

# Chapter 10: Common Complications in Splinting

## SPLINTING DOS AND DON'TS

### DOS



Immobilize above and below the injury

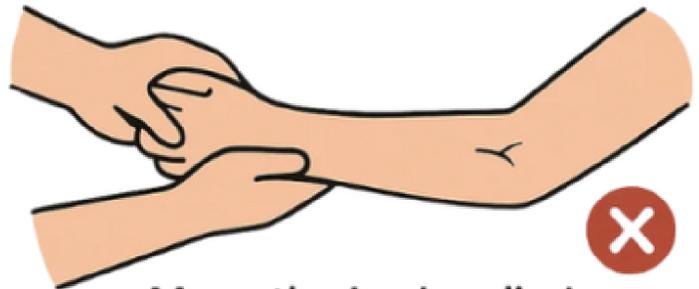


Add padding

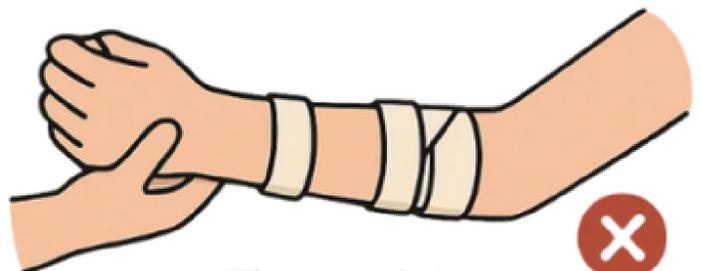


Check circulation

### DON'TS



Move the broken limb



Tie too tight

# 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.