

THE BALANCE EFFECT OF REARFOOT WEDGES WITH DIFFERENT HEIGHT FOR COLLEGIATE STUDENTS WITH CHRONIC ANKLE INSTABILITY: PILOT STUDY

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Chronic ankle instability (CAI) is caused by recurrent lateral ankle sprain. Foot orthotic is one option of treatment. The purpose of this study was to determinate the balance effect of rearfoot wedges with different height in collegiate students with chronic ankle instability. Eight collegiate students with CAI subjects were voluntarily participated in this study. The area of center of pressure was used as balance variable of outcome measurement. Seven height of rearfoot wedge was used to test, included 0°, 2°, 4°, 6° of medial wedge and 2°, 4°, 6° of lateral wedge. One-way ANOVA was used to analyze the difference among seven height of wedge intervention in CAI group. The results were showed no significantly difference among seven height of wedge intervention. However, we found a trend of balance improvement with the wedge intervention, especially in 4 degrees of medial wedge intervention.

KEY WORDS: chronic ankle instability, wedge, center of pressure.

INTRODUCTION: Lateral ankle sprain is one of common injuries which suffered in competitive and recreational athletics (Fernandez, Yard & Comstock, 2007; Hootman, Dick & Agel, 2007). Recurrence rate for lateral ankle sprain has been reported to be as high as 70% among athletes (McKay, Goldie, Payne & Oakes, 2001). Approximately 75% of those suffered lateral ankle sprains would progressively developed into chronic ankle instability(CAI) (Anandacoomarasamy & Barnsley, 2005). Patients with CAI had many complications, such as they might feel “giving way”, pain, and instability in the ankle joint, proprioceptive ability decreasing, and balance deficit (Wikstrom, Fournier & Mckee, 2010; Brown, 2011). When suffered ankle sprain and caused proprioceptive ability decreasing, the postural sway during static stance has showed increased (Amy & Christina, 2005; Brown, 2011). That may result in balance change. However, balance deficit might affect the sports performance (Amy & Christina, 2005; Brown, 2011). Foot orthotic is one option while athletes with CAI sought treatment. It could provide better alignment and redistribution of the center of pressure of the foot. However, few studies provided the evidence related to wedge intervention on the rearfoot. Therefore, the purpose of this study was to investigate the balance effect of rearfoot wedges with different height in collegiate students with chronic ankle instability.

METHODS: Eight collegiate students with CAI were voluntarily participated in this study (average height: 163.88±8.22 cm; average weight: 59.63±8.21 kg; average age: 21.25±1.83 years). Seven height of rearfoot wedge (Vasyli medial, Australia) were used in the intervention, including 0°, 2°, 4°, 6° of medial wedge and 2°, 4°, 6° of lateral wedge. The area of the center of pressure (Figure 1) was used as a balance in outcome assessment. The Zebris force plate (Zebris medical GmbH, Germany) was used to assess the area of center of pressure. The subjects stood on one-leg on the force plate for the assessment (Figure 2). Two conditions were assessed, eyes open and eyes closed with vestibular interference

(subjects wore the earphone and noise interfered the vestibular function). One way ANOVA and appropriate post-hoc tests were used to compare the area of center of pressure among 7 wedges for subjects with CAI.

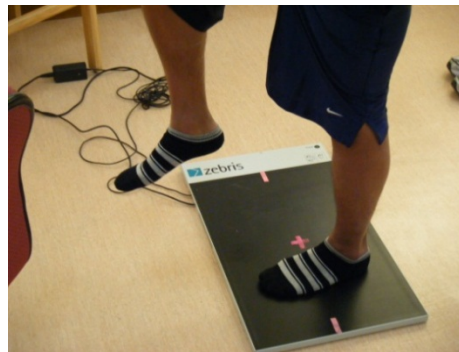
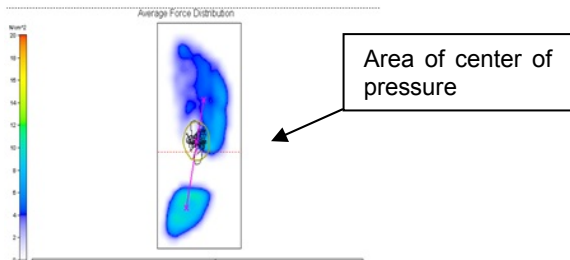


Figure 1: Area of center of pressure.

Figure 2: The subjects with one-leg standing on the force plate to assessment balance.

RESULTS: The results were showed that were no significant differences among seven heights of rearfoot wedge for subjects with CAI. However, the trend has been shown in area of center of pressure. Although the results showed no significant differences, but we could saw the lateral or medial wedge also represented lower than 0° wedge in the area of COP in either the eyes open or eyes close condition (Figure 3).

Table 1: The results of area of center of pressure of wedge intervention on rearfoot for subjects with CAI*

	6° Medial wedge	4° Medial wedge	2° Medial wedge	0°	2° lateral wedge	4° lateral wedge	6° lateral wedge	F	P
Eye open	170.0±41.2	184.9±104.8	152.3±44.8	196.5±141.1	155.9±49.7	168.3±54.3	182.1±56.0	.33	.92
Eye close	504.9±236.9	410.8±120.8	462.4±191.1	570.7±270.8	459.8±209.6	445.2±172.1	422.6±185.7	.58	.75

*the value was represented in mm².

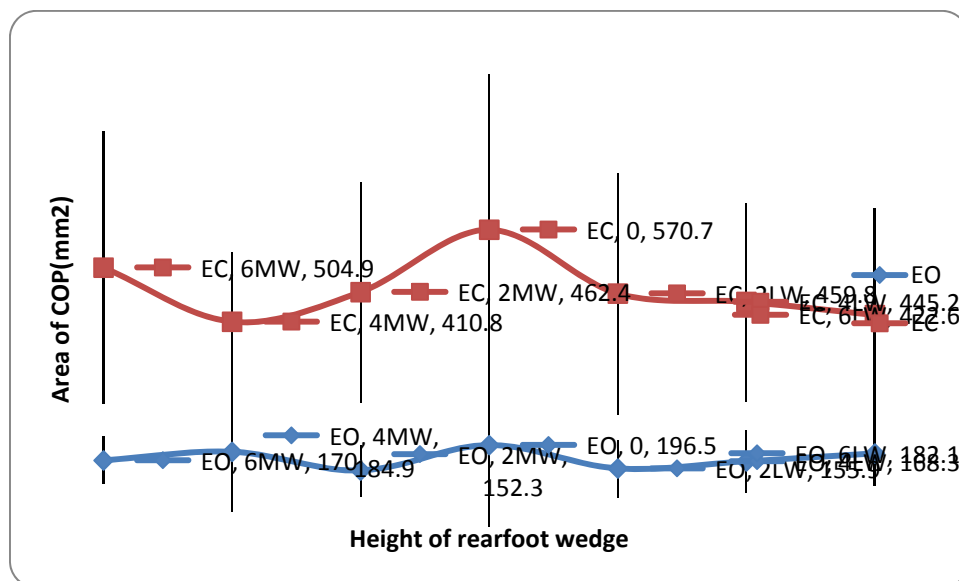


Figure 3: Area of center of pressure (COP) for different height of rearfoot wedge. 6MW: 6° of medial wedge; 4 MW: 4° of medial wedge; 2 MW: 2° of medial wedge; 2 LW: 2° of lateral wedge; 4 LW: 4° of wedge; 6 LW: 6° of lateral wedge.

DISCUSSION: Although there were no significant differences among different wedge heights, there was a trend of enhanced balance ability for the CAI group in 4 degrees of medial wedge, especially in the eyes closed condition. In the eyes closed condition, subjects maintained their static balance by depending on proprioception of the ball of foot. A previous study has found excessive pressure on the lateral edge of the foot and balance deficit for subjects with CAI when they were in monopodal weightbearing condition (Bonnell, Toullec, Mabit & Toume, 2010). We suspected that the center of pressure of foot has been redistributed when the medial wedge filled up the rearfoot, this might increase the contact area of the foot on floor resulting in balance improvement for subjects with CAI. The main therapy to CAI included joint mobilization between tibia and talus (Hertel, 2008), neuromuscular control training and balance training (Emery & Meeuwisse, 2010). But few studies provided the evidence related to wedge intervention on the rearfoot in CAI. However, a limitation of this study was the smaller sample size which reduced the probability of obtaining significant differences. Data from the present study could be used to calculate effect size and power for future studies.

CONCLUSION: The results were shown that there were no significant differences among seven heights of rearfoot wedge for subjects with CAI. However, a trend of balance improvement was observed with wedge intervention, especially in 4 degrees of medial wedge intervention. Further research could use more subjects to provide the more specific results.

REFERENCES:

- Amy, S.N., & Christina, W.Y. (2005). Ankle joint proprioception and postural control in basketball players with bilateral ankle sprains. *American Journal of Sports Medicine*, 33: 1174-1182.
- Anandacoomarasamy, A., & Barnsley, L.(2005). Long term outcomes of inversion ankle injuries. *British Journal of Sports Medicine*, 39, e14.
- Bonnell, F., Toullec, E., Mabit, C., & Toume, Y. (2010). Chronic ankle instability: Biomechanics and pathomechanics of ligaments injury and associated lesions. *Orthopaedics & Traumatology, Surgery & Research*, 96: 424-432.
- Brown, C. (2011). Foot clearance in walking and running in individuals with ankle instability. *The American Journal of Sports Medicine*, 39: 1769-1776.
- Emery, C.A., & Meeuwisse W.H. (2010)The effectiveness of a neuromuscular prevention strategy to reduce injuries in youth soccer: a cluster-randomised controlled trial. *British Journal of Sports Medicine*, 44: 555-562.
- Fernandez, W.G., Yard, E.E., & Comstock, R.D. (2007). Epidemiology of lower extremity injuries among U.S. high school athletes. *Academic Emergency Medicine*, 14, 641-645.
- Hertel J. (2008) Sensorimotor deficits with ankle sprains and chronic ankle instability. *Clinics in Sports Medicine*, 32: 82-86.
- Hootman, J.M., Dick, R., & Agel, J. (2007). Epidemiology of collegiate injuries for 15 sports: summary and recommendations for injury prevention initiatives. *Journal of Athletic Training*, 42, 311-319.
- McKay, G.D., Goldie, P.A., Payne, W.R., & Oakes, B.W.(2001). Ankle injuries in basketball: Injury rate and risk factors. *British Journal of Sports Medicine*, 35,103-108.
- Wikstrom, E. A., Fournier, K. A., & Mckeon, P. O. (2010). Postural control differs between those with and without chronic ankle instability. *Gait & Posture*, 32, 82-86.

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