Casting Techniques: Splints, Casts, and Removal

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Problem Identification and Needs Assessment

Identification of targeted learners
The target learner is the PGY-1 resident in Orthopaedic Surgery.

Identification of need or problem for targeted learners
Adequate cast technique is paramount for appropriate management of orthopaedic injuries, including fractures, dislocations, and deformity, such as club foot. Cast technique requires multiple steps, including adequate padding, molding, and immobilization during cast application, and safe removal. Further, techniques of cast application differ with different materials (plaster, fiberglass, Gortex waterproof casts) and between splints and casts. Standard techniques of splint and cast application can be applied across body parts once proficiency is met.

Current educational approach to address need or problem
Most housestaff gain experience in cast and splint application in Emergency Room consultations, outpatient clinics, and in the operating room – in some situations without direct oversight. Standardization of technique and assessment of skills is often lacking in these settings or occurs late after cast application during patient reassessments or at patient follow-up appointments.

Ideal educational approach to address need or problem
Skills lab with a cast sink, plaster/fiberglass cast material, cast padding, and cast saw/removal tools. Lab should have at least two participants (one applying, one acting as patient) with faculty supervision and oversight.

Goals and Objectives

Specific educational goals
- Understand principles of casting/splinting in management of acute trauma (when to apply a cast vs. splint and why).
- Learn how to apply cast padding across a joint (ankle, elbow) to optimize padding but prevent pressure during joint flexion.
- Learn how to manipulate plaster and fiberglass when wet to optimize cast hardening.
- Learn techniques of cast application with even layers without excessive constriction circumferentially.
- Learn how to mold casts around joints and bony prominences to prevent pressure on the skin.
- Apply principles of splint/cast molding for fracture reduction and maintenance of reduction (NO straight cylinder casts).
- Learn safe use of a cast saw and cast removal tools.
- Apply principles to 5 casts/splints: “Sugartong” forearm splint, “Sugartong/posterior” leg and ankle splint, Long arm cast, Short arm cast, and Thumb spica cast.
- Learn principles of finger splints

Syllabus Development

Assumptions
The resident hasn’t done this before.
Suggested readings

- Charnley's Closed Management of Fractures
- Skeletal Trauma
- Greens Textbook of Hand Surgery

Description of skills module

This skills module will consist of the steps of cast application: cast padding, cast material preparation, cast molding and smoothing, cast shaping/fracture reduction, and finally cast removal.

The second aspect of the module will review principles of finger splints, including dorsal and volar splints and buddy taping.

Description of techniques and procedures

Learners should learn appropriate steps of cast/splint application:

- Application of a stockinette of appropriate length and size.
- Layers of cast padding:
  - 1-2 layers, with padding concentrated around bony prominences, but not excessively around joints or flexion creases.
- Layers of cast or splint material:
  - Splint: 10-12 sheets
  - Cast: 2-3 layers, again taking effort to insure no increased material around joints or flexion creases.
- Water Temperature:
  - Cool water to prevent burns.
- Molding and lamination of casts as they set to smooth them and optimize cast integrity and strength.
- 3-point pressure application to mold casts to optimize fracture reduction and orientation.
- Incorporation of the stockinette in the cast molding.
- Adhering to principles of appropriate length of cast (e.g. a short arm cast that is too long and goes distal to the metacarpal-phalangeal flexion crease and prevents finger flexion).
- Cast removal techniques to minimize burns or cuts:
  - Careful use of the cast saw, gentle motions without excessive pressure, no continuous cutting, etc.
- Principles of Patient Safety:
  - Burns from water too hot and cast heating up during hardening
  - Pressure sores from pressure during cast molding (using the finger tips rather then cupping the hand) or over bony prominences.
  - Cast saw errors (as above).
- Assessment of cast integrity after removed:
  - Examine lamination in cross-section, assess brittleness of cast and ability to break, etc.

Exercises – Casts and Splints:

- Application of a "sugartong" and posterior ankle splint with appropriate 3-point fixation, ankle flexion, and splint length/thickness.
- Application of a "sugartong" forearm/wrist splint with appropriate 3-point fixation, hand MCP joint free for full flexion, wrist in neutral rotation and position, and adequate splint length/thickness.
- Application of a Long-arm cast with 90° elbow flexion, appropriate 3-point flexion, appropriate hand/wrist length (as above for sugartong forearm splint), and cast thickness.
- Application of a Short leg cast with 90° ankle dorsiflexion, adequate heel padding, 3-point fixation and molding, and cast length and thickness.
- Application of a Thumb spica cast/splint incorporating the thumb (full extension position) and wrist (neutral rotation and flexion/extension).

Exercises: Finger Splints:

- Apply a dorsal finger splint with the MCP free (allowing full flexion) but the PIP and DIP immobilized in extension.
- Apply a dorsal splint for the DIP in extension but keep the PIP free (allowing full flexion).
- Buddy tape two fingers together (e.g. the ring and small finger).
Common errors and prevention strategies

- Too much padding or padding balling up in flexion creases.
- Casts of inadequate thickness (too thin will not be durable, too thick are too heavy).
- Casts are too long or short to provide optimal fracture control or lead to surrounding joint stiffness (e.g. finger flexion in a short arm cast).
- Accumulation of cast material over the “fracture site” rather than at the ends of the cast.
- Casts are too constrictive.
- Cast is not molded and is a “cylinder” – not adequately incorporated or laminated and therefore cracks in the layers.
- Cast saw is used to aggressively and burns/cuts the patient.

Demonstrate expert performance

By attending faculty overseeing the module.

Supplies and station setup

- 4 and 6-inch plaster and fiberglass rolls
- 4 and 6-inch cast padding rolls
- 4 and 6-inch ACE wraps
- Cast saw and cast cutter/opener
- Sink with plaster trap, bucket for water, and IV pole for hanging arm or leg
- Kerlex rolls or finger traps for hanging arm/leg

Suggested duration for completion of module

- Introduction to cast principles, materials, and cast removal: 15 minutes
- Faculty demonstration of cast application, manipulation, and molding: 15 minutes
- Application of AO forearm splint: 15 minutes
- Application of AO ankle splint: 15 minutes
- Application of Long arm cast and removal: 30 minutes
- Application of Short leg cast and removal: 30 minutes
- Assessment: 30 minutes

Total time: 2.5 hours

Estimated budget

TBD

Learner Evaluation and Feedback

Methods of performance assessment

- Learner can appropriately apply a splint with adequate shape, length, integrity, and molding.
- Learner can appropriately apply a cast across a joint with appropriate joint flexion, cast length and molding, and cast integrity.
- Learner can safely remove/bivalve the cast once hard.
- “What is wrong with this cast” assessment checklist:
  - Checklist of key components of a successful cast or splint:
    - Stockinet length/width
    - Cast padding: too little, too much
    - Cast application: number of layers, lamination, molding, pressure points, cracking from cast motion, etc.
    - Water temperature
    - Length of cast: too long (stiffness at surrounding joints) or too short (inadequate fracture immobilization).
    - Cast shape: molded or a cylinder
    - Cast saw technique

Suggested proficiency benchmarks

Each exercise is analyzed for resident proficiency. Proficiency is demonstrated by the resident who completes each step of each module exercise correctly and without error. Each step should be assessed for correctness and summative errors per exercise (more then 2 out of the 10 steps) are indicative of need for further practice on the module. Residents who demonstrate proficiency with all exercises have completed this module.
Faculty assessment of resident performance of cast placement on a series of patients. Evaluate quality of cast, reduction of fracture, etc.