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In Patients Post-stroke, Is Implantable Peroneal Nerve E-stim More Effective Than Transcutaneous E-stim In Improving Foot Clearance?

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Messiah DPT Mission Statement:
To graduate ***ethical, compassionate, autonomous*** doctors of physical therapy who are competent to practice in diverse settings. Graduates will be life-long learners informed by ***evidenced-based practice*** who exemplify the values of Messiah University and the physical therapy profession.

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INTRODUCTION

A cerebrovascular accident (CVA) more commonly known as a stroke, is a life changing event resulting in impairments that decrease the quality of life.[1] Over 795,000 people each year suffer from a stroke and are affected by resulting impairments and disabilities, of these impairments 20% of those affected by a stroke will acquire foot drop.[2] Foot drop is due to paralysis or weakness of the ankle dorsiflexor muscles[3,4] and therefore describes the inability to actively raise the toes up required to clear the ground during swing phase, resulting in the toes to drag. Foot drop not only causes abnormal gait patterns and compensations, but increases the risk of falls, increases energy expenditure, and potential orthopedic issues up the chain.[5-8] Literature has shown the use of ankle foot orthoses (AFOs), transcutaneous functional electrical stimulation (FES), and implantable FES to be effective interventions used to decrease the severity of foot drop in patients post CVA. [8,9]

Implantable FES offers an alternative to the transcutaneous e-stim by allowing patients to have a more permanent device to address their foot drop impairment that is more convenient and eliminates the need for daily application. Furthermore, there has been no research in the comparison of transcutaneous FES to implantable FES and their effectiveness on foot clearance during gait for individuals post CVA.

METHODS

Data Sources
- Cochrane, PubMed, Cinahl

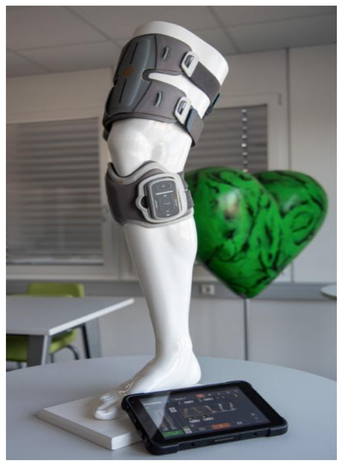
Inclusion Criteria
- Human participants, Post-stroke, Foot drop, FES, Implantable e-stim

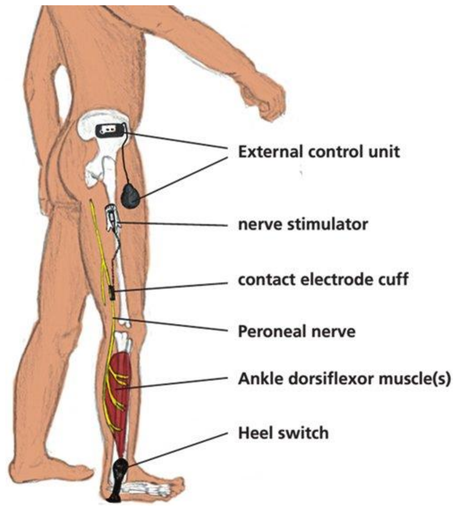
Exclusion Criteria
- Non-post stroke humans

Articles included
- Nine critically appraised articles included

RESULTS

Implantable FES (3 Studies)
- Significant improvements in plantar flexion power/ankle power, ROM, and gait speed using implantable electrical stimulation.
- Implantable FES provided superior knee stability than AFO.
- Most articles compared implantable FES to AFO.





Transcutaneous FES (6 Studies)
- The research conducted on transcutaneous FES measured significant improvements in:
- Gait speed, active dorsiflexion ROM, reduced energy expenditure during gait, improved lower extremity motor recruitment, strength, propulsion/plantar flexion, functional mobility, balance, and overall reduced risk for falls using functional electrical stimulation.[10-15]
- Most articles compared FES to conventional stroke rehabilitation.

CLINICAL RELEVANCE

- Clinical relevance of this CAT to physical therapy is to provide an evidence-based comparison of transcutaneous e-stim and implantable e-stim in improving acquired foot drop post-stroke.
- Electrical stimulation, regardless of dermal delivery, is an effective method to stimulate activation of the anterior tibialis muscle and facilitate dorsiflexion during gait. The implications of this research provides evidence-based data to support clinical decision-making when determining the most appropriate treatment option for patients post-stroke affected by foot drop.
- Based on the results, it is recommended that implantable FES and transcutaneous FES are both safe and effective modalities to be used by patients with foot drop secondary to stroke. Evidence provided by the research supports use of either device to decrease foot drop, decrease their risk for falls, improve overall gait kinematics, and improve quality of life. [13,16]
- It was inferred that FES therapy may have the potential to be used as a daily assistive technique in individuals recovering from a stroke.[12]
- Clinical decision-making for the selection of a device should include consideration of the patient's cognitive status (ability to don/doff device or post-surgical recovery), comorbidities, financial abilities, and patient preference.
- To be a candidate to receive implantable FES surgery, the patient must meet specific criteria, including a history of having a positive response with prior use of a surface-based peroneal nerve stimulator.[11]
- Considerations for transcutaneous FES include making sure the electrodes are placed in the same location to gain the same therapeutic effect with each use.

DISCUSSION

- Previous studies have looked at transcutaneous or implantable electrical stimulation in comparison to conventional treatments (i.e. AFOs, physical therapy), but currently there is no current literature comparing the effectiveness of the two modalities against each other.
- Long-term use of FES may provide further improvements in gait such as endurance and functional ambulation.[13]
- Findings support the use of FES therapy in combination with gait training to increase lower extremity motor control.[11]
- Results indicated the use of FES combined with conventional rehabilitation was more effective than conventional therapy alone in improving gait quality and enhancing motor function.[12]
- Limitations included small sample sizes, varying degrees of post-stroke recovery (3-96 months), wide age range of participants, one study lacked a control group[14], and there was selection bias for participants willing to have surgery to receive the implantable e-stim device.[17] Additionally, there was a limited number of studies that measured foot clearance as a primary outcome of the study.
- Future research should focus on the direct comparison of transcutaneous FES to implantable FES on foot drop in patients post-stroke, measure the long-term effects of FES (>1 year) of either device, and include a larger number of participants in future studies to allow for generalization of results among the post-stroke population.

CONCLUSION

- Both implantable and transcutaneous e-stim were effective interventions to decrease foot drop, as quantified by the ability for patients post-stroke to ambulate with increased gait speed. Neither device was found to be inferior to the other. [24,29]
- Studies used in this CAT did not directly measure foot drop as an objective measure, but other aspects of gait kinematics were assessed to quantify changes in foot drop.
- Benefits and effects of implantable e-stim versus transcutaneous e-stim on patients with foot drop post-stroke can only be fully addressed in a study that specifically utilizes foot drop as an outcome measure and compares its effects from both devices.

REFERENCES