Functional Electrical Stimulation

A large and consistently increasing amount of evidence supports the utilization of functional electrical stimulation (FES) to improve gait for individuals who have experienced a cerebrovascular accident (CVA). Much of that support is specific to the use of peroneal nerve FES to alleviate drop foot. The improvements shown in these and other studies demonstrate that utilization of FES can significantly impact gait speed, quality and symmetry as well as energy costs, spasticity, neuroplasticity and quality of life.

Benefits of FES found in the published research for individuals with CVA include:

**Gait Speed**
- Statistically significant improvement in gait speed.1,3,5,7,10,12-21,29,33-36,40
- Significant changes in gait speed with FES short term (2 to 5 months).3,5,12-14,20
- Significant changes in gait speed with FES long term (6 to 12 months).7-10,15-19,29
- Significant therapeutic effect (improvement in gait speed even with FES device turned off).15,17,19-20,29

**Energy Cost**
- Reduced effort required to ambulate.1,12,14,17-20,22
- Decreased physiological cost index (PCI); energy cost considering heart and respiratory rates.1,12,14,17-20,22
- Decreased total work; energy cost of walking both when the FES was turned on and off.22
- Subjective reports that walking with FES was more comfortable,37-38 less fatiguing37 and felt more normal.38

**Gait Symmetry**
- Improved Gait Asymmetry Index; marker of inter limb coordination/balance status and fall risk.13,15,24
- Decreased gait swing and stride time variability increased gait stability (correlates with fall reduction).13,15,24
- Improved hip and knee flexion angles and symmetry of hip and knee motion during gait.23
- Improved push off at terminal stance; demonstrated restoration of gait symmetry to near normal.23
- Improved ankle dorsiflexion and symmetry of swing.23
- Improved entire lower extremity flexor pattern.23
- Improved Rivermead Visual Gait Analysis (RVGA); trunk, pelvis, hip, knee and ankle symmetry.6

**Spasticity**
- Decreased spasticity of the antagonist gastroc-soleus/plantar flexor muscles.2,28,39
- Improved Composite Spasticity Score (CSS).2

**Neuroplasticity**
- Improved Motor Evoked Potentials (MEP).18,29
- Increased voluntary anterior tibialis muscle activity and maximum voluntary contractions (MVC).2,6,18,29
- A “training or therapeutic effect” with improvements in gait speed when FES is turned off.40

**Quality of Life (QOL), Patient Preference and Rehabilitation Efficiency**
- Preferred FES to an AFO.7-8,25
- Felt safer when using FES.7,13,32,38
- Objective improvements in obstacle avoidance.37
- Decreased fear of falling.27
- Reported fewer falls.13
- More stability of gait with FES, which helped walking over uneven terrain or on inclines.41
- Positive impact on disability post CVA and overall QOL.26
- Improved functional independence in the activities of daily living, motor recovery and gait performance.43
- Positive effects associated with FES use via the Psychosocial Impact of Assistive Devices Scale (PIADS).5
- Improved balance abilities; Overall Stability Index and Overall Directional Control Index.26
- Improved Berg Balance Scale.9
- Improved 6-Minute Walk Test.9
- Improved Modified Emory Functional Ambulation Profile tasks.9,10
- Cost effective, decreased time to complete rehabilitation, improved rehabilitation outcomes, increased number of patients discharged to home.2,30,31
- Improved functional mobility and QOL.4
These studies support that FES is at least an equivalent alternative to bracing and may perform better than an AFO on some measures of function and balance. Gait speed is an important indicator of overall functional mobility and has been shown to be a good, discriminate measure of physiological and functional recovery for patients post CVA. The support in the literature for changes in gait speed with the utilization of FES is robust. The literature also shows that FES improves gait speed at no additional energy cost. Reported decreases in PCI, which indicate that individuals using FES walk faster and farther with less effort, have significant and positive implications and improve the prognosis for functional mobility. The positive neuroplastic outcomes of cortical activation and motor control represent true CNS recovery, even in patients many years post CVA, making the neuroprosthetic application of FES a viable option for any patient suffering from decreased mobility after CVA.

Bibliography


44. ACP Outcomes Accelerated

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