

CHARACTERISTICS OF STANDING AND ANTERIOR TILTING POSTURES IN RELATION TO THE TIME OF DAY

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INTRODUCTION

Standing balance and mobility has been essential to our daily lives and physical wellbeing, especially to the aged and/or people with physical disabilities [1]. Understanding its functions is important in improving safety in their daily lives, especially in decreasing fall risks and improving their physical wellbeing. The purpose of this study was to investigate the characteristics of anterior tilting movement and the difference in balance and mobility function in respect to the time of day, i.e. AM and PM by analyzing coordinates of the center of foot pressure (CFP) and the minimum jerk theory [2].

METHODS

Fourteen older subjects (older group: 8 female; 6 male; age 63.3 ± 6.04 years) and nine younger female subjects (younger group: age 20.5 ± 0.53 years) were recruited for this study with informed consent. On the Kistler force platforms, the subjects were instructed to stand still barefoot for the first five seconds. When they hear a beep, they were to tilt their body forward as quickly as possible around the ankle joint keeping the heel on the force platforms and holding that position until the second beep. When the third beep is heard, they were instructed to go back to the previous erect position as quickly as possible. The subjects kept the anterior tilt position for about 15 second and the total time was 30 seconds per trial (Figure 1). The subjects had two trials in a single day. The subjects were evaluated three times in a single day i.e. AM (around 8:30) and PM (around 15:30), and were tested over five non-consecutive days in a span of two weeks. The subjects sat down for about a minute to rest between the tests. The signals from the force platforms were sampled at 30Hz using A/D converter and PC. Analyses were done using variables derived from x-y coordinates (x: medial-lateral; y: anterior-posterior) of CFP. Each CFP data was analyzed statistically, and the level of significance was set at $P < 0.05$.

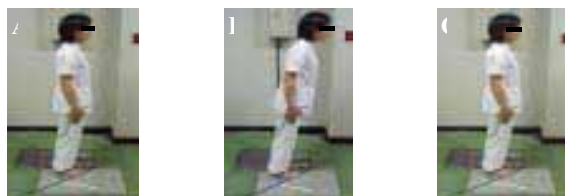


Figure 1: Standing and tilting postures. A: standing still; B: anterior tilting; C: return to the previous position

RESULTS AND DISCUSSION

The mean anterior-posterior CFP coordinate (C_y) for 5 seconds when the subject returned to the previous erect position was found to be significantly more posterior than for 5 seconds prior to the tilting position (paired t test, $P < 0.05$). Similar results were also obtained from the subjects. The subjects appear to lose

their sense of positioning when a relatively stressful posture is applied to their lower extremity muscles. This phenomenon was observed in both groups. Therefore, there is a possible risk of posterior fall, when a person tries to lift a relatively heavy object, which is in front of her/him.

The C_y of the while maintaining the anterior tilting position was found to be significantly more anterior in PM than in AM (Figure 2, Repeated measures ANOVA; $P < 0.05$). Conversely, this means that a person does not have better mobility in AM as in PM. The human foot is long and narrow and the distance between the ankle and toe is longer than that of between the ankle joint and the heel. In other words, a more anterior CFP is advantageous in controlling the standing position using the braking function of the triceps surae. Therefore, when treating patients and caring for older people, we need to keep in mind that there is a difference in the standing balance and mobility in respect to the time of day.

There were no significant difference in the jerk costs (JC) of x-y coordinates of CFP in respect to the time of day during the standing still and maintaining the anterior tilting positions as well as the phases of the anterior tilting and posterior returning motions in the. This suggests that the task adopted in this study was linear movement, indicating that a significant difference in JC motion smoothness was not obtained between AM and PM.

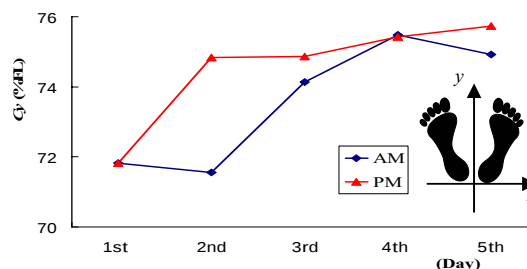


Figure 2: Mean CFP y-coordinate C_y . Values are expressed in percentages to the foot length (FL) from the heel ($P < 0.05$).

CONCLUSIONS

Since there seems to be an illusion of postural control to some extent, we have to keep that in mind when we care for not only older adults but also healthy persons who require physical therapy. For a much better detailed understanding in the differences of postural control and mobility in time of day, additional evaluations, such as electromyography and three dimensional motion analysis, are needed.

REFERENCES

1. Shinkoda K, et al. *Jpn J Traumatol Occup Med* **47**, 30-38, 1999.
2. Hreljac A, *Gait Posture* **11**, 199-206, 2002.