

Botulinum neurotoxin injection techniques for the treatment of limb spasticity: a systematic review

Aaron Kin-Yun Chan, MD^{1,2}; Heather Finlayson, MD, FRCPC^{1,2}; Patricia Branco Mills, MD, MHSc, FRCPC^{1,4}

¹Department of Medicine, Div of Physical Medicine and Rehabilitation, University of British Columbia; ²GF Strong Rehabilitation Centre, Vancouver Coastal Health, Vancouver, BC; ³ICORD (International Collaboration on Repair Discoveries); ⁴Rehabilitation Research Program, VCHRI



Background

- Spasticity is a sensori-motor disorder characterized by sustained or intermittent involuntary motor contractions following injury to the central nervous system¹
- Botulinum neurotoxin (BoNT) is commonly used to treat focal spasticity²⁻⁵
- Clinicians should utilize BoNT injection techniques that improve accuracy and outcomes post injection

Objective

To systematically review the literature on different injection techniques used to improve outcomes post BoNT injection for treatment of limb spasticity.

Methods

Data Sources: MEDLINE, EMBASE, CINAHL, and Cochrane Central Register of Controlled Trials electronic databases were searched for English language human randomized controlled trials (RCTs) involving adult participants (≥ 16 years old) with upper and/or lower limb spasticity from various neurological conditions, from 1990 to May 2016.

Data Extraction: Studies were assessed in duplicate for data extraction and risk of bias using the Physiotherapy Evidence Database (PEDro) scale and graded according to Sackett's levels of evidence.

Level 1 Evidence: PEDro score ≥ 6

Level 2 Evidence: PEDro score ≤ 5

Results

Nine of 347 studies screened met selection criteria and were included in this systematic review.

Four categories of injection techniques were found:

- Injection site localization (4 RCTs⁴⁻⁷): manual needle placement (MNP) vs electromyography (EMG) vs electrical stimulation (ES) vs ultrasound (US)
- Injection site selection (3 RCTs⁹⁻¹¹)
- Injectate volume and/or dilution (2 RCTs⁸⁻⁹)
- Injection volume and site selection (1 RCT⁹)

See Table 1 for a summary of the levels of evidence

Table 1. Levels of evidence for limb spasticity botulinum neurotoxin injection techniques.

LOE	Studies	Recommendations
Injection Site Localization		
1	1 RCT (Picelli 2012)	In the gastrocnemius: Ultrasound is superior to manual needle placement Ultrasound is superior to electrostimulation Electrostimulation and manual needle placement are equivalent
1	1 RCT (Picelli 2014)	In the wrist and finger flexors: Ultrasound is superior to manual needle placement Electrostimulation is superior to manual needle placement Ultrasound and electrostimulation are equivalent
1	1 RCT (Santamato 2014)	In the wrist and finger flexors: Ultrasound is superior to manual needle placement
1	1 RCT (Ploumis 2014)	In various muscle groups: Electromyography is superior to manual needle placement
Injection Site Selection		
1	1 RCT (Childers 1996)	Motor point and multisite injections are equivalent
1	1 RCT (Im 2014)	Endplate and mid-belly injections are equivalent
1	1 RCT (Gracies 2009)	Endplate injections are superior to multisite quadrant injections
1	1 RCT (Mayer 2008)	Motor point and multisite quadrant injections are equivalent
Injectate volume and/or dilution		
1	1 RCT (Francisco 2002)	High volume and low volume preparations are equivalent
1	1 RCT (Gracies 2009)	High volume preparation is superior to low volume (for one outcome measure of uncertain clinical significance)
Different volume, different localization		
1	1 RCT (Gracies 2009)	High volume injections distant from endplates are superior to low volume injections close to endplates

Conclusion

Level 1 and 2 evidence exist for differences in accuracy and treatment outcomes using specific BoNT injection techniques.

Results when using EMG, ES or US for injection site localization are consistently better than with MNP alone. Larger volumes and targeting of endplates may result in better outcomes. Success of techniques differ depending on which muscles are being injected.

Findings are based on single studies that require independent replication.

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Author contact information

Aaron K Chan; aaron.chan@vch.ca
Patricia B Mills; patricia.mills@vch.ca (PI)