

Design Evaluation of the MOVE-D Orthotic Brace Prototype for Upper Extremity Tremors in Pediatric Patients

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Abstract

- Tremors affect pediatric and adult populations, with roughly 3% worldwide experiencing essential tremor.
- Treatments include medication, deep brain stimulation, occupational/physical therapy, or adaptive equipment.
- This unblinded experimental pretest posttest study was performed (April–September 2021) at Children’s Health of Orange County, evaluating the effectiveness of Move-D, a novel orthotic brace, on pediatric tremors.
- Ten participants (14–19 years old) experiencing upper extremity tremors, (5 essential, 2 dystonic, 1 coarse, 1 postural, and 1 unspecified), were enrolled. Participants completed a usability survey and performance was measured utilizing the Bruininks Oseretsky Test of Motor Proficiency, second edition with and without the brace, using one-sided t-tests of mean differences. Move-D improved age equivalent scores in fine motor precision by 20.5 (95% CI –3.8, 44.8) months and upper limb coordination by 15.1 (95% CI 2.4, 27.8) months. Manual coordination percentile rankings increased by 2.9 (95% CI –1.3, 7.1)%. Manual dexterity performance was unaffected. The usability survey revealed that 7/10 participants agreed or strongly agreed that they could move their arm freely while wearing the brace, the brace reduced their tremors, and they felt comfortable wearing the brace at home. Through standardized testing and findings from the usability survey, Move-D showed improvement of functional abilities in a pediatric population with tremors.

Figure 1



Materials & Methods

- Objective: to evaluate the usability and effectiveness of the Move-D brace prototype in reducing/dampening upper extremity tremors and its impact on fine and gross motor skill level.
- Internal Review Board (2010151) approval was obtained through CHOC and written informed consent was obtained for each participant. This study was in part funded by the Innovation Institute and CHOC.

Inspiration

- The inspiration behind the Move-D came from a pediatric patient (first initial D) diagnosed with cerebral palsy with severe bilateral dystonic tremors. Using a client center designed approach, patient D was instrumental in providing crucial feedback to enhance the comfort and functionality of the brace.

Brace Design

- The Move-D orthotic brace is a light weight (< 1lb) mechanical brace that distributes weight evenly along the length of the arm, providing proprioceptive input both proximally and distally (Figure 1). Velcro straps at the upper arm and forearm secure the brace in place, ensuring that the hinge is located at the elbow.
- The Move-D’s telescopic feature and adjustable straps permit participants to customize stability in both distal and proximal areas of the upper extremity allowing the brace to target both dystonic and essential tremors. In addition, the telescopic feature grants longevity of use as it elongates and grows with the patient.
- Located posteriorly on the brace above the hinge is a soft protrusion that applies pressure along the course of the ulnar nerve. During the early design phase of the Move-D prototype, it was discovered that the combination of the resistance provided by the brace and the pressure along the ulnar nerve helped reduce tremors.
- The resistance provided by the brace can be adjusted at the user’s discretion through rotation of the dampening knob located at the elbow joint.
- Left- and right-handed model options are available.

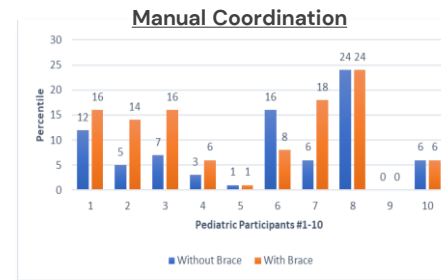
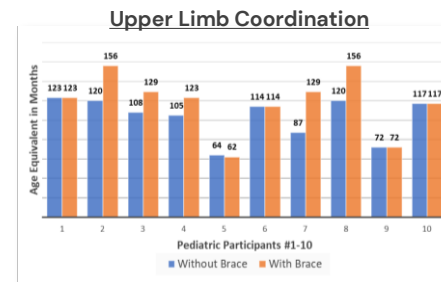
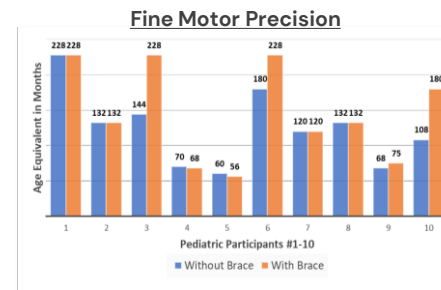
Interventions

- Participants were assessed with and without the use of the brace using a subset of BOT-2 tests.

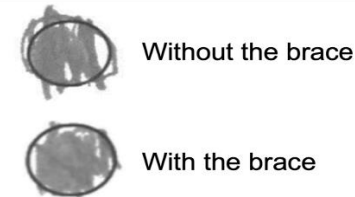
Outcome Measures

- BOT-2 age equivalent scores in the three subtests and percentile scores were compared from baseline/control data (results of testing without assistance) to experimental data (results of testing when wearing the brace) using one-sided t-tests of mean differences.

Results



Participant #3 Coloring



Discussion

- Through standardized testing and findings from usability survey, Move-D showed improvement of functional abilities in a pediatric population with tremors.
- Overall, the results showed that the Move-D orthotic brace enhanced dynamic and static performance for both fine motor precision skills and upper limb coordination. Out of 10 participants, 7 felt that the brace minimized tremors and did not limit their range of motion.
- Perhaps the most rewarding finding of this study were reports that patients felt more confident in their skills when wearing the brace.
- This study is limited by the small sample size, wide variability in effects, and the cohort imbalance between male and females, which may limit generalizability.
- Further studies that include larger sample size of both pediatric and adult populations as well as longer duration of evaluation are planned. Additionally, feasibility studies utilizing various metrics such as the spiral drawing TETRAS, the subject rated Bain and Findley Activities of the Daily Life (BF-ADL), and a digitized tablet to provide precise quantification of tremor during writing/drawing tasks, will help to evaluate further potential effects of the Move-D on functional performance in ADLs.

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Author(s) Disclosures: Li, Moss, and Taraman are inventors and hold intellectual property related to the Move-D brace.

