

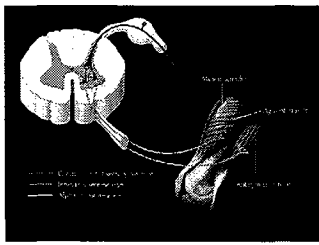
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Spasticity defined

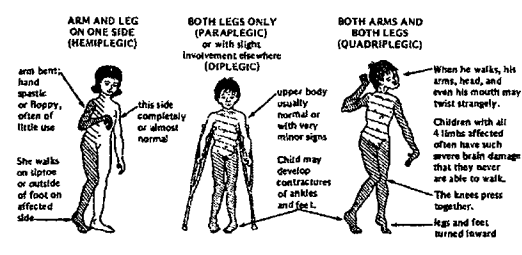
- Abnormal velocity-dependent increase in muscle tone resulting from interruption of the neural circuitry regulating the muscles

Rehabilitation medicine: management of adult spasticity. Satkunam LE. *CMAJ*. 2003 Nov25;169(11):1173-9.

- The stretch reflex arc works via Ia and II sensory neuron input and alpha motoneuron output to activate agonist muscle and reciprocally inhibit antagonist muscle
- Stretch reflex arc** excitability is increased in spasticity



Spasticity & Spastic co-contraction

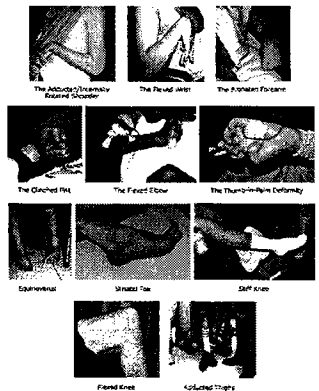


ARM AND LEG ON ONE SIDE (HEMIPLEGIC)
 arm bent, hand spastic or floppy, or use of little use
 She walks on tiptoe or outside of foot on affected side

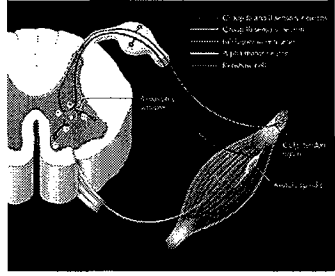
BOTH LEGS ONLY (PARAPLEGIC) or with slight involvement elsewhere (DIPLEGIC)
 this side completely or almost normal
 upper body usually normal or with very minor signs
 Child may develop contractures of ankles and feet.

BOTH ARMS AND BOTH LEGS (QUADRIPLEGIC)
 When he walks, his arms, head, and even his mouth may twist strangely.
 Children with all 4 limbs affected often have such severe brain damage that they never are able to walk.
 The knees press together.
 legs and feet turned inward

Spastic dystonia



The spinal pathophysiology of spasticity – from a basic science point of view. Nielsen JB et al. *Acta Physiol (Oxf)*. 2007 Feb;189(2):171-80



- Central nervous system inhibitory pathways are altered or reduced

Modified Ashworth Score

- 0 -No increase in muscle tone
- 1 -Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion when the affected part is moved in flexion or extension
- 1+ -Slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the ROM
- 2 -More marked increase in muscle tone through most of the ROM, but affected part easily moved
- 3 -Considerable increase in muscle tone, passive movement difficult
- 4 -Affected part(s) rigid in flexion or extension

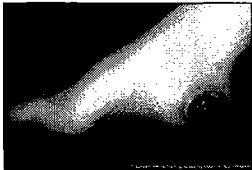
How to clinically assess and treat muscle overactivity in spastic paresis. Yelnik AP et al. *J Rehabil Med.* 2010 Oct;42(9):801-7

- Assess:
 - Passive range of motion
 - Angle of catch
 - Angle of clonus
 - Active range of motion
 - Rapid alternating movements
 - Functional consequences
- Discuss risk and benefits of treatments
- Treatment, based on personal objectives of the individual:
 - Mainstay is **physical therapy**
 - Importance of self-rehabilitation with stretching and exercise
 - Intramuscular injections
 - Oral medications
 - Intrathecal infusions
 - Surgery
- Provide reassessments

Secondary Causes of Spasticity

Treatable conditions that can worsen spasticity

- Fecal impaction/Constipation
- Poorly fitting wheelchair
- Pressure ulcer or sore
- Poorly fitting brace
- Bladder infection
- Ingrown toenail



Complications of Spasticity

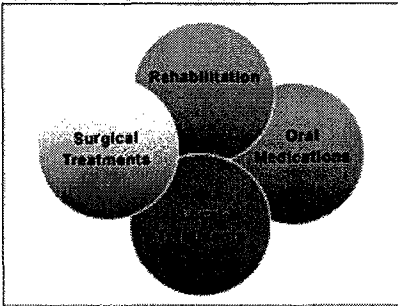
- pain
- skin breakdown
- hygiene difficulties
- trouble moving in bed
- difficulty with transfers
- poor seating position
- impaired ability to walk
- diminished functional independence
- muscle contracture leading to joint deformity

Barthel Index

Assesses independence with activities of daily living: Range 0 - 100

- Bathing, Grooming
 - 5 – Independent
 - 0 – Assistance needed
- Dressing, Toilet Use, Stairs, Feeding, Bowels, Bladder
 - 10 – Independent
 - 5 - Needs assistance, Modified diet, Occasional incontinence
 - 0 – Dependent
- Transfers, Mobility
 - 15 – Independent with or without use of assistive devices
 - 10 – Assist of one for Distance > 50 yards, minor help
 - 5- Independent in wheelchair > 50 yards, major help but can sit
 - 0- Immobile, distances 50 yards or less, poor static sitting balance

Spasticity Treatment



A Venn diagram with three overlapping circles. The top circle is labeled 'Rehabilitation', the bottom-left circle is labeled 'Surgical Treatments', and the bottom-right circle is labeled 'Oral Medications'. All three circles overlap in a central region.

Spasticity Pharmacotherapy

- Oral Medications
 - Baclofen (Lioresal)
 - Tizanidine (Zanaflex)
 - Dantrolene (Dantrium)
- Surgically Implanted Pump
 - Baclofen Intrathecal infusion system

Spasticity Pharmacotherapy

- Temporary Intramuscular Injectable Medications
 - Botulinum toxin type A (Botox or Dysport)
 - Botulinum toxin type B (Myobloc)
- Permanent Intramuscular Injectable Medication
 - Phenol
- Intramuscular injections allow for reduction of problematic spasticity in one area, while preserving functional spasticity in another area

Comparison of phenol block and botulinus toxin type A in the treatment of spastic foot after stroke. Kirazli et al. *Am J Phys Med Rehabil*. 1998 Nov-Dec; 77(6):510-5

- In randomized double-blind trial
- Significant decrease in Ashworth spasticity scores were seen at week 2 and week 4 for individuals receiving Botulinum toxin A compared to those who received Phenol
- No significant difference was seen in Ashworth spasticity score changes at week 8 and week 12 between for individuals receiving Botulinum toxin A compared to those who received Phenol
- Study did not extend to evaluate long-term comparisons near the 3 month time frame

Botulinum Toxins



Inhibits release of the Acetylcholine from peripheral cholinergic nerve endings, like motor axons.

Cleavage of SNAP-25 leads to intracellular blockage and prevents exocytosis of ACh into the neuromuscular junction.

A randomized, double-blind, placebo-controlled study of the efficacy and safety of botulinum toxin type A in upper limb spasticity in patients with stroke. Bakheit AM et al. *Eur J Neurol*. 2001 Nov;8(6):559-65

- N=59, Dysport versus placebo saline
- Summed Modified Ashworth Score was significantly reduced in BtxA group versus placebo at 4 weeks
- No significant difference between groups in joint range of motion, muscle pain, goal achievement or Barthel index scores at week 4
- Global assessment of benefit as rated by patients as either "much improved" or "some improvement" was 50% in placebo group and 92.3% in BtxA group, at week 16
- Global assessment of benefit as rated by investigators as either "much improved" or "some improvement" was 50% in placebo group and 88.4% in BtxA group, at week 16

Orthoses

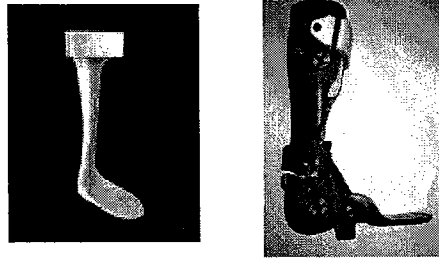
- inhibit muscle activity,
- compensate for limb weakness,
- stabilize a joint,
- enhance movement,
- reduce pain
- prevent joint deformities.

Shoulder Orthoses

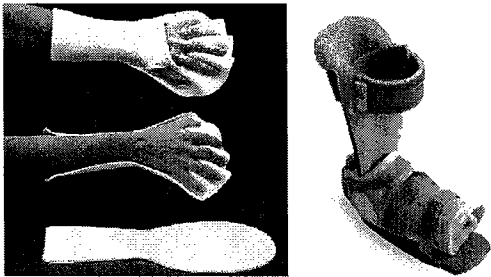


GivMohr Sling

Ankle Foot Orthosis

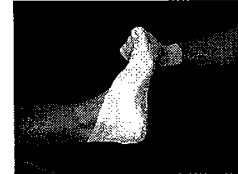


Overnight/ Sleep Splints



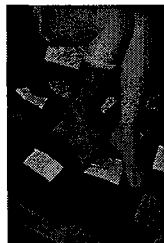
Serial Casting

- The joint is stretched to the end of passive range of motion and casted in that position.
- After 7-10 days, the cast is removed, range of motion therapy is reinstated, and then the extremity is re-casted at the new, improved angle.



Serial Casting

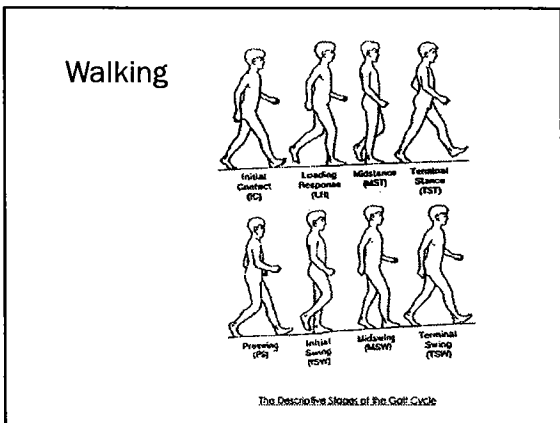
- Serial casts may also be bivalved for use as an orthosis.
- Serial casting may be repeated 4-5 times to get optimal range of motion
- Once improved range of motion is obtained, serial casting may be followed by the daily use of a removable orthosis.



Spasticity Physio-therapy

- Daily range of motion and stretching
- Icing, taping, tapping, vibration
- Acupuncture
- Selective strengthening of muscles,
- Electrical stimulation
- Movement patterning activities
- Serial casting





Contractures

- If spasticity is untreated: muscles, ligaments and tendons may permanently shorten.
- Shortening and stiffness of the soft tissues makes the joint resistant to stretching and prevents normal movement at the joint.
- To prevent further loss of motion and restore joint function, treatments to control spasticity and to stretch the stiffening tissues are effective.
- Surgery may be needed to release the tissues.

Surgical Options

- Orthopedic surgeons may cut and/or reposition tendons to treat contractures or to rebalance muscular forces across a joint to improve function.
- Neurosurgeons may cut nerve roots to treat severe spasticity not responsive to any other measures.
- All surgical procedures pose significant inherent risks.

In Conclusion . . .

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      A[Evaluate the patient  
• Does spasticity significantly affect function (gait, transfers, dressing, continence)?  
• Does spasticity result in pain or discomfort (e.g., with hygiene or footwear)?  
• Is there a risk of or presence of complications (e.g., contractures, skin breakdown)?] -- No --> B[No spasticity treatment necessary]
      A -- Yes --> C[Identify specific patient and caregiver objectives  
• To improve gait, activities of daily living, hygiene  
• To provide pain relief, ease of care  
• To enhance safety, recovery, and pain]
      C --> D[Initiate comprehensive spasticity management program (usually in the following order)  
• Removal or treatment of noxious stimuli  
• Physical and occupational therapies, including proper positioning and regular stretching  
• Oral drug therapy: injection of botulinum toxin type A, phenol or alcohol  
• Intrathecal baclofen  
• Surgical interventions]
    
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