Activity and Participation Outcomes in Children with Hemiplegia Following Functional Electrical Stimulation Neuroprosthesis Use

Amy F. Bailes1,2,3, Cailee Caldwell1, Mike Clay1, Melissa Tremper1, Kari Dunning2,3, Erin Haynes2, and Jason T. Long1

1Cincinnati Children’s Hospital Medical Center, 2Division of Epidemiology University of Cincinnati, 3Rehabilitation Sciences University of Cincinnati

Background

Functional electrical stimulation (FES) neuroprostheses offer an alternative to ankle foot orthoses (AFOs) for children with hemiplegia. Studies examining the effects of functional electrical stimulation (FES) neuroprostheses in children report improvements in ankle range of motion (ROM),1 gait kinematics,2,3,4 muscle size,5 muscle control,1,2,6 strength7 and reduced spasticity.1,2,8,9 Widespread use of the International Classification of Function has resulted in an increased emphasis on activity and participation outcomes. Few have investigated the effect of FES neuroprosthesis on activity or participation in children with hemiplegia. The use of new technology not only requires understanding the changes it imposes on BSF, but practitioners also need to understand how these interventions affect a child’s participation in meaningful activities.5 More studies are warranted using this technology before it is regularly recommended for home use in this population. The purpose of this study was to evaluate the effects of FES neuroprosthesis use on activity and participation outcomes in children with hemiplegic CP.

Methods

Participants and Setting: A convenient sample consisting of eleven children with hemiplegic CP GMFCS I, II recruited from a tertiary care pediatric institution participated in this prospective repeated measure design.

Materials/Methods: Participants were evaluated before and after a 16 week FES neuroprosthesis intervention (4 weeks accommodation, 12 weeks daily use). The Timed Up and Down Stairs (TUDS)7 and the Standardized Walking Obstacle Course (SWOC)6 were administered with the FES turned off (Stim Off) and repeated with the FES turned on (Stim On) at baseline and post. Performance and satisfaction with individualized goals were assessed with the Canadian Occupational Performance Measure (COPM)8. Walking activity was sampled with the StepWatch™ activity monitoring system (Orthocare Innovations) for 3 days prior to participation and during the last week of intervention. Caregivers reported trip and fall frequency in the previous month at baseline and post. Comparisons of interest were immediate orthotic effect, therapeutic effect, and total effect. A two factor repeated measures ANOVA or Friedman test was computed for TUDS and SWOC values. Multiple comparisons were made using the Tukey procedure. Paired t test or Wilcoxon signed rank test was computed for COPM. StepWatch values, falls and trips.

Results

No significant differences were observed in StepWatch™ activity outcomes suggesting that FES neuroprosthesis use did not have any effect on daily walking activity in the individuals, possibly due to the already high functioning ability of the children in this study. Longer data capture and during different seasons may provide more information about changes in children with hemiplegic CP using the FES neuroprosthesis device. This study was the first to evaluate obstacle course negotiation after FES neuroprosthesis use in children with hemiplegia. Only a therapeutic effect was detected for the number of steps to complete the SWOC. A total effect on the number of steps to complete the SWOC was not observed likely due to increased variation in participants performance in the Post unit on condition. Results from this study are in agreement with others reporting the COPM as responsive to meaningful changes due to therapy interventions.8,9,11 Goals identified by the client and caregiver reflected individual goals of participation (e.g. playing hopscotch better, improved butterfly kicking result in less disqualifications during swim meets and more even weight distribution on legs when playing baseball) which is consistent with family centered care. Similar to Pool10 the current study reports a decrease in the number of falls at post intervention however, we did not report a decrease in falls. Recall bias in the current study may have limited our ability to detect changes in falls. Limitations of this study include a small sample size, lack of control group and an unblinded assessor.

In conclusion, daily FES neuroprosthesis use may improve performance and satisfaction with individualized goals and decrease trip frequency. Effects on other activity measures are limited. Further study comparing FES neuroprosthesis to AFO is warranted before ongoing home use of FES neuroprosthesis is recommended.

References


Acknowledgements

A special thank you to the children and families who participated. This project was supported by the Pedal with Pete Foundation. Thank you to Scott Dean, Alisa Brummet and Ashley Hall who assisted with data collection, and to Bioense Inc. for donation of the Ness L300 units.