REHABILITATION OF CHRONIC BALANCE DISORDERS USING THE BRAINPORT® BALANCE DEVICE . PRELIMINARY RESULTS.

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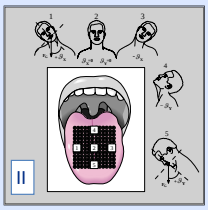
BRAINPORT® BALANCE DEVICE (WICAB): "Vestibular Substitution" Via Electro-Tactile Stimulation of the Tongue

I) A: intra-oral device with an accelerometer and an electrode array, B: generator of electrical signal

II) Direction of lingual stimulus according to the head position.



The accelerometer transmits information about the head tilt to electrodes placed on the tongue. Patients perceive the stimulus on specific areas of the tongue depending on their head position. Patients adjust their posture in order to centre the stimulus on their tongue (stabilisation of the head) and to achieve better balance while standing in the Romberg stance.

SUBJECTS

13 patients suffering from chronic imbalance resistant to traditional rehabilitation

REHABILITATION PROTOCOL (intensive therapy)

Two 1-hour sessions per day, separated by 4 hours, for 4 consecutive days

Each session consists of:
- BrainPort training
4 x 3 mins and 1x 20 mins per session

- balance exercises
(5 mins) for subjective evaluation of progress made by the patient during each session

SUBJECTIVE EVALUATION OF EFFICACY

AVS - Analogue Visual Scale (score out of 10)

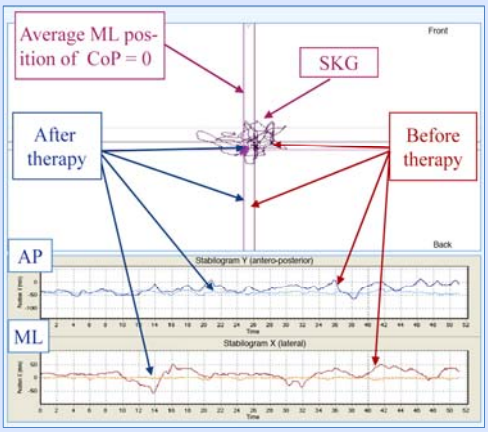
OBJECTIVE ASSESSMENT OF EFFICACY

SYNAPSYS SPS
Static and dynamic posturography platform

Patients were assessed before and after therapy.

We performed an analysis of the variations of the centre of pressure (CoP) with eyes open (EO) and eyes closed (EC), on a static and dynamic platform (support referenced by anterio-posterior (AP) and medio-lateral (ML) postural sways).

RESULTS OF SUBJECTIVE AND OBJECTIVE ASSESSMENTS

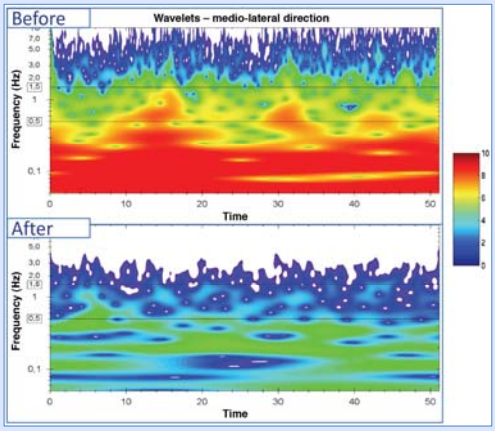


Left: Examples of statokinesigrams (SKG) and anterior (AP) and mediolateral (ML) stabilograms for a patient with bilateral vestibular loss, recorded in a static EC condition, before and after therapy.

Right: Frequency analysis of ML stabilograms using the wavelet decomposition method. The power is colour-coded, the warm colours (yellow-orange-red) correspond to higher power levels.

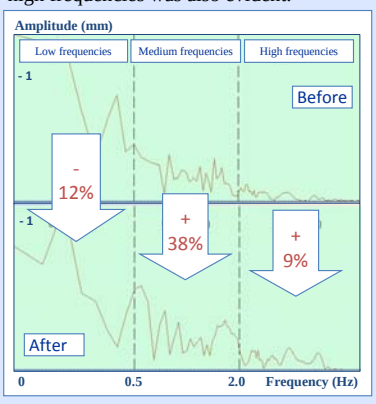
Before therapy, the patients showed large, low-frequency oscillations, ML oscillations being more marked.

After therapy, a reduction was evident in the variance and power (78% and 63% respectively) of postural sways.



Results of frequency analysis (FFT) of ML stabilogram recorded in dynamic EC condition

The arrows show the average change (as a percentage) in the proportion of low, medium and high frequencies. There was a 24% ($P<0.05$) reduction in the power of postural oscillations. A shift in the frequency spectrum toward medium and high frequencies was also evident.



Age	Sex	Etiology + Antecedents	AVS	OBS
72	M	BVL + CCI	±	+
67	M	BVL	+	±
66	M	BVL + CCI	+	+
66	M	BVL + discal hernia + depression	±	=
59	M	BVL + otospongiosis	+	±
48	M	BVL + cardiac hypervolemia	±	±
83	M	UVL + BPPV + AMD	+	+
72	M	UVL + BPPV	+	±
66	F	UVL + depression	±	=
48	M	UVL + cervical sprain	+	±
63	F	DCA+ AMD + FP hygroma	+	+
58	F	MS+ LCS	+	±
20	F	Otolithic syndrome	+	+

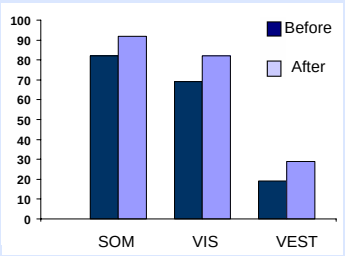
Efficacy of an intensive BrainPort® balance device therapy according to age, sex and etiology.

+ more than 30% improvement; ± less than 30% improvement; = no change

OBS: overall balance score; BVL: bilateral vestibular loss; CCI: cerebral circulatory insufficiency; UVL: unilateral vestibular loss; BPPV: benign paroxysmal positional vertigo; AMD: age-related macular degeneration; DCA: diffuse cerebellar atrophy; MS: multiple sclerosis; LCS: lumbar canal stenosis

Results of the sensory organisation test. Average scores

An increase in the overall balance score was evident ($P<0.05$) after the therapy. The somatosensory (SOM), visual (VIS) and vestibular (VEST) scores increased by an average of 12%, 19% and 54% respectively.



Before and after therapy, patients suffering from bilateral vestibular loss demonstrated falls in the dynamic EC condition. However, after therapy, their balance improved considerably in the static EC/EO condition and the dynamic EO condition, which is demonstrated by the increase in the SOM and VIS scores.

CONCLUSIONS

These preliminary results show that an intensive 4-day therapy with the BrainPort® device improved the static and dynamic balance of patients suffering from chronic instability, who did not achieve sufficient results with traditional balance rehabilitation. Patients adopted a new balancing strategy making greater use of medium and short loops of postural control.

This therapy could therefore complement an existing rehabilitation programme for balance disorders with exercises based on sensory substitution mechanisms.

Further studies are necessary in order to examine the placebo effect and the long-term efficacy of this new tool for balance rehabilitation.