

A critical appraisal of “Restoration of gait and motor recovery by functional electrical stimulation therapy in persons with stroke”

By

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Abstract

This appraisal takes a look at a study completed that was examining the effects of functional electrical stimulation (FES) on nervous system injuries like foot drop. Each section of the study is broken down with strengths and weaknesses examined along with possible clinical applications. As the appraisal starts the search process is detailed, with background of the clinical question being explained. The study's article is introduced and its publishing information is given. The introduction of the study is examined and found to be sufficient in laying out the information needed to understand the nervous system injuries and the potential of FES on those injuries. The methods of the study had more positives than not, with the design and control of the experiment being positives. The smaller sample size was one of the main knocks against the study, without detracting too much. The results obtained found FES led to many positive outcomes in the areas that were being monitored by the group regarding gait. With statistical significance, a larger sample size would be likely able to heighten awareness of what FES can provide. Unfortunately, not much was planned in the form of further experiments or studies, as again taking this idea to a larger group of subjects could provide a real impact to the population suffering from these injuries. The discussion of this appraisal covers the significance of the study and whether or not it could be applied clinically. With appropriate resources and training, this could likely be replicated and would be trusted if further work could prove the significance. This appraisal concludes with highlighting the overall positive work that comes from this research article, just missing a few things from having significant meaning.

Key words

Electrical, Stimulation, Stroke, Gait, Rehabilitation

Introduction

Nervous system injuries can be tricky compared to those of the musculoskeletal nature, and seeing a few more similar nervous system injuries through my previous shadowing experience and in sports I was curious on the topic. Foot drop was the specific injury I was curious about, and most often could fall into one of two categories. Typically there were central nervous system issues, and these would be your strokes that could be more commonly found in the elderly. There were also peripheral nerve injuries that could occur in situations such as athletics where an acute trauma could cause damage to a nerve. The rehabilitation from those injuries using functional electrical stimulation (FES) was a topic I had heard of for other injuries in the past but not as much for nerve injuries. As foot drop can be a severe limiting factor in the gait process, I was intrigued. Determining if adding FES to the conventional rehabilitation programs is important as it could mean the difference for patients looking to return to their favorite activities or simply just returning to walking in a shorter period of time and more effectively. Determining if this treatment of FES should lead to further studies is what this appraisal is being completed for, leading into the clinical question of whether or not functional electrical stimulation can affect nerve injuries such as drop foot in the lower extremities.

Methods

For the literature search, Pubmed and PEDro were the databases used, with Pubmed being the one for this chosen article. There were enough hits that came back to where electrical stimulation and foot drop were the only key words I needed to add. The main exclusion for the

search was to keep out reviews as finding an experimental study was an important requirement of the assignment. The inclusion that was important was ensuring the results that came back involved the lower extremities, as that was the focus of my question. While there were still around 60 hits that came back once reviews were filtered out I was surprised at the smaller number of studies than I had anticipated. (took an hour and a half?)

The journal the selected article came from was *Disability and Rehabilitation*. The journal is run by Taylor & Francis Group that is apart of the larger Informa PLC based out of London. Taylor & Francis Group do their part to provide access to a large source of ebooks and journals across the globe. Sukanta K Sabut, Chanda Sikdar, Ramkrishna Mondal, Ratnesh Kumar, and Manjunatha Mahadevappa were the authors of this article. It was published in 2010, with the assessments and training taking place at the National Institute for Orthopaedically Handicapped, located in Kolkata, West Bengal. This is the capital city the Indian West Bengal State. I chose this article out of the three I had it narrowed down to as I specifically wanted the electrical stimulation as the only treatment. One article had FES being compared with an ankle-foot orthosis which would be interesting, but not entirely what I was looking for even if it had a larger sample size. I was more curious with a more mature population as well, as the other article from my top 3 had younger children/adolescents as the subjects. A combination of an acceptable sample size given the pathology and the treatment I was most interested in was how I chose this article.

Results

Summary of the study

Strokes resulting in hemiplegia were the main pathology resulting in the nervous system issues that were addressed in this study. The goal was to determine if functional electrical stimulation in combination with the standard rehabilitation would improve the results of gait parameters and efficiency and other values. The study addressed FES not being a normal treatment of these nervous system injuries and this could possibly be attributed to the lack of previous work done involving FES and foot drop injuries, along with the possible lack of devices or lack of availability. Thirty subjects all suffering from this stroke related deficit were put into the control or treatment group, with minimal differences between those groups physically and in certain baseline clinical characteristics relevant to this study. The electrical stimulation came from portable neuromuscular stimulators, these had electrodes placed on the tibialis anterior muscle of the impaired leg. This was to activate this muscle of dorsiflexion to minimize foot drop during the step. Treatment was applied over 12 weeks, with the results being measured in a variety of methods. Outcomes such as the physiological cost index of walking (PCI) and the Fugl-Meyer assessment score (FMA) were among those that indicated improvements in the desired outcomes within the treatment group.

Appraisal of the study introduction

This was a well put together introduction for the most part. Adequate background information was given about strokes, along with common deficits and impairments stroke could

cause. A background is given on FES including its potential in rehabilitation of various nervous system injuries. The key words of stroke, FES, and gait were addressed and are all expanded upon with the variety of literature presented. The intro presents FES as the independent variable and various motor recovery elements as the dependent variables.

There was not much wrong with the introduction of the article. It was clearly written and explained most everything relevant to the paper. The keyword “spasticity” was left out, but it did not detract from the message. There was also some older literature presented, while that might be just in part to the lack of previous work in this area.

Appraisal of the study methods

The methods of this article were more positive than negative. This was a prospective randomized control trial, with the subjects being randomly selected into each group. These subjects all had similar demographic and clinical characteristics. It is important that the outcome assessors were unaware of each subject’s group, limiting possible bias in that regard. These subjects all underwent the same process outside of the specific treatment for the non-control group. Appropriate objective outcome measures were used including the step length and frequency for a 10m walk test. Other outcome measures for the improvement of subjects were the FMA and the PCI, which the literature determined valid and reliable.

One of the limiting factors of the study would be the smaller sample size of just 30 subjects. While the subjects were randomly placed in groups, it wasn’t clear if enough was done to ensure they knew or didn’t regarding to their group status. Sham FES would’ve been a good way to keep the groups more similar in appearance. It would’ve also been important to know

social characteristics of these subjects. Understanding their habits, hobbies, and lifestyle could play a role in how their rehabilitation went. While the application and use of the FES was clearly written, it could be hard to reproduce this study without the appropriate training of the specific device used.

Appraisal of the study results

The results were presented in a clear and organized manner, effectively answering the hypothesis of whether or not FES stimulation would be effective for this specific rehabilitation. All of the outcome measures were presented in the results, including gait data, the Fugl-Meyer assessment, and the PCI. Figure 2 paints the picture of the FES treatment group showing improvements in most everything measured, with tables 2-4 displaying all of the data collected that further backs up that point. The significance was attained through p values of .05 and under in the different parameters.

Nothing too serious affected the results section negatively. I would've liked to see a clearer separation of the control and treatment groups in table 2, but that didn't take away from its impact. The authors did eventually mention the minimal clinical significance but not until the brief conclusion at the end, more expansion on that concept and the number needed to treat would be helpful.

Appraisal of the study discussion

The discussion of this did tie in literature from the past referencing topics such as gait, versions of electrical stimulation, the issues of strokes, and the normal rehabilitation program for

these injuries discussed in the article. The authors do recognize their limitations, while it is only in the conclusion. The conclusions drawn in the discussion do appear accurate based on their findings in their study. They believed in clinical significance for their findings, while they are aware of the continued need for more work with their population of 30 used here.

The discussion is the weaker section of this article. Not much is elaborated on throughout, it is little more than regurgitation of the numbers and statistics given for the outcomes. Even while literature was referenced, it was very brief discussion. Once again, it would be better for the authors to mention limitations before the brief conclusion at the end. There is also no plan for further work or another study, which is odd considering the promising findings that could hopefully be applied to a greater number of subjects.

Discussion

This article is clinically relevant as strokes are commonly found in the acute care setting or in geriatric settings. This study deemed FES an effective rehabilitation technique for nervous system issues that included the clinical question's topic of foot drop. It is important to have effective rehabilitation measures when a larger percentage of the population will be among those at greater risk for strokes within the next decade or two.

The study listed many benefits that included measures such as different parameters of gait and a cost index to assess effort. Every single person affected by this condition should want to walk quicker, more steadily, and to use less effort. These benefits would improve the daily living for all that could receive this treatment. Arguments against this intervention could include the training that would be needed to safely operate and assess the FES device used here in the study.

No mention of the price or availability of these devices was given so the practicality of widespread use could be questioned. Knowing more information on the pricing, training if any needed, and availability of these FES devices could do more to provide an argument for or against this intervention.

Even with the limited sample size, I would be confident using this intervention with patients. I understand that the sample size is small but there is only so much you can do for selecting patients that meet the requirements the study required. It would be great to have follow up work to build on what this study has shown but in the meantime I believe enough of a difference was made to trust FES's effectiveness. The location I worked in would more than likely determine if I could use this method in the future. I'd like to believe I will be well versed in assessing the current evidence to see if any updates have been made, and I trust my education I will be receiving to prepare me to be comfortable using the FES device or to learn how to. It once again falls back likely on whether the devices are widely available or whether the clinic or setting I'll be at has the funds to acquire the technology.

Overall this study was conducted well for the most part. There was a clear and organized introduction and methods that laid out what was going to be done and the reasons behind it. The literature was mostly effective in adding to the paper when called upon, while it could've been referenced more in certain places. Groups were organized and the experiment was performed well with results that while might not be appropriately labeled as clinically significant yet, were important. More attention to the future of this intervention and how its clinical significance could be expanded upon would be the biggest area where this study had room to grow, but as it stands it was more effective than not.