SUPPORT EFFECTS ON STANDING POSTURE

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INTRODUCTION

Examination of postural sway using assistive supports is particularly important when attempting to enhance the balance of a clinical population. Postural stability has been measured in a variety of ways (e.g., sway area and anterior-posterior (AP) and medial-lateral (ML) sway), and tests have been performed both with the force plate under the cane and feet (Milczarek et al, 1993; Lu et al, 1997) and with the force plate under the feet only (Nandapalan et al, 1995; Maeda et al, 1998; Jeka, 1997). Enhanced support has been demonstrated by decreased postural sway in subjects stabilized with canes and from touch. Jeka and colleagues have conducted a large body of work on the efficacy of light touch (less than 1 N) to restore postural stability. He shows light touch to be comparable to force touch (with a higher contact force) in reducing postural sway measured by the ML center of pressure (COP) excursion (Jeka, 1997). We explore the question of how effective light touch is in reducing sway as the contact surfaces vary in stability. We hypothesize that light touch may prove less effective on a less stable surface.

PROCEDURES

The results reported here are from three healthy subjects. Tests were of thirty (30) seconds duration and were conducted using a 46 cm X 51 cm AMTI (model OR6-7) force plate. The sway variables measured in this study were: the sway area (the 95% confidence ellipse determined by BioSoft software from AMTI, Watertown, MA), COP path length, and AP and ML sway.

The first series consisted of trials with eyes open (EO) and eyes closed (EC) unsupported (US) and with support provided through the left hand using each of the following: 1) Regular single-point, swan-neck cane (LC) at the height of the wrist crease of each subject (WC) and 2) Standard quad, or four-footed cane (LQ) at WC. Tests using canes were conducted under both ON (feet and cane on the force plate) and OFF (feet only on the force plate, cane next to the force plate) conditions. Finally, a second set of US EO and EC tests were performed. Each test series was repeated twice to determine fatigue effects and repeatability.

A second series of tests was conducted with support provided OFF the force plate in all cases. Each subject performed the following tests under both EO and EC conditions: 1) Unsupported (US), 2) Standard one-point cane in the left hand (LC), 3) Standard quad cane in the left hand (LQ), 4) Large quad cane (feet spacing: 28 cm (AP) X 17 cm (ML)), or about 50% larger than a standard quad cane), 5) Walker providing ample stability gripped with the left hand (LW), and 6) Wall. Tests on each of the five mobility aids above (2-6) were performed both using natural touch (NT) and fingertip (or light) touch (LT). Finally, there was a second set (EO and EC) of US tests. Both
unsupported tests were averaged and used to normalize other support conditions.

RESULTS AND DISCUSSION

Our three subjects obtained varying levels of sway reduction from the regular single point cane (LC). Use of the single point cane by Subject 2 (s2) did not reduce sway area, AP or ML sway. Subjects 1 and 3 (with EO) showed decreased sway areas and decreases in AP and ML sway (but not sway path length); this finding was more obvious in the tests in which the cane was OFF the force plate and after repeated testing. All three of our subjects were able to decrease sway area and AP and ML sway with the quad cane. Results OFF the force plate showed a larger effect.

Although we tested our subjects with eyes open and closed, we found the ratio between these two conditions to be largely unaffected by the nature of the support provided (not significant using a paired t-test on the ratios of EC/EO for all tests on LQ or LXQ as opposed to the two tests (LW and Lwall) on stable objects. The percentage reduction in sway area is thus reported as the average over our three subjects of all 6 tests with EO or EC. Figure 1 shows a plot of this average percentage reduction for NT and LT (fingertip touch) under LQ, LXQ, LW, and Lwall support conditions. The mean sway area difference between the NT and LT tests was significant (p=0.026) when the support surface was a quad cane or an extended quad cane. This difference was not significant (p=0.08) when the support surface was stable, as in the LW and Lwall tests. This finding suggests that light touch may be modified by the support provided by the object being touched. If the object is not stable, as in the easily-tipped quad canes, the subject may not be able to use haptic cues as effectively.

![Figure 1](image)

Figure 1: This figure shows the greater gap between NT and LT with the relatively unstable quad canes (LQ and LXQ) compared to (LW and Lwall). Error bars are one standard deviation above the average.

REFERENCES


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