PRE AND POST ASSESSMENT OF NORMAL PRESSURE HYDROCEPHALUS PATIENTS USING A HEAD MOUNTED ACCELEROMETER

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INTRODUCTION

Normal pressure hydrocephalus (NPH) is a neurologic condition. It is diagnosed with imaging to confirm enlarged ventricles of the brain and little to no increase in intracranial pressure. NPH is generally seen in elderly patients (age≥55y.o.), and is attributed to cerebrospinal fluid (CSF) accumulation and abnormal brain compliance. The standard treatment is a surgical procedure, where a shunt is implanted to divert the CSF away from the brain. Neuropsychological and stability testing are helpful in the diagnosis and treatment of patients on an individual basis and in assessing the effects of shunting.

METHODS AND PROCEDURES

We assessed 59 patients (31 males and 28 females), ranging from 47 to 94 years old who underwent 36-hour CSF trial drainage as part of the diagnostic protocol for NPH. Patients who were diagnosed with NPH that went onto CSF shunt treatment (N= 27) were also assessed after 3 and 12 months.

Patients were asked to stand and perform a Romberg-type assessment with an accelerometer placed upon their head (Figure 1). A total of six tests were completed; three with the eyes open and three with the eyes closed. Random walk theory (Collins and DeLuca, 1993) was used to assess the path of antero-posterior versus medio-lateral head accelerations. Short term correlations (H1 values) were selected as the primary outcome variable.

Figure 1. Placement of head accelerometer on a subject.

RESULTS

Our statistical analysis shows that there is a significant difference (p = .001) between each visit (Figure 2) visit. As the value H1 decreases, this indicates more coordination of movement, as a patient strives to maintain a steady upright posture. The time when H1 decreased corresponds to the 3rd visit, i.e., 3 months post-shunt.
DISCUSSION

The maintenance of balance has always been a concern to various neurological patient populations, especially those with NPH. Gait disturbance and postural instability are prominent symptoms in patients with NPH, thus making these patients at risk for injuries relating to falling. Blomsterwall et al. found larger displacements and sway areas in NPH patients when compared to controls during quiet standing (Blomsterwall et al., 2000).

While the Romberg test itself is simple to administer, the head mounted accelerometer is a very small and convenient piece of equipment to use along with the test. The device is the size of a pager and simply requires placement upon the head and can be used in any preferred location.

At this time, biomechanical postural analysis has not been done on NPH patients. Having used the cranial accelerometer and analysed the data, we can see a significant difference in patients stability three months post shunt.

SUMMARY

Decisions for shunt placement are based on gait evaluation, cognitive testing, and patient/family self-report. Our head mounted accelerometer testing protocol, and the novel manner of assessing multiple trials easily, allows clinical decisions to be made as to whether patients’ gait and dynamic balance have improved.

REFERENCES


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Figure 2. Average coefficients plotted at each visit. Visit 1 corresponds to the baseline condition, visit 2 is “post drainage”, visits 3 and 4 are 3 months and 12 months post-op, respectively.