1 **Stabilizing Acute Orthopedic Injuries In The Pediatric Patient and Cast Management Principles**

Torrie D. Edwards, FNP-C, CPN
Department of Orthopedics
Cook Children's Physician Network

2 **Discussion Topics**

- Purpose of Splinting
- Splinting and Casting Materials
- Types of Splints and Their Uses
- Positioning Basics
- Risks and Complications Associated with Immobilization
- Caring for the Immobilized Extremity

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Why Do We Splint The Injured Extremity?

4 **Purpose of Splinting**

- Provide comfort
- Protect and position the injured extremity
- Prevent further injury
- More easily able to accommodate and adjust for swelling
- Allows for easy visualization of the extremity if needed
- If high quality and with correct application, it can aid in maintaining optimum injury position that can affect the overall treatment plan
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Splinting and Casting Materials

6 **Prefabricated Splint**

- Injury specific premade splints exist for almost any body location
  - Aluminum and Foam Constructs
  - Soft (Neoprene, elastic)
  - Semi-rigid
  - Rigid (plastic, metal)
- Good for soft tissue injuries or stabilized fractures with low risk of loss of position

7 **Plaster**

- Used for splints and casts
- Slow setting time
  - Produces less heat
- More pliable than fiberglass

- Requires 10-12 layers
- More mess than fiberglass

8 **Fiberglass**

- Used for splints and casts
- Quick setting time
- Little mess
- Light material
- Requires less layers than plaster
- Moldable
- Can be waterproof if used in conjunction with other waterproof materials
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9 **Soft Fiberglass**

- Semi-rigid due to incomplete setting
- Patient has some motion
- Can be removed without a cast saw
- Used most commonly for clubfoot casting in infants

10 **Encased Fiberglass**

- Fiberglass covered by a felt covering
- Used for splinting
- Able to mold in multiple planes
- Comes either precut or in a roll that can be cut to length
- Used in conjunction with padding and Ace wrap to secure
- Commonly referred to as Ortho-Glass

11 **Encased Fiberglass**

12 **ACE Wrap**

- Often used for minor muscle or soft tissue injuries
- If used correctly, can help control swelling
- Good reminder to not overuse the extremity
- Does not provide much support
- Will not prevent re-injury

13 **Magazine, Newspaper, Cardboard**

- Used in emergency settings
- Immobilize the joint above and below the fracture site
- Splint the injury prior to moving the patient in order to minimize further damage, unless the patient is in a dangerous setting that requires immediate removal
- Do not attempt to straighten severely deformed limbs as this may cause further damage

14 **Tape**

- Used to stabilize and support the injury or prevent re-injury
- Provides pain relief by de-loading the painful structure

- Helps to facilitate normal movement
- Avoid wrinkles in the tape, as this can result in discomfort and blisters on the skin
- Apply the tape in angles that are natural to the body
- Should not be used in place of a rehab program that includes strengthening and proprioception

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Types of Splints, Their Uses and Positioning Basics

16 **Posterior Splint – Upper Extremity**

- Used for immobilization of the wrist, forearm, elbow and distal humerus
- Positioning for Upper Extremities
  - Wrist and forearm in neutral position
  - Elbow at 90 degrees of flexion
  - Splint terminates 2 inches distal to the axilla and palmar crease
  - Humerus – have patient lean forward, keeping the humerus vertical to allow axilla access and prevent angulation of the humerus
  - Adequately pad the olecranon due to risk of skin breakdown in this high tension area

17 **Posterior Splint – Short Leg**

- Immobilization for the foot, ankle, tibia and fibula
- Positioning for the Short Leg Splint
  - Neutral position of the foot
  - Ankle at 90 degrees
  - Knee flexed at 90 degrees
  - Splint terminates distally at the metatarsal heads and 2 inches distal to the popliteal crease
  - Adequately pad the heel to avoid pressure sores
  - Educate patient on floating the heel when elevating to avoid pressure sores
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18 **Posterior Splint – Long Leg**

- Immobilization of the foot, ankle, tibia, fibula, knee and femur
- Positioning for the Long Leg Splint
  - Neutral foot position
  - Ankle at 90 degrees
  - Knee is flexed 10 -15 degrees
  - Splint terminates distally at the metatarsal heads and 2 inches distal to the gluteal crease
  - Adequately pad the heel to avoid pressure sores
  - Educate patient on floating the heel when elevating
  - Avoid bunching of the splint material behind the knee – keep the leg in the same angle throughout application to avoid this
  - Support the leg with the palms to avoid creating indentations in the splinting materials – can result in pressure sores

19 **Sugar Tong Splint**

- Long, U shaped splint
  - Named after a utensil used to pick up sugar cubes
- Immobilization of the wrist, forearm and elbow
- Positioning for the Sugar Tong Splint
  - Neutral position for wrist and forearm
  - Elbow in 90 degrees of flexion
  - Ulnar and Radial aspects of the splint should not come in contact with one another to allow for possible swelling
  - Splint terminates distally at the metacarpal heads on the dorsal aspect and palmar crease on the volar aspect
  - Avoid positioning to where the patient is able to pronate and supinate

20 **Stirrup Splint (U Splint)**

- Splint that has a strap that wraps around the bottom of the foot leaving the heel exposed
- Immobilization of the foot, ankle, tibia and fibula
- Positioning for Stirrup Splint
  - Neutral foot position
  - Ankle at 90 degrees
  - Knee flexed at 90 degrees
  - Splint terminates distally at the metatarsal heads and 2 inches distal to the popliteal crease
  - The stirrup portion should terminate 3 inches distal to the popliteal crease on the medial and lateral sides
  - Stirrup should not overlap anteriorly

21 **Coaptation Splint**

- Immobilization of midshaft humerus fractures
- Positioning for Coaptation Splint
  - Humerus resting on torso supported with a sling
  - Elbow flexed to 90 degrees
  - Medial portion of splint should be 2 inches distal from axilla
  - Lateral portion of splint should be 2 inches proximal to the AC joint, well padded and molded
  - Natural tendency is for this fracture to drift into a varus position – when in doubt, add a little more valgus positioning to the splint
  - Avoid Radial Nerve Trauma - limit the amount of manipulation and movement to the arm, have the patient lean forward to allow gravity to assist in alignment
  - Document radial nerve function before and after splinting

22 **Removable Volar Wrist Brace**

- Used for soft tissue injuries and certain stable wrist fractures
- Positioning for comfort in rheumatoid arthritis or carpal tunnel
- Used when transitioning out of a cast

23 **Sling**

- Provides support to the collarbone, shoulder or arm after and injury or surgery
- Positioning For The Sling
  - Elbow at 90 degrees
  - Forearm against the torso
  - Ensure wrist is included in the sling for forearm support
  - Can use a safety pin to help secure the sling in the small child

24 **Ankle Brace**

- Used to immobilize ankle injuries, prevent re-injuries and provide support to the joint
- Types of Ankle Braces
  - Rigid – immobilizes the entire ankle
  - Functional or Semi-Rigid – Allows for some plantar and dorsiflexion while controlling inversion and eversion
- The use of an ankle brace in an athlete should not replace a quality rehab program that includes strengthening and proprioception
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25 **Stirrup Ankle Brace**

26 **Lace Up Ankle Brace**

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Risks and Complications Associated With Immobilization

28 **Thermal Injury**

- Plaster and fiberglass harden by an exothermic reaction which can burn the underlying skin
  - Plaster usually creates more heat than fiberglass
- Factors That Increase The Risk of Injury:
  - Temperature of the Dip Water – keep the temperature below 75 degrees Fahrenheit and check the manufacturers recommendations
  - Number of Layers of Material (>24 ply) – the thicker the cast/splint, the more heat produced
  - Too Little Padding – less padding allows more heat to reach the skin
  - Pillows/Blankets Under the Cast – keeps heat around the limb rather than allowing it to disperse to the surrounding air
  - Applying Several Rolls of Material At Once – allow for heat to escape for a few minutes after some rolls applied before applying the remainder

29 **Compartment Syndrome**

- Increased pressure within the soft tissue becomes too great that blood cannot flow to the tissue, resulting in necrosis and death of the tissue
- Emergency that requires immediate treatment
- Casts and splints by nature will provide some degree of compression to the extremity
  - Casts create higher pressure than a non-circumferential splint
  - Uni-valving a cast can reduce internal pressure by as much as 40%

  - Fiberglass applied under tension creates the highest skin surface pressures
  - Fiberglass applied with stretch-relaxation technique creates the lowest skin surface pressures

30 **Compartment Syndrome**

- Signs and Symptoms
  - Pain that is out of proportion to the injury
  - Worsening pain over time that is non-responsive to analgesics
  - Numbness
  - Tingling
  - Swelling
  - Blue/gray color to the skin or nail beds distal to the cast
  - Sluggish capillary refill
- For very early presentation, loosen or remove the cast/splint

31 **Pressure Sores**

- Focal areas of pressure (pressure points) that damages the skin being pressed upon, ultimately resulting in an ulcer
- Risk Factors – Application Technique
  - Do not use fingertips
  - Rough edges can cause pressure sores
  - Excess padding – causes cast to be loose and the limb inside can move, resulting in skin irritation from the cast sliding up and down
  - Molding over bony prominences and not molding uniformly
- Risk Factors – Patient Population
  - No or decreased sensation – spinal cord injuries, neuropathic or diabetic patients
  - Communication Issues – young age, developmental delay, sedated or comatose patients
  - Spastic Limbs – cerebral palsy, spina bifida
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32 **Pressure Sores**

33 **Wound Infection**

- Inspect extremity being immobilized for the presence of wounds that occurred at time of injury and use caution splinting around these areas
- Iatrogenic wounds can be caused by abrasions or pressure sores from improperly padding the ends of the splints and casts
- Wounds with subsequent infection can also be caused by the patient when they attempt to scratch under the cast/splint with a foreign object
- Can occur if a wet cast goes unreported, causing skin irritation and breakdown

34 **Cast Saw Burn**

- If used correctly, the oscillation of the cast saw blade should only cut through rigid material
- Use an in-and-out drop motion when cutting the cast

- Never drag the blade across the cast surface
- The blade can become hot enough to cause full thickness burns
  - More heat produced in a thicker cast
  - Fiberglass creates more heat than plaster
- Prevention of Cast Saw Burns
  - Good control over the saw to keep it from plunging through the cast
  - Take breaks frequently as the blade becomes hot or use a cool cloth over the blade
  - Can use a protective strip that goes into the cast between the material and the patient's skin. The saw is then used directly over the strip to protect the underlying skin

35 **Cast Saw Burn**

36 **Deep Vein Thrombosis (DVT)**

- Occurs when a blood clots forms in one or more of the deep veins of the body
  - Usually in the legs
- More common in the adult population than in children
- The longer the length of immobilization, the higher the risk of DVT development
- Anticoagulation may be used in high risk patient populations

37 **Loss Of Reduction**

- Can occur with both splints and casts
- Decrease in swelling after the acute phase can result in a more loose fitting cast/splint, resulting in loss of reduction
  - Properly applied and molded casts reduce the risk
- Weekly in cast x-rays are recommended for unstable fractures until risk of loss of position has abated
- Cast wedging or modification, re-reduction or operative interventions can be considered for loss of reduction

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Care of the Immobilized Extremity

39 **General Splint and Cast Care**

- Elevate the extremity at a level above the heart in the first 48-72 hours after the cast is placed and then as needed for swelling
- Keep the splint/cast dry
- Do not break or trim cast edges
  - For rough patches, you can apply a band-aid over the site
- Do not pull out the padding
- Do not remove the splint or cast yourself unless instructed by the orthopedic provider to do so
- Do not stick anything inside the cast
- Do not use powder or lotion under the cast – powder can form into clumps that cause skin sores

40 **General Splint and Cast Care**

- Check At Least Twice Daily For:
  - Movement and feeling in the fingers or toes and above and below the cast or splint
  - Change in color to fingers or toes
  - Swelling above and below the cast or splint – compare with the opposite side
  - Rashes, bruising or red raw areas around cast edges
- Full activity restrictions unless otherwise specified by the orthopedic provider

41 **Splint/Cast Troubleshooting Tips**

- Swelling
  - Evaluate the extremity for blood flow and sensation
  - Elevate the extremity higher than the heart
  - Encourage frequent movement of the fingers or toes while elevated
  - Loosen the splint or the cast
    - Loosen/unwrap the outer bandage layer of the splint, taking care to leave the slab in place
    - Remove the tape and/or widen the space in the cast that is uni-valved or bi-valved
  - Look for indents on the cast that may be causing focal pressure areas
  - If compartment syndrome is suspected, refer to the emergency room immediately
- Wet Splint/Cast
  - Use a blow dryer on cool setting to blow cool air into the cast
  - Call the Orthopedic Clinic if the padding does not dry within 12 hours or if the extremity was completely submerged in water
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42 **Splint/Cast Troubleshooting Tips**

- Skin Irritation
  - Apply material to cast edge to create a barrier between the skin and the cast
    - Mole skin
    - Band-Aid
    - Duct tape
  - If concerned for infection or worsening of site, call the orthopedic clinic
- Itching
  - Decrease activity that would raise body temperature
  - Use a hair dryer on a cool setting and blow cold air into the cast
  - Gently tap on the outside with a pencil
  - Oral Benadryl at night
  - Never stick anything in the cast to scratch
- Foreign Object in the Cast
  - Call the orthopedic clinic immediately
  - Do not try to retrieve the object yourself

43 **When To Call The Orthopedic Clinic**

- Soft spots or cracks in the cast
- Skin looks raw or red around cast edges
- Pain that will not go away
- Numbness/tingling in the fingers or toes
- Color changes to the fingers or toes
- Swelling that is not relieved
- Cast too tight or too loose
- Odor from the cast
- Drainage from the cast
- Burning or stinging sensation
- Unexplained fevers
- If you suspect or know that something is in the cast
- Toes that disappear into the cast
- Increased fussiness in a young child without an explanation

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