SERIAL CASTING

Arika Button PT, DPT, CBIS
Mackenzie Patterson MS, OTRL, CBIS

Objectives

- Describe the purpose of serial casting as it relates to a variety of neurological diagnoses
- Discuss the various approaches to serial casting
- Name the various considerations of casting and recognize the importance of client education
- Identify types of upper and lower extremity casts
- Recognize the various treatment adjuncts to serial casting
- Discuss post-cast management

What is serial casting?

- Serial casting is a series of casts that are applied to a joint with a low load, continuous stretch to improve functional use of an upper or lower extremity.

Benefits

- Non-invasive
- Targets a specific body part
- Draws attention to a neglected limb
- Cost
- Can help fit for orthotics

Disadvantages

- Time consuming
- Takes 2+ people
- Complications
- Prevents active use of casted extremity
- Interrupts other programs

Job Duties

Caster-

- Primary roles include:
  - Utilization of casting material in order to create an effective cast based on splinting purpose and goals
  - Preventing complications/errors in casting

Holder-

- Primary roles include:
  - Maintaining ideal joint(s) positioning at submaximal
  - Give feedback to the caster throughout the process
    - Client needs break
    - Spasticity is changing
    - Gaps in casting material
    - Preventing complications/errors in casting

What are the goals of serial casting?

- Reduce spasticity and/or abnormal tone
- Prevent and reduce contractures
- Increase AROM/PROM
- Facilitate proper positioning
- Regain functional use of an extremity & management of care
- Pain reduction as a secondary goal

Frequency & Duration

- Series of 5-7 casts
- 3-5 days at a time
- Each time a cast is removed, time is spent stretching the newly gained ROM before another cast is reapplied that same day (provided no complications)

Approaches to Serial Casting

1. Biomechanical
2. Neurophysiological

Biomechanical Approach

- ROM focused
- Goal: prevent/reduce contractures
- Collagen change
- Sarcomere change

Neurophysiological Approach

- Focus is on inhibition overall (inhibiting/ decreasing spasticity is key)
- Muscle spindle change
- Inhibitory approach
  - Prolonged stretch
  - Neural warmth
  - Resets muscle spindle

Considerations

- Patient/family goals
- Team goals
- Patient tolerance
- Level of cognition
- Safety to self and others
- Upcoming medical procedures/needs

Precautions

- Skin integrity
- Behavior
- Sensation
- Circulation
- Edema
- Cognition
- Upcoming medical procedures
- Heterotopic Ossification
- Arthritis
- Wounds
- Shoulder stability

Contraindications

- Fractures
- Deep Vein Thrombosis (DVT)

Pre-Casting Decisions

- Clear all precautions and contraindications
- Prioritize based on functional needs
- Type of cast
- What material is most appropriate?

Assessment Tools

- PROM
- AROM as appropriate
- Skin checks
- Muscle tone: Modified Ashworth Scale & Modified Tardieau for inhibitory casting
- Reflexes for inhibitory casting
- Functional use scales/tasks as appropriate

Modified Ashworth Scale

0	No increase in muscle tone
1	Slight increase in muscle tone, minimal resistance at end ROM
1+	Slight increase in muscle tone, minimal resistance throughout the remainder (less than half) of the ROM
2	Marked increase in muscle tone through the ROM, but the part is easily moved
3	Considerable increase in muscle tone, passive movement difficult
4	Affected part(s) rigid in flexion or extension

Modified Tardieau Scale

1. Measure R2= Passive ROM of the joint
2. Measure R1= Where the first catch is felt performing a quick stretch into the targeted ROM
3. Subtract R1 from R2 and record

- R2-R1= Modified Tardieu Scale
- Goal is to get closer to 0
  - The passive ROM and the Quick Stretch ROM are the SAME= no impact of spasticity on the range

Types of Material

- **Fiberglass**
  - + Lightweight
  - + Excellent strength/rigidity
  - + Good durability
  - + Fast drying time
  - - More expensive than plaster
  - - Sharp edges
  - - Shrinks after drying
- **Plaster**
  - + Inexpensive
  - + Conformable
  - + Easy to work with for difficult hand placements
  - + Good strength
  - + Can reinforce easily with more plaster
  - - Messy to work with
  - - Long drying time
  - - Heavy
  - - Smelly

Types of Casts

Rigid Circular Elbow

Elbow Drop-Out

Long Arm

Short Arm

Ankle

Finger

Treatment Adjuncts to Serial Casting

- Oral medications
- Botulinum toxin type A
- Motor Point Blocks
- ITB pump
- NMES
- Taping

Oral medications

- Baclofen= most common
- Systemic, not specific
- Sedating effects
- Strong support and evidence of decreasing tone when used with casting

Botox

- Purpose: impair function at the muscle level by a direct injection into the muscle
- Lasts 3-4 months
- Peak effect is 2-3 weeks
- Maximum amount allowed not enough for larger muscles

Botox

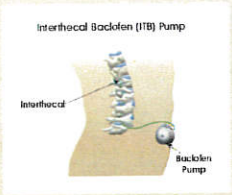
- 2004 study: Glanzman, Kim, Swaminathan, Beck
  - Children with spastic equinus contractures
  - 3 groups:
    - Casting with Botox
    - Casting without Botox
    - Botox injection only
  - Significant difference with both casting groups
  - No difference with Botox only
    - **Except** that the Botox only group led to an early return of spasticity compared to the other groups

Motor Point Blocks

- Purpose: impair function at the nerve/motor point via injection of a chemical
- Phenol alcohol
  - Nerve block
  - Motor point block
  - Very inexpensive compared to Botox

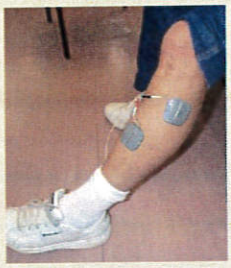
ITB Pump

- Internally placed
- Provides steady does of Baclofen directly into intrathecal space of spine
- Used for severe spasticity
- Systemic response
- Requires surgical placement and ongoing management
- No direct literature on pump and UE casting



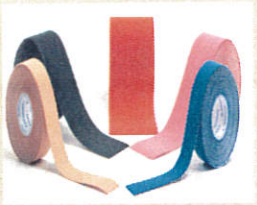
NMES

- Purpose: activate and strengthen inactive muscles, provide sensorimotor input- no direct literature on this
- Inhibit agonist muscle with a dynamic cast
- Excite antagonist muscle with NMES



Taping

- Purpose: edema control or joint positioning
- Joint positioning= leukotape
- Edema control or inhibition/activation= kiniesiotape



Post Cast Management

When to conclude the casting plan?

- When goals are met
- When 5-7 casts have been used
- If it becomes detrimental to the client's well being
- If 5-10 degrees of ROM have not been achieved over 2 casts
- If spasticity has not decreased over 2 casts
- If volitional movement has not increased over 2 inhibitory casts

Management between casts

- Check skin integrity
- Redo outcome measures
- Wash area with soap and thoroughly dry
- Allow 10-20 minutes of bending/ROM (can use heat)

Bi-Valving

- Made from a cast that has been on the limb for 2-5 days
- Last cast in series
- Adjunct therapy
- Benefits: hygiene, skin needs, allows for periods of active motion
- Does not increase ROM
- Main reason for noncompliance is improper fit

Bi-valving continued

- Maintains ROM better than manual stretching and positioning (Moseley et al., 2006)
- Fabricate at submaximal range to ensure comfort
- Ask yourself:
  - is the ROM submaximal?
  - does it fit?
  - is it secured with tape?
  - is the strapping secure?
  - are the sides marked to match and correctly align?
  - are the top and bottom clearly labeled?
  - is the correct extremity labeled (R vs. L)?

Splinting

- Alternative to bi-valving
- Pros: washable, don't have to be custom made
- Must be available immediately after last cast is removed
- Casting will be unsuccessful if not splint or bivalve

Consider:

+ Can this splint maintain the ROM gained?

+ Can the skin tolerate use?

+ Does it align with post-casting goals?

QUESTIONS?

References

- Al-Zamil, Z., Hassan, N., & Hassan, W. (1995). Reduction of Elbow Flexor and Extensor Spasticity Following Muscle Stretch. *Neurorehabilitation and Neural Repair*, 9(3), 161-165. doi:10.1177/154596839500900305
- Shakta, B. S. (2000). Management of spasticity in stroke. *British Medical Bulletin*, 56(2), 476-485. doi:10.1258/0007142001903111
- Blackmore, A. M., Boettcher-Hunt, E., Jordan, M., & Chan, M. D. (2007). A systematic review of the effects of casting on equinus in children with cerebral palsy: an evidence report of the AACPDM. *Developmental Medicine & Child Neurology*, 49(10), 781-790. doi:10.1111/j.1469-8749.2007.00781.x
- Childers, M. K., Biswas, S. S., Petraski, G., & Merveille, O. (1999). Inhibitory casting decreases a vibratory inhibition index of the H-reflex in the spastic upper limb. *Archives of Physical Medicine and Rehabilitation*, 80(6), 714-716. doi:10.1016/s0003-9993(99)90178-8
- Cattalorda, J., Gautheron, V., Metton, G., Charmet, E., & Chavrier, Y. (2000). Toe-walking in children younger than six years with cerebral palsy. *The Journal of Bone and Joint Surgery*, 82(4), 541-544. doi:10.1302/0301-620x.82b4.10188
- Gianzman AM, Kim H, Swaminathan K, Beck T. (2004). Efficacy of botulinum toxin A, serial casting, and combined treatment for spastic equinus: a retrospective analysis. *Dev Med Child Neurol*. Dec;46(12):807-11.
- Hill, J. (1986) *The effects of casting on motor disorders associated with spasticity*. Unpublished manuscript (No. RT 20-PR 149A).
- Kamper, D. G., & Rymer, W. Z. (2000). Quantitative features of the stretch response of extrinsic finger muscles in hemiparetic stroke. *Muscle & Nerve*, 23(6), 954-961. doi:10.1002/(sici)1097-4598(200006)23:6<954::aid-mus17>3.0.co;2-0
- Kelly, B., Mackay-Lyons, M., Ruggles, T., & Woodward, J. (2008). Botulinum toxin type A and serial casting versus botulinum toxin type A or serial casting in treating equinus gait of children with cerebral palsy. *Cochrane Database of Systematic Reviews*. doi:10.1002/14651858.cd007343
- King, T. I. (1982). Plaster Splinting as a Means of Reducing Elbow Flexor Spasticity: A Case Study. *American Journal of Occupational Therapy*, 36(10), 671-673. doi:10.5014/ajot.36.10.671
- Lannin, N., Novak, I., & Cusick, A. (2007). A systematic review of upper extremity casting for children and adults with central nervous system motor disorders. *Clinical Rehabilitation*, 21(11), 963-976. doi:10.1177/0269215507079141

References

- Moseley, A. M. (1993). The effect of a regimen of casting and prolonged stretching on passive ankle dorsiflexion in traumatic head-injured adults. *Physiotherapy Theory and Practice, 9*(4), 215-221. doi:10.3109/09593989309036493
- Moseley, A. M., Hassett, L. M., Leung, J., Clare, J. S. Herbert, R. D., & Harvey, L. A. (2008). Serial casting versus positioning for the treatment of elbow contractures in adults with traumatic brain injury: a randomized controlled trial. *Clinical Rehabilitation, 22*, 406-417
- Pohl, M., Rückriem, S., Mehrholz, J., Ritschel, C., Strik, H., & Pause, M. R. (2002). Effectiveness of serial casting in patients with severe cerebral spasticity: A comparison study. *Archives of Physical Medicine and Rehabilitation, 83*(6), 784-790. doi:10.1053/apmr.2002.32821
- Scholtes, V. A., Dallmeijer, A. J., Knol, D. L., Speth, L. A., Maathuis, C. G., Jongerius, P. H., & Becher, J. G. (2006). The Combined Effect of Lower-Limb Multilevel Botulinum Toxin Type A and Comprehensive Rehabilitation on Mobility in Children With Cerebral Palsy: A Randomized Clinical Trial. *Archives of Physical Medicine and Rehabilitation, 87*(12), 1551-1558. doi:10.1016/j.apmr.2006.08.342
- Stoeckmann, Tina. "Casting for the Person with Spasticity." *Topics in Stroke Rehabilitation* 8.1 (2001): 27-35. Web.
- Tabary, J. C., Tabary, C., Tardieu, C., Tardieu, G., & Goldspink, G. (1972). Physiological and structural changes in the cat's soleus muscle due to immobilization at different lengths by plaster casts*. The Journal of Physiology, 224*(1), 231-244. doi:10.1113/jphysiol.1972.sp009891
- Tona, J. L., & Schneck, C. M. (1993). The Efficacy of Upper Extremity Inhibitive Casting: A Single-Subject Pilot Study. *American Journal of Occupational Therapy, 47*(10), 901-910. doi:10.5014/ajot.47.10.901
- Yasar, E., Tok, F., Safaz, I., Balaban, B., Yilmaz, B., & Alaca, R. (2010). The efficacy of serial casting after botulinum toxin type A injection in improving equinovarus deformity in patients with chronic stroke. *Brain Injury, 24*(5), 736-739. doi:10.3109/02699051003610524
- Yasukawa, A., Matas, B. S., & Gabler-Spira, D. J. (2003). Efficacy for maintenance of elbow range of motion of two types of orthotic devices: A case series. *Journal of Prosthetics and Orthotics, 15*(2), 72.

Brain Injury Rehabilitation Center Origami

Serial Casting Care & Education

Purpose: A conservative clinical intervention that can be used to manage the effects of increased spasticity following a brain injury through a low load, continuous stretch to improve functional use of an extremity. Mild discomfort may be experienced as the extremity is in a stretched position.

Length: A series of ~5-7 casts for 3-5 days at a time. Casts are removed and reapplied in the newly gained range of motion.

Goals: Reduce spasticity/abnormal tone

Prevent/reduce contracture

Increase passive and/or active range of motion

Facilitate proper positioning

Regain functional use of an extremity and management of care

Possible Complications: swelling, skin breakdown, peripheral nerve injury, compartment syndrome

Danger Signs- When to call during business hours:

- If there are sore areas and/or a foul odor coming from the cast
- Cracks or breaks in the cast
- Cast feels too tight or too loose, but you can still move your fingers or toes
- The cast becomes soaking wet and does not dry with a hair dryer or vacuum

Danger Signs- When to visit urgent care/emergency room (may call clinic first during business hours):

- You develop swelling that causes pain or makes it so you cannot move your fingers or toes
- You develop tingling or numbness in the extremity that has the cast
- Your fingers or toes are blue or cold
- You develop severe pain in or near the casted arm or leg

Cast care: It is important that you care for your cast in order to minimize the risk of potential complications, such as skin infection or breakdown.

- To keep your cast dry while showering, first wrap a dry absorbent Terry Cloth towel around the cast, tucking it into the edges to absorb any dampness which may soak through. Then cover it with 1-2 plastic bags, using a rubber band or water proof tape to wrap the top of the cast. Reusable waterproof cast protectors may also be purchased at a local pharmacy. Try to hold the cast outside the tub or shower while you wash. When finished bathing, dry everything off first including your hair, then take the plastic covering off the cast. This is to avoid the wetness from rolling down your cast. Even when covered with plastic, you should not place a cast in water or allow water to run over the area.
- If the cast becomes wet, you can dry it with a hair dryer on the cool setting. Do not use the warm or hot setting because it can burn the skin. You can also use a vacuum cleaner with a hose attachment to pull air through the cast and speed the drying process
- Keep the cast clean and avoid getting dirt or sand inside the cast. Do not apply powder or lotion on or near the cast.
- Do not place anything inside the cast, even for itchy areas. Sticking items in the cast can injure the skin and lead to infection. Tapping on the cast or using a hair dryer on the cool setting may help soothe itching.
- Do not pull the padding out from inside your cast.

What happens after the casting program?

- The post-casting program is just as important as the serial casting program.
- Recommendations may be made for orthotics, splints, injections, and/or home stretching exercises with compliance to the prescribed program being critical to maintain the newly gained range of motion.
- Continued physical therapy and/or occupational therapy may be needed to assist with gaining strength and or function in the new range of motion area.