

American Society of Orthopedic Professionals

Orthopedic Lecture Series[©]

Bone/ Structures, Fracture Types and Skeletal Disorders/ Specialty Casts and Appliances/Surgical Procedures, Positioning and Devices

Lesson 10: Casting, Splinting, and Orthopaedic Appliances

Indications for Immobilization

- Fractures
- Sprains
- Severe soft-tissue injuries
- Reduced joint dislocations
- Inflammatory conditions: arthritis, tendinopathy, tenosynovitis
- Deep laceration repairs across joints
- Tendon lacerations

Standard Materials / Equipment for Application

- Adhesive tape (prevent slippage of elastic wrap used with splints)
- Bandage scissors
- Water at room temperature (dipping water)
- Casting gloves (necessary for fiberglass)
- Elastic bandage (for splints)
- Padding
- Fiberglass casting material
- Sheets, underpads (to minimize soiling of the patient's clothing)
- Stockinette

Factors that affect Setting Times

Factors that speed setting times

- Higher temperature of dipping water
- Use of fiberglass
- Reuse of dipping water

Factors that slow setting times

- Cooler temperature of dipping water
- Use of plaster

Guidelines for Proper Application

- Use appropriate amount and type of padding
- Properly pad bony prominences and high-pressure areas
- Properly position the extremity before, during, and after application of materials
- Avoid tension and wrinkles on padding, plaster, and fiberglass
- Avoid excessive molding and indentations

Complications for Cast or Splint Immobilization

- Compartment syndrome
- Ischemia
- Heat injury
- Pressure sores and skin breakdown
- Infection
- Dermatitis
- Joint stiffness
- Extremity swelling
- Impaired Arterial Supply
- Pain
- Loss of position
- Nerve damage

Avoiding Complications with Casting

- Patient is well instructed about care of cast
- Application of the plaster cast should be done by a skilled person in proper manner
- Patient follow up examination next day. Strict elevation of the limb should be instructed.
- Patient should report on pain that is not relieved, swelling, bluishness or pallor of distal part.
- Patient should be carefully examined in the follow up for probable complications of cast

General Patient Instructions

- Keep the cast clean and dry.
- Check for cracks or breaks in the cast.
- Pad the rough edges to protect the skin from scratches.
- Do not scratch the skin under the cast by inserting objects inside the **cast**. *Instead one can use a hairdryer placed on a cool setting to blow air under the cast and cool down the hot, itchy skin. Never blow warm or hot air into the cast.*
- Do not put powders or lotion inside the cast.

General Patient Instructions

- Prevent small toys or objects from being put inside the cast.
- Elevate the cast above the level of the heart to decrease swelling and move the fingers or toes to promote circulation.
- Do not pull support or lift the person by cast or bar on the cast.

Splints vs Casting

Splint/cast	Construction	Indications	Advantages	Risks/disadvantages
Splint	Noncircumferential	Acute and definitive treatment of select fractures	Allows for acute swelling	Lack of compliance
		Soft tissue injuries (sprains, tendons)	Decreased risk of complications	Increased range of motion at injury site
		Acute management of injuries awaiting orthopedic intervention	Faster and easier application	Not useful for definitive care of unstable or potentially unstable fractures
			Commercial splints available and appropriate for select injuries	
			May be static (preventing motion) or dynamic (functional; assisting with controlled motion)	
Cast	Circumferential	Definitive management of simple, complex, unstable, or potentially unstable fractures	More effective immobilization	Higher risk of complications
		Severe, nonacute soft tissue injuries unable to be managed with splinting		More technically difficult to apply

Commonly used Splints and Casts

Area of injury	Type of splint	Type of cast
Hand/finger	Ulnar gutter, radial gutter, thumb spica, finger	Ulnar gutter, radial gutter, thumb spica
Forearm/wrist	Volar/dorsal forearm, single sugar-tong	Short arm, long arm
Elbow/forearm	Long arm posterior, double sugar-tong	Long arm
Knee	Posterior knee, off-the-shelf immobilizer	Long leg
Tibia/fibula	Posterior ankle (mid-shaft and distal fractures), bulky Jones	Long leg (proximal fracture), short leg (mid-shaft and distal)
Ankle	Posterior ankle ("post-mold"), stirrup, bulky Jones, high-top walking boot	Short leg
Foot	Posterior ankle with or without toe box, hard-soled shoe, high-top walking boot	Short leg, short leg with toe box for phalanx fracture

Lower Extremity Splinting and Casting

Region	Type of splint/cast	Indications	Pearls/pitfalls	Follow-up/referral
Ankle	Posterior ankle splint ("post-mold")	Severe sprains	Splint ends 2 inches distal to fibular head to avoid common peroneal nerve compression	Less than one week
		Isolated, nondisplaced malleolar fractures		Refer for displaced or multiple fractures or significant joint instability
		Acute foot fractures		
Ankle	Stirrup splint	Ankle sprains	Mold to site of injury for effective compression	Less than one week
		Isolated, nondisplaced malleolar fractures		
Lower leg, ankle, and foot	Short leg cast	Isolated, nondisplaced malleolar fractures	Compartment syndrome most commonly associated with proximal mid-tibial fractures, so care is taken not to over-compress	Two to four weeks
		Foot fractures—tarsals and metatarsals	Weight-bearing status important; initially non-weight bearing with tibial injuries	Refer for displaced or angulated fracture or proximal first through fourth metatarsal fractures
Knee and lower leg	Posterior knee splint	Acute soft tissue and bony injuries of the lower extremity	If ankle immobilization is necessary, as with tibial shaft injuries, the splint should extend to include the metatarsals	Days
Foot	Short leg cast with toe plate extension	Distal metatarsal and phalangeal fractures	Useful technique for toe immobilization	Two weeks
			Often used when high-top walking boots are not available	Refer for displaced or unstable fractures

Lower Extremity Splinting and Casting

Region	Type of splint/cast	Indications	Pearls/pitfalls	Follow-up/referral
Ulnar side of hand	Ulnar gutter splint/cast	Fourth and fifth proximal/middle phalangeal shaft fractures and select metacarpal fractures	Proper positioning of MCP joints at 70 to 90 degrees of flexion, PIP and DIP joints at 5 to 10 degrees of flexion	One to two weeksRefer for angulated, displaced, rotated, oblique, or intra-articular fracture or failed closed reduction
Radial side of hand	Radial gutter splint/cast	Second and third proximal/middle phalangeal shaft fractures and select metacarpal fractures	Proper positioning of MCP joints at 70 to 90 degrees of flexion, PIP and DIP joints at 5 to 10 degrees of flexion	One to two weeksRefer for angulated, displaced, rotated, oblique, or intra-articular fracture or failed closed reduction
Thumb, first metacarpal, and carpal bones	Thumb spica splint/cast	Injuries to scaphoid/trapezium Nondisplaced, nonangulated, extra-articular first metacarpal fractures Stable thumb fractures with or without closed reduction	Fracture of the middle/proximal one third of the scaphoid treated with casting	One to two weeksRefer for angulated, displaced, intra-articular, incompletely reduced, or unstable fractureRefer displaced fracture of the scaphoid
Finger injuries	Buddy taping	Nondisplaced proximal/middle phalangeal shaft fracture and sprains	Encourage active range of motion in all joints	Two weeks Refer for angulated, displaced, rotated, oblique, or significant intra-articular fracture or failure to regain full range of motion
	Aluminum U-shaped splint	Distal phalangeal fracture	Encourage active range of motion at PIP and MCP joints	
	Dorsal extension-block splint	Middle phalangeal volar plate avulsions and stable reduced PIP joint dislocations	Increase flexion by 15 degrees weekly, from 45 degrees to full extension	
			Buddy taping permitted with splint use	
Mallet finger splint	Extensor tendon avulsion from the base of the distal phalanx	Continuous extension in the splint for six to eight weeks is essential		

Lower Extremity Splinting and Casting

Region	Type of splint/cast	Indications	Pearls/pitfalls	Follow-up/referral
Wrist/hand	Volar/dorsal forearm splint	Soft tissue injuries to hand and wrist Acute carpal bone fractures (excluding scaphoid/trapezium) Childhood buckle fractures of the distal radius	Consider splinting as definitive treatment for buckle fractures	One week Refer for displaced or unstable fractures Refer lunate fractures
	Short arm cast	Nondisplaced, minimally displaced, or buckle fractures of the distal radius Carpal bone fractures other than scaphoid/trapezium		
Forearm	Single sugar-tong splint	Acute distal radial and ulnar fractures	Used for increased immobilization of forearm and greater stability	Less than one week Refer for displaced or unstable fractures
Elbow, proximal forearm, and skeletally immature wrist injuries	Long arm posterior splint, long arm cast	Distal humeral and proximal/midshaft forearm fractures Nonbuckle wrist fractures	Ensure adequate padding at bony prominences	Within one week Refer for displaced or unstable fractures
	Double sugar-tong splint	Acute elbow and forearm fractures, and nondisplaced, extra-articular Colles fractures	Offers greater immobilization against pronation/supination	Less than one week Refer childhood distal humeral fractures

Serial Casting

- ▶ Used to correct joint position, and improve mobility
- ▶ The cast is changed at specific intervals, to slowly induce a change in the joint position
- ▶ This technique can be used to treat a deformity caused by an imbalance of the muscles
 - A child suffering from cerebral palsy might benefit from this technique
- ▶ Serial casting can also be used in the treatment of an acquired injury, such as a rupture of the Achilles tendon
 - An Achilles tendon rupture treated with serial casting involves initially casting the foot in extreme plantar flexion
- ▶ When a certain amount of healing has occurred, the cast is removed and a new cast decreasing the amount of plantar flexion is applied
- ▶ The cast will remain in place for a period of 7-10 days
- ▶ This process is repeated until a normal range of motion has been re-established



Delbert, Dehne, and Gauntlet Casts

1. Delbert cast

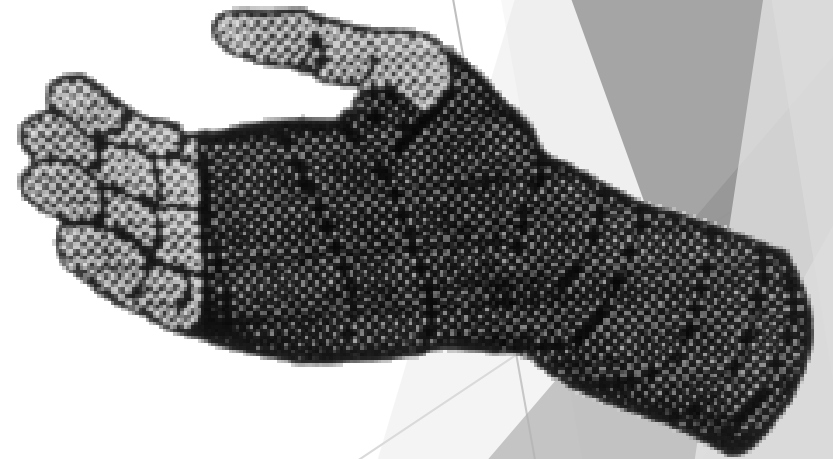
- ▶ A short leg cast that prevents lateral movement while allowing dorsiflexion, and plantar flexion
- ▶ It is applied, and then trimmed away from the anterior and posterior ankle, and the heel

2. Dehne cast

- ▶ Also called a three-finger spica cast
- ▶ Used to treat fractures of the navicular, it is comprised of a section covering the thumb, and a separate section enclosing the index, and middle fingers

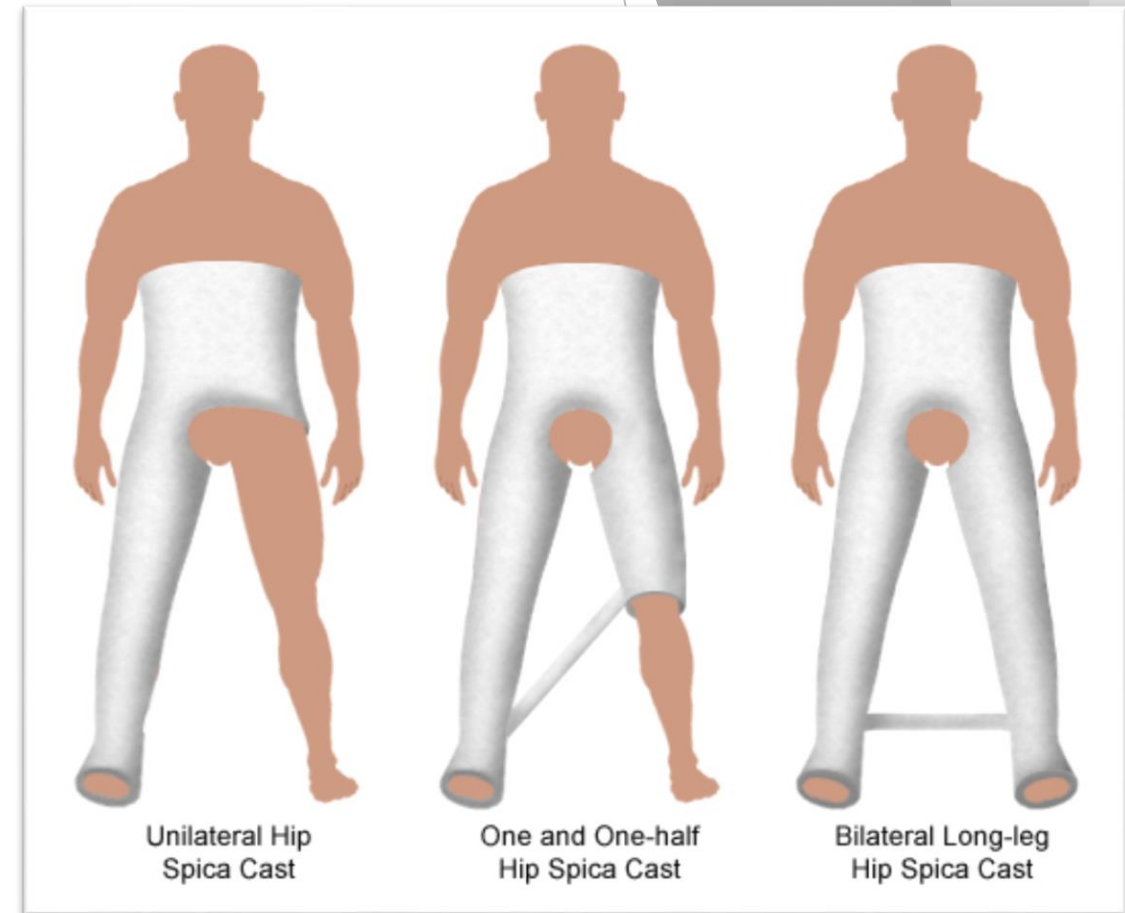
3. Gauntlet cast

- ▶ Used to treat fractures, or dislocations, of the metacarpals and phalanges
- ▶ It is a short cast that extends from above the wrist to cover part of the palm of the hand
- ▶ It often has an extension to control 1 or more of the digits



Hip Spica Cast

- ▶ Used to prevent movement of the hip joints, and/ or thighs to allow healing after injury
- ▶ This cast is often used in the treatment of fractures of the femur, or damaged hip joints
- ▶ The length of the cast varies with the injury, but generally extends from the middle of the chest to an area below the knees
- ▶ If both hips or both thighs are affected, the case will cover both knees
- ▶ If only one side is affected only 1 knee will be covered
- ▶ A space is left in the cast to allow the wearer to use the bathroom
- ▶ The cast is usually used in the treatment of injuries in children.
- ▶ The cast is usually applied under general anesthetic
 - The iliac spines, ribs, and back must be well padded to protect these pony sites



Velpeau Dressing

- ▶ Also called Velpeau sling, is designed to treat injuries to the shoulder and humerus
- ▶ It can be used to treat fractures, or dislocations in these areas
- ▶ This device is used when the fracture is minimally displaced, or non-displaced
- ▶ Similar to a sling and swathe dressing, but more restrictive
- ▶ The elbow is held at the side in a flexed position, and the hand is affixed to the upper chest
- ▶ It is generally used to treat injuries in individuals who would not be able to tolerate other kinds of treatment
 - It is therefore often used to treat young children, or the elderly
- ▶ The angulation of the fracture can be controlled by pads placed in the axilla



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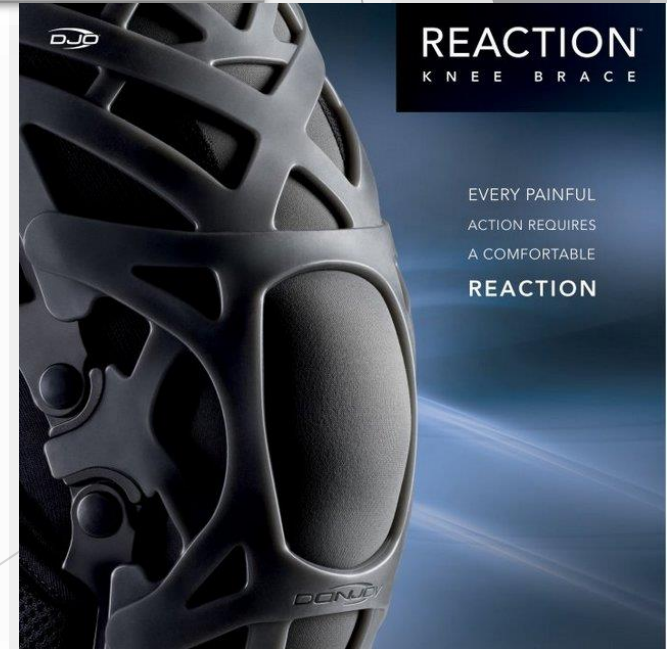
Knee Unloader Braces

- ▶ The incidence of degenerative arthritis of the knee is increasing with the increase in activity level in society.
 - ▶ When the cartilage in the knee degenerates, the underlying bone loses its cushion, and the ensuing friction leads to pain.
 - ▶ Most approaches to addressing this pain are invasive (injections and surgery), or require the continuing use of medication.
 - ▶ The unloader brace is a non-invasive therapy
 - ▶ It is often the case that one side of the knee is degenerative (usually the medial), and one side is healthy.
 - ▶ To balance this, the unloader brace puts pressure on the healthy side of the knee with counter pressure above and below the damaged side.
 - ▶ This creates a triangle of support with the base of the triangle on the affected side.
 - ▶ This serves to correct the misalignment of the knee, restore function, and decrease pain
- Multiple fittings of the brace may be required



Patellar Brace

- ▶ In patellar femoral chondromalacia (PFC) the cartilage under the patella becomes damaged
- ▶ Extension and flexion of the knee causes pain as the patella rubs against the femur
- ▶ This condition may result from a muscle imbalance in the quadriceps that causes the patella to be pulled laterally preventing it from sliding smoothly in the groove of the femur
- ▶ Exercises to strengthen the medial side of the quadriceps may aid in pulling the patella over
- ▶ The use of the patellar brace will often be advised until the muscular imbalance is resolved
 - The brace is fitted over the knee and has a large pad on the lateral side that pushes the patella toward the midline into proper alignment
 - The correct fitting and sizing of these braces is imperative because the pad must fit precisely along the lateral patella



REACTION
K N E E B R A C E

EVERY PAINFUL
ACTION REQUIRES
A COMFORTABLE
REACTION

Ankle Foot Orthosis

- ▶ Ankle Foot Orthosis (AFO) is a brace that holds the foot in a neutral position
- ▶ It accomplishes this by preventing plantar flexion
- ▶ It starts at the proximal calf and continues along the plantar surface of the foot.
- ▶ This device is very useful in the treatment of a drop foot injury in which the nerves to the foot's dorsiflexor muscles are damaged
 - The dorsiflexor muscles are used in normal walking to lift the foot, and ensure that the heel strikes the ground before the toes
- ▶ Individuals with drop foot that goes untreated often stub their toes which may cause falls
- ▶ AFOs can be purchased off the shelf, but a custom made brace is more efficient, and therefore preferable
- ▶ A technologist may be involved in the fitting of the AFO brace

