

Ankle Kinematic Symmetry Differences During a Hop-to-Stabilization Task Across Sexes in Healthy and Unilateral Chronic Ankle Instability Patients

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Summary

The utilization of limb symmetry index (LSI) in patients with unilateral chronic ankle instability (U-CAI) could enhance clinicians' decision making. Females with U-CAI had greater peak dorsiflexion asymmetry performance during a hop-to-stabilization task compared to males with U-CAI and healthy females.

Introduction

Limb symmetry index (LSI) is an accessible clinical tool used in return-to-play decision making following musculoskeletal injuries [1]. However, LSI has not been widely used in patients with unilateral chronic ankle instability (U-CAI). This project aimed to compare LSI values of peak inversion and dorsiflexion angles and range of motion at the ankle in the frontal and sagittal plane within 200ms of landing a forward hop-to-stabilization (HTS) task across sexes in healthy and U-CAI individuals.

Methods

Forty-one volunteers (Healthy: 9F/10M, 22.6±5.6 years, 168.7±10.2cm, 69.2±13.2kg; U-CAI: 9F/13M, 21.0±5.6 years, 171.7±9.8cm, 73.53±13.1kg) were instrumented with inertial measurement units (IMUs) secured to the lower back (L4/L5), lateral femoral condyles, medial aspects of the tibial tuberosities, and on the dorsal aspect of the foot under the laces and tongue of standardized athletic footwear (MVN Awinda, Movella Holdings Inc., Henderson NV, USA). Participants were instructed to start in a double-leg stance, hop over a 30cm hurdle, and land on a single limb [2]. Prior to the hop, participants were positioned to a starting mark at 40% of their height away from a landing zone. A hurdle was positioned at half the distance between the mark and landing zone. Once landed, participants held their balance for 5-seconds with their hands on their hips. A trial was repeated if participants did not clear the hurdle, twisted or hopped on the stance limb, landed outside the landing zone, or was unable to maintain balance for 5-seconds. At least two successful trials were recorded bilaterally at 100Hz and averaged for analysis. Peak inversion and dorsiflexion angles and range of motion at the ankle were extracted from initial contact to 200ms post-landing. The LSI was calculated by dividing the affected or nondominant limb by the contralateral or dominant limb and multiplied by 100%. Analysis of variance (ANOVA) were performed to determine sex (male vs female) and group (healthy vs U-CAI) differences in ankle LSI values. *Post hoc* analyses were performed as appropriate.

Results and Discussion

A significant sex-by-group interaction was observed for LSI peak dorsiflexion ($F_{(1,37)}=4.73$, $p=0.03$, $\eta_p^2=0.11$). *Post hoc* analysis showed U-CAI females had more asymmetric LSI peak dorsiflexion (\bar{x} LSI: 130.5±47.9%) than U-CAI males (\bar{x} LSI: 92.4±28.5%). Additionally, U-CAI females had more asymmetric LSI peak dorsiflexion (\bar{x} LSI: 130.5±47.9%) than healthy females (\bar{x} LSI: 88.1±14.0%). No other differences were observed ($p>0.05$).

Peak Dorsiflexion Angle Limb Symmetry Index (LSI)

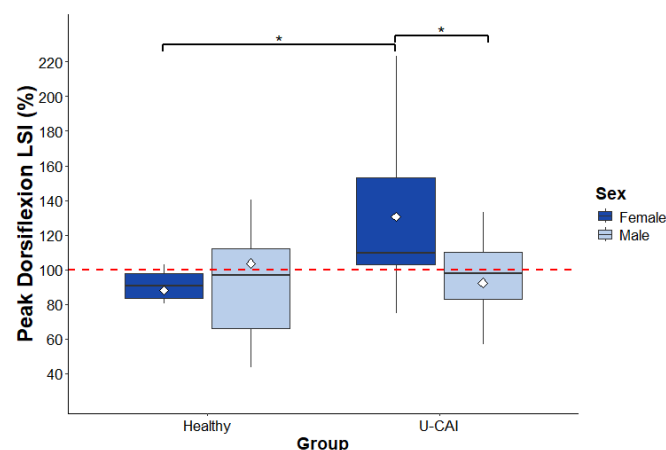


Figure 1: Peak dorsiflexion LSI differences between sex and group. The red dashed line indicates 100% LSI. The white diamond indicates the sample means. *Significant differences ($p<0.05$).

Conclusions

Females with U-CAI had more asymmetric peak dorsiflexion angles than U-CAI males and healthy females during a HTS task. Future investigation is needed to determine if differences persist in a large participant sample.

Acknowledgments

This work was supported by The Office of the Assistant Secretary of Defense for Health Affairs, through the Peer Reviewed Orthopaedic Research Program under Award No. W81XWH-22-1-0664. Opinions, interpretations, conclusions, and recommendations are those of the author and are not necessarily endorsed by the Department of Defense.

References

- [1] Kotsifaki et al. (2022). *Br J Sports Med*, **56**: 490-498.
- [2] Heebner et al. (2015). *Gait Posture*, **41**: 535-539.