EFFECTS OF DIFFERENT BASES OF SUPPORT ON POSTURAL SWAY

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INTRODUCTION. Human standing is characterized by spontaneous changes in the projection of the center of pressure (COP) commonly addressed as postural sway. The components of sway in the anterior-posterior direction, AP, or medio-lateral direction, ML, have been reported to be relatively independent. It has observed [1] that changes in the dimension of the support surface in one direction could affect stability when the other dimension of the support surface was much smaller and kept constant. These observations have suggested that AP and ML sways can become interdependent in conditions of postural instability. The aim of this study was to investigate changes in postural sway induced by manipulations of the dimensions of the supporting surface and presence of a light touch.

PROCEDURES. Ground reaction force and moments applied by each foot to force platform (Bertec, Inc.) were collected at 40 Hz during 40 s task, to calculate COP trajectory. A 12 bit AD converter was used. Then, those signals were low-pass filtered at 10Hz using a 2nd order Butterworth filter. The subjects were 9 healthy adults (32±8 years old, 76±10 kg weight, 1.80±0.09 m height). They were instructed to stand as still as possible on three different unsteady boards with a narrow beam attached to the bottom and placed on the force plate. Those boards had the same dimension as the force plate. Each one had a rectangular supporting surface, which was 4.3 cm wide, and 8.6 cm, 17.2 cm or 50 cm long. During the trials, subjects stood on the top of each board facing along the beam's axis (instability in the frontal plane) or perpendicular to that axis (instability in the sagittal plane). A light touch of the right index finger to a fixed surface placed at the subject's right side was used in half of the trials. The combination of those factors and normal standing with and without touch resulted in 14 different tasks performed. The following mean measurements were taken from COP for both AP and ML direction: maximum amplitude (*max*), standard deviation (*std*), mean velocity ($\bar{v}$), and excursion area (e-area) [2]. Statistical methods included repeated measures analysis of variance (ANOVA) with direction of instability and touch as factors.

RESULTS AND DISCUSSION. During normal standing, AP *std* was smaller than ML *std*; *max* and $\bar{v}$ were higher at AP-COP, and the use of light touch decreased *max* for both AP and ML directions. During standing on unstable boards, both *max* and $\bar{v}$ became much larger for ML than for AP direction. Besides, *std* had bigger values in AP direction than ML. Instability in the sagittal plane produced higher *std* than in the frontal plane. Those results point that, when an instability is added to a standing task, sway constrains may be changed, even when subjects are standing on a board whose support dimensions are much larger than typical sway characteristics.

The direction of instability (sagittal or frontal) did not influence the size of COP excursion area, but all means of other variables in unstable conditions were bigger than in normal standing. During sagittal instability, *std*, *max* and $\bar{v}$ were bigger ($p<0.02$) than during frontal instability.

The addition of a light touch led to a decrease in e-area ($p<0.03$), but no changes in such indexes as *max* and *std* were observed. *A*n interesting effect was observed: in no touch condition the excursion area in frontal instability was higher than during sagittal instability, but the inverse result was observed when the subjects were touching the support. The mean velocity increased with touch during instability conditions (sagittal instability had higher values than frontal instability, and $\bar{v}$ in AP direction was slower than in ML direction); on the other hand, the same variable was decreased during normal standing. The instability when the subjects were asked to stay as quiet as possible on different boards did not change *max* due to physical constraints: If the amplitude were increased in the direction of instability, COP could go beyond the boundaries of the support causing a fall. The increased $\bar{v}$ combined with the effect of touch during unstable conditions was probably reflective of a strategy used to reach a more stable equilibrium. An evidence for such an argument is the fact that the use of a light touch during normal standing decreased $\bar{v}$.

CONCLUSIONS. Postural instability during standing on unstable boards is a mechanical challenge that produces different patterns in COP, particularly increasing constraints in ML direction of sway. Frontal stability increased COP sway excursion and velocity more than for sagittal direction stability as compared to normal standing. The addition of touch decreased only the area of sway, but increased the mean COP velocity in postural instability, opposite to what was observed during normal standing.

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