POSTURAL CONTROL UNDER VISUAL AND PROPRIOCEPTIVE PERTURBATIONS DURING DOUBLE AND SINGLE LIMB STANCE

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INTRODUCTION

Postural control is known to result from the integration of visual, somesthesic and vestibular information. In the therapeutic settings, proprioception rehabilitation programs often prescribe exercises involving single-leg stance or single-leg hop in order to restore proprioceptive deficits and functional stability of the ankle [1]. We wish to test the hypotheses that, when proprioception is perturbed, the role of vision in postural control increases with the difficulty of the standing task. Additionally, we wish to investigate the effect of vision during postural adaptation after withdrawn of the somesthesic perturbation during double (DLS) and single limb stance (SLS).

METHODS

Eleven healthy and active young male adults (29.6 ± 5.8 years; 181.2 ± 4.6 cm; 81.9 ± 11.5 kg) participated in this study.

To perturb the visual input, the laboratory room was darkened in such a way that participants could not see the environment [2]. Ankle proprioception was perturbed with four vibrators placed transversely to the tendons of triceps surae and tibialis anterior muscles. Four test conditions were collected: normal vision + normal proprioception (20s); reduced vision + normal proprioception (20s); normal vision + perturbed proprioception (10s) to normal vision to proprioception reintegration (10s) and reduced vision + perturbed proprioception (10s) to reduced vision to proprioception reintegration (10s). Five trials of each condition were collected in DLS and SLS using an AMTI force platform. The COP speed of two intervals of proprioception perturbation (V1, V2) and proprioception reintegration (R1, R2) were compared to control conditions using Analysis of Variance (ANOVA) followed by Tukey HSD test ($p<0.01$).

RESULTS AND DISCUSSION

A significant condition by task interaction was revealed. Post hoc comparisons showed that vision has a main effect in SLS ($F(1, 20) = 47.70$, $p<0.001$) while proprioception perturbation showed effect only during DLS ($F(2, 40) = 29.11$ $p<0.001$) (Fig. 1). Postural control in DLS was achieved independently of visual input after 5s of proprioception reintegration (R2). In the present study the difficulty of the task condition seems to be highly related to the visual dependency.

Our results suggest that to perform challenging tasks vision and possibly vestibular system dominates the postural control.

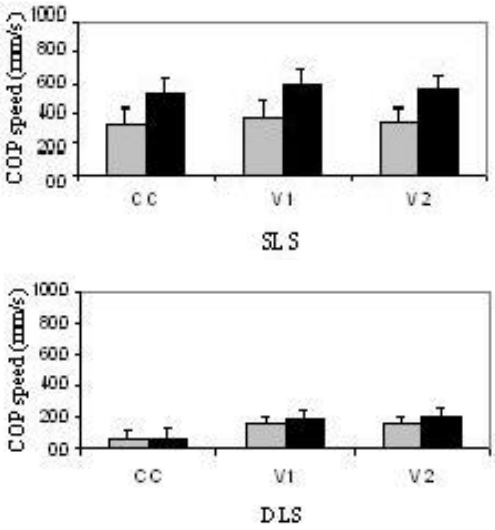

Fig. 1: Mean COP speed during control condition (CC) and two intervals (V1, V2) of proprioception perturbation. Normal vision (▒); reduced vision (■); double limb stance (DLS); single limb stance (SLS).

Therefore, exercises involving single-leg stance can improve functional stability probably due to some neuromuscular requirement other than enhance of proprioception system.

CONCLUSIONS

Vision plays a more important role according to the task to be accomplished. The more challenging is the task, more the balance control mechanisms rely on vision. These results can help clinicians and researchers to make decisions about tasks and sensorial availability during assessment and training.

REFERENCES

1. Rozzi SL; Lephart SM; Sterner R; Kuligowski L. Balance training for persons with functionally unstable ankles. *J Orthop Sports Phys Ther* 1999; 29:478-86.
2. Tropp H, Odenrick P, Ekstrand J. Factor affecting stabilometry recordings of single limb stance. *Am J Sports Med* 1984;12:185-188.