Effects of Balance Training with Strobe Vision on Static Postural Control in Individuals with Chronic Ankle Instability

Supitra Namhong[1], Kyung-Min Kim[2], Ampika Nanbancha[1], Weerawat Limroongreungrat[1]
[1]College of Sports Science and Technology, Mahidol University, Nakhon Pathom, Thailand
[2]Department of Sport Science, Sungkyunkwan University, Suwon, Republic of Korea
Email: supitra.nah@student.mahidol.edu

Summary

Individuals with chronic ankle instability (CAI) appear to exhibit increased reliance on visual input for postural control. To optimize sensory reweighting and enhance postural stability, balance training with strobe vision (BTSV) has been incorporated into CAI rehabilitation. However, the present findings indicate that after a 4-week BTSV program, no significant changes were observed in time-to-boundary (TTB) measure or integrated electromyography (iEMG), suggesting that BTSV does not improve static postural control in those with CAI.

Introduction

In mechanisms related to postural control, increased reliance on visual input has been identified as a compensatory strategy for somatosensory deficits in individuals with CAI [1]. Such changes in sensory reweighting may impair the ability to control posture under varying task and environmental constraints. To address this alteration, BTSV has been proposed as a rehabilitation approach to refine sensory organization and enhance postural stability in individuals with CAI. While BTSV has shown promise in improving the dynamic aspect of postural control [2], its effects on the static postural control remain inconclusive. Therefore, this study aimed to investigate whether BTSV can enhance postural stability during single-leg stance, a static task that requires precise postural adjustments on a limited base of support.

Methods

Eighteen participants with CAI were randomized into two groups: control (CG; n = 9) and strobe (SG; n = 9). Postural stability was assessed using a single-leg stance test with eyes open (Fig. 1A), conducted before and after a 4-week intervention. The three-dimensional force and moment signals (1000 Hz) were recorded via a force plate (Bioware 5.4.8.0; Kistler). EMG signals (2000 Hz) of the tibialis anterior (TA), peroneus longus (PL), medial gastrocnemius (MG), and soleus (SL) muscles, were measured with wireless surface EMG (myoRESEARCH 3.20; Noraxon). For the intervention, participants engaged in balance training three times per week. The training tasks included single-leg stance with and without ball tossing, single-leg deadlifts, and single-leg hops to stabilization, with progressive difficulty. CG trained with eyes open, while SG trained using stroboscopic glasses, progressing from level 2 (weeks 1–2) to level 3 (weeks 3–4).

Results and Discussion

No significant change was observed in mean minima TTB in the anteroposterior (AP) direction between pre- and post-intervention in SG. In contrast, CG showed a marked increase

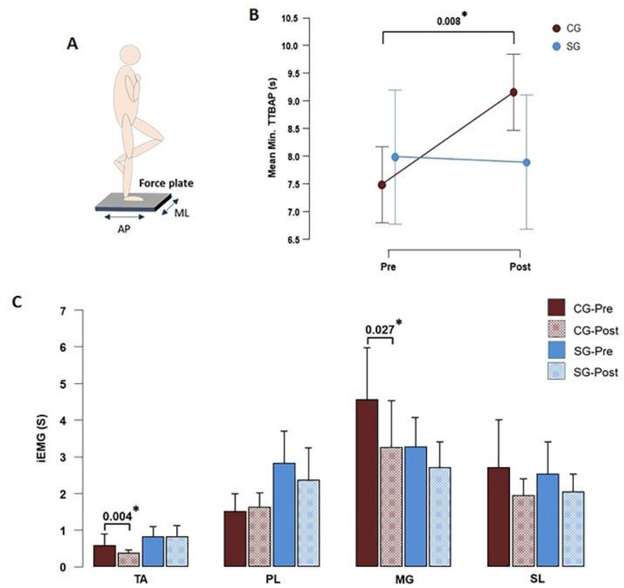

Figure 1: (A) Single-leg stance test. (B) Mean minima TTBAP. (C) Integrated electromyography. *Significant difference ($P < 0.05$) in Wilcoxon signed-rank test for pre-post comparison in each group.

in mean minima TTBAP from pre- to post-intervention (p = 0.008, r = -0.956), indicating improved static postural stability (Fig. 1B). This improvement was accompanied by reductions in iEMG, reflecting changes in neuromuscular control (Fig. 1C). Specifically, CG exhibited significant decreases in the iEMG of the TA (p = 0.004, r = 0.358) and MG (p = 0.027, r = 0.822). Conversely, no significant changes in iEMG were observed in SG.

These findings suggest that balance training with eyes open enhances static postural stability more effectively than BTSV. However, further assessment of static postural control with eyes closed is necessary to better understand the effects of BTSV.

Conclusions

BTSV did not enhance static postural control in individuals with CAI. Visual input is likely crucial for static postural adjustments on a limited base of support in this population.

Acknowledgments

This research is supported by National Research Council of Thailand (NRCT): N41A650106.

References

[1] Song et al. (2016). *Med. Sci. Sports Exerc*, **48(10)**: 2046–2056.
[2] Kim et al. (2021). *Int. J. Environ. Res. Public Health*, **18(10)**: 5364.