encourage independence
Adolescents (12+)	Concern about appearance, privacy, autonomy	Use respectful language, offer detailed explanations

Clinical Insight: "Procedure fatigue" may occur in children with chronic conditions. Use positive reinforcement and create predictable routines during splinting procedures.

II. Sensory Challenges in Pediatric Patients

- Children with ASD or sensory processing disorders may be hypersensitive to:
- Touch (tactile defensiveness),
- Noise (auditory overload),
- Smell (sensory aversion to medical supplies),
- Light or movement.

Signs of Sensory Distress during Splinting

- Flinching or pulling away from materials,
- Crying, screaming, or covering ears,
- Rigid posture or shutdown,
- Repetitive or self-soothing movements such as rocking or humming.

III. Clinical Strategies for Sensory and Behavioral Accommodation

Environment-Based Modifications:

- Quiet, low-stimulus setting; reduce overhead lights and ambient noise.
- Consider weighted blankets, fidget tools, or deep pressure touch to increase comfort
- Allow time for the child to explore non-threatening materials beforehand (e.g., wrapping Webril around a stuffed animal)

Procedure-Based Strategies:

- Allow visual modeling by demonstrating splinting on a doll or caregiver’s hand.
- Provide step-by-step verbal explanations (“First I wrap your arm with soft cotton, then the special strip that keeps it safe.”).
- Let the child choose splint color, tape patterns, and names for the splint or decorated imagery

Collaborative Techniques:

- Involve the caregiver in comfort holding or verbal soothing;
- Provide positive reinforcement via sticker charts, praise, or a post-procedure reward;
- For repeated procedures, use social stories or picture schedules to prepare the child.

Tip: For children with severe tactile defensiveness, use low-temperature thermoplastics which can be applied quickly and molded with minimal material contact.

IV. Special Populations: Clinical Considerations

Children with Autism Spectrum Disorder (ASD):

- Avoid sudden touch or movement;
- Do not restrain unless absolutely necessary;
- Provide countdowns and warning before each step;
- Use “first-then” language (“First we place the padding, then you choose a color”).

Children with ADHD:

- Use shorter procedural steps;
- Provide kinesthetic breaks before splinting;
- Avoid overstimulating environments that increase fidgeting or impulsivity.

Children with Cognitive or Physical Disabilities:

- Adapt splints to accommodate limited range of motion;
- Provide custom padding or adaptive straps;
- Position the limb in neutral if cooperation is limited.

V. Multidisciplinary Collaboration

Work with:

Child life specialists to develop individualized procedural plans;

Occupational therapists for long-term splint wear compliance in sensory-sensitive children; and

Behavioral therapists or caregivers to ensure carryover of strategies at home.

Integrating Anatomy, Behavior, and Family-Centered Care

Managing orthopedic concerns in pediatric and adolescent populations demands a comprehensive, developmentally attuned approach that integrates anatomical precision, behavioral insight, and collaborative caregiver communication. Unlike adults, children are undergoing continuous skeletal growth and neuromuscular development, making them uniquely susceptible to both acute injury and long-term iatrogenic harm if immobilization is improperly applied. Growth plates—non-ossified, metabolically active regions—must be protected from compression, misalignment, or rotational forces to prevent growth disturbances, angular deformity, or premature closure.

Moreover, splinting children and adolescents goes beyond physical stabilization. The clinician must engage in thoughtful behavioral management, particularly for patients with heightened anxiety, sensory sensitivities, or neurodevelopmental conditions. Adaptations in communication style, procedural pacing, and environmental control are often necessary to ensure a safe and positive experience for both the patient and family. These behavioral techniques not only enhance cooperation during the procedure but can also reduce psychological trauma, which may otherwise hinder follow-up compliance or contribute to care avoidance in future encounters.

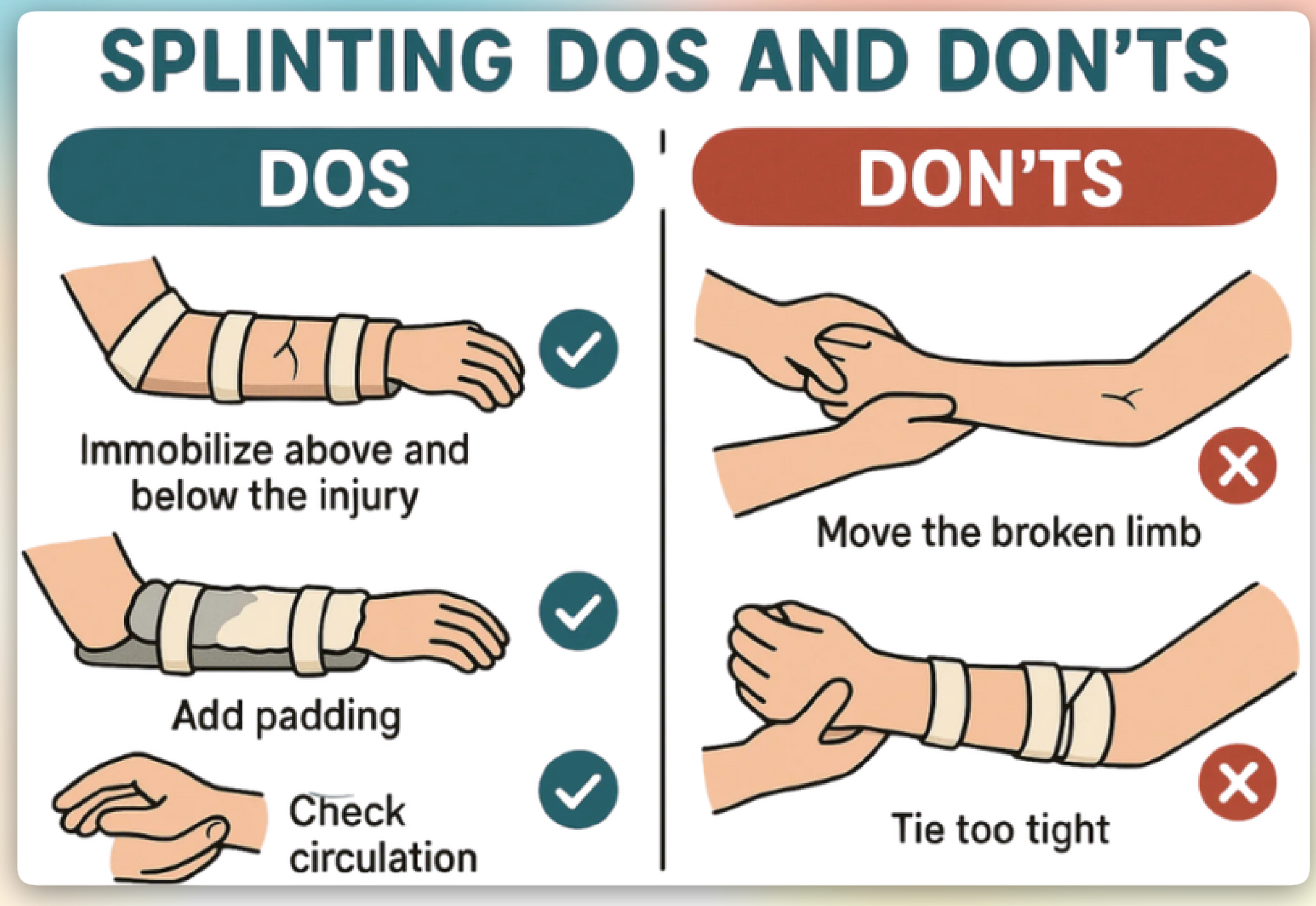
The pivotal role of caregivers cannot be overstated. Pediatric splinting outcomes are tightly linked to post-application monitoring, adjustment, and caregiver education. Providing clear, accessible instructions on splint care, neurovascular symptom recognition, and appropriate activity limitations helps prevent complications and supports optimal healing. Tools such as red flag symptom checklists, pediatric observation logs, and pictorial instructions empower families and foster shared responsibility in recovery.

In essence, pediatric orthopedic splinting is not simply the miniaturization of adult techniques—it is a nuanced, multi-dimensional process requiring specialized anatomical knowledge, adaptive procedural skills, and a deeply patient-centered mindset. Orthopedic technologists and clinicians who master these competencies are uniquely positioned to protect musculoskeletal development, reduce trauma, and positively impact the lifelong orthopedic health of the children they serve.

Conclusion

Behavioral and sensory adaptations in pediatric splinting are essential to achieving safe, effective immobilization. By understanding the unique neurological, developmental, and emotional profiles of young patients, orthopedic clinicians can modify both the clinical environment and procedure to foster trust and cooperation. Beyond achieving technical success, these strategies contribute to a child’s long-term comfort, psychological safety, and engagement in care. When splinting becomes a personalized and inclusive experience, resistance diminishes and outcomes improve

Chapter 10: Common Complications in Splinting



Section A: Skin Complications

Overview

Skin complications are among the most frequent and preventable adverse effects associated with orthopedic splinting. While splints are designed to immobilize and protect injured musculoskeletal structures, they also introduce risk to the integumentary system—especially when improperly applied, inadequately padded, or left unmonitored. The unique vulnerability of skin over bony prominences, in patients with impaired mobility or sensation, or under high-pressure zones makes it essential that clinicians approach splinting with a skin-first safety mindset.

I. Pressure Injuries (Pressure Ulcers)

Pathophysiology: Pressure ulcers occur when sustained mechanical force over a localized area exceeds capillary closing pressure, impeding tissue perfusion and leading to ischemia, necrosis, and ulceration. Bony prominences under rigid splint material are especially susceptible.

Common Sites:

- Heel (calcaneus)
- Olecranon process
- Ulnar styloid
- Lateral malleolus
- Medial femoral condyle (long leg splints)

Risk Factors:

- Inadequate padding
- Excessive circumferential pressure
- Fragile skin (elderly, malnourished, corticosteroid use)
- Prolonged wear without inspection

Prevention:

- Always pad pressure points thoroughly, especially over bony prominences.
- Use posterior slab splints with heel cut-outs when immobilizing the ankle.
- Reassess splint fit and skin integrity within 24–48 hours.
- Educate caregivers and patients on signs of early skin breakdown (redness, warmth, tenderness).

II. Maceration and Moisture-Associated Skin Damage (MASD)

Pathophysiology: Moisture trapped between the skin and splint material—whether from sweat, wound exudate, or incontinence—leads to epidermal breakdown, softening, and increased permeability to bacteria and irritants.

Clinical Signs:

- Pale, wrinkled, or waterlogged skin
- Foul odor
- Excoriation and skin peeling
- Pruritus or stinging sensation

Common Scenarios:

- Fiberglass splints applied while skin is still damp from wound cleansing
- Warm climates with excessive sweating beneath splints
- Pediatric patients with diaper leaks affecting lower limb splints

Prevention:

- Ensure the skin is completely dry before splint application.
- Use moisture-wicking stockinette material.
- Avoid occlusive wrapping in warm, humid environments.
- In high-risk patients, implement a scheduled splint removal and skin inspection protocol.

III. Allergic Contact Dermatitis

Etiology: Contact dermatitis arises from a type IV hypersensitivity reaction to adhesives, padding, or resin components found in some splinting materials.

Common Allergens:

- Latex (stockinettes, gloves)
- Adhesive tape (e.g., benzoin, acrylate adhesives)
- Resin in thermoplastic or fiberglass

Presentation:

- Localized erythema, pruritus, or blistering at the contact site
- Delayed onset (24–72 hours after exposure)
- May mimic early cellulitis or maceration

Prevention & Management:

- Screen for material allergies in advance.
- Use hypoallergenic materials (e.g., latex-free gloves, cotton padding).
- Discontinue contact with the allergen and apply topical corticosteroids if needed.
- Document any adverse reaction in the patient record for future reference.

IV. Friction and Shear Injuries

Pathophysiology: Friction occurs when two surfaces rub against each other; shear occurs when skin remains stationary while underlying tissue moves in the opposite direction—both lead to blistering, abrasions, or deep-tissue damage.

Mechanisms in Splinting:

- Movement of loosely applied splint material over the skin
- Misaligned joints causing rubbing within the splint
- Patients moving independently without instruction

Prevention:

- Secure splints snugly (but not tightly) to prevent movement.
- Confirm joint alignment with anatomical landmarks.
- Provide weight-bearing restrictions when necessary to minimize movement.

V. Thermal Burns

Etiology: Exothermic reactions during plaster curing can cause thermal injury, particularly in pediatric or geriatric patients with thin skin or sensory deficits.

High-Risk Scenarios:

- Using overly hot water to activate plaster
- Applying thick plaster layers without allowing heat dissipation
- Wrapping insulating material too tightly over fresh plaster

Clinical Signs:

- Immediate discomfort, burning sensation
- Erythema, blistering beneath splint site
- Patient reports “hot” sensation during or immediately after application

Prevention:

- Use lukewarm water (not to exceed 24–27°C or 75–80°F).
- Limit plaster layers to 8–12 strips max per slab.
- Monitor plaster temperature during setting, particularly in infants and elderly patients.

Conclusion

Skin complications, though often preventable, are a significant cause of discomfort, morbidity, and potential legal liability in orthopedic splinting. Whether due to pressure, moisture, allergic response, or mechanical error, skin breakdown not only undermines healing but can lead to secondary infections, delayed recovery, and loss of patient trust. Orthopedic technologists and clinicians must apply a skin-protective mindset throughout the splinting process—prioritizing appropriate materials, sound technique, frequent reassessment, and education of both patients and caregivers. Mastery of these preventative strategies is essential to ensure splinting not only immobilizes injury, but also safeguards the skin as the body's first defense in recovery.

Section B: Neurovascular Compromise

Overview

Neurovascular compromise is among the most serious and potentially irreversible complications associated with splint application. Failure to promptly identify and correct compression of neural or vascular structures can result in nerve palsy, limb ischemia, compartment syndrome, or even amputation. Because splints—especially circumferential or poorly padded constructs—have the potential to constrict soft tissues, orthopedic technologists and clinicians must maintain constant vigilance in both the application and monitoring of splints. A complete neurovascular assessment must precede and follow every splint application.

I. Pathophysiology of Neurovascular Compromise

Neurovascular compromise arises when excessive external pressure, limb malpositioning, or internal tissue swelling interferes with:

- **Arterial inflow**: leading to ischemia and tissue necrosis
- **Venous return**: resulting in congestion, edema, and increased compartment pressure
- **Neural conduction**: causing paresthesia, motor weakness, or neuropraxia

Causes of compromise in splinting include:

- Overly tight bandaging or rigid splint material
- Inadequate space for post-injury swelling
- Improper joint positioning that stretches or compresses nerves
- External compression of neurovascular zones (e.g., ulnar nerve at the elbow)

II. High-Risk Anatomical Sites

Region	Structure at Risk	Common Mechanism
Elbow	Ulnar nerve (cubital tunnel)	Posterior slab pressing medially
Forearm/wrist	Median nerve (carpal tunnel)	Volar splints with excessive wrist flexion
Leg	Common peroneal nerve (fibular neck)	Long-leg splints compressing laterally
Ankle	Posterior tibial artery, dorsalis pedis artery	Ankle stirrup with circumferential wrapping
Hand/Fingers	Digital nerves and vessels	Improper padding at MCP or PIP joints

💡 *Clinical Tip:* Always palpate and document dorsal pedal and posterior tibial pulses before and after lower leg splinting.

III. Clinical Assessment of Neurovascular Status

A complete **neurovascular examination** includes the "6 Ps":

1. **Pain**: Disproportionate to injury, worsens with passive stretch
2. **Pallor**: Pale or cyanotic skin compared to contralateral side
3. **Pulselessness**: Diminished or absent distal pulses
4. **Paresthesia**: Numbness, tingling, or burning sensations
5. **Paralysis**: Motor dysfunction or inability to move digits
6. **Poikilothermia**: Limb feels cooler than unaffected side

Documentation should include:

- Capillary refill (<2 seconds is normal)
- Pulse quality (present/absent, strong/weak)
- Sensory testing (light touch, two-point discrimination)
- Motor testing (active flexion/extension of fingers or toes)

IV. Compartment Syndrome: A Time-Sensitive Emergency

Definition:A condition where increased pressure within a confined fascial space impairs circulation and threatens limb viability.

Classic signs ("6 Ps") often appear late. Early indicators include:

- Intense, escalating pain out of proportion
- Pain with passive stretch of affected muscle group
- Paresthesia or altered sensation

Most common locations:

- Anterior leg compartment
- Volar forearm

Clinical Response:

- Immediately loosen or bivalve the splint
- Elevate the limb to heart level (not above)
- Notify physician/surgeon for emergent fasciotomy evaluation

⏱️ *Urgency Warning:* Irreversible muscle and nerve damage can occur within 6–8 hours of onset.

V. Prevention Strategies

- Use the **two-finger test**: you should be able to insert two fingers under the edge of the splint
- Leave **distal digits exposed** to monitor color, swelling, and temperature
- Avoid circumferential wraps when unnecessary (use posterior slabs instead)
- Always **pad bony prominences and neurovascular corridors**
- Reassess NV status:
    - **Immediately** after application
    - At **15–30 minutes**
    - At **1–2 hours** post-application
    - At **every shift** (in inpatient settings)
- Educate patients and caregivers on **red flag symptoms** (numbness, coolness, color change, severe pain)

VI. Pediatric and Geriatric Considerations

- **Pediatric patients** may not verbalize symptoms clearly; observe for fussiness, withdrawal, or refusal to use the limb.
- **Geriatric patients** with vascular disease or thin skin are at higher risk of silent ischemia.
- Use **extra padding and lower-tension wraps** in both populations.

VII. Documentation of Neurovascular Monitoring

- Use standard documentation templates or flowcharts.
- Always include:
    - Pre- and post-splint NV status
    - Which digits were exposed
    - Patient-reported symptoms
    - Any modifications made during follow-up

Conclusion

Neurovascular compromise is one of the most critical complications that can occur after splint application. Its prevention depends on precise anatomical knowledge, careful technique, and diligent monitoring. Orthopedic clinicians and technologists must not only be proficient in identifying early warning signs but also be prepared to respond immediately to changes in distal perfusion or nerve function. Incorporating a structured NV assessment protocol into routine practice—along with patient and caregiver education—can prevent life-altering outcomes such as nerve palsy or limb loss. In every splint applied, circulation and sensation must remain the clinician's top priority.

Section C: Mechanical and Functional Failures

Overview

Mechanical and functional failures in splinting compromise the therapeutic purpose of immobilization and may lead to delayed healing, persistent pain, deformity, or reinjury. Unlike complications related to skin or neurovascular integrity, mechanical failures typically result from flaws in application technique, material selection, or anatomical misalignment. In functional terms, a splint must maintain biomechanical positioning, resist external forces, and support safe transition to recovery. Failure in any of these domains may render the splint ineffective—or worse—harmful.

Orthopedic technologists and clinicians must understand the mechanical principles that govern immobilization, including force distribution, joint leverage, and load absorption. Functional failures often stem from avoidable mistakes such as loose application, incorrect angulation, or poor material conformity. This section explores common mechanical complications, their consequences, and actionable strategies to prevent them.

I. Slippage, Loosening, and Loss of Immobilization

Description:A splint that shifts from its intended position or loosens with motion no longer provides adequate immobilization and may cause friction injuries or secondary instability.

Contributing Factors:

- Inadequate conforming of splint material to limb contours
- Improper anchoring with straps, fasteners, or wrap
- Failure to secure across joint axes or leverage points
- Excess swelling reduction post-injury (leading to volume mismatch)

Clinical Signs:

- Visible misalignment of the splint on the limb
- Loss of intended joint positioning or angulation
- Patient reports of “wobbling” or instability
- Increased pain or apprehension with limb motion

Prevention:

- Anchor the splint securely above and below the injured joint
- Reassess and re-wrap if swelling decreases significantly
- Use adjustable straps when possible to accommodate volume changes
- Confirm fit and alignment after 5–10 minutes of wear or with gravity stress

II. Improper Joint Positioning

Description: Incorrect joint angulation reduces therapeutic value and can lead to ligament shortening, capsular contracture, or impaired functional recovery.

Examples:

- Wrist splinted in flexion instead of extension → Weak grip mechanics
- MCP joints immobilized in extension → Collateral ligament contracture
- Knee splinted in excess flexion → Flexion deformity

Consequences:

- Joint stiffness or fixed contractures
- Loss of functional arc of motion
- Prolonged rehabilitation due to adaptive shortening

Prevention:

- Use anatomical guidelines for ideal joint positioning (e.g., 90° elbow, 30° wrist extension)
- Reference contralateral limb for natural resting angles
- Include functional positioning checklists during application

III. Incomplete Immobilization (Joint Above and Below Not Stabilized)

Description: Fractures or soft tissue injuries require immobilization of the **bone and the adjacent joints**—failure to do so allows rotational or shear forces to persist across the injury.

Common Mistakes:

- Distal radius fracture splinted without elbow control (short splint)
- Tibial shaft injury stabilized without knee support

Resulting Complications:

- Malunion or nonunion of fracture
- Continued motion at injury site → microtrauma
- Need for surgical intervention due to failed conservative treatment

Prevention:

- Follow the rule: "**Immobilize the joint above and below the injury site**"
- Apply splints long enough to restrict primary and secondary axes of motion
- Reinforce splints with rigid backboards or joint stabilizers when needed

IV. Inadequate Load Distribution and Stress Risers

Description: When splints are unevenly applied or focus pressure over a narrow area, they create "stress risers" that amplify force and can cause secondary injury.

Mechanisms:

- Rigid splint edges pressing over soft tissue (ulnar border, gastrocnemius belly)
- Weight-bearing through improperly distributed contact points
- Cast shoes or walking boots without proper rocker support

Clinical Sequelae:

- Stress fractures
- Tendinopathy or myofascial pain
- Unrelieved pain with activity or ambulation

Prevention:

- Contour splint to the full surface of the limb
- Pad transitions between splint layers to eliminate focal ridges
- Avoid edge pressure and confirm symmetry of the immobilizer
- For lower limb splints, consider gait training referral to avoid asymmetric stress

V. Fatigue or Failure of Splinting Materials

Description: Over time, materials can degrade due to moisture, repeated load cycles, or improper storage. Thermoplastics may deform; padding may compress; fiberglass may delaminate.

Indicators:

- Visible cracking or peeling of splint
- Excessive flexibility or loss of rigidity
- Delamination or bubbling in fiberglass constructs

Implications:

- Decreased limb support
- Compromised safety during ambulation
- Recurrent injury or instability

Prevention:

- Choose materials based on weight-bearing expectations and activity level
- Use manufacturer guidelines for use duration and integrity checks
- Reinforce critical zones with additional layers if extended use is anticipated
- Schedule routine splint reassessment in chronic or outpatient cases

VI. Behavioral or Environmental Influences on Function

Description: Even well-applied splints can fail functionally if the patient misuses or alters them. Pediatric or cognitively impaired patients may tamper with devices, while environmental factors like humidity or extreme temperature may warp thermoplastics.

Strategies:

- Educate patients/families on splint care, activity restrictions, and consequences of misuse
- Reinforce pediatric splints with additional security (Velcro tabs, fabric sleeves)
- Avoid thermoplastics in high-heat environments unless protected

Conclusion

Mechanical and functional failures are preventable complications that often stem from overlooked details in splint application, anatomical inaccuracy, or poor follow-up. These failures jeopardize healing and can lead to prolonged disability, chronic pain, or unnecessary surgical intervention. Orthopedic technologists must possess more than the ability to mold or apply a splint—they must apply biomechanical insight, understand functional anatomy, and anticipate patient-specific variables. Every splint should be evaluated not only for its fit and appearance but for its performance over time. Vigilance, quality materials, and patient education form the triad for effective splint functionality.

Introduction

Introduction Pediatric and specialty splinting require a distinct clinical approach, informed by the unique anatomical, physiological, and behavioral characteristics of growing children and medically complex patients. Unlike adult populations, pediatric patients are in a continuous state of musculoskeletal development, with open physes (growth plates), more cartilaginous skeletal structures, and heightened tissue plasticity. These features not only influence fracture patterns but also alter how immobilization must be applied to ensure both efficacy and safety. Additionally, pediatric splinting intersects with developmental psychology, requiring tailored communication, behavioral strategies, and caregiver engagement to achieve compliance and therapeutic success.

Beyond age-related anatomy, this chapter also addresses splinting adaptations required in specialty populations—such as children with neurodevelopmental disorders, sensory integration challenges, or congenital limb differences. These patients often require modifications in technique, materials, and environment to reduce anxiety and support cooperation during immobilization procedures. For instance, tactile sensitivities, impaired expressive communication, or heightened reactivity to pain may necessitate nontraditional splinting workflows.

The successful application of pediatric or specialty splints extends beyond technical execution—it requires interdisciplinary awareness, family-centered care, and vigilant monitoring. Parents and caregivers must be empowered with education to recognize red flag symptoms, promote skin integrity, and maintain positioning. When done correctly, splinting in these populations not only stabilizes musculoskeletal injuries but also contributes to the child's overall comfort, trust in care, and long-term functional recovery. This chapter explores these considerations in depth, equipping the orthopedic technologist or clinician with evidence-based strategies for delivering safe, effective, and developmentally informed splint care.

Section 1:

Anatomical Growth Considerations and Physeal Protection

Children are not merely "small adults" when it comes to musculoskeletal anatomy and orthopedic management. Pediatric bones are actively growing, more porous, less mineralized, and possess a greater cartilaginous composition than adult bones. One of the most clinically significant distinctions is the presence of open growth plates, or physes, which serve as the primary centers of longitudinal bone development. These cartilaginous zones are biomechanically weaker than adjacent bone and are uniquely vulnerable to injury. Splinting in pediatric patients must account for these anatomical realities to avoid iatrogenic damage, growth disturbances, or deformity.

I. Growth Plate Anatomy and Physiology:

The physis is a multilayered, cartilaginous structure situated between the metaphysis and epiphysis of long bones. It is composed of five histologic zones:
1) Reserve (resting) zone

2) Proliferative zone

3) Hypertrophic zone

4) Calcification zone

5) Ossification zone

Each zone contributes to the regulated growth and elongation of bones. The hypertrophic and proliferative zones are particularly susceptible to shear and compressive forces—types of mechanical stress that splints must mitigate during immobilization. Clinical Note: Damage to the physis during splinting—either through poor positioning or inadequate padding—can lead to physeal arrest, resulting in premature closure, limb-length discrepancy, or angular deformity.

II. Age-Based Skeletal Development Considerations

• **Infants and Toddlers (0–3 years):** Epiphyses are largely cartilaginous; radiographs may not show complete joint surfaces. Splints should avoid placing rigid force across joints with visible deformity but no bony fracture on imaging.
• **Preschool to Early Childhood (3–8 years):** Rapid longitudinal bone growth occurs. Splint contact with the physis should be minimal and well-padded.
• **Late Childhood to Adolescence (9–16 years):** Physes begin to close in a distal-to-proximal and gender-dependent pattern (earlier in females). Injury to closing physes can create partial growth arrests and angular deformities.

III. Common Growth Plate Locations and Splinting Implications

Bone	Growth Plate Location	Implications for Splinting
Radius	Distal	Avoid excessive dorsiflexion/volar flexion in wrist splints
Ulna	Distal	Ulnar gutter must not impinge distal ulna or styloid
Humerus	Proximal and distal	Pad both epicondyles and greater tuberosity
Femur	Proximal and distal	Long leg splints should avoid posterior thigh compression
Tibia	Proximal and distal	Malleoli and tibial tubercle require padding
Fibula	Proximal and distal	Watch for peroneal nerve compression near fibular head
Metacarpals/Metatarsals	Base and head	Use flexible materials and avoid direct splint compression

IV. Salter-Harris Fractures and Immobilization

The Salter-Harris classification system helps describe the location and severity of physeal injuries: Type I: Fracture through physis only – often radiographically occult. Type II: Through physis and metaphysis – most common. Type III: Through physis and epiphysis – intra-articular. Type IV: Across metaphysis, physis, and epiphysis – risk of growth arrest. Type V: Crush injury of physis – least common but most serious. Management Tip: Types I and II may be treated conservatively with splints or casts; Types III–V often require orthopedic consultation and surgical evaluation due to risk of deformity.

V. Biomechanical Considerations for Physeal-Safe Splinting

• Avoid longitudinal pressure or torsional forces across growth plates. • Use extra padding at all physis-adjacent prominences (e.g., tibial tuberosity, distal radius). • In growing children, materials should accommodate tissue expansion and swelling, especially in the first 48 hours post-injury. • Choose low-temperature thermoplastics when possible for younger children, especially in hand/finger splints, to allow for more flexible control and easier adjustment. • When splinting across a joint containing an open physis, maintain neutral positioning to reduce mechanical strain.

VI. Imaging and Reassessment

Radiographs should be obtained both before and after splinting, especially in suspected physeal injury. Because some growth plate injuries are radiolucent, maintain a high index of suspicion when there is focal tenderness over the physis despite normal imaging or when swelling or joint effusion is disproportionate to clinical findings. Children with suspected or known physeal involvement should be reassessed within 5–7 days for alignment, healing progress, and potential need for orthopedic referral or conversion to a cast.

VII. Case Example: Distal Tibial Physeal Injury

A 12-year-old male soccer player presents with ankle pain after eversion injury. X-rays reveal a Salter-Harris II fracture of the distal tibia. The plan includes: Stirrup + posterior slab combination; heavy padding over medial/lateral malleoli and Achilles tendon; 90° ankle positioning; recheck in 3–5 days with repeat radiographs.

Conclusion

Proper splinting in pediatric patients hinges on understanding the physiology and vulnerability of growing bones. Growth plates demand careful protection from mechanical stress, compression, or improper alignment. A thorough knowledge of skeletal maturity patterns, splinting biomechanics, and age-specific adaptations enables clinicians to provide safe, effective immobilization while safeguarding the long-term development of the musculoskeletal system. Pediatric splinting is not just an orthopedic task—it is a precise act of developmental protection.

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Section 2:

Behavioral and Sensory Integration Adaptations

Successfully splinting pediatric and neurodiverse patients requires more than anatomical knowledge—it demands behavioral insight, sensory awareness, and flexible clinical technique. Many children, particularly those with autism spectrum disorder (ASD), attention-deficit/hyperactivity disorder (ADHD), sensory processing disorders (SPD), or cognitive developmental delays, may experience fear, anxiety, or physical discomfort during immobilization. Without appropriate behavioral adaptations, these patients may resist treatment, remove their splint prematurely, or experience psychological trauma. This section outlines clinical strategies to foster cooperation, build trust, and accommodate the individual needs of pediatric patients.

I. Understanding Pediatric Behavioral Responses

Pediatric patients interpret clinical procedures through the lens of developmental stage, previous experiences, and emotional maturity. A one-size-fits-all approach often fails to meet the needs of diverse pediatric populations.

Age Group	Common Reactions	Communication Tips
Toddlers (1–3 yrs)	Separation anxiety, fear of strangers, physical resistance	Use simple, reassuring phrases and involve caregivers
Preschool (3–5 yrs)	Imagination-driven fears, attention span limits	Offer choices (e.g., bandage color), use distraction toys
School Age (6–11 yrs)	Fear of pain, need for autonomy, peer awareness	Explain the purpose of splinting, encourage independence
Adolescents (12+)	Concern about appearance, privacy, autonomy	Use respectful language, offer detailed explanations

Clinical Insight: “Procedure fatigue” may occur in children with chronic conditions. Use positive reinforcement and create predictable routines during splinting procedures.

II. Sensory Challenges in Pediatric Patients

- Children with ASD or sensory processing disorders may be hypersensitive to:
- Touch (tactile defensiveness),
- Noise (auditory overload),
- Smell (sensory aversion to medical supplies),
- Light or movement.

Signs of Sensory Distress during Splinting

- Flinching or pulling away from materials,
- Crying, screaming, or covering ears,
- Rigid posture or shutdown,
- Repetitive or self-soothing movements such as rocking or humming.

III. Clinical Strategies for Sensory and Behavioral Accommodation

Environment-Based Modifications:

- Quiet, low-stimulus setting; reduce overhead lights and ambient noise.
- Consider weighted blankets, fidget tools, or deep pressure touch to increase comfort
- Allow time for the child to explore non-threatening materials beforehand (e.g., wrapping Webril around a stuffed animal)

Procedure-Based Strategies:

- Allow visual modeling by demonstrating splinting on a doll or caregiver's hand.
- Provide step-by-step verbal explanations ("First I wrap your arm with soft cotton, then the special strip that keeps it safe.").
- Let the child choose splint color, tape patterns, and names for the splint or decorated imagery

Collaborative Techniques:

- Involve the caregiver in comfort holding or verbal soothing;
- Provide positive reinforcement via sticker charts, praise, or a post-procedure reward;
- For repeated procedures, use social stories or picture schedules to prepare the child.

Tip: For children with severe tactile defensiveness, use low-temperature thermoplastics which can be applied quickly and molded with minimal material contact.

IV. Special Populations: Clinical Considerations

Children with Autism Spectrum Disorder (ASD):

- Avoid sudden touch or movement;
- Do not restrain unless absolutely necessary;
- Provide countdowns and warning before each step;
- Use "first-then" language ("First we place the padding, then you choose a color").

Children with ADHD:

- Use shorter procedural steps;
- Provide kinesthetic breaks before splinting;
- Avoid overstimulating environments that increase fidgeting or impulsivity.

Children with Cognitive or Physical Disabilities:

- Adapt splints to accommodate limited range of motion;
- Provide custom padding or adaptive straps;
- Position the limb in neutral if cooperation is limited.

V. Multidisciplinary Collaboration

Work with:

Child life specialists to develop individualized procedural plans;

Occupational therapists for long-term splint wear compliance in sensory-sensitive children; and

Behavioral therapists or caregivers to ensure carryover of strategies at home.

Integrating Anatomy, Behavior, and Family-Centered Care

Managing orthopedic concerns in pediatric and adolescent populations demands a comprehensive, developmentally attuned approach that integrates anatomical precision, behavioral insight, and collaborative caregiver communication. Unlike adults, children are undergoing continuous skeletal growth and neuromuscular development, making them uniquely susceptible to both acute injury and long-term iatrogenic harm if immobilization is improperly applied. Growth plates—non-ossified, metabolically active regions—must be protected from compression, misalignment, or rotational forces to prevent growth disturbances, angular deformity, or premature closure.

Moreover, splinting children and adolescents goes beyond physical stabilization. The clinician must engage in thoughtful behavioral management, particularly for patients with heightened anxiety, sensory sensitivities, or neurodevelopmental conditions. Adaptations in communication style, procedural pacing, and environmental control are often necessary to ensure a safe and positive experience for both the patient and family. These behavioral techniques not only enhance cooperation during the procedure but can also reduce psychological trauma, which may otherwise hinder follow-up compliance or contribute to care avoidance in future encounters.

The pivotal role of caregivers cannot be overstated. Pediatric splinting outcomes are tightly linked to post-application monitoring, adjustment, and caregiver education. Providing clear, accessible instructions on splint care, neurovascular symptom recognition, and appropriate activity limitations helps prevent complications and supports optimal healing. Tools such as red flag symptom checklists, pediatric observation logs, and pictorial instructions empower families and foster shared responsibility in recovery.

In essence, pediatric orthopedic splinting is not simply the miniaturization of adult techniques—it is a nuanced, multi-dimensional process requiring specialized anatomical knowledge, adaptive procedural skills, and a deeply patient-centered mindset. Orthopedic technologists and clinicians who master these competencies are uniquely positioned to protect musculoskeletal development, reduce trauma, and positively impact the lifelong orthopedic health of the children they serve.

Conclusion

Behavioral and sensory adaptations in pediatric splinting are essential to achieving safe, effective immobilization. By understanding the unique neurological, developmental, and emotional profiles of young patients, orthopedic clinicians can modify both the clinical environment and procedure to foster trust and cooperation. Beyond achieving technical success, these strategies contribute to a child's long-term comfort, psychological safety, and engagement in care. When splinting becomes a personalized and inclusive experience, resistance diminishes and outcomes improve

Chapter 11: Troubleshooting and Modification Techniques

Section A: Splint Adjustment Strategies

Overview

Even the most precisely applied orthopedic splint may require modifications during the healing process. Changes in limb volume, patient activity, or splint integrity can reduce the effectiveness of immobilization or cause new complications. The ability to identify, assess, and safely adjust a splint is essential to maintaining therapeutic alignment, protecting soft tissues, and enhancing patient comfort.

This section provides actionable strategies for adapting splints after application, focusing on three key challenges: **(1) swelling and volume fluctuations**, **(2) re-padding and reshaping of thermoplastics**, and **(3) stabilization of loose or unstable splints**. Each of these scenarios demands clinical judgment, patient communication, and material competency.

I. Managing Swelling and Volume Changes

Clinical Context:

Post-injury or post-operative swelling typically peaks within 48–72 hours. As inflammation resolves, the limb may reduce significantly in girth, leading to a loose-fitting splint that no longer immobilizes effectively.

Signs of Volume Change:

- Splint moves independently from limb
- Gaps appear between padding and skin
- Patients report instability or “slippage”
- Loss of contact at key support points (e.g., heel, wrist, elbow)

Adjustment Strategies:

- **Re-wrap with elastic bandage**: Apply a fresh ACE wrap or cohesive bandage more snugly (without increasing circumferential pressure).
- **Add additional padding**: Insert extra cotton roll or foam layers, especially at the splint-limb interface.
- **Switch to a molded thermoplastic device**: In cases of significant edema reduction, consider replacing the splint entirely with a custom-contoured orthosis.
- **Patient Reassessment Timeline**: Schedule a recheck within 48–72 hours in acute injuries to assess fit and function.

🔎 *Note:* Never attempt to tighten or compress a splint in a patient with active swelling without reassessing neurovascular status.

II. Re-padding or Reshaping Thermoplastics

Clinical Context:

Thermoplastic splints, common in upper extremity and pediatric applications, are valued for their ability to be reheated and remolded. However, improper handling during adjustments can compromise both fit and structural integrity.

Reasons for Modification:

- Pressure points develop (skin irritation or redness)
- Joint alignment needs refinement (especially in dynamic joints)
- Patient reports discomfort, friction, or pinching

Techniques:

- **Spot Heating with a Heat Gun**: Use a localized heat source (e.g., heat gun at low setting) to soften a specific region without deforming the entire splint.
- **Full Remolding via Water Bath**: Reheat the splint in 160°F (70°C) water for 1–2 minutes, reshape to anatomical contours using standard precautions.
- **Padding Substitution**: Replace worn, adhesive-based padding (e.g., moleskin or foam) using hypoallergenic, breathable options.
- **Edge Flanging:** Roll back sharp or uncomfortable edges using partial heating and manual contouring with gloves or molding tools.

⚠️ *Clinical Caution:* Overheating thermoplastics may alter material integrity. Never apply heated thermoplastics directly to skin—always use a protective stockinette.

III. Securing Loose or Unstable Splints

Clinical Context:

Splints must remain snug and immobile to serve their purpose. Looseness can stem from inadequate anchoring, user tampering (especially in pediatrics), or changes in limb volume.

Stabilization Techniques:

- **Reinforcement Straps**: Add hook-and-loop Velcro straps across key regions (proximal and distal to joint).
- **Elastic Sleeve Overlay**: Use a tubular elastic netting or compression sleeve to maintain contact and prevent migration.
- **Splint Overwrapping**: Use self-adherent wrap to bind the splint tighter without excessive constriction.
- **Splint Lock Systems**: In pediatrics or cognitively impaired patients, use tamper-resistant locking tabs or specialty orthotic fasteners.

Behavioral Strategies (for repeat tampering):

- Engage caregivers in splint monitoring and explain injury risks
- Reinforce splints during sleep or activity periods
- Use distraction techniques or incentive plans for compliance (especially in pediatric patients)

✅ *Tip:* Involve the patient in adjustment decisions where appropriate. Empowering them increases compliance and comfort.

Documentation of Modifications

Every splint adjustment should be clearly documented in the medical record, including:

- Reason for modification (e.g., discomfort, poor fit)
- Assessment findings (skin check, neurovascular status)
- Materials added or removed
- Patient education provided
- Follow-up plan (e.g., recheck in 24 hours)

Conclusion

Adjustment and modification are integral parts of splint management. Whether addressing swelling, poor fit, or patient discomfort, clinicians must intervene decisively and skillfully to ensure therapeutic goals are preserved. Successful adjustment hinges on anatomical knowledge, material familiarity, and proactive monitoring. As orthopedic technologists refine their skills in dynamic splint management, they contribute to faster healing, fewer complications, and higher patient satisfaction.

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Section B: Patient Non-Compliance

Overview

Patient non-compliance is a frequent and often underestimated barrier to effective orthopedic splinting. Whether intentional or unintentional, failure to adhere to prescribed splint use can delay healing, lead to reinjury, or even cause complications that require surgical correction. In orthopedic practice, non-compliance is particularly common among pediatric and adolescent populations, individuals with cognitive or psychiatric impairments, and patients who misunderstand the role and necessity of immobilization.

Effective management of non-compliance begins with anticipating behavioral resistance and proactively implementing strategies that support patient understanding, comfort, and accountability. Clinicians must identify patterns of non-adherence and adapt both the splinting technique and the care plan to maximize therapeutic success.

I. Behavioral Refusal in Pediatric and Adolescent Patients

Clinical Context: Children and adolescents may resist splint use due to discomfort, fear, social stigma, restricted activity, or misunderstanding. In younger children, non-compliance is often rooted in sensory intolerance or anxiety about the immobilization process.

Common Behaviors:

- Refusing to wear the splint entirely
- Crying, agitation, or removing the splint at night
- Expressing embarrassment or social self-consciousness (especially adolescents)

Strategies for Pediatric Compliance:

- **Child-Centered Education**: Use age-appropriate language and visual aids to explain why splints are necessary.
- **Customization**: Offer cast covers or colorful wrap materials to encourage pride and ownership.
- **Involve Parents Actively**: Assign parents or guardians the role of compliance monitors and educate them on signs of poor adherence.
- **Behavioral Reinforcement**: For young children, use sticker charts, small rewards, or positive reinforcement schedules.
- **Routine and Structure**: Incorporate splinting into daily routines (e.g., “splint time” after brushing teeth) to reduce resistance.

🎨 *Tip:* Encourage “splint decorating” with safe, removable stickers for children who need a sense of control or identity with their treatment.

II. Recurrent Removal or Tampering

Clinical Context:

Intentional or unintentional removal of the splint is a primary cause of re-injury. This is common in:

- Pediatric patients
- Patients with developmental delays or sensory processing disorders
- Patients with psychiatric conditions (e.g., dementia, psychosis)
- Adolescents testing limits of autonomy

Signs of Tampering:

- Splint found removed or misaligned
- Excessive wear or distortion on straps and edges
- Skin marks suggesting inconsistent application

Interventions:

- **Secure Application**: Use tamper-resistant fasteners such as Velcro lock tabs, D-ring straps, or overlay sleeves.
- **Reinforcement Wraps**: Consider placing cohesive bandage or tubular elastic netting over the splint to discourage easy removal.
- **Behavioral Contracts**: In older children or teens, use signed behavioral agreements that outline expectations and risks.
- **In-Home Supervision**: For cognitively impaired patients, assign a caregiver to monitor splint adherence and perform regular checks.
- **Documentation**: Record all incidents of tampering in the patient record and escalate to physician if injury risk is heightened.

⚠️ *Warning:* Never use mechanical restraints (e.g., tape, zip ties) to enforce compliance. All modifications must be safe, ethical, and clinically justified.

III. Use of Reinforcement Devices and Parental/Caregiver Supervision

Goal:

To enhance splint adherence without compromising patient autonomy or comfort.

Recommended Devices:

- **Reinforcement Straps**: Velcro bands secured in areas that prevent detachment but allow clinician access.
- **Soft Restraint Sleeves**: Fabric sleeves that cover and obscure splint access in high-risk tampering cases (especially overnight).
- **Adaptive Orthotic Systems**: For complex patients (e.g., post-TBI, cerebral palsy), use modular splint systems designed for prolonged wear with tamper-resistant configurations.

Role of Parents and Caregivers:

- Conduct daily checks of splint position, integrity, and skin condition.
- Record wear time if compliance is being tracked by the clinical team.
- Use distraction techniques (e.g., reading, toys, digital tools) during wear periods.
- Be empowered to contact the provider immediately if the child refuses or cannot tolerate the splint.

✅ *Recommendation:* Provide a written splint care and monitoring checklist to caregivers at the time of discharge.

IV. Clinical Escalation and Documentation

When non-compliance presents a risk to healing or safety:

- Notify the referring physician or orthopedic provider
- Consider re-evaluation for alternative immobilization methods (e.g., casting, rigid orthosis)
- Document:
  - Nature and frequency of non-compliance
  - All interventions or adjustments made
  - Caregiver education and responses
  - Patient's attitude or explanation (if applicable)

🧾 *Legal Consideration:* Clear documentation protects the provider from liability in cases where patient non-compliance leads to adverse outcomes.

Conclusion

Patient non-compliance, especially in pediatric and cognitively impaired populations, is a common but addressable barrier to successful orthopedic splinting. Clinicians must view splint adherence as a modifiable behavior influenced by education, comfort, aesthetics, and environmental support. Through thoughtful communication, adaptive equipment, and family collaboration, many forms of non-compliance can be anticipated and mitigated. Ultimately, the goal is not just immobilization—but cooperation and healing.

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Section C: Field and Transport Challenges

Overview

Transporting a patient with a musculoskeletal injury introduces dynamic challenges that may compromise the effectiveness of a well-applied splint. Whether during emergency medical services (EMS), intra-hospital transfer, or movement within rehabilitation and outpatient settings, the forces generated by jostling, elevation shifts, and improper positioning can destabilize immobilization, exacerbate pain, or cause secondary injuries. These risks are amplified in cases of long bone fractures, spinal instability, or acute joint dislocations.

Orthopedic technologists, EMS personnel, and hospital staff must be trained to recognize splint vulnerabilities during transport and adapt immobilization methods accordingly. This section outlines best practices for immobilizing during movement, securing splints on various transport surfaces, and performing temporary field modifications to accommodate equipment limitations or patient needs.

I. Immobilizing During EMS and Intra-Hospital Transfer

Challenges:

- Limited access to orthopedic-grade splinting materials in pre-hospital settings
- Need for rapid stabilization without compromising neurovascular integrity
- Maintaining alignment while transferring between stretchers, beds, or imaging tables

Recommended Strategies:

- **Rigid Support Reinforcement**: Use board splints or vacuum splints in the field when fiberglass or thermoplastics are unavailable. Combine with well-padded supports.
- **Three-Point Immobilization**: Stabilize above and below the injury site with additional support beneath the joint. Avoid allowing a limb to “dangle” or rest unsupported during movement.
- **Elevate if Necessary**: Elevate the limb to reduce swelling only if it does not compromise spinal precautions or cardiorespiratory monitoring.
- **Minimize Limb Manipulation**: Avoid readjusting splint angles during transfer unless neurovascular compromise is suspected.

Case Consideration:

- *Femoral fracture splinted with padded board*: Ensure hip, knee, and ankle are all immobilized in the supine position. Use soft restraints to prevent leg rotation during ambulance motion.

🚑 *Tip:* EMS personnel should document time and method of immobilization and inform receiving clinicians if any temporary techniques were used that may require revision.

II. Temporary Field Modifications

Context:

In emergency or remote settings, traditional splint materials may not be available. Improvised or temporary techniques may be necessary to protect the injury until definitive care is reached.

Effective Improvised Materials:

- Cardboard, rolled newspapers, or padded boards (for rigid support)
- Towels, jackets, or clothing (for padding and joint positioning)
- Belts or tape (to secure the structure)

Key Principles:

- Always pad between the splint and the skin
- Avoid constrictive wrapping that may impair circulation
- Immobilize the joint above and below the injury when possible
- Check distal pulses and sensation before and after application

Documentation for Continuity:

- Indicate the improvised nature of the splint in the patient record
- Note materials used, time of application, and any observed complications

⚠️ *Caution:* Field splints must be reassessed immediately upon hospital arrival, as improvised techniques lack material integrity over time.

III. Securing Splints During Motion (Stretchers, Wheelchairs, Transfers)

Goals:

- Prevent shifting or collapse of splint structure
- Avoid pressure points from straps or hard surfaces
- Ensure joint and fracture site alignment is maintained

Stretcher Transport Techniques:

- **Strap Over Splint**: Use soft, wide stretcher straps over the splinted limb, not under it. Protect bony prominences with extra padding.
- **Limb Stabilization Cradles**: For upper extremity splints, use arm boards or foam wedges to maintain position during lateral motion or turning.
- **Securing Below Joint Axis**: Ensure that pressure from securing straps avoids joints or splint breakpoints (e.g., distal radius splints should not be compressed at the wrist joint).

Wheelchair Transport Considerations:

- Use lap trays or foam supports for upper limb positioning
- Elevate leg rests and use calf supports for lower extremity splints
- Secure limbs with elastic bands or soft straps to prevent accidental movement during transitions

Imaging and Therapy Transfers:

- Confirm that splints are radiolucent (if thermoplastic) or appropriately positioned for imaging
- Reassess splint fit and padding after repeated transfers, especially in elderly or high-risk patients

🧾 *Clinical Reminder:* Every transfer is an opportunity for splint disruption. Perform a brief **post-transfer neurovascular reassessment** to ensure stability and safety.

IV. Pediatric and Geriatric Considerations

Pediatric

- Extra padding may be needed to accommodate growth plates or sensitive skin
- Parents/caregivers should be instructed not to lift or adjust the child by the splinted limb
- Children may attempt to move limbs during transfers—always secure gently but firmly

Geriatric

- Fragile skin and altered balance require more cushioning and clear communication
- Watch for shifting of splints due to atrophy or edema during long transports
- Adjust for kyphosis, joint stiffness, or prior contractures that may impact positioning

Conclusion

Splint integrity does not end at the point of application. Transport introduces variables—motion, vibration, positioning, and access—that can undermine immobilization and risk patient safety. Proactive preparation, adaptive problem-solving, and strong interdisciplinary communication are essential. Whether stabilizing a limb in a pre-hospital emergency or navigating intra-hospital imaging, orthopedic technologists and allied professionals must be vigilant in preserving therapeutic alignment and neurovascular safety. Proper securing techniques, informed improvisation, and universal reassessment protocols are the hallmarks of splinting competence across care settings.

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Chapter 12: Legal, Ethical, and Documentation Standards

Section A: Documentation Essentials

Overview

Accurate and complete documentation is not only a clinical responsibility—it is a legal safeguard. In orthopedic splinting, every detail recorded can serve as a reference for patient safety, care continuity, billing justification, and protection against liability. The documentation process must reflect the complexity of the injury, the rationale for immobilization, patient cooperation, and the education provided for home care and follow-up.

Incomplete or vague notes may compromise patient care and open the door to legal scrutiny. This section outlines the key components of effective documentation in splinting procedures and provides examples of best practices for clinical records.

I. Describing the Injury, Splint Type, and Application Details

Every splint application note should contain detailed descriptions of the following:

1. Clinical Presentation and Injury Description

- Mechanism of injury (e.g., FOOSH, MVC, fall from height)
- Exact anatomical site and laterality (e.g., right distal radius, left 5th metacarpal)
- Suspected or confirmed diagnosis (e.g., greenstick fracture, suspected scaphoid fracture)
- Signs/symptoms (e.g., edema, ecchymosis, deformity, neurovascular status)

2. Splint Type and Positioning

- Name of splint (e.g., Volar wrist, Ulnar gutter, Long leg posterior)
- Joint positions (e.g., wrist at 30° extension, elbow at 90° flexion)
- Rationale for splint choice (e.g., preserves function, prevents contracture)
- Side applied and materials used (e.g., 4-inch fiberglass, stockinette, cast padding)

3. Application Technique

- Description of layers and order (e.g., “Applied stockinette, followed by 2 layers of cast padding, 4-inch splint roll, and elastic bandage wrap.”)
- Skin condition before and after
- Patient positioning during splinting (e.g., seated, supine)
- Support surfaces and padding considerations (e.g., offloading bony prominences)

II. Neurovascular Assessment

Before and After Application, the following neurovascular elements should be documented clearly:

Parameter	Details to Include
Sensation	“Intact to light touch at radial, ulnar, median distributions”
Motor function	“Able to extend fingers, dorsiflex ankle”
Capillary refill	“<2 seconds at nail beds bilaterally”
Pulse	“Radial/dorsalis pedis pulse 2+ and symmetric”
Skin color/temp	“Pale, warm; no cyanosis noted”
Pain	“Non-exacerbated by splint; tolerable at 4/10”

If any compromise is observed, urgent re-evaluation and provider notification must be documented, along with corrective actions taken.

III. Refusal of Care and Consent Procedures

Splinting procedures, though generally non-invasive, still require **informed consent**, particularly in pediatric, cognitively impaired, or legally vulnerable populations.

Documentation Components:

- Patient (or parent/guardian) **verbal or written consent**
  - "Verbal consent obtained from patient to apply short leg splint"
  - "Parent signed consent form prior to pediatric splint application"
- **Discussion of risks/benefits**
  - "Patient advised on risks including skin irritation, pressure injury, need for elevation"
- **Refusal of care**
  - "Patient declined splint application after explanation of risks; verbalized understanding"
  - "Provider notified; education reinforced; patient signed AMA form"

🧾 *Note:* Always follow institutional policy for documenting refusal and have a witness (preferably clinical staff) co-sign when possible.

IV. Educational Documentation Provided to Patient/Family

Educational efforts must be recorded to support patient safety and legal defensibility. Include:

Topics Covered:

- Home care instructions (e.g., elevation, ice, skin monitoring)
- Red flag symptoms (e.g., numbness, discoloration, excessive pain)
- Activity restrictions and positioning
- Splint hygiene and dressing care
- Follow-up instructions and emergency contact protocols

Documentation Sample Phrases:

- “Reviewed splint care instructions and red flag symptoms with patient and mother. Written handout provided.”
- “Patient verbalized understanding of how to monitor for swelling and when to return for follow-up.”

Educational Materials Provided:

- Checklist handouts (e.g., neurovascular check guide)
- Verbal instructions confirmed with teach-back
- QR code or website for video demonstration (if applicable)

Conclusion

Documentation in orthopedic splinting is more than a record of action—it is a clinical and legal narrative that captures the care rendered, the rationale behind each decision, and the patient's role in their recovery. From injury description and technique specifics to consent and follow-up education, well-documented encounters support continuity of care, reduce liability, and ensure adherence to professional standards. Orthopedic technologists must view documentation as a vital extension of their technical expertise—where clarity, completeness, and precision are non-negotiable.

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Section B: Liability and Risk Management

Overview

Orthopedic splinting, while typically low-risk, can carry significant medicolegal consequences if improperly performed or poorly documented. Adverse outcomes such as nerve damage, pressure sores, loss of circulation, or incorrect anatomical positioning can lead to patient harm, prolonged disability, and legal claims of malpractice or negligence. Additionally, splinting procedures often involve vulnerable populations—such as children, the elderly, and cognitively impaired individuals—requiring heightened attention to ethical standards and informed consent.

Effective risk management is a combination of technical competency, clinical judgment, proactive communication, and timely reporting. This section provides a framework for minimizing liability and addressing critical legal responsibilities in orthopedic splinting practice.

I. Avoiding Allegations of Negligence or Harm

Definition of Negligence in Clinical Practice: Failure to provide care that a reasonably prudent professional with similar training would offer under the same circumstances. In splinting, this can include:

- Improper splint application causing neurovascular compromise
- Inadequate padding over bony prominences resulting in pressure injuries
- Incorrect joint positioning leading to stiffness or contracture
- Failure to reassess circulation or sensation post-splinting
- Delayed recognition of complications

Best Practices for Prevention:

- **Standardized Training**: Ensure splinting is performed by credentialed or supervised personnel with formal training.
- **Procedural Checklists**: Use application protocols that mandate neurovascular checks before and after application.
- **Documentation**: Accurately document injury details, materials used, positioning, and patient response.
- **Visual and Manual Inspections**: Double-check for excessive tightness, splint migration, or contact with open wounds.
- **Clinical Escalation**: Promptly report complications such as numbness, cyanosis, or increasing pain to the supervising provider.

🛑 *Risk Alert:* In court proceedings, the standard is not perfection but reasonableness. Your best legal defense is a documented record showing you followed recognized clinical guidelines.

II. Informed Consent and Legal Considerations in Minors

Key Principles of Consent:

- Patients must voluntarily agree to treatment after being informed of:
  - The nature of the procedure (e.g., “splinting to stabilize a wrist fracture”)
  - Risks and benefits (e.g., “may cause discomfort but prevents further injury”)
  - Reasonable alternatives (e.g., casting or sling if applicable)

Documentation of Consent:

- “Verbal consent obtained prior to splinting”
- “Procedure and risks explained; patient (or guardian) verbalized understanding”

Special Situations:

- **Minors (<18 years of age):**
  - Legal guardian or parent must provide consent.
  - Exception: Emancipated minors or emergencies (e.g., life/limb-threatening injuries).
- **Language Barriers**: Use certified medical interpreters when needed—never rely on children or family members.
- **Cognitively Impaired Adults**: Consent should come from a legally authorized representative (LAR).

🧾 *Legal Tip:* Informed consent is a **process**, not just a form. Documentation must reflect discussion and understanding, not merely a signature.

III. Incident Reporting and Adverse Outcome Protocols

In the event of a complication or patient harm associated with splinting, a timely and complete **incident report** must be filed per facility policy. These reports are **non-punitive tools** used for quality improvement and legal protection—not disciplinary records.

Trigger Events for Reporting:

- Development of pressure ulcer beneath splint
- Post-splint neurovascular impairment
- Improvised field splints requiring urgent revision
- Patient or family complaint about splint discomfort, misuse, or trauma
- Near-miss events (e.g., almost applying a splint on the wrong limb)

Incident Report Components:

1. Patient identifiers and date/time
2. Description of the event (objective, no speculation)
3. Actions taken (e.g., splint removed, physician notified)
4. Outcome and follow-up plan
5. Witnesses or personnel involved

Follow-up Documentation in Medical Record:

- Brief summary of the incident (if clinically relevant)
- Description of patient’s condition and any interventions
- Notification of supervising provider

Confidentiality Reminder: Incident reports are internal and should **never** be placed in the patient’s official medical chart.

📋 *Example:* “Patient reported numbness in left fingers 1 hour post-splinting. Splint removed immediately. Capillary refill slow in digits 2–5. Notified physician. Neurovascular reassessment performed. Incident report filed per protocol.”

Conclusion

Legal and ethical accountability is an inseparable part of orthopedic splinting practice. Whether it is through preventing avoidable harm, securing valid consent, or documenting unexpected complications, healthcare providers must uphold standards that protect both the patient and the clinician. Understanding your professional responsibilities, adhering to protocols, and embracing transparency through documentation and incident reporting are essential to quality care—and legal resilience. Splinting is not only a technical skill but a practice embedded in trust, safety, and responsibility.

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CHAPTER 13
SKILL ASSESSMENT SHEETS

THUMB SPICA SPLINT
COMPETENCY ASSESSMENT SHEET

NAME:_________________________________ **EVALUATOR:**____________________
Date:__________________

Skill Area	4 - Proficient (Exceeds Expectations)	3 - Competent (Meets Expectations	2 - Developing (Basic Proficiency)	1 - Novice (Needs Improvement)
Verifies patient identity and explains procedure clearly	4	3	2	1
Confirms clinical indication (e.g., scaphoid fracture, thumb sprain, De Quervain's)	4	3	2	1
Identifies surface anatomy (radial styloid, thumb MCP, CMC joints)	4	3	2	1
Selects appropriate materials and prepares workstation	4	3	2	1
Positions wrist at 20–30° extension, thumb abducted and opposed	4	3	2	1
Applies stockinette and padding, emphasizing snuffbox and radial styloid	4	3	2	1
Applies splint material in hockey stick configuration	4	3	2	1
Contours splint to maintain anatomical thumb position and wrist support	4	3	2	1
Secures splint without constricting MCP or thumb IP joints	4	3	2	1
Performs and documents thorough neurovascular checks before and after	4	3	2	1
Provides clear verbal and written home care instructions	4	3	2	1
Instructs on red flag symptoms and confirms understanding	4	3	2	1
Documents splint type, limb position, NV status, and patient education	4	3	2	1
Demonstrates safe handling, PPE use, and professional behavior	4	3	2	1

Comments:

SKILL POINTS: ___________

ULNAR GUTTER SPLINT
COMPETENCY ASSESSMENT SHEET

NAME:________________________________ EVALUATOR:___________________
Date:_________________

Skill Area	4 - Proficient (Exceeds Expectations)	3 - Competent (Meets Expectations	2 - Developing (Basic Proficiency)	1 - Novice (Needs Improvement)
Verifies patient identity and explains procedure clearly	4	3	2	1
Confirms clinical indication (e.g., scaphoid fracture, thumb sprain, De Quervain's)	4	3	2	1
Identifies surface anatomy (radial styloid, thumb MCP, CMC joints)	4	3	2	1
Selects appropriate materials and prepares workstation	4	3	2	1
Positions wrist at 20–30° extension, thumb abducted and opposed	4	3	2	1
Applies stockinette and padding, emphasizing snuffbox and radial styloid	4	3	2	1
Applies splint material in hockey stick configuration	4	3	2	1
Contours splint to maintain anatomical thumb position and wrist support	4	3	2	1
Secures splint without constricting MCP or thumb IP joints	4	3	2	1
Performs and documents thorough neurovascular checks before and after	4	3	2	1
Provides clear verbal and written home care instructions	4	3	2	1
Instructs on red flag symptoms and confirms understanding	4	3	2	1
Documents splint type, limb position, NV status, and patient education	4	3	2	1
Demonstrates safe handling, PPE use, and professional behavior	4	3	2	1
Follows PPE and infection control protocols throughout procedure	4	3	2	1

Comments:

SKILL POINTS: ___________

RADIAL GUTTER SPLINT
COMPETENCY ASSESSMENT SHEET

NAME:________________________________　　**EVALUATOR:___________________**

Date:_________________

Skill Area	4 - Proficient (Exceeds Expectations)	3 - Competent (Meets Expectations	2 - Developing (Basic Proficiency)	1 - Novice (Needs Improvement)
Confirms patient identity and explains procedure	4	3	2	1
Confirms diagnosis or indication (e.g., 2nd/3rd metacarpal fracture)	4	3	2	1
Identifies landmarks (2nd/3rd metacarpals, MCP, PIP joints)	4	3	2	1
Prepares proper splint length, width, and materials	4	3	2	1
Positions wrist and 2nd/3rd fingers in intrinsic-plus position	4	3	2	1
Applies stockinette and padding over radial styloid and MCP heads	4	3	2	1
Applies splint along radial border extending to index/middle fingers	4	3	2	1
Contours splint to maintain MCP flexion and wrist extension	4	3	2	1
Secures wrap evenly; ensures thumb free and digits aligned	4	3	2	1
Performs and documents neurovascular checks pre/post	4	3	2	1
Provides clear home care instructions	4	3	2	1
Educates on red flag symptoms and confirms comprehension	4	3	2	1
Documents splint type, NV status, and education provided	4	3	2	1
Uses PPE and infection control standards	4	3	2	1

Comments:

SKILL POINTS: __________

VOLAR WRIST SPLINT
COMPETENCY ASSESSMENT SHEET

NAME:_______________________________ **EVALUATOR:__________________**
Date:________________

Skill Area	4 - Proficient (Exceeds Expectations)	3 - Competent (Meets Expectations	2 - Developing (Basic Proficiency)	1 - Novice (Needs Improvement)
Verifies patient identity and explains procedure	4	3	2	1
Confirms indication (e.g., wrist sprain, carpal instability)	4	3	2	1
Identifies landmarks (radial/ulnar styloids, metacarpals)	4	3	2	1
Selects appropriate splint materials and length	4	3	2	1
Positions wrist at 20–30° extension, forearm neutral	4	3	2	1
Applies stockinette and padding, emphasizing bony prominences	4	3	2	1
Applies splint from distal palm to proximal forearm	4	3	2	1
Contours splint to anatomical curvature	4	3	2	1
Secures with elastic wrap, maintains finger visibility	4	3	2	1
Performs/document NV assessment pre/post	4	3	2	1
Provides verbal and written home care instructions	4	3	2	1
Explains red flag symptoms and ensures comprehension	4	3	2	1
Documents splint type, NV status, and patient education	4	3	2	1
Maintains PPE and infection control standards	4	3	2	1

Comments:

SKILL POINTS: __________

NAME:______________________________ **EVALUATOR:__________________**
Date:________________

Skill Area	4 - Proficient (Exceeds Expectations)	3 - Competent (Meets Expectations	2 - Developing (Basic Proficiency)	1 - Novice (Needs Improvement)
Verifies patient identity and explains procedure	4	3	2	1
Confirms indication (e.g., distal radius/ulna fracture)	4	3	2	1
Identifies landmarks (olecranon, wrist crease, MCP joints)	4	3	2	1
Prepares splint materials and positions patient correctly	4	3	2	1
Applies stockinette and padding with focus on elbow and wrist	4	3	2	1
Cuts/activates splint to appropriate length	4	3	2	1
Applies splint in U-shape from palm around elbow to forearm	4	3	2	1
Contours splint to elbow at 90° and wrist neutral	4	3	2	1
Wraps with elastic bandage evenly without over-compression	4	3	2	1
Performs/document NV checks pre/post	4	3	2	1
Provides home care and splint precautions	4	3	2	1
Reviews red flag symptoms with patient	4	3	2	1
Documents splint application, NV status, and education	4	3	2	1
Uses PPE and maintains infection control	4	3	2	1

Comments:

SKILL POINTS: __________

LONG ARM POSTERIOR SPLINT
COMPETENCY ASSESSMENT SHEET

NAME:_________________________________ **EVALUATOR:**__________________

Date:_________________

Skill Area	4 - Proficient (Exceeds Expectations)	3 - Competent (Meets Expectations	2 - Developing (Basic Proficiency)	1 - Novice (Needs Improvement)
Confirms patient identity and explains purpose of long arm posterior splint				
Verifies indication (e.g., forearm fracture, elbow injury)				
Assesses/document baseline NV status				
Identifies landmarks (metacarpal heads, wrist, olecranon, condyles)				
Selects appropriate splint materials and length				
Applies stockinette smoothly hand to upper arm				
Applies cast padding with extra at olecranon/epicondyles				
Prepares splint slab (hand to mid-humerus, 8–12 layers)				
Positions elbow 90° flexion, wrist slightly extended				
Applies splint posteriorly with anatomical contouring				
Folds stockinette over edges to protect skin				
Secures with elastic wrap distal to proximal				
Ensures fingers exposed, thumb mobility as indicated				
Reassesses/document NV status post-application				
Provides patient instructions (elevation, mobility restrictions)				
Reviews red flag symptoms				
Documents splint application, NV status, and education				

Comments:

SKILL POINTS: __________

SHOULDER IMMOBILIZER
COMPETENCY ASSESSMENT SHEET

NAME:________________________________ **EVALUATOR:__________________**
Date:_________________

Skill Area	4 - Proficient (Exceeds Expectations)	3 - Competent (Meets Expectations	2 - Developing (Basic Proficiency)	1 - Novice (Needs Improvement)
Confirms patient identity and explains purpose of shoulder immobilizer	4	3	2	1
Verifies indication (e.g., dislocation, rotator cuff injury, humeral fracture)	4	3	2	1
Identifies landmarks (acromion, clavicle, olecranon, wrist crease)	4	3	2	1
Selects appropriate size and type of immobilizer	4	3	2	1
Positions elbow at 90°, forearm across abdomen neutral rotation	4	3	2	1
Applies waist strap snug but not restrictive	4	3	2	1
Secures forearm cradle supporting elbow, wrist, hand	4	3	2	1
Applies optional shoulder strap to reduce sagging if indicated	4	3	2	1
Ensures elbow against torso, neutral shoulder position	4	3	2	1
Performs/document NV checks pre/post	4	3	2	1
Educates on donning/doffing, sleeping, hygiene considerations	4	3	2	1
Reviews red flag symptoms	4	3	2	1
Documents procedure, NV status, and education	4	3	2	1
Uses PPE and infection control protocols	4	3	2	1

Comments:

SKILL POINTS: ___________

POSTERIOR ANKLE SPLINT
COMPETENCY ASSESSMENT SHEET

NAME:________________________________ **EVALUATOR:**__________________

Date:_________________

Skill Area	4 - Proficient (Exceeds Expectations)	3 - Competent (Meets Expectations	2 - Developing (Basic Proficiency)	1 - Novice (Needs Improvement)
Confirms patient identity and explains purpose of posterior ankle splint	4	3	2	1
Verifies indication (e.g., ankle fracture, Achilles rupture)	4	3	2	1
Identifies landmarks (malleoli, heel, metatarsals)	4	3	2	1
Selects proper splint materials and length	4	3	2	1
Positions ankle at 90° dorsiflexion, knee slightly flexed	4	3	2	1
Applies stockinette/padding from toes to below knee	4	3	2	1
Prepares splint material to correct length and thickness	4	3	2	1
Applies posterior splint from toes to calf with heel contour	4	3	2	1
Contours splint to calf, Achilles, heel, plantar surface	4	3	2	1
Secures splint with elastic wrap avoiding NV restriction	4	3	2	1
Performs/document NV checks pre/post (toes exposed)	4	3	2	1
Provides instructions on elevation, weight-bearing, and red flags	4	3	2	1
Educates on splint hygiene and follow-up	4	3	2	1
Documents splint type, NV status, and patient education	4	3	2	1
Follows PPE/infection control standards	4	3	2	1

Comments:

SKILL POINTS: ___________

ANKLE STIRRUP U-SHAPED SPLINT
COMPETENCY ASSESSMENT SHEET

NAME:______________________________ **EVALUATOR:__________________**
Date:________________

Skill Area	4 - Proficient (Exceeds Expectations)	3 - Competent (Meets Expectations	2 - Developing (Basic Proficiency)	1 - Novice (Needs Improvement)
Confirms patient identity and explains purpose of posterior ankle splint	4	3	2	1
Verifies indication (e.g., ankle fracture, Achilles rupture)	4	3	2	1
Identifies landmarks (malleoli, heel, metatarsals)	4	3	2	1
Selects proper splint materials and length	4	3	2	1
Positions ankle at 90° dorsiflexion, knee slightly flexed	4	3	2	1
Applies stockinette/padding from toes to below knee	4	3	2	1
Prepares splint material to correct length and thickness	4	3	2	1
Applies posterior splint from toes to calf with heel contour	4	3	2	1
Contours splint to calf, Achilles, heel, plantar surface	4	3	2	1
Secures splint with elastic wrap avoiding NV restriction	4	3	2	1
Performs/document NV checks pre/post (toes exposed)	4	3	2	1
Provides instructions on elevation, weight-bearing, and red flags	4	3	2	1
Educates on splint hygiene and follow-up	4	3	2	1
Documents splint type, NV status, and patient education	4	3	2	1
Follows PPE/infection control standards	4	3	2	1

Comments:

SKILL POINTS: __________

LONG LEG POSTERIOR SPLINT
COMPETENCY ASSESSMENT SHEET

NAME:______________________________ **EVALUATOR:__________________**
Date:_________________

Skill Area	4 - Proficient (Exceeds Expectations)	3 - Competent (Meets Expectations	2 - Developing (Basic Proficiency)	1 - Novice (Needs Improvement)
Confirms patient identity and explains purpose of long leg posterior splint	4	3	2	1
Verifies indication (e.g., tibial shaft fracture, patellar injury)	4	3	2	1
Identifies landmarks (heel, malleoli, tibial tubercle, femoral condyles)	4	3	2	1
Selects correct splint materials and dimensions	4	3	2	1
Positions patient supine, knee 20–30° flexion, ankle 90° dorsiflexion	4	3	2	1
Applies stockinette/padding toes to thigh emphasizing heel and popliteal fossa	4	3	2	1
Prepares/applies splint slab (metatarsal heads to gluteal crease)	4	3	2	1
Contours splint to heel, calf, knee, posterior thigh	4	3	2	1
Secures with elastic wrap distal to proximal	4	3	2	1
Leaves toes exposed; performs/document NV checks pre/post	4	3	2	1
Provides instructions: elevation, weight-bearing restrictions	4	3	2	1
Educates on red flag symptoms	4	3	2	1
Documents splint application, NV status, and teaching provided	4	3	2	1
Follows PPE/infection control standards	4	3	2	1
Ensures alignment maintained during repositioning	4	3	2	1

Comments:

SKILL POINTS: __________

CHAPTER 14
MULTIPLE CHOICE ASSESSMENTS

CHAPTER 1

1. What is the primary function of a splint throughout history?

a) Prevent infection

b) Provide cosmetic correction

c) Immobilize injured anatomical regions

d) Increase circulation

2. What was Ambroise Paré's most significant contribution to splinting during the Renaissance?

a) Use of bamboo splints

b) Mass production of iron splints

c) Design of padded wooden splints emphasizing patient comfort

d) Creation of thermoplastic splints

3. The term 'orthopaedics,' coined by Nicolas Andry in 1741, is derived from Greek meaning:

a) Straight child

b) Bone mender

c) Joint healer

d) Medical splint

4. Which innovation most revolutionized immobilization during the 18th and 19th centuries?

a) Thermoplastics

b) Plaster of Paris

c) Fiberglass

d) 3D printing

5. Hugh Owen Thomas and Robert Jones are best known for:

a) Creating the first fiberglass splints

b) Developing standardized fracture protocols

c) Discovering antibiotics for fracture care

d) Designing thermoplastic braces

6. Compared to plaster, fiberglass splinting material is:

a) Heavier and slower to set

b) Preferred only in pediatric settings

c) Less durable and more rigid

d) Radiolucent and faster to cure

7. Which modern advancement allows custom-fitted splints to be designed for complex cases?

a) Industrial iron molding

b) Thermoplastic carving

c) 3D scanning and printing

d) Linen and resin soaking

8. Which of the following is a key advantage of splints compared to casts?

a) Total immobilization

b) Easier adjustability and allowance for swelling

c) Complete circumferential rigidity

d) Superior molding capabilities

9. Splints are typically the preferred initial immobilization device because:

a) They allow soft tissue swelling to expand safely

b) They are always cheaper than casts

c) They prevent infection more effectively than casts

d) They never require patient compliance

10. Casts are most appropriately applied:

a) Immediately after acute trauma with swelling

b) Only for tendon injuries

c) Once swelling subsides and long-term immobilization is required

d) Exclusively in children

11. Which risk is greater with casts compared to splints?

a) Skin maceration and compartment syndrome

b) Fracture displacement

c) Reduced bone healing

d) Infection spread

12. An appropriate sequence for managing a displaced distal radius fracture is:

a) Immediate circumferential casting followed by surgery

b) No immobilization until surgical fixation

c) Thermoplastic brace on day of injury

d) Initial sugar-tong splint, then short arm cast after swelling decreases

13. The evolution of splinting—from bark and linen to fiberglass and 3D printing—illustrates what broader medical theme?

a) Transition from superstition to evidence-based practice

b) Shift from orthopedic care to cosmetic medicine

c) Return to herbal remedies for healing

d) Decreased emphasis on patient safety

14. Archaeological evidence shows that ancient Egyptians immobilized limbs using:

a) Iron rods and plaster

b) Wooden sticks, linen, and resins

c) Thermoplastic sheets

d) Waxed gauze and fiberglass

15. Hippocrates' contributions to fracture care included all of the following EXCEPT:

a) Advocating for fracture alignment

b) Promoting immobilization with splints

c) Inventing plaster of Paris

d) Preventing deformity through stabilization

CHAPTER 2

1. Which of the following is a common reason for splinting a distal radius fracture?

a) Limit micromotion and protect neurovascular structures

b) Enhance joint flexibility

c) Improve circulation

d) Prevent infection

2. What is the preferred position for immobilizing an elbow dislocation post-reduction?

a) Full extension

b) Slight flexion

c) 90 degrees flexion

d) Neutral rotation with extension

3. Why should a splint not be applied immediately over an open fracture?

a) It increases fracture healing time

b) It may trap debris and increase infection risk

c) It interferes with imaging

d) It restricts motion excessively

4. Which of the following is a contraindication for immediate splinting?

a) Mild swelling

b) Non-displaced fracture

c) Absent distal pulses

d) Low-grade sprain

5. Which splint would be most appropriate for a patient with an MCL knee injury?

a) Posterior ankle slab

b) Sugar-tong splint

c) Thumb spica splint

d) Knee immobilizer

6. Which of the following is a primary goal of splinting in orthopedic trauma?

a) Stabilize injured structures and allow soft tissue rest

b) Prevent muscle hypertrophy

c) Promote joint instability for healing

d) Reduce skin irritation

7. Why should a splint not be used to correct a limb malalignment before fracture reduction?

a) It prevents swelling

b) It can cause increased bleeding

c) It may convert a closed fracture into an open one

d) It slows healing

8. Which of the following is considered an absolute contraindication to splinting?

a) Minor abrasions

b) Patient allergy to padding

c) Elderly age

d) Signs of compartment syndrome

9. A patient presents with a second-degree burn and a distal radius fracture. What is the best approach to splinting?

a) Avoid splinting altogether

b) Use fiberglass directly on the skin

c) Pad thoroughly and avoid burn area contact if possible

d) Use adhesive foam and wrap tightly

10. Which condition would benefit from splinting to reduce pathologic motion and support healing?

a) Stable shoulder contusion

b) Grade III ankle sprain

c) Mild cellulitis without trauma

d) Non-displaced midshaft femur fracture

11. Which of the following is a relative contraindication to splinting?

a) Open fracture

b) Uncontrolled bleeding

c) Skin infection at the application site

d) Pediatric age

12. Which splinting goal focuses on preventing permanent physical deformity?

a) Contracture prevention

b) Structural preservation

c) Pain modulation

d) Radiographic realignment

13. Why is it important to balance immobilization with mobility in splinting?

a) To enhance splint aesthetics

b) To increase muscle fatigue

c) To reduce dependency on braces

d) To avoid stiffness and support optimal healing

14. A splint is applied to a patient with diabetic neuropathy. What is the key risk?

a) Elevated oxygen saturation

b) Overgrowth of muscle tissue

c) Skin breakdown due to loss of sensation

d) Improved neurovascular feedback

15. Which of the following goals best explains the rationale for immobilizing a lacerated flexor tendon?

a) Allow tendon healing in lengthened position

b) Maintain muscle tone

c) Prevent fracture displacement

d) Avoid joint dislocation

CHAPTER 3

1. Which material is most moldable and commonly used for precise contouring around bony prominences?

a) Plaster of Paris

b) Thermoplastics

c) Fiberglass

d) Acrylic resin

2. What is a key safety concern when working with plaster activated in hot water?

a) Delayed setting

b) Toxic fumes

c) Thermal burns due to exothermic reaction

d) Increased brittleness

3. Which splinting material is radiolucent and ideal for frequent imaging follow-ups?

a) Plaster

b) Cotton padding

c) Velcro strapping

d) Fiberglass

4. Which thermoplastic is commonly used for hand orthoses and becomes pliable at low temperatures?

a) Gypsum

b) Polycaprolactone

c) Acrylic resin

d) PVC

5. Why should extra care be taken when applying adhesive-backed padding?

a) It melts during curing

b) It becomes hard after 48 hours

c) It may lose adhesion or irritate fragile skin

d) It causes material failure

6. What is the most appropriate use of thermoplastics in splint fabrication?

a) Circumferential immobilization of lower limbs

b) Custom hand and wrist splints

c) Temporary traction devices

d) External fixator frame reinforcement

7. Which of the following is a disadvantage of plaster over fiberglass?

a) Slower setting time and increased weight

b) Radiolucency interference

c) More difficult to mold

d) Cannot be used on acute fractures

8. Which material provides conformability and is most often used in acute trauma splinting?

a) Rigid plastic

b) Plaster of Paris

c) Rubber composites

d) Elastic mesh wrap

9. Which padding material is most appropriate for protecting bony prominences?

a) Cotton cast padding

b) Laminated foam with adhesive backing

c) Elastic tubular netting

d) Gauze wrap

10. What is the main purpose of stockinette in splint construction?

a) To provide rigid support

b) To anchor Velcro straps

c) To wick moisture and create a barrier between skin and padding

d) To reinforce joint alignment

11. Which of the following fasteners is preferred for pediatric splinting?

a) Plastic zip ties

b) Cohesive wrap and Velcro straps

c) Cable clamps

d) Rubber bands

12. Why is fiberglass preferred for patients who will undergo frequent imaging?

a) It is reusable and eco-friendly

b) It improves splint moisture absorption

c) It changes color with inflammation

d) It is radiolucent and does not interfere with X-rays

13. What precaution should be taken when trimming splint material near the skin?

a) Always cut in multiple layers

b) Do not use gloves for better grip

c) Use bandage scissors and protect underlying skin with fingers

d) Use high-heat tools only

14. Which splint material should be immersed in warm water before molding?

a) Polycaprolactone thermoplastic

b) Rigid aluminum sheets

c) Plaster of Paris

d) Carbon fiber splint sheets

15. Which item is considered a safety tool during splint removal?

a) Electric cast saw

b) Bandage scissors

c) Trauma shears

d) Oscillating blade with guard

CHAPTER 4

1. Which of the following is a key goal of functional positioning in splinting?

a) Preserve anatomical integrity and prevent complications

b) Minimize joint motion for permanent stiffness

c) Maximize cosmetic appearance

d) Favor immobilization over mobility

2. What is the recommended 'position of function' for the wrist and hand?

a) Full wrist flexion, MCP extension, IP flexion

b) Wrist neutral, MCP extension, thumb adduction

c) Wrist 20–30° extension, MCPs 60–70° flexion, IPs extended

d) Wrist extension, MCPs extended, thumb abducted

3. Which region's surface anatomy includes the anatomical snuffbox, critical in trauma assessment?

a) Ankle

b) Wrist

c) Elbow

d) Shoulder

4. Why is ankle immobilization in plantarflexion for more than 2 weeks problematic?

a) Leads to posterior tibial nerve entrapment

b) Encourages Achilles tendon elongation

c) Increases venous return

d) May result in equinus contracture

5. What functional position is recommended for elbow immobilization?

a) Full extension with forearm pronated

b) Flexed at 90° with forearm neutral or slightly supinated

c) Hyperextended with wrist dorsiflexed

d) Slight flexion with full wrist pronation

6. Which term describes the posture that allows for long-term usability and efficient return to activity?

a) Position of safety

b) Position of instability

c) Position of function

d) Position of elongation

7. How do splints counteract muscle-induced deforming forces in distal radius fractures?

a) By casting in ulnar deviation and slight flexion

b) By positioning in radial deviation and extension

c) By immobilizing in neutral wrist extension

d) By increasing MCP extension

8. Which landmark is essential for correct shoulder immobilizer application?

a) Radial head

b) Acromion process

c) Cubital fossa

d) Ulnar styloid

9. What is the clinical implication of applying a splint over the cubital tunnel?

a) Enhances elbow range of motion

b) Increases triceps activation

c) Can cause ulnar nerve compression

d) Promotes capillary refill

10. Which structure must be offloaded in posterior ankle splinting to prevent skin breakdown?

a) Medial malleolus

b) Navicular tuberosity

c) Plantar fascia

d) Calcaneus

11. Which population requires special care due to risk of pressure ulcers and skin fragility during splinting?

a) Pediatric

b) Athletes

c) Geriatric

d) Military recruits

12. What deformity can occur if MCPs are immobilized in full extension for an extended period?

a) Swan neck deformity

b) Claw hand

c) Ulnar drift

d) Boutonnière deformity

CHAPTER 5

1. Which of the following is the PRIMARY goal of sterile technique in splinting?

a) Minimize patient anxiety

b) Eliminate all microorganisms from the environment

c) Create an efficient workflow

d) Reduce the cost of supplies

2. Which situation requires the use of sterile technique?

a) Application of a thumb spica splint in a clinic

b) Splinting a non-displaced ankle fracture with intact skin

c) Placing a long leg splint over a surgically debrided wound

d) Applying a wrist brace to an outpatient with tendonitis

3. What is the purpose of clean technique?

a) To ensure the operating room remains sterile

b) To eliminate all bacteria from the patient's skin

c) To improve the effectiveness of medications

d) To reduce the number and spread of microorganisms

4. Which PPE item is MOST appropriate during cast sawing to protect against airborne particles?

a) Sterile gloves

b) Surgical mask

c) N95 respirator

d) Latex apron

5. Which of the following is considered a clean technique scenario?

a) Teaching a patient to rewrap their own wrist splint

b) Changing a surgical dressing with sutures

c) Placing a splint over exposed bone

d) Sterile dressing application for an external fixation device

6. Which PPE item is essential when irrigating wounds or handling splinting over draining tissue?

a) Head cap

b) Gloves only

c) Eye protection

d) Compression sleeves

7. Which step is performed LAST when doffing PPE?

a) Remove gloves

b) Remove mask or respirator

c) Remove gown

d) Remove eye protection

8. What is a key strategy to prevent HEPA filter contamination during cast trimming?

a) Sterilize the patient's limb

b) Use suction from the hospital oxygen line

c) Attach a HEPA-filtered vacuum to the cast saw

d) Trim with the cast still wet

9. Which of the following practices is INCORRECT and risks cross-contamination?

a) Changing gloves between patients

b) Disposing of splinting waste in biohazard containers

c) Sanitizing table surfaces between patients

d) Reusing previously opened padding rolls

10. Why is PPE particularly important when working with immunocompromised patients?

a) They sweat more during splinting

b) They prefer extra attention to detail

c) They are at higher risk for infection from minor contamination

d) They usually request more PPE be worn

11. What surface in a splinting room should be disinfected at least twice daily?

a) Light switches and door handles

b) Cast saw blades

c) Plaster buckets

d) Clean storage bins

12. Which is an OSHA-mandated requirement for sharps disposal in a splinting environment?

a) Sharps containers must be locked in a cabinet

b) Sharps must be disposed immediately in a labeled, puncture-resistant container

c) Sharps must be recapped before disposal

d) Sharps must be rinsed prior to disposal

13. How should used fiberglass dust from trimming be handled?

a) Bagged and placed in regular waste bin

b) Recycled with plaster

c) Discharged down the sink

d) Vacuumed with HEPA filter and bagged in sealed trash

14. Which is a common splint room design recommendation by the CDC?

a) Wooden cabinets and carpet floors

b) Open windows for ventilation

c) Minimum of 6 air changes per hour (ACH)

d) Shared clean and dirty zones

15. What is the purpose of a daily environmental safety checklist in a splinting room?

a) Reduce staff paperwork

b) Train patients on splinting techniques

c) Ensure all infection control and room prep measures are performed

d) Replace equipment more frequently

CHAPTER 6

1. Why is patient-centered communication considered essential in orthopedic splinting?

a) It reduces time spent applying the splint

b) It eliminates the need for written documentation

c) It allows providers to skip verbal instruction

d) It improves patient trust, compliance, and outcomes

2. Which of the following is a best practice in non-verbal communication during splint application?

a) Avoiding eye contact to reduce anxiety

b) Fast, hurried hand movements to show efficiency

c) Maintaining calm posture and deliberate hand movements

d) Standing over the patient to maintain authority

3. How should clinicians explain the purpose of keeping a splint dry?

a) To prevent skin breakdown and infection

b) To ensure it looks clean for longer

c) To prevent it from falling off

d) To maintain its waterproof seal

4. What communication technique helps verify patient understanding?

a) Asking if the patient has any questions

b) Reading the handout aloud

c) Using the teach-back method

d) Giving vague reassurances

5. Which population benefits most from caregiver-included splint education?

a) College athletes

b) Independent adults under 40

c) Postmenopausal women

d) Pediatric or cognitively impaired patients

6. Which is an appropriate way to describe a splint to a young child?

a) Orthosis for distal stabilization

b) A cast that can't be taken off

c) A superhero shield to protect your arm

d) A brace that limits your activity permanently

7. When should red flag symptoms be discussed with patients?

a) Only if complications occur

b) Before splint application

c) At the follow-up visit

d) After insurance paperwork is completed

8. Why is cultural sensitivity important during splinting education?

a) It respects the patient's background and improves compliance

b) It reduces staff workload

c) It helps promote better insurance billing

d) It ensures splints are applied faster

9. What is the primary goal of patient education in splinting?

a) To ensure the splint is removed correctly

b) To prevent patient questions

c) To empower patients and prevent complications

d) To eliminate the need for follow-up

10. What type of written material should be used for patients with low health literacy?

a) Plain language handouts with visuals

b) Charts filled with medical acronyms

c) University-level articles with references

d) Insurance forms and policy summaries

11. Why is documentation of patient education important?

a) To meet social expectations

b) To protect both patient and provider legally and clinically

c) To reduce charting time for nurses

d) To impress insurance auditors

12. What phrase best models effective orthopedic communication during a procedure?

a) Just sit still, I'll be done soon

b) I'm in a hurry so let's finish this quickly

c) This splint won't hurt unless you move

d) It may feel warm, but let me know if it feels too tight or uncomfortable

13. How can technology be used to enhance splint instruction?

a) Through interactive billing apps

b) By emailing radiology reports

c) Using QR codes linking to care videos

d) By texting cast removal reminders only

14. Which component should always be documented after providing education?

a) Brand of splint used

b) Patient's occupation

c) Patient response and comprehension

d) Provider's lunch break time

15. Which is an example of the teach-back method?

a) Giving the patient a form to sign

b) Asking, 'Can you show me how you'll keep your splint dry?'

c) Telling the patient to call if something feels wrong

d) Pointing to a diagram and saying 'Read this at home'

CHAPTER 7

1. What is the ideal wrist position in a volar wrist (cock-up) splint?

a) 45° flexion

b) Neutral (0°)

c) 20–30° extension

d) Full extension

2. Which of the following is a contraindication to immediate volar wrist splinting?

a) Post-cast rehabilitation

b) Marked edema with risk of compartment syndrome

c) Carpal tunnel syndrome

d) Radial nerve palsy

3. What does the 'sugar-tong' forearm splint primarily prevent?

a) Wrist flexion

b) Thumb opposition

c) Forearm pronation and supination

d) Shoulder abduction

4. In a thumb spica splint, which joint is immobilized in addition to the wrist?

a) CMC joint of the thumb

b) PIP joint of the thumb

c) Index MCP joint

d) 3rd DIP joint

5. Why is the intrinsic-plus position important for hand splints?

a) It improves cosmetic appearance

b) It enhances flexor tendon repair strength

c) It preserves collateral ligament length and hand function

d) It eliminates wrist motion

6. What is the most common use of a long arm posterior splint?

a) Thumb arthritis

b) Scaphoid fracture

c) Wrist sprain

d) Elbow dislocation or distal humerus fracture

7. In an ulnar gutter splint, which fingers are immobilized?

a) 1st and 2nd

b) 2nd and 3rd

c) 4th and 5th

d) All five digits

8. What material provides better molding for hand splints?

a) Plaster

b) Rubber

c) Thermoplastic

d) Acrylic

9. What is a complication of including the thumb IP joint in a thumb spica when not indicated?

a) Scaphoid nonunion

b) Median nerve compression

c) Thumb IP stiffness

d) CMC subluxation

10. Which splint should be applied for a non-displaced scaphoid fracture?

a) Ulnar gutter

b) Thumb spica

c) Sugar-tong

d) Posterior long arm

11. What is the elbow angle used during long arm splinting?

a) 0°

b) 15°

c) 90°

d) 120°

12. Why should MCP joints be left uncovered in a cock-up splint?

a) To increase compression

b) To allow better cast saw access

c) To keep the splint shorter and lighter

d) To prevent grip loss and claw hand deformity

13. What condition is a contraindication for sugar-tong splinting?

a) Post-reduction distal radius fracture

b) Open fracture with exposed bone

c) Forearm swelling

d) Unstable wrist sprain

14. How is a shoulder immobilizer different from a sling?

a) It supports only the hand

b) It stabilizes the hand and wrist

c) It restricts shoulder abduction and external rotation

d) It is worn on the opposite arm

15. Which of the following is a safety check after splinting?

a) Loss of capillary refill

b) Increased warmth of material

c) Thickness of the padding

d) Splint length compared to uninjured side

CHAPTER 8

1. What is the correct ankle position when applying a posterior ankle splint?

a) 30° plantarflexion

b) 90° dorsiflexion

c) Full inversion

d) 45° eversion

2. Which structure must be padded and offloaded during posterior ankle splinting to prevent ulceration?

a) Metatarsal heads

b) Achilles tendon

c) Calcaneus

d) Fibular neck

3. What is a common indication for a stirrup splint?

a) Lateral malleolus fracture

b) Scaphoid fracture

c) Elbow dislocation

d) Distal radius fracture

4. Which complication may occur if an elastic bandage is applied too tightly during ankle splinting?

a) Joint hypermobility

b) Plantar fascial rupture

c) Neurovascular compromise

d) Increased calcification

5. When measuring for a posterior leg splint, where should the splint extend proximally?

a) Above the hip

b) Below the patella

c) To the mid-calf

d) 2 inches below the popliteal fossa

6. What is the proper knee position for a long leg posterior splint?

a) 0° extension

b) 20–30° flexion

c) 90° flexion

d) Full extension with valgus force

7. Which of the following is a contraindication to long leg splinting?

a) Patellar fracture

b) Post-operative meniscal repair

c) Unstable femoral shaft fracture

d) Post-reduction tibial fracture

8. Which neurovascular structure is most at risk during lower leg splinting?

a) Peroneal nerve at fibular neck

b) Femoral artery

c) Radial nerve

d) Axillary artery

9. What is the best patient position for applying a stirrup splint?

a) Prone with knee extended

b) Supine with leg flat and foot off table edge

c) Sitting with knee at 90°

d) Lateral decubitus

10. Which landmark defines the base for stirrup splint placement?

a) Anterior tibial crest

b) Lateral thigh

c) Calcaneus

d) ASIS

11. Why is 90° ankle positioning important during lower extremity splinting?

a) Prevents plantarflexion contracture

b) Improves circulation

c) Increases padding effectiveness

d) Enhances cosmetic appearance

12. Which complication can result from molding plaster too tightly at the popliteal space?

a) Ankle instability

b) Fibular shaft rotation

c) Calcaneal fracture

d) Popliteal artery compression

13. What key sign should prompt urgent reassessment after lower limb splinting?

a) Mild numbness after 2 hours

b) Cool, pale toes with no capillary refill

c) Mild edema at the ankle

d) Increased appetite

14. Why is toe exposure important after splint application?

a) To allow splint trimming

b) To reduce infection risk

c) To assess circulation and swelling

d) To improve shoe fit

15. Which splint is best suited for rotational control of an unstable ankle fracture?

a) Ulnar gutter splint

b) Stirrup splint

c) Thumb spica

d) Posterior long arm

CHAPTER 9

1. What is the primary concern when splinting across a pediatric growth plate?

a) Improved cosmetic healing

b) Compression can trigger premature physeal closure

c) Growth plate fractures heal faster than adult fractures

d) Children feel less pain in growth areas

2. Which Salter-Harris fracture type poses the greatest risk of growth arrest?

a) Type I

b) Type II

c) Type IV

d) Type V

3. What adjustment should be made when splinting a toddler's wrist?

a) Avoid pressure over cartilaginous structures

b) Omit padding for better conformity

c) Use rigid fiberglass across MCPs

d) Apply hyperextension for future growth

4. What is a common clinical feature of Salter-Harris Type I fractures?

a) Dislocation of the epiphysis

b) Visible fracture line on radiograph

c) Radiographically occult physeal injury

d) Complete metaphyseal fracture

5. Which age group has the most cartilaginous, radiolucent epiphyses?

a) Adolescents

b) Preschoolers

c) Infants and toddlers

d) Adults

6. Which strategy can reduce anxiety in children with sensory processing disorders?

a) Bright lights and loud music during splinting

b) Provide quiet room, weighted tools, and step-by-step instructions

c) Quickly apply the splint without explanation

d) Use unfamiliar tools to distract

7. Which pediatric patient requires joint-neutral positioning due to limited communication ability?

a) 6-year-old with wrist sprain

b) Toddler with bruising

c) Teen with a sports injury

d) Nonverbal child with cognitive disability

8. Which communication technique works best for preschoolers during splinting?

a) Scientific explanation of the injury

b) Direct instructions and parental exclusion

c) Choice of splint colors and distraction toys

d) Written handouts only

9. Which growth plate is most at risk during improper ulnar gutter splinting?

a) Distal ulna

b) Tibial tubercle

c) Distal radius

d) Femoral neck

10. How should splints be adjusted in children with ADHD?

a) Make steps longer and more detailed

b) Add multiple adhesive straps for control

c) Use short procedures and offer movement breaks

d) Apply splints with no parental involvement

11. What splinting material is best for a small child with tactile defensiveness?

a) Fiberglass with cold water dip

b) Aluminum rods

c) Dry cotton gauze

d) Low-temperature thermoplastic

12. Why is caregiver education essential in pediatric splinting?

a) To replace follow-up visits

b) To ensure they can diagnose fractures

c) To monitor for complications and ensure home compliance

d) To train them to fabricate new splints

13. How should limb deformity without visible fracture in toddlers be treated?

a) Immediate surgery

b) Splint conservatively and re-image in 5–7 days

c) Skip treatment if X-ray is clear

d) Apply full cast immediately

14. Why is it important to avoid torsion in splints applied to growing bones?

a) It can damage the proliferative zone of the physis

b) It increases strength of metaphyseal bone

c) Torsion improves healing time

d) It promotes remodeling

CHAPTER 10

1. Which skin site is most vulnerable to pressure ulcer formation during long leg splinting?

a) Posterior thigh

*b) Medial femoral condyle

c) Anterior tibial crest

d) Lateral thigh

2. What is the most effective strategy for preventing moisture-associated skin damage (MASD)?

a) Apply splints while skin is still damp

b) Use occlusive wrappings in hot climates

*c) Ensure skin is dry and use moisture-wicking stockinette

d) Use fiberglass without padding

3. A patient reports burning under a plaster splint. What is the likely cause?

a) Bacterial infection

b) Improper bandage tension

*c) Thermal injury from exothermic reaction

d) Skin allergy

4. Which nerve is at risk of compression from a poorly padded long-leg splint?

*a) Common peroneal nerve

b) Sciatic nerve

c) Femoral nerve

d) Obturator nerve

5. Which of the following is NOT part of the '6 Ps' of neurovascular assessment?

a) Pain

*b) Pulse pressure

c) Paresthesia

d) Poikilothermia

6. What immediate action is required if compartment syndrome is suspected?

a) Apply additional padding

b) Request more imaging

c) Measure blood pressure

*d) Bivalve or loosen the splint and elevate the limb

7. What is the two-finger test used for in splinting?

a) Assess joint stability

b) Check padding thickness

*c) Ensure the splint is not too tight

d) Test temperature of plaster

8. Which splinting mistake most likely leads to mechanical failure?

*a) Incorrect joint positioning

b) Applying minimal wrap tension

c) Exposing the fingers

d) Leaving the toes uncovered

9. Which of the following complications is most likely with a splint that fails to immobilize the joint above and below the fracture?

a) Skin maceration

b) Nerve palsy

*c) Fracture malunion

d) Hypothermia

10. How can shear injuries during splinting be prevented?

a) Using loose wraps over joints

b) Instructing patients to exercise the limb immediately

c) Applying rigid orthotics only

*d) Ensuring snug splint fit and correct joint alignment

11. What condition is characterized by early signs of pain on passive stretch and deep, burning discomfort?

a) Cellulitis

b) Neurogenic pain

*c) Compartment syndrome

d) Dermatitis

12. What should be done if a patient shows delayed capillary refill after splint application?

*a) Rewrap or loosen the splint and reassess

b) Remove the padding

c) Refer to physical therapy

d) Wait 12 hours and reassess

13. Which group is most at risk for silent neurovascular compromise due to poor symptom reporting?

a) Middle-aged adults

*b) Children and elderly

c) Manual laborers

d) Athletes

14. Which material failure indicates splint degradation and requires replacement?

a) Bright coloration

*b) Delamination and bubbling

c) Increased splint weight

d) Sound when tapped

15. Which prevention strategy is most critical for long-term splint effectiveness?

a) Matching patient clothing

b) Using reusable materials

*c) Regular reassessment and patient education

d) Avoiding splint use entirely

CHAPTER 11

1. Which of the following signs suggests that a splint has become too loose due to volume changes?

*a) Splint movement independent of limb

b) Reduced joint range of motion

c) Increased warmth

d) Improved skin color

2. What is the recommended timeline for reassessing splint fit in the acute injury phase?

a) Immediately after application

b) Every 7 days

*c) Within 48–72 hours

d) Only after pain returns

3. What should be avoided when tightening a splint in a swollen limb?

a) Using cohesive wrap

b) Padding over pressure points

c) Applying thermoplastics directly to skin

*d) Tightening without assessing neurovascular status

4. Which method allows safe reshaping of a localized area in a thermoplastic splint?

a) Submerging the entire splint in boiling water

*b) Spot heating with a low-heat gun

c) Washing with warm soapy water

d) Microwave reheating

5. What is the first action if pressure points are observed under a thermoplastic splint?

a) Replace the entire splint

b) Apply more elastic wrap

*c) Reheat and reshape the area

d) Ask the patient to wait 24 hours

6. Which adjustment may be used to reduce edge irritation in thermoplastic splints?

*a) Flanging the edge with partial heating

b) Cutting off the edge

c) Taping the sharp edges

d) Filing the plastic

7. What is a recommended solution for recurrent splint slippage in pediatric patients?

a) Metal fasteners

*b) Overwrapping with ACE or cohesive bandage

c) Reapplying without stockinette

d) Leaving splint loose to encourage comfort

8. What is the purpose of using Velcro lock tabs or D-ring straps?

a) Decorative enhancement

b) To secure padding material only

*c) To reinforce splint adherence and reduce tampering

d) To increase flexion of joints

9. Which documentation element is required after a splint is adjusted?

a) Time of the original injury

b) Type of wrap used

c) Clinic phone number

*d) Reason for modification and neurovascular findings

10. What behavioral technique supports pediatric splint compliance?

a) Applying the splint without informing the child

b) Using loud instructions

*c) Using positive reinforcement charts

d) Restraining the child until application is complete

11. What type of splint modification is useful during patient transport?

a) Edge flanging

*b) Three-point immobilization

c) Shortening splint length

d) Padding only one side of the limb

12. What is the best temporary material for splinting in field emergencies?

a) Plaster cast roll

*b) Newspaper and tape

c) Steel rod and gauze

d) Medical suture

13. What patient population may require tamper-resistant splint devices?

a) Post-operative adults

b) Professional athletes

*c) Cognitively impaired patients

d) Medical students

14. Which is the most appropriate transport adjustment for an upper extremity splint?

a) Removing straps during imaging

*b) Securing the limb with a lap tray or arm board

c) Allowing unsupported lateral movement

d) Reapplying the splint after imaging

15. What post-transfer step ensures splint integrity and patient safety?

a) Measure the temperature of the limb

b) Recheck patient insurance eligibility

*c) Repeat a neurovascular assessment

d) Ask about appetite

CHAPTER 12

1. What is a primary purpose of documentation in orthopedic splinting?

a) To increase billing amounts

*b) To support legal, clinical, and educational responsibilities

c) To avoid using pre-printed forms

d) To reduce patient contact

2. Which of the following MUST be documented during splint application?

*a) Type of splint and joint positions

b) Patient's favorite color

c) Clinician's lunch break time

d) Expected casting schedule

3. What is the appropriate documentation of a normal neurovascular assessment?

a) Color pink, pain present, numb fingers

b) No circulation but no pain

*c) Radial pulse 2+, cap refill <2s, sensation intact

d) Warm fingers, no pulses

4. Which element is critical to informed consent?

a) Patient's income level

*b) Discussion of risks and benefits

c) Verbal agreement only

d) Nursing notes only

5. When documenting education provided to the patient or caregiver, what should be included?

a) Instructions for cast removal

*b) Red flag symptoms, home care, and follow-up

c) Provider's telephone extension

d) A list of prescription medications

6. Which population always requires guardian consent before splinting?

a) Adolescents over 14

b) Retired military personnel

c) Patients in pain

*d) Minors under 18 unless emancipated

7. What is the best practice when a patient refuses a recommended splint?

a) No documentation is needed if they decline

b) Apply the splint anyway

*c) Document refusal, reason, and provider notification

d) Call their emergency contact

8. Which of the following does NOT belong in the medical chart?

a) Patient education and NV status

*b) Splinting incident report form

c) Provider notification of complications

d) Consent form language

9. Which of the following BEST defines clinical negligence in splinting?

*a) Failure to monitor for complications post-splinting

b) Following a senior provider's instructions

c) Using low-cost materials

d) Choosing a fiberglass material over plaster

10. What must be documented during informed consent for splinting?

a) Future diagnosis

b) Family history

*c) Patient (or guardian) verbal understanding of risks and benefits

d) Radiology report notes

11. Why is a procedural checklist helpful in splinting?

a) To avoid training new staff

b) To ensure all billing codes are entered

c) To impress hospital auditors

*d) To standardize safe practices and documentation

12. What is a key requirement in incident reports?

a) Subjective analysis by the technologist

*b) Objective description, actions taken, and witnesses

c) Emotional reaction of the family

d) Patient signature on the report

13. Which scenario requires an incident report?

a) Mild pain after splinting

b) Patient arrives late to appointment

*c) Splint applied to wrong side, corrected immediately

d) Splinting performed with supervisor's permission

14. What is the primary legal standard in court cases involving splinting complications?

a) 100% accuracy at all times

b) Actions above average expectations

*c) Whether a reasonably trained professional would have acted similarly

d) Use of expensive materials

15. What ethical principle supports full disclosure of risks before splinting?

*a) Autonomy

b) Confidentiality

c) Non-maleficence

d) Justice

CHAPTER 15
ANSWER KEY

CHAPTER ANSWER KEY

Chapter 1	Chapter 2	Chapter 3	Chapter 4	Chapter 5	Chapter 6
1. C	1. A	1. A	1. A	1. B	1. D
2. C	2. C	2. C	2. C	2. C	2. C
3. A	3. B	3. D	3. B	3. D	3. A
4. B	4. C	4. B	4. D	4. C	4. C
5. B	5. D	5. C	5. B	5. A	5. D
6. D	6. A	6. B	6. C	6. C	6. C
7. C	7. C	7. A	7. A	7. B	7. B
8. B	8. D	8. B	8. B	8. C	8. A
9. A	9. C	9. B	9. C	9. D	9. C
10. C	10. B	10. C	10. D	10. C	10. A
11. A	11. C	11. B	11. C	11. A	11. B
12. D	12. A	12. D	12. B	12. B	12. D
13. A	13. D	13. C		13. D	13. C
14. B	14. C	14. A		14. C	14. C
15. C	15. A	15. D		15. C	15. B

Chapter 7	Chapter 8	Chapter 9	Chapter 10	Chapter 11	Chapter 12
1. C	1. B	1. B	1. B	1. A	1. B
2. B	2. C	2. D	2. C	2. C	2. A
3. C	3. A	3. A	3. C	3. D	3. C
4. A	4. C	4. C	4. A	4. B	4. B
5. C	5. D	5. C	5. B	5. C	5. B
6. D	6. B	6. B	6. D	6. A	6. D
7. C	7. C	7. D	7. C	7. B	7. C
8. A	8. A	8. C	8. A	8. C	8. B
9. C	9. B	9. A	9. C	9. D	9. A
10. B	10. C	10. C	10. D	10. C	10. C
11. C	11. A	11. D	11. C	11. B	11. D
12. D	12. D	12. C	12. A	12. B	12. B
13. B	13. B	13. B	13. B	13. C	13. C
14. C	14. C	14. A	14. B	14. B	14. C
15. A	15. B		15. C	15. C	15. A

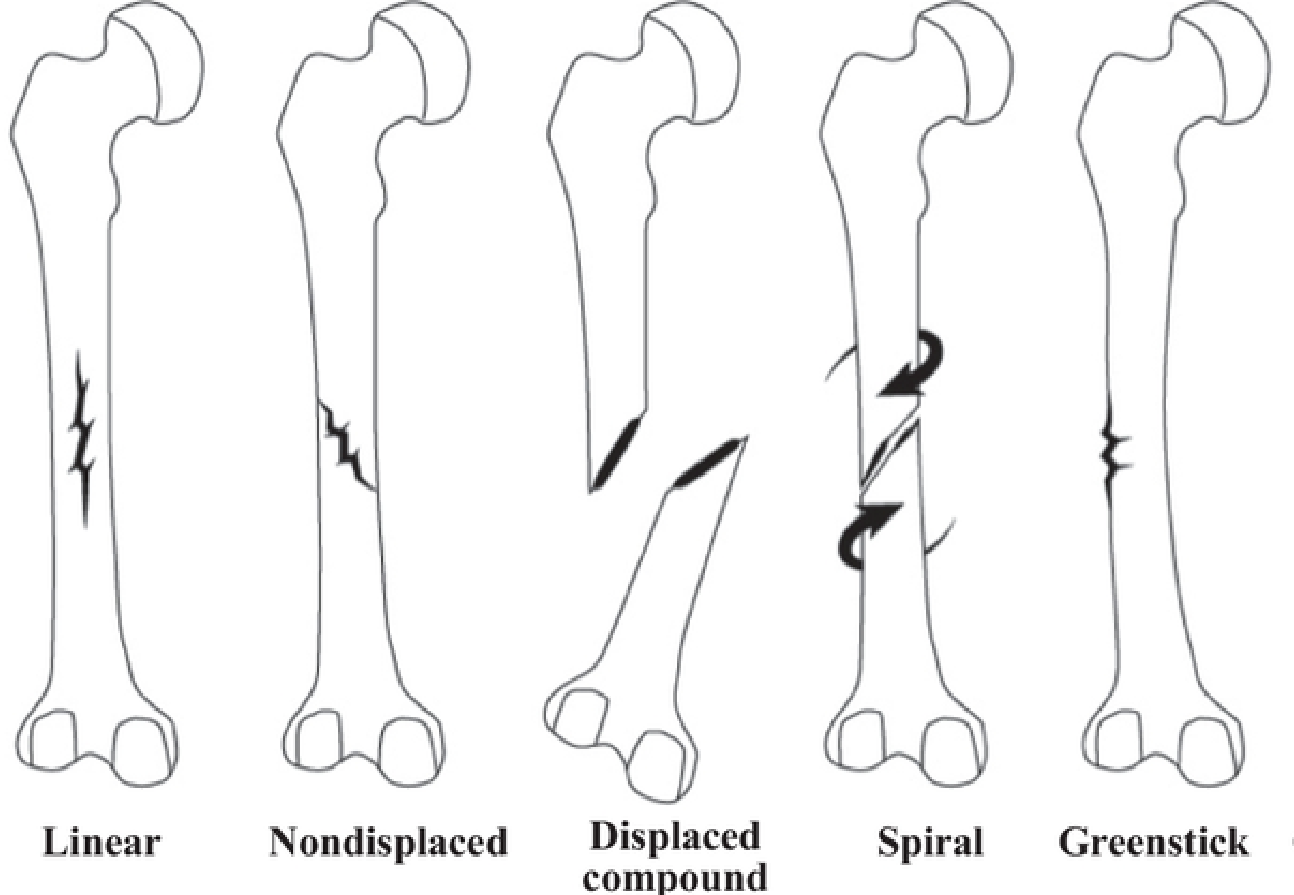
BONUS COURSE: Orthopedic Terminology 101

01 Fracture Classification

02 General Terminology in Orthopedics

Section 1:
Fracture Classification

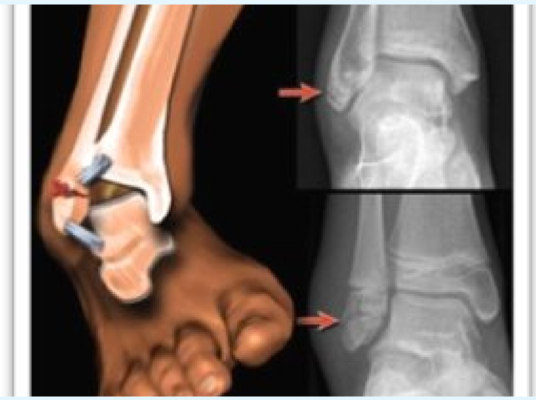
Introduction: Fractures represent a common yet complex challenge in musculoskeletal healthcare, requiring a comprehensive understanding of both the injury and the patient's unique needs. Each fracture scenario is distinct, influenced by factors such as the mechanism of injury, the patient's age, bone 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:

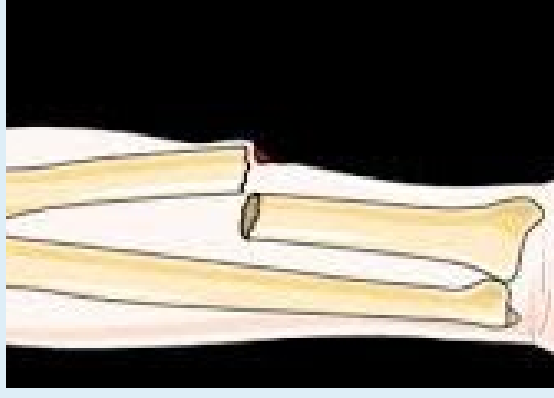
- Identify the primary types of fractures (e.g., transverse, oblique, spiral, comminuted) and their distinguishing features.
- Explain the criteria used in fracture classification, such as displacement, angulation, and location.
- Describe the clinical relevance of fracture classification in guiding treatment decisions.
- Use fracture classification to suport 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.

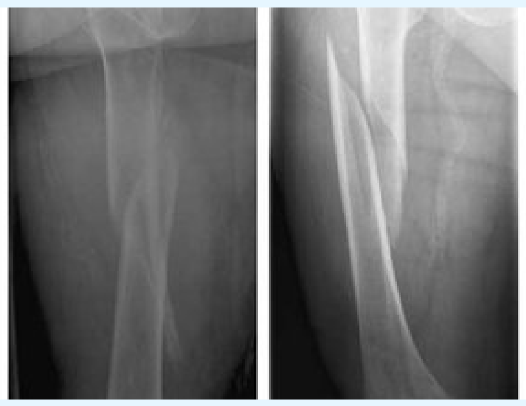
Transverse Fracture

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

Oblique Fracture

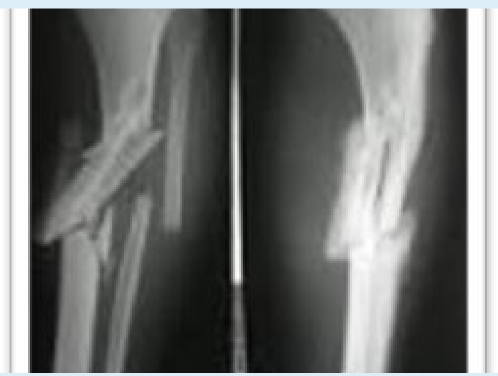
- Definition: A fracture with an angled line across the bone.
- Mechanism of Injury: Caused by indirect trauma, such as a twisting force or a fall at an angle.

Spiral Fracture



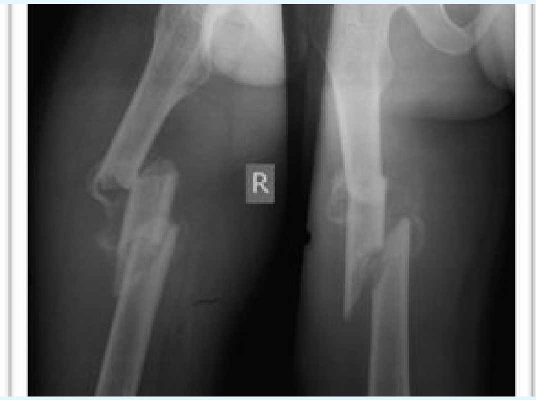
- Definition: A fracture that spirals around the bone, often resembling a corkscrew.
- Mechanism of Injury: Result of rotational or torsional forces, such as twisting injuries during sports.

Comminuted Fracture



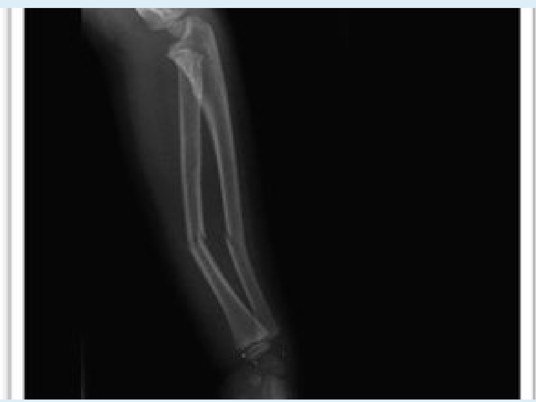
- Definition: The bone is shattered into three or more fragments.
- Mechanism of Injury: High-energy trauma, such as vehicle collisions or severe falls.

Segemental Fracture



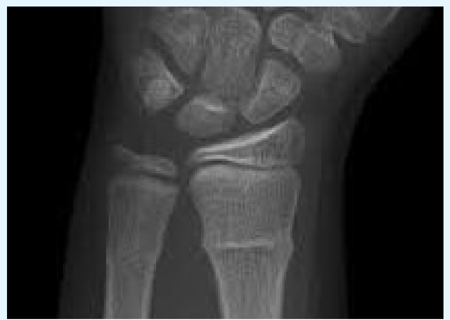
- Definition: A bone is fractured in two distinct places, creating a segment of bone that is unattached.
- Mechanism of Injury: High-energy trauma..

Greenstick Fracture



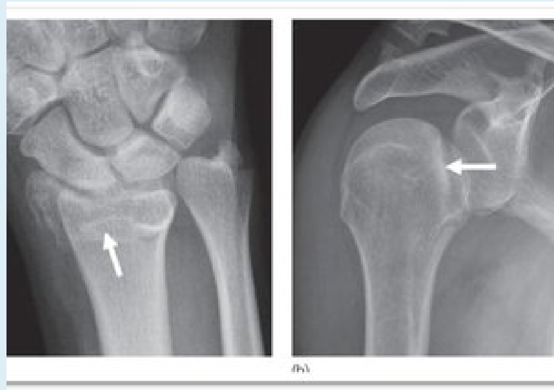
- Definition: An incomplete fracture where one side of the bone bends, and the other side breaks.
- Mechanism of Injury: Common in children due to the flexibility of their bones.

Buckle (Torus) Fracture



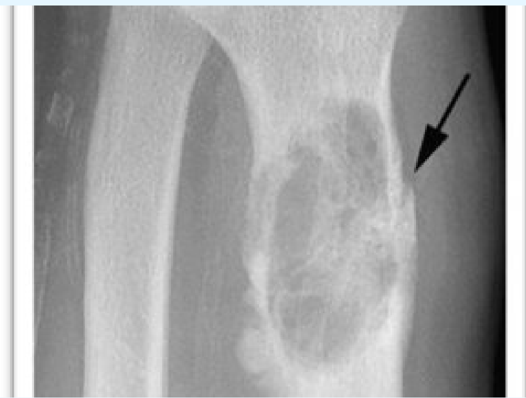
- Definition: A compression fracture where the bone buckles outward.
- Mechanism of Injury: Typically caused by axial loading in children.

Impacted Fracture



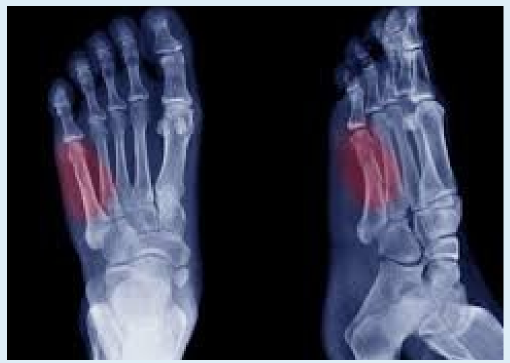
- Definition: The broken ends of the bone are driven into each other.
- Mechanism of Injury: Results from compressive forces, such as a fall from height.

Pathologic Fracture



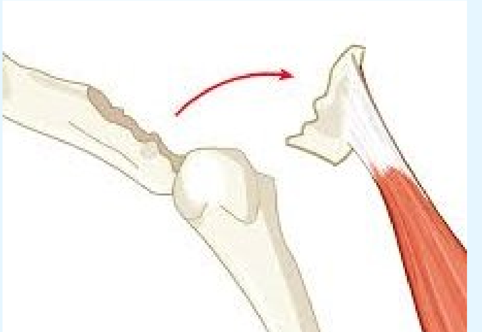
- Definition: A fracture occurring in bone weakened by disease (e.g., osteoporosis, cancer, Paget’s disease).
- Mechanism of Injury: Minimal or no trauma.

Stress Fracture



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

Avulsion Fracture

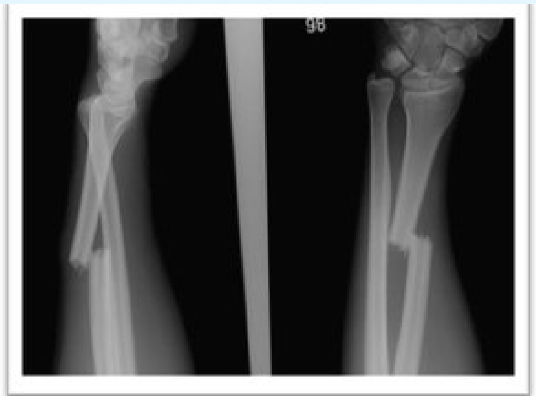


- Definition: A fragment of bone is pulled away by a tendon or ligament.
- Mechanism of Injury: Sudden forceful contraction or trauma.

Compression Fracture

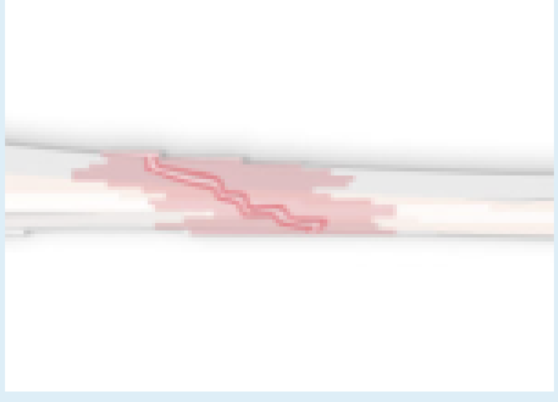
- Definition: A fracture resulting in bone collapse, often in vertebrae.
- Mechanism of Injury: Osteoporotic bones subjected to axial loading.

Displaced Fracture



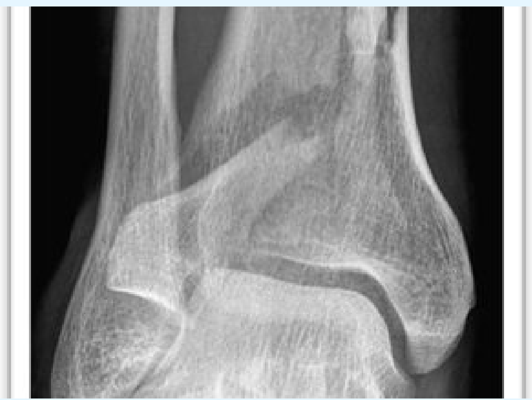
- Definition: Bone fragments are out of alignment.
- Management: Reduction and surgical fixation.

Non-Displaced Fracture



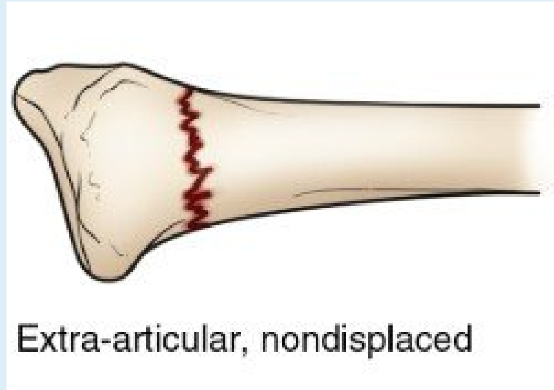
- Definition: Bone fragments remain in alignment.
- Management: Immobilization.

Intra-Articular Fracture



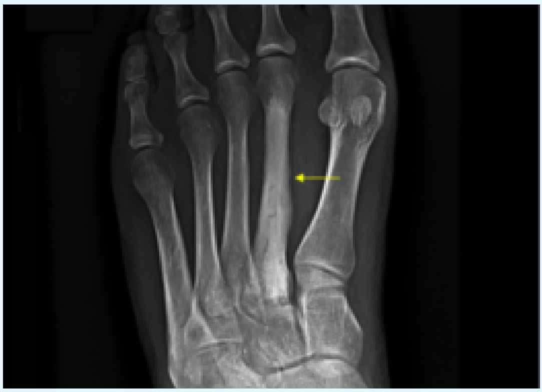
- Definition: The fracture extends into the joint surface.
- Mechanism of Injury: High-energy trauma.

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.

Section 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.

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.

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.

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.

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.

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.

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.

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\u2019s walking pattern to identify abnormalities or inefficiencies.

Orthopedic Trauma

Severe injury to the musculoskeletal system requiring urgent care.

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