Neuromuscular electrical stimulation (NMES) on the tibialis anterior muscle and the effects on strength and gait mechanics on stroke patients: A systematic review.

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Neuromuscular electrical stimulation (NMES) on the tibialis anterior (TA) muscle and the effects on strength and gait mechanics on stroke patients: A systematic review

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Introduction

BACKGROUND
After a stroke, many people are left with various functional deficiencies, including impairments to one’s gait pattern. These impairments can lead to a higher risk for injuries and falls, increased energy expenditure, and decreased walking velocity—all affecting functionality, independency, and quality of life.

Currently, many different rehabilitation treatment methods exist to treat gait impairments, including ankle foot orthoses (AFO), conventional rehabilitation programs (CRP), and the use of NMES on the Tibialis Anterior muscle.

Many review articles have concluded that NMES can improve gait, functional ability, and motor function in patients with chronic stroke; however, the results do not consistently compare NMES to the use of CRP or AFOs.

PURPOSE
To establish the effects of neuromuscular electrical stimulation (NMES) on the tibialis anterior (TA) muscle on chronic stroke patients in order to improve gait mechanics.

Methods

SEARCH STRATEGY
• Databases: PubMed, PEDro, Cinahl, and Cochrane.
• Timetable of search: October 2013 - April 2015.
• Key Words: Stroke, electrical stimulation, tibialis anterior, strength, drop foot, MMT or EMG or active range of motion.

INCLUSION CRITERIA
• Outcome measured strength of tibialis anterior
• Strength can be defined by MMTs
• EMG study, or active range of motion
• Subjects are greater than 6 months post-stroke
• Published in English
• Parameters of electrical stimulation must be defined
• Patients must present with stroke that impairs motor function
• Peer-reviewed experimental and quasi-experimental

EXCLUSION CRITERIA
• Experimental interventions other than electrical stimulation for experimental group and standard of care.
• Systematic reviews or case studies.

RESULTS

Study Participants N, time from stroke Intervention Parameters Outcome Measures
Belhouch et al. 2014 PEDro = 6 N = 12, ±242, 6.5 yrs
Placement: Surface electrodes over peroneal nerve, controlled by tib sensor and accelerometer.
- 2 week adaptation period
- 5 mos, 2 wk full time wear
Primary:
- Gait Velocity (6MWT)
- SIS Composite
- FAP Score
- Total MEAP
- MEAP subtasks of floor time
Intervention and control groups both improved with primary and secondary outcomes, no statistically significant difference between groups

Pikkar et al. 2013 PEDro = 6 N = 4, 57 ±10 mos
Placement: Surface electrodes over peroneal nerve with custom molded cuff, controlled by tib sensor and accelerometer.
- During community ambulation for 4 wks
- TA activation during walking
- BDI
- TA activation in initial double stance
- Terminal double stance
- Swing
BDSI scores significantly increased. No significant difference between post- and pre-treatment for all outcome measures

Sabut et al. 2010 PEDro = 6 N = 25, 16 ±2 mos
Placement: Anode placed on TA motor point and cathode over peroneal nerve
- 20-30 min/day, 5x/wk, for 12 weeks total
- Walking speed
- Cadence
- Step Length
- Stride Length
- Physiological Cost Index
- RMSmax
Intervention group improved TA voluntary max contraction, but no more effective than CRP for gait parameters

Sabut et al. 2011 PEDro = 6 N = 25, 16 ±2 mos
Placement: Tibialis Anterior over common peroneal nerve
- 2 week adaptation period, up to 6 hrs/day for 7 mos
- RMSmax
Intervention group improved more with MAS, DF MTF, DF AROM, FMA, and ankle PROM.

Van Swigchem et al. 2012 PEDro = 6 N = 24, 35 ±30 mos
Placement: Common peroneal nerve at tibialis anterior muscle
- 6 hrs/day - 6 mos
- Obstacle Avoidance
- Motricity Index
- FES greater obstacle avoidance than AFO

Kotnik et al. 2008 PEDro = 7 N = 24, 9.07 ±2 yrs
Placement: Implanted under the epineurium of the superficial peroneal nerve and under the epineurium of the deep peroneal nerve.
- 26 wks
- RMSmax with knee in flexion and 90° dorsiflexion
- TA muscle activity during swing phase
- Walking speed
- Correlation between RMSmax of the TA muscle and walking speed
No therapeutic effect of implantable peroneal nerve stimulation

Kotnik et al. 2007 PEDro = 7 N = 14, 9.07 ±2 yrs
Placement: Implanted under the epineurium of the superficial peroneal nerve and under the epineurium of the deep peroneal nerve.
- 26 wks
- 6MWT
- walking speed of 10m
- Assessment of Activity Level using activePAL (accelerometer)
No significant difference at 12 weeks between between groups for all outcome measures

No significant difference at 26 weeks between groups for walking speed or active PAL

Conclusion

NMES was supported by the research to be an effective treatment for drop foot following stroke.
NMES was as effective as AFO or CRP.
The parameters of prescription and application of NMES to treat drop foot vary in each study; future research could address standardizing parameters.

REFERENCES