VARIATIONS IN POSTUROGRAPHY TESTING METHODS: EFFECT OF TALKING, VISUAL FIXATION, AND TIME ON PLATE ON SWAY MEASUREMENTS

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INTRODUCTION

Posturography, the measurement of postural stability using a force plate, has demonstrated potential to identify individuals with vestibular and balance problems, neurological disorders, high risk of falls, and susceptibility to sports-related injuries [1]. However debate over the clinical utility of posturography continues, in part due to significant variations in testing methods which may affect the conclusions drawn [1,2]. Previous efforts to standardize posturography methods have focused on more explicit variations in testing, such as feet placement, the number and duration of trials, and which postural measures to report [3,4]. Although these findings were a step toward reducing the more obvious variations in testing procedure, little information exists on the more implicit variations that occur within the clinical setting.

In a step toward creating standardized methods for posturography, this study examined three variations in testing methods that have previously received limited attention: the effect of a subject talking during the test, the time on the balance plate before initiation of data collection, and the presence or absence of a visual fixation point.

METHODS

Thirty healthy young adults participated in this study (22 female, 8 male; mean age 21.4±1.4 years; mean height 170.1 ± 8.7 cm; mean weight 74.1±14.5 kg). A Design of Experiments methodology was utilized to test the three independent variables of interest. Each of these factors was analyzed at two levels: Present (+) and Absent (-). For those trials where Factor A, Subject Talking, was present (+), the researcher asked the subject to: "Please state your birth date including the year" approximately 15 seconds into data collection and the subject responded. For those trials where the same factor was absent (-), no question was asked and the subject remained quiet throughout testing. For trials where Factor B, Time On the Balance Plate, was present (+), the data collection did not begin until 30 seconds after the subject stepped onto the plate. When this time was absent (-), the subjects stepped onto the plate and the researcher began testing quickly, normally within 5 seconds. For those trials where Factor C, Visual Fixation, was present (+), a scenic poster was placed on the wall at subject eye level. When this poster was absent (-), subjects were instructed to look straight ahead at the beige painted wall.

Tests were run for all possible factor/level combinations. This resulted in a total of eight trials per subject, where each factor, at each level, was present a total of four times. For all trials, subjects stood barefoot on a force plate (Bertec Corp., Model BP5050) while wearing a harness connected to a safety structure. Subjects were instructed to stand comfortably, remaining as still and as quiet as they could, and looking straight ahead with eyes open, arms at their side. Anterior-posterior (A/P) and medial-lateral (M/L) center of pressure data was collected for 60 seconds at 1000 Hz for each trial. Between trials subjects stepped off the plate, and after four trials all subjects were given a 2 minute break. From the center of pressure data A/P Sway Range, M/L Sway Range, Mean Sway Velocity, and M/L Mean Sway Velocity were calculated. A multivariate analysis of variance (MANOVA) was conducted to determine the statistical significance of the interactions and main effects of these three factors ($p < 0.05$).

RESULTS AND DISCUSSION

Figure 1 shows the mean A/P and M/L sway ranges for each factor at each level.

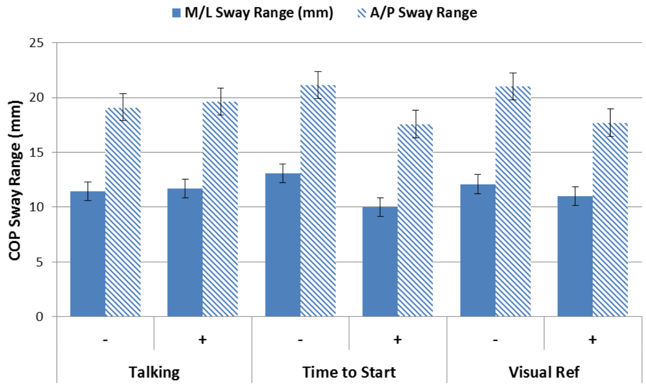

Figure 1: Mean M/L and A/P Sway Ranges when each factor is either absent (-) or present (+), with errors bars representing the 95% confidence intervals.

Statistical analysis revealed that there were no interactions between variables, allowing the main effects of the three factors to be examined. Table 1 shows the p-values for each of the sway measures.

Table 1: P-values for Main Effects, with statistically significant (p<0.05) denoted with *

	Talking	Time Prior to Start	Visual Fixation
M/L Sway Range	0.677	0.000*	0.079
A/P Sway Range	0.550	0.000*	0.000*
Mean Velocity	0.063	0.000*	0.000*
M/L Sway Velocity	0.546	0.000*	0.000*

Results indicate that when the subject talks briefly during testing, postural sway measurements are not significantly affected. This is notable, as it was observed that while talking, some subjects also moved their head or motioned with their hands, actions initially believed to likely affect postural sway measurements. These findings suggest that should an individual briefly talk or move during quiet standing balance tests, it may not be necessary to discard the trial. However the observed power for the analysis on this factor was low (less than 0.50), indicating the need for significantly more subjects to confirm this particular conclusion.

Results show that the presence of a visual target to fixate on significantly reduced A/P Sway Range (p=0.000), Velocity (p=0.000), and M/L Velocity (p=0.009). Though having subjects fixate on a black, circular-shaped target is common, artwork was used in this study to mimic a typical clinical environment. In this study, subjects were not explicitly instructed to look at the poster during the test, but results indicate most did. This suggests that hanging artwork in clinical exam rooms used for balance testing may have the unintended consequence of masking subtle postural instability by reducing sway, while also having a potential benefit in rehabilitation settings, where patients may achieve stabilized balance through purposefully gazing at artwork.

The presence of a “stabilization period” prior to the initiation of data collection strongly affected postural sway results, with all four sway measures significantly reduced (p = 0.000 for all). The observed powers were all above 0.95, indicating sufficient number of subjects to draw this conclusion. This suggests that, as proposed by others [2], individuals take a short period of time to “settle” and that posturography reporting should only occur after this point.

Future work is now needed to relate the findings of this study to the ability to discriminate healthy individuals from those with compromised balance so that standards to improve clinical utility can be proposed.

CONCLUSIONS

Providing subjects with time to stabilize prior to data collection and artwork to look at during testing both significantly reduce postural instability. Brief periods of talking do not appear to influence sway, but additional subjects are needed to confirm.

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