

RECOVERY OF POSTURAL SWAY AFTER STATIC STRETCH OF THE ANKLE JOINT

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INTRODUCTION

It has been well assumed that stretching is an effective exercise for the purpose of warming up, improving flexibility and preventing injury (Ferber et al., 2002; Wilson et al., 1991). However, recently it has also been reported that stretching decreases muscular force development and delay the onset of muscle power (Cornwell et al., 2002; Fowles et al., 2000; Young & Elliott, 2001). It was also reported that balance maintenance ability decreases with stretch (Behm et al., 2004). An additional experiment was conducted to evaluate the effects of stretching, vision and their interaction on postural sway (Nagano et al., 2006). Although the preceding study investigated the change in postural sway, it did not consider the trend after stretching. Therefore the purpose of this paper was to investigate the effects of vision and stretching on postural sway during quiet standing and to evaluate the recovery phase after stretching.

METHODS AND PROCEDURES

Healthy male subjects participated in this study. Participants quietly stood as upright as possible on a force plate (9286A, Kistler Instrumente AG, Winterthur, Switzerland) while ground reaction force data were collected. Both feet were arranged on the center of the force plate. Arms were crossed in front of the chest. In the eyes-open

condition, participants stared at a marker placed in front of the face 2m apart at the eye level. In the eyes-closed condition, participants voluntarily closed their eyes and stood upright. Recordings were initiated after the posture became stable on the force plate. Data were recorded at 100 Hz (PowerLab, ADInstruments, Colorado Springs, CO, USA). Thirty seconds were recorded and utilized for analysis. The sway of ground reaction force center of pressure (COP) was calculated from the force plate data. In order to apply stretch, participants were asked to quietly stand as upright as possible on a device that caused a static dorsiflexion (STR-158, COMBI Wellness, Tokyo, Japan). The device was set to 20° for the first one minute. Then it was set to 25° for ten minutes (Figure 1).



Figure 1. The standing posture on the stretching device.

Measurements were conducted in two parts, with a total of four experimental conditions. Two conditions were first measured without stretch, i.e., eyes-open and eyes-closed. These conditions will be called “pre-stretch eyes-open” and “pre-stretch eyes-closed”. Six trials of each were performed in random order, resulting in 12 total trials. A ten minutes of static stretch was applied after these measurements. Following the stretch, two conditions were measured as described previously. These conditions will be called “post-stretch eyes-open” and “post-stretch eyes-closed”. Each condition was performed for seven times. The subjects took a rest of one minute on a chair after every two trials.

RESULTS

There was a clear change in the sway speed associated with stretch: (1) the sway speed of the COP increased after stretching, (2) the sway speed increased when vision was removed, (3) the sway speed recovered to the original level in about 20 minutes (Figure 2). Similar trends were found for the standard deviation (RMS) and maximal sway range of the COP trajectory.

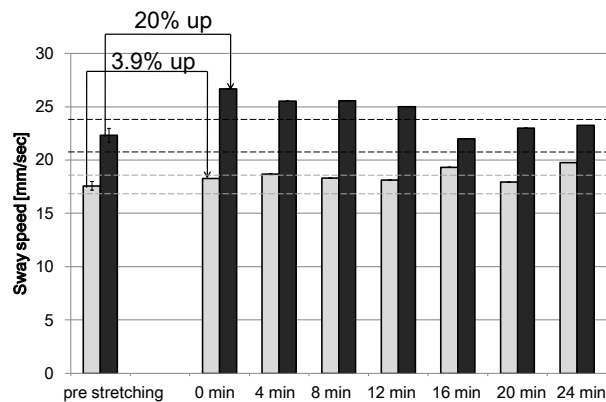


Figure 2. Trend of the sway speed. Light color shows “eyes-open” and dark color shows “eyes-closed”. The magnitude of sway recovered to the original level in 20 minutes.

DISCUSSION

Through this experiment, it was confirmed that there are clear effects of vision and stretching on postural sway. Moreover, it was found that the sway speed of the COP recovered to the original level while repeating the measurements. This result may suggest that the force deficit caused by stretching disappears after approximately 20 minutes, although this point was not tested in this study. We will work on the development and evaluation of a training apparatus that contributes to the improvement of balance ability (decrease in postural sway) in the future.

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