“Tightening” Our Understanding of Spasticity

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**Scap mobs that you just did:
infographic available www.steveprehab.com/freebies

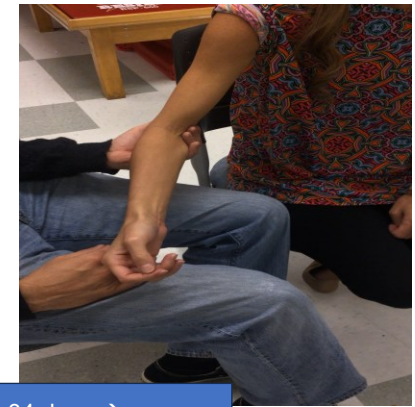
What is spasticity??

“…***velocity-dependent*** increase in tonic stretch reflexes (muscle tone) resulting from hyperexcitability of the stretch reflex…”

Lance, 1980

“co-contraction, with the antagonist firing when it’s not supposed to…”

Page, now



Median onset = 34 days →
Important to assess chronic stages!

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What mm are we testing? What is the MAS score?

0	• No increase in tone
1	• Slight increase in tone • Catch/release at end ROM
1+	• Slight increase in tone • Catch/release and resistance through rest ROM (1/2 ROM)
2	• More marked increase in tone through ROM, but affected part moved easily
3	• Considerable increase in tone, passive movement difficult
4	• Affected part in rigid flexion and extension

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Co-contraction is occurring (but the flexors usually "win")

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Contractures are not the same as spasticity (but may be a result)

Sustained shortening of muscle tissue →

Fibrosis of the tissues supporting the muscle or the joint → □

The muscle becomes resistant to stretch

NOT velocity dependent

ROM difficult regardless of positioning or other extraneous factors

Develops chronically

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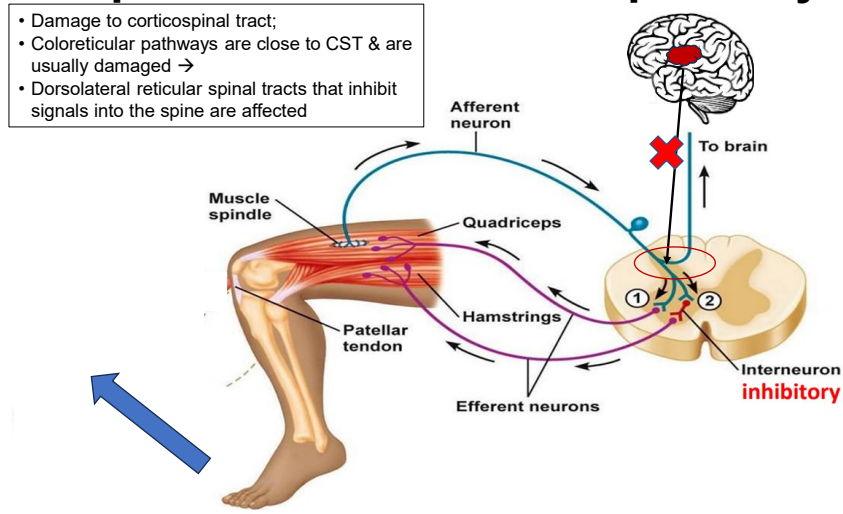
Reciprocal Inhibition and Spasticity

- Damage to corticospinal tract;
- Coloreticular pathways are close to CST & are usually damaged →
- Dorsolateral reticular spinal tracts that inhibit signals into the spine are affected



A lesion affects efferents after stroke → disinhibition → co-contraction

Prolonged muscle contraction can reduce acetylcholinesterase activity and trap inflammatory markers in the joint, propogating stiffness and pain.

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UE SPASTICITY TREATMENT

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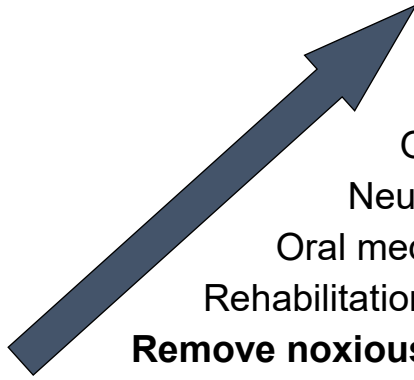
Traditional Step-Ladder Approach to Management of Spasticity



Neurosurgical procedures
Orthopedic procedures
Neurolysis
Oral medications
Rehabilitation Therapy
Remove noxious stimuli

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Remove Noxious Stimuli

CUTANEOUS STIMULI	VISCERAL STIMULI	OTHER NOXIOUS TRIGGERS
• Ulcers • Pressure sores • Skin infection/ inflammation • Chapped/broken skin	• Internal Infection • DVT • Bowel (constipated) • Bladder (pain from failure to empty or UTIs)	• Extreme Temperature • Clothing too tight/loose • Uncomfortable seating • Stress • Positional changes • Noxious sensory stimuli (brushing) • Poorly fitting orthotics

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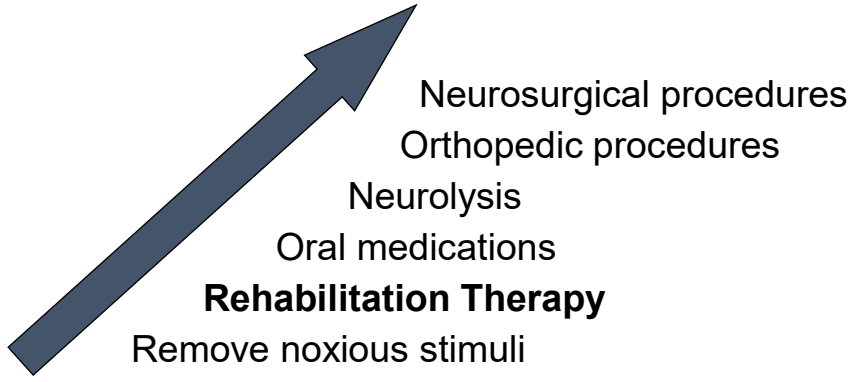
Traditional Step-Ladder Approach to Management of Spasticity



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So what can we do with the UE?

Quiet the muscle activity

Heat

Cold

Practical Applications

- Nursing staff/STNA/pt ices before session
- While PT works on LE, ice UE
- Ice during the drive into OP therapy

Rationale: Gives you a window to work with a more pliable UE;

Benefits: Transient reduction **in pliability of the limb d/t muscle change**

Disadvantages: TRANSIENT; Efficacy varies on patient attributes (e.g., subcutaneous fat) and length of time used

Gracies JM. Physical modalities other than stretch in spastic hypertonia. Phys Med Rehabil Clin N Am. 2001; 12(4):74(10):1121-112.

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UE Treatment Progression

Have the care partner, assistant or pt apply a cold compress **onto the antagonist muscle belly** (THE ONE NOT SUPPOSED TO BE FIRING)

15 mins. duration, *prior to your arrival*

CBAN:
***C**old*
***B**urning*
***A**ching*
***N**umb*

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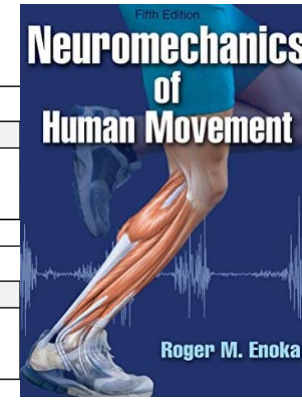
Stretching



SPASTICITY	
LoE	**Conclusion Statement**
2	**Stretching programs** may produce greater improvements in spasticity than **conventional therapy**.

RANGE OF MOTION	
LoE	**Conclusion Statement**
1b	**Stretching programs** may produce greater improvements in range of motion than **conventional therapy**.

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Stretching programs** may produce greater improvements in performance of activities of daily living than **conventional therapy**.	2	You et al. 2014; Tseng et al. 2007

PDF guide with evidence-based stretches for post-stroke spasticity, each paired with an AMA-formatted reference
https://www.steveprehab.com/freebies

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Stretching Benefits Muscle Physiology In Spasticity

Prolonged muscle contraction **reduces acetylcholinesterase activity**

Prolonged muscle contraction **traps inflammatory markers in the joint**, contributing to stiffness and pain.

This contraction **compresses local blood vessels** → reduced oxygen and nutrient delivery.

This leads to **impaired ATP production which is needed for relaxation** → creating a vicious cycle of contraction and metabolic crisis.

Stretching **lengthens the muscle fibers**.

Mechanically elongating the sarcomeres relieves compression on capillaries, improving local circulation, improving oxygen and nutrient delivery.

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Stretching Requires Home Practice; Home Practice Requires Good Patient and Care Partner Education

In 2025, the Centers for Medicare & Medicaid Services introduced new codes for caregiver training services:

G0541: Initial 30 minutes of caregiver training, focusing on essential skills such as ensuring patient safety at home.

G0542: Each additional 15-minute increment for extended training sessions covering complex techniques.

G0543: Group sessions allowing multiple caregivers to participate together (shared learning and support). Great for peds!!

These codes are additional tools for structuring caregiver education sessions (CPT codes 97550, 97551, and 97552 for caregiver training services)

Where to Use These Codes:

Outpatient Clinics: When providing caregiver training as part of a patient's rehabilitation plan.

Private Practices: For therapists offering individualized or group caregiver education sessions.

Home Health Services: When training caregivers in the patient's home environment to ensure proper care techniques.

Verify with specific payers regarding their coverage policies for these codes, as reimbursement may vary.

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Wedge stretch (without therapist)

Anterior joint capsule of shoulder + pec + bicep + wrist flexors + long finger flexors + thenar

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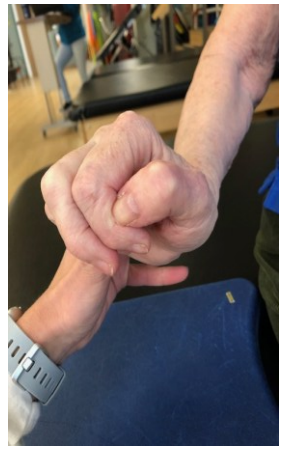
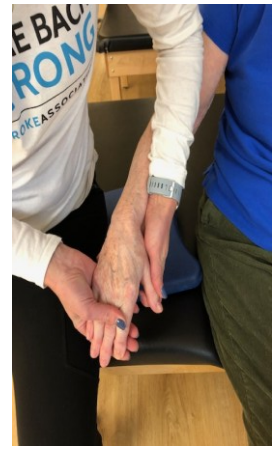
Hand and Wrist (with therapist)

Hand before stretching



UE and hand stretched



WB/Closed chain

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Wedge stretch (with therapist)

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Scapular protraction (and retraction)

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Myofascial Release

- Changes in myofascial chains → increased ROM and ADL participation (Grieve et al*, J Bodyw Mov Ther;* 2015; Wilke et al, *Arch Phys Med Rehabil*, 2016)
- Self myofascial release w a tennis ball to biceps brachii, pronator teres, long finger flexors → increased FM, reduced MAS scores (Parkikh et al, *J Bodyw Mov Ther*, 2022)

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Dry Needling

"A technique used to treat dysfunction of skeletal muscle and connective tissue, minimize peripheral nociception (pain), and improve or regulate structural or functional damage…" (APTA)

Not trying to affecting qi or meridians; using needles to address impairment; drive repair; take away pain

CHECK YOUR STATE PRACTICE GUIDELINES

Effect of Dry Needling at Myofascial Trigger Point on Hand

Immediate effect on hand spasticity (multicenter trial) (n=210)

Immediate Spasticity in Chronic Post-stroke Patients

Description of the technique:

https://jmmtonline.com/documents/v14n4/DommerholtDryNeedlingV14N4.pdf

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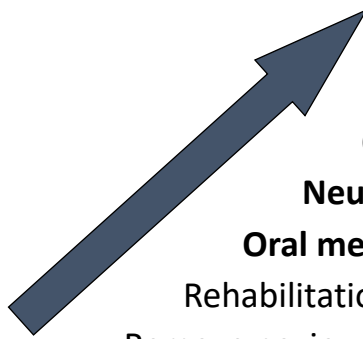
Traditional Step-Ladder Approach to Management of Spasticity



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Rehabilitation Therapy

Remove noxious stimuli

Other professionals

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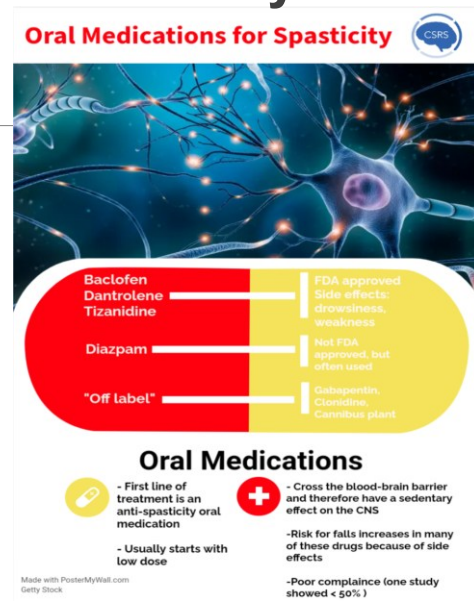
Does Their Family Doctor Know?



Median time to onset among 861 patients = 34 days (Nam et al., 2019)

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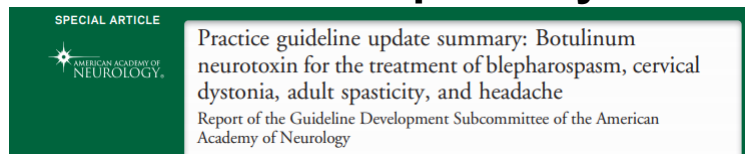
Block the Spasticity



https://n.neurology.org/content/neurology/86/19/1818.full.pdf

	Onabotulinumtoxin A	Abobotulinumtoxin A	Incobobotulinumtoxin A	Rimabotulinumtoxin B
Brand Name	Botox	Dysport	Xeomin	Myobloc
Approved Conditions	Focal upper or lower limb (TOES) spasticity in adults Cervical dystonia in adults	Focal upper or lower limb spasticity in adults LE spasticity in children 2 y.o.+ Cervical dystonia in adults	Upper limb spasticity in adults Cervical dystonia in adults	Cervical dystonia in adults

https://www.clinicaltrials.gov/study/NCT04936542

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Visually-guided (EMG) injection

Audio-guided (EMG) injection

EVERYTHING GOES BETTER WITH BONT A??

- Electrical stimulation (eg, Maruvelli et al., 2016; Sahin et al., 2012; Sung-In et al., 2021; *"increased reciprocal inhibition"* {Nakipoglu, 2017})
- Kinesiology taping (eg, Carda et al., 2005; Santamato et al., 2015)
- Casting/Splinting/Orthotics (eg, Giray et al., 2019; Lai et al., 2009)

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Electrical stimulation for spasticity

- Maintain PROM
- Activate muscle pump → reduce edema
- Afferent stimulation for motor recovery
- Fatigue the antagonists/activate the agonists (figure)

Stein et al, 2015; *Stroke* – 29 RCTs across 940 subjects

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Vibration for Post Stroke Spasticity

Wearable vibrotactile stimulation for upper extremity rehabilitation in chronic stroke

Steim et al., 2021; *J Neuroeng Rehabil*

n=16; (mean age: 54; 1-13 years post-stroke) with diminished movement and tactile perception in their affected hand

No exercises; No minimum motor criterion

Approx. amplitude of 1.5 g and 210 Hz; Vibration duration between 210 and 700ms; 3 hours/day for 7 weeks

Increased sensation, reduced MAS, increased AROM

Daily Vibrotactile Stimulation Exhibits Equal or Greater Spasticity Relief Than Botulinum Toxin in Stroke

Steim et al., 2023; *Arch Phys Med Rehabil*

n=20; mean age=54 years, mean time since stroke=6.9 years

No exercises; No minimum motor criterion

Modified Ashworth and Modified Tardieu scores were reduced by an average of 0.9 (*P*=.0014) and 0.7 (*P*=.0003), respectively, at week 8 of daily VTS Glove use, and by 1.1 (*P*=.00025) and 0.9 (*P*=.0001), respectively, 1 month after stopping VTS Glove use.

Confirmatory study: Steim et al., 2023; *Front Neurosci*

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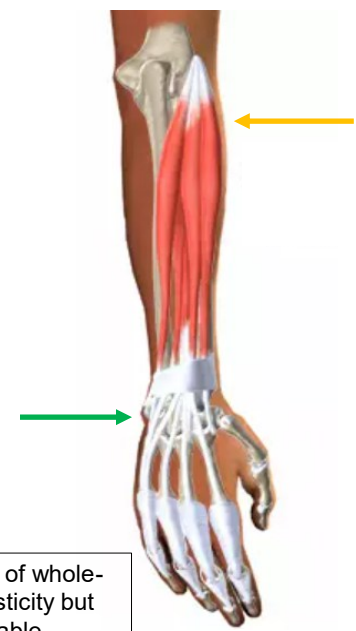
How To Do It?

Electrode placement:

- Distal to the extensor hood (optimal)
- OR extensor wad on lateral aspect of affected UE distal to the elbow

Sensory stim provided at approx. 200 Hz

21 h of weekly use



Several studies suggest efficacy of whole-body vibration in mitigating spasticity but WBV machines aren't portable

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All roads lead to repetitive task practice

Repetitive practice restores brain control over muscles

Restoring brain control over spastic muscle reduces spasticity

Provide Education/HEP if therapy will not occur

Levine, P Stronger After Stroke (3rd ed.)

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