

The BrainPort® balance device as a potential training aid in the rehabilitation of balance following vestibular surgery

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SUMMARY

Sixteen subjects with balance problems following either acoustic neuroma resection or traumatic brain injury-related fistula repair completed training with the BrainPort balance device. Two sites participated in this pilot study: Lahey Clinic, MA, and Northern New Jersey Pain and Rehabilitation Center, NJ, respectively. Subjects were tested at baseline and after the last training session using objective tests and quality of life questionnaires. In addition, both subjective reports and researcher observations were also documented.

The BrainPort balance device



Treatment with the BrainPort balance device is based on principles of sensory substitution and biofeedback. The device substitutes for the vestibular system by detecting the user's relative head position through an accelerometer, and transmitting the information to the tongue in the form of electrical impulses correlated with head position (electrotactile stimulation). With training, the brain learns to appropriately interpret electrotactile information displayed on the tongue, and thus to improve the motor control necessary for balance.

TRAINING AND TESTING PROTOCOL

1. Baseline testing: Subjects are given baseline assessments of postural stability, balance, and subjective well being according to standardized tests.



2. Clinical training: Each subject is trained to perceive the dynamic patterns presented on the tongue as head position information and instructed to use the position of the stimulus on the tongue display to correct their posture with eyes closed and with altered proprioceptive input (e.g. altered foot position or standing on foam). Each subject participates in 5 to 10 clinical training sessions (1 hour 2X/day). Training sessions consisted of several short trials (1 to 5 minutes) of progressively challenging postural tasks followed by a 20-minute trial while using the device.

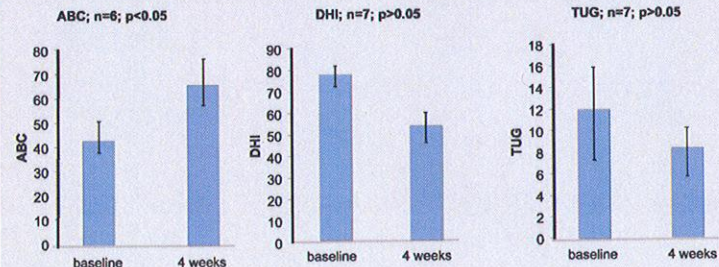
3. In home treatment: Subjects continue with home treatment for 4-8 weeks. During this period, the participant uses the device 20 minutes two times per day, separated by at least 4 hours.

4. End point testing: All tests administered at baseline were also performed at the end of the in-home training period.

Standardized clinical tests of balance:

- The Computerized Dynamic Posturography Sensory Organization Test (**SOT**) is used to evaluate the visual, somatosensory and vestibular affect on postural stability (scale from 0-100; increasing scores reflect better balance; an increase of 8 points is clinically relevant).
- The Dynamic Gait Index (**DGI**) is designed to assess the ability to perform movement tasks while walking and is used to determine risk of falls. A DGI below 19 is correlated with risk of falls.
- The Berg Balance Scale (**BBS**) tests 14 motor tasks common to everyday life. BBS < 46 is correlated with increased risk of falls.
- The Timed Up and Go (**TUG**) measures the time (in seconds) required to rise from a chair, walk 3 meters, turn, and return to the original sitting position. A TUG score >11.2 sec is correlated with increased risk of falls.
- The Dizziness Handicap Inventory (**DHI**) is a self-assessment questionnaire designed to measure the subject's perception of their unsteadiness and dizziness (0 = no handicap; 100 = significant handicap).
- The Activities-specific Balance Confidence (**ABC**) Scale is a self-assessment questionnaire designed to measure independence and functional limitations in terms of confidence score (0 = no confidence; 100 = complete confidence). A 10 point increase is generally considered clinically relevant.

Pilot study conducted at Northern New Jersey Pain and Rehabilitation Clinic



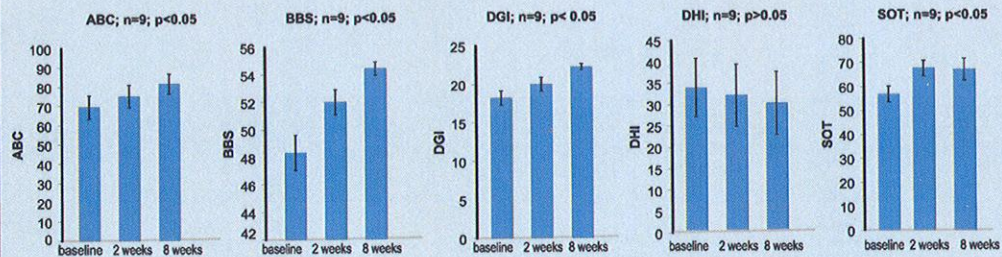
Subjects also reported improvements in:

- ambulation without assistance
- stair climbing
- walking
- standing on one leg
- tolerance of busy environments
- endurance
- driving
- mental clarity
- concentration

Changes in clinical tests of balance after four weeks of training in subjects post fistula surgery.

The ABC score increased an average of 22.5 points, with 5 subjects improving over 10 points. The DHI improved an average of 24 points, with 4 subjects improving over 18 points. TUG score decreased from an average 12.3s to 8.7s.

Pilot study conducted at Lahey clinic



Changes in clinical tests of balance and gait in subjects after acoustic neuroma surgery. At 8 weeks, the ABC improved an average of 12 points, with 5 subjects improving over 10 points. The BBS improved an average of 6 points, with 5 subjects improving over 5 points. The DGI improved an average of 4 points with 5 subjects improving over 3 points and 5 subjects improving over a DGI of 19. The trend for changes in DHI was towards improvement. The SOT showed a 10.5 average improvement, with 5 subjects improving over 8 points.

CONCLUSION

Our preliminary data suggest that treatment with the BrainPort balance device may be effective in improving balance dysfunction after vestibular surgery. Because the majority of patient training is conducted at home, the BrainPort balance device would greatly reduce the burdens on PT staff, patients, and caregivers alike. The effective treatment of balance dysfunction could result in accelerated or improved overall rehabilitation for this patient population.

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