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INTRODUCTION

The spastic flexed elbow can be a problematic secondary complication of stroke. Cryoneurotomy (CryoN) involves the introduction of an ice ball at -60°C through a cryoprobe with the purpose of causing myelin disruption and Wallerian degeneration of the targeted nerve. With preservation of the peri and epineurium.^{2,3} A nerve stimulator is used for localization with ultrasound guidance. The small focus of the ball is felt to cause less damage than alcohol/phenol to surrounding structures. CryoN has been shown to be effective in the spastic adducted hip.⁴

OBJECTIVE

Present a case where post-stroke elbow flexor spasticity is successfully treated with CryoN of the musculocutaneous nerve (MSCN) to the brachialis.

CASE

Four months post-stroke, a 54-year-old man with right spastic hemiplegia began 5 rounds of BoNT injections into the brachialis, brachioradialis, and biceps muscles with partial improvement in elbow range of motion (ROM) and Modified Ashworth Scale (MAS).

At 16 months, a lidocaine nerve block to the brachialis branch of the musculocutaneous nerve (MSCN) demonstrated temporary improvements in active ROM, MAS and Modified Tardieu Scale (MTS) (Fig. 4).

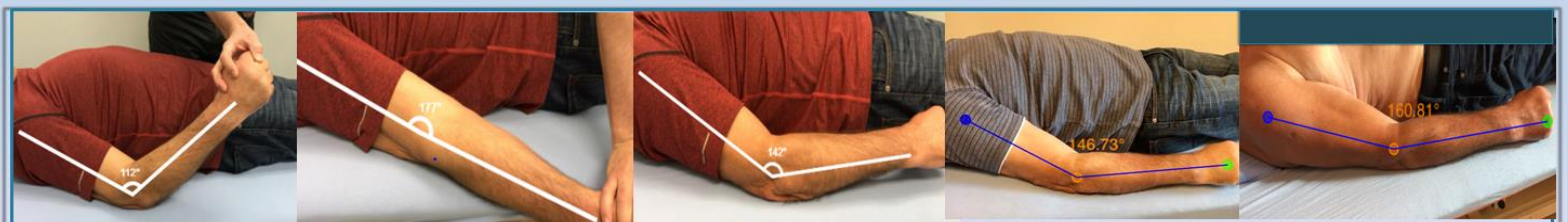
At 24 months, CryoN of this motor branch with a Westco Lloyd SL Neurostat was performed. (Fig. 5)



Figure 1. Brachialis MSCN Branch¹ Figure 2. Westco Lloyd SL Neurostat Figure 3. MSCN on ultrasound



Figure 4. Results of the lidocaine nerve block at 16 months post stroke, as measures by the Modified Tardieu Scale.



V3 Post CryoN V1 Post CryoN AROM 2 weeks post CryoN AROM 3 months post CryoN AROM 9 months post CryoN

Figure 5. Results of cryoneurotomy at 24 months post stroke.

RESULTS

Following CryoN, improvements in ROM, MAS, and MTS were observed with ongoing gains seen at the 9-month follow-up (Table 1). The paresis angle improved to -19° as the patient's post-CryoN AROM (161°) exceeded the maximum pre-CryoN PROM (142°).⁵ Maximal PROM improved by 35 degrees to full ROM. Improvements in the muscles innervated by the MSCN allowed for redistribution of BoNT to the finger flexor muscles.

CONCLUSION

CryoN using published protocols for muscle selection and nerve localization⁶⁻⁸ resulted in improvement of the patients ROM, MAS score, and MTS values with no detectable adverse events. The increase in AROM of 89° at 3 years post-stroke exceeded patient and physician expectations. CryoN also allowed for redistribution of BoNT to other muscles for potential future gains in other problematic areas. Ongoing follow up will determine whether elbow range continues to improve, plateau, or regress to baseline due to the potential for nerve regeneration.

Table 1. Results for the Spastic Elbow Treated With Botulinum Toxin and CryoN

Time Post Stroke	Event	V3*	V1*	AROM	Paresis Angle*	MAS
16 Months	Pre- /post-lidocaine nerve block	97/110	142/142	72/96	70/49	3/2
27 Months	Follow-up 3 months post-CryoN	112	177	151	-9	1+
30 Months	Follow-up 6 months post-CryoN	120	177	161	-19	1+
33 Months	Follow-up 9 months post-CryoN	125	177	161	-19	1+

*Modified Tardieu Scale: V1 = maximal passive ROM; V3 = catch passively as fast as possible; Paresis angle = Initial V1-AROM.

REFERENCES

- Genet F, Schnitzler A, Droz-Bartholet F, et al. Successive motor nerve blocks to identify the muscles causing a spasticity pattern: example of the arm flexion pattern. *J Anat.* 2017;230(1):106-116.
- Cheng J-G. Cryoanalgesia for refractory neuralgia. *J Perioper Sci Cheng J Perioper Sci.* 2015;2(2). <http://www.perioperative-science.com/content/02/02>.
- Ilfeld BM, Preciado J, Trescot AM. Novel cryoneurolysis device for the treatment of sensory and motor peripheral nerves. *Expert Rev Med Devices.* 2016;13(8):713-725.
- Kim PS, Ferrante FM. Cryoanalgesia: A novel treatment for hip adductor spasticity and obturator neuralgia. *Anesthesiology.* 1998;89(2):534-536.
- Gracies JM, Bayle N, Vinti M, et al. Five-step clinical assessment in spastic paresis. *Eur J Phys Rehabil Med.* 2010;46(3):411-421.
- Deltombe T, Bleyenheuft C, Gustin T. Comparison between tibial nerve block with anaesthetics and neurotomy in hemiplegic adults with spastic equinovarus foot. *Ann Phys Rehabil Med.* 2015;58(2):54-59. doi:10.1016/j.rehab.2014.12.003.
- Matsumoto ME, Berry J, Yung H, Matsumoto M, Munin MC. Comparing Electrical Stimulation With and Without Ultrasound Guidance for Phenol Neurolysis to the Musculocutaneous Nerve. 2018. doi:10.1016/j.pmrj.2017.09.006
- Mikalef P, Power D. The role of neurotomy in the management of spasticity of the upper limb. *EFORT Open Rev.* 2017;2(11):469-473. doi:10.1302/2058-5241.2.160074.