INTRODUCTION

- Poor balance is often due to lack of sensory information.
- Biofeedback provides subjects additional sensory information about their body movements.
- Hypothesis - audio biofeedback, ABF, can provide an artificial sensory channel for postural control and can be successfully applied for balance rehabilitation.

METHODS

EQUIPMENT

This ABF system uses a laptop PC (Celeron 2.3 GHz) with data acquisition board (NI DAQcard-6024E) to:

1) Collect 2D, anterior-posterior (AP) and medial-lateral (ML) linear acceleration data via a portable sensor (based on ADXL202) installed on the subject's back (LS);
2) Create real-time ABF stereo sound processing data from the portable accelerometric sensor.

- Centre of Pressure (COP) data are recorded from an AMTI OR6-6 force plate (100Hz).
- Processing data from the portable accelerometric sensor.
- This ABF system uses a laptop PC (Celeron 650MHz) to:

ABF generates two sine waves in real-time. The modulation of these two sine waves represents the accelerometric information sensed at the subjects' trunk.

- Anterior Posterior (AP) movement is represented by frequency and volume modulation.
- Medial Lateral (ML) movement is represented by the balance of the volume of the two ABF sound channels.

SUBJECTS

Nine bilateral Vestibular Loss Subjects and nine Control Subjects matching the VS in gender and age (Table 1).

EXPERIMENTAL CONDITIONS

ABF stereo sound generation

ABF sound volumes and frequency as functions of sensor acceleration detection

RESULTS

1) ACCELERATION SENSED AT TRUNK LEVEL AND COP DISPLACEMENT ARE HIGHLY CORRELATED

- Correlation between COP displacement and acceleration was r=0.88 (p<0.01).
- Coherence between COP displacements and acceleration was high for the low frequencies (0-2Hz).

2) ABF CAN SUBSTITUTE FOR THE LACK OF SENSORY INFORMATION

Vestibular loss subject

Control subject

Vestibular loss subject reduced sway more than control subjects on foam with eyes closed

- This subject was able to perform the trials ONLY with the help of ABF.
- This subject wasn’t able to perform the condition both with and without ABF.

- The subject fell twice without ABF but never fell during the trials using ABF.

CONCLUSION

1. ABF feedback provides acceleration information highly correlated to COP displacement.
2. ABF effectively reduces body sway in stance, especially when other sensory information is compromised by pathology or by environmental conditions.
3. ABF increases the number of postural corrections applied by the subjects.
4. ABF may provide an effective balance prosthesis because patients with profound bilateral vestibular loss who could not stand or were unstable on the foam with eyes closed effectively substituted ABF.
5. Whether ABF will also be useful for dynamic postural stability during gait remains to be tested.

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