Serial Casting For The Lower Extremity: An Introduction Using An Evidence-Based Care Guideline

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Objectives

- To review an evidence-based care guideline for lower extremity serial casting treatment
- To examine the current body of evidence related to lower extremity serial casting

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Objectives

- To observe and discuss serial casting techniques for the ankle-foot complex
- To facilitate open-ended conversations across disciplines to determine best plan of care during serial casting of the lower extremities (i.e. casting with botulinum toxin injections, knee extension splinting, etc.)

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Development of an Evidence-Based Care Guideline - Background

- Stretching has always been a core therapeutic intervention for physical therapists
- Despite stretching, ROM limitations often persist and progress into contractures
- Also joint stiffness can result from immobilization, especially in an abnormal or non-functional position

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Development of an Evidence-Based Care Guideline - Background

- Animal models show that muscle tissue can be effectively stretched by:
  - Low load: i.e. not too aggressively
  - Long duration: at least 6 hours in a muscle with abnormal muscle tone (Tardieu, 1987).
- Prolonged immobilization in plaster casts started in earnest in the 1970s.

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Development of an Evidence-Based Care Guideline - Background

- Theories about casting include:
  - Increase in number of sarcomeres in series
  - Reduce abnormal muscle tone by interfering with muscle spindle excitation**
  - Neutral warmth of casts aid relaxation**
- **Studies to support these theories have had inconclusive results.

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Development of an Evidence-Based Care Guideline - Background

- Variation was noted regarding the methods of delivery of serial casting treatment
- An evidence based practice group assembled in 2006 to search the literature and make recommendations regarding serial casting process including frequency, duration, and materials

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Development of an Evidence-Based Care Guideline – EBP Process

- Basic steps which lead to an evidence-based decision are:
  - development of a specific clinical question
  - conduction of a precise literature search
  - critical appraisal of each article
  - synthesis of the evidence
  - development of care recommendations

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Development of an Evidence-Based Care Guideline – EBP Process

- We used LEGEND (Let Evidence Guide Every New Decision) evidence evaluation system
- It includes tools and resources for gathering and critically appraising published works, grading the body of evidence found, and judging the strength of the concluding recommendation statements

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Development of an Evidence-Based Care Guideline – Literature Search

- **Keywords:** serial casting, casting, cast, physical therapy, spasticity, cerebral palsy, idiopathic toe walking, toe walking, brain injury, Duchenne Muscular Dystrophy

- **Databases:** CINAHL, Medline, Pubmed, PEDro, Cochrane Library, Scopus, ACP Journal Club, Hooked on Evidence, PsychInfo

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Development of an Evidence-Based Care Guideline – Critical Appraisal

- In 2009: 18 research articles and 3 books were deemed appropriate to include in the Clinical Practice Guideline, including 4 RCTs and several lower level studies (including case reports, cohort studies and general reviews).

- In 2013: All original research studies were reviewed as well as several new articles. 30 research articles and 2 books have been used in revising the Clinical Practice Guideline. 5 systematic reviews, 2 RCTs, as well as a few lower level studies were added. More research articles studying ITW were included.

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Evidence Summary – Cerebral Palsy

- Strong support that casting improves ankle DF PROM
- Moderate support for short term gait improvements
- Insufficient evidence or lack of consensus to support muscle tone and long term gait improvements

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Evidence Summary – Cerebral Palsy

- Novak, I, et al. (2013). A systematic review of interventions for children with cerebral palsy: state of the evidence. *Developmental Medicine and Child Neurology.* 55, 885-910.
- Contracture management utilizing Serial Casting: “green-light” intervention in the lower extremity, strong “yellow-light” intervention in the upper extremity.
- 1b

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Evidence Summary – Cerebral Palsy

- Blackmore, AM, et al. (2007). A systematic review of the effects of casting on equinus in children with cerebral palsy: an evidence report of The AACPDM. *Developmental Medicine and Child Neurology.* 49(10), 781-790.
  - Compared casting vs botox in terms of spasticity reduction – neither superior.
  - Compared casting with botox to casting alone – neither superior.
  - Casting improved gait more so than botox alone.
  - 1a

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Evidence Summary – Cerebral Palsy

- Park, E., et al. (2010). Short-Term Effects Of Combined Serial Casting And Botulinum Toxin Injection For Spastic Equinus In Ambulatory Children With Cerebral Palsy. *Yonsei Medical Journal*. 51(4), 579-584.
  - Significant improvements in tone, dynamic spasticity, and PROM in both treatment groups, but the results were more significant in botox with casting group.
  - Standing dimension D of GMFM-66 significantly improved in botox with casting group.
  - 3a

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Evidence Summary – Brain Injury

- Strong support that casting improves ankle DF PROM
- Lack of consensus or insufficient evidence to support changes in muscle tone or gait after casting.

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Evidence Summary – Brain Injury

- Hellweg S. Physiotherapy after traumatic brain injury: A systematic review of the literature. *Brain Injury*. 2008;22(5): 365-373.
  - Serial casting was shown to be an effective treatment strategy for improving passive ROM, but not clear as to reducing muscle tone.
  - Takeaway: serial casting needs to be an adjunct therapy with this population - it is not a stand alone treatment.
  - 1a level

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Evidence Summary – Brain Injury

- Marshall S. Motor impairment rehabilitation post acquired brain injury. *Brain Injury*. 2007;21(2): 133-160.
  - Strong evidence that serial casting does reduce ankle plantarflexion contractures
  - Moderate evidence to show that using botox A with casting is no more effective than casting alone
  - 1b level

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Evidence Summary – Brain Injury

- Mortenson P. The Use of Casts in the Management of Joint Mobility and Hypertonia Following Brain Injury in Adults: A Systematic Review. *Physical Therapy.* 2003;83(7): 648-658.
  - Levels of evidence were low due to study designs
  - Consistent evidence though that PROM improved when joints were casted
  - 1b level

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Evidence Summary – Idiopathic Toe Walking

- Moderate support for improvements in ankle DF PROM
- Moderate support for short term gait improvements
- Insufficient evidence to support long term gait improvements.

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Evidence Summary – Idiopathic Toe Walking

- Engstrom, P., et al. (2013). Botulinum Toxin A Does Not Improve The Results Of Cast Treatment For Idiopathic Toe-Walking. *The Journal of Bone and Joint Surgery.* 95(5), 400-407.
  - There was no significant difference between the study groups with respect to 3D gait analysis, parent rating of time on toes, PROM hip/knee/ankle, and ankle DF strength.
  - They had similar improvement and longevity of results.
  - 2a

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Evidence Summary – Idiopathic Toe Walking

- Pistilli, EE., et al. (2014). Non-Invasive Serial Casting To Treat Idiopathic Toe Walking In An 18 Month Old Child. *Neurorehabilitation.* 34(2):215-220.
  - Supported serial casting as a conservative treatment option to prolong/avoid surgery in ITW population
  - Author supported use of serial casting in children under 2 y.o.
  - 5a

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Evidence Summary – Duchenne Muscular Dystrophy

- Overall low level of evidence
- Moderate support for improved ankle DF PROM with casting.
- There was a lack of evidence to support gait changes.

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Evidence Summary – Duchenne Muscular Dystrophy

- Glanzman, A., et al. (2011). Serial Casting For The Management Of Ankle Contracture In Duchenne Muscular Dystrophy. *Pediatric Physical Therapy.* 23(3), 275-279.
  - Ankle DF improved w/ knee flexed and knee extended (B)
  - No change in timed tests pre- and post-casting
  - Negative correlation b/t age and # of casts (i.e. younger need less casts)
  - 4a

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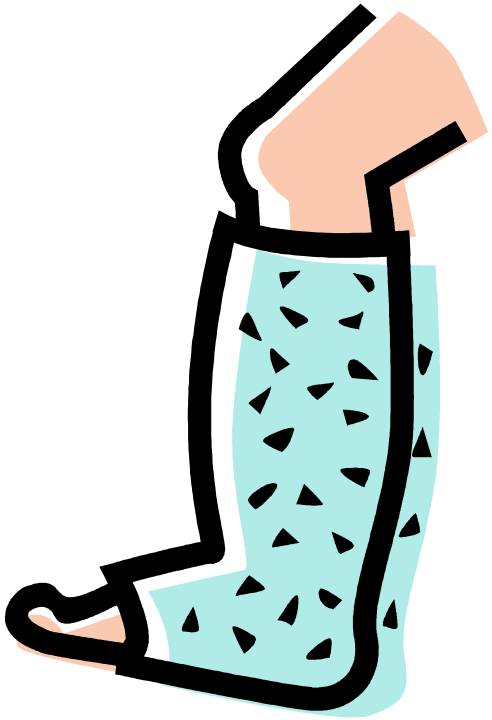
Serial Casting of the Lower Extremities



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Indications for Serial Casting

- Decreased ROM in children who are diagnosed with CP, TBI, DMD, juvenile idiopathic arthritis, etc.
- More than 5 degrees difference is noted between R1 and R2 (Tardieu and Tardieu, 1987)
- Persistent hypertonicity/spasticity

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Indications for Serial Casting

- Poor joint alignment
- Shortened soft tissue, nerves, vessels, and ligaments
- Risk of further deformity
- Extremity cannot be controlled with splinting alone

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Precautions

- Allergies or prior skin reactions to casting materials
- Decreased sensation
- Poor communication
- Excessive sweating

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Precautions

- Confirmed fracture healing if recent fracture
- Longstanding/fixed contracture at extremity to be casted
- Sensory issues (i.e. tactile defensiveness, poor tolerance to handling etc.) may cause decreased compliance

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Contraindications

- Poor skin integrity
- HTN or increased ICP
- Uncontrolled autonomic storming
- History of or recent non-union fracture at the site to be casted
- Marked edema in extremity to be casted
- Inadequate bone density (osteoporosis) at the extremity to be casted

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Contraindications

- Need for limb access for monitoring vital signs or medication administration
- Impaired circulation or recent DVT in limb
- Hetereotopic ossification at the extremity to be casted
- Bony joint limitations in area to be casted

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Casting Evaluation

- Patient/Client History
  - Medical/Surgical History
  - Botulinum toxin injections sites and dates
  - Allergies/skin sensitivities
  - Current conditions
- Patient/client goals
- Past casting/PT treatment
- Orthotic, Protective, and Supportive Devices
- Gait, Locomotion, and Balance
  - Observational Gait Scale (if appropriate)

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Casting Evaluation

- Motor Function
  - Gross Motor Function Classification System (if appropriate)
- Muscle Performance
  - Strength (functional assessment only)
- Pain
- Posture
- Range of Motion
  - Active and Passive
- Reflex Integrity/Muscle Tone
  - Muscle tone-Modified Tardieu scale (R1/R2)

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Casting Procedures

- Perform casting after being trained and demonstrating competency
- Solid soft cast or bi-valved fiberglass cast
- Once per week for 4-6 weeks
- Bi-valved cast or custom nighttime splint after completion of casting
- Recommendations for AFOs and burst of PT following casting

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Discussion Questions

- Botox
- Knee extension splinting
- Duration of casting
- Other

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