Controlling Ankle Motion During Sideways Landings Using an External Ankle Brace

D. Clark Dickin[1], Cole Geschwender[1], Hannah Bradshaw[1], Dylan Rumpke[1], Henry Wang[1]
[1]Biomechanics Laboratory, Ball State University, Muncie, Indiana, USA
Email: dcdickin@bsu.edu

Summary

External ankle braces (EAB) have been previously used to restrict ankle motion and reduce injury risk for military personnel during parachute landings, however, their design limited sagittal plane motion potentially altering natural gait. Using an EAB permitting sagittal plane motion, participants performed sideways drop landings across three heights. The EAB significantly reduced frontal and transverse ankle motion across various heights without influencing motion up the kinetic chain. Findings indicate that while the EAB controlled non-sagittal plane ankle motion, motion was not translated proximally.

Introduction

Ankle braces are known to restrict motion [1] and have been used by military personnel to mitigate injury risk during parachute landings [1,2]. While external ankle braces (EAB) may help to protect the ankle, the paratrooper needs to remain mobile following the landing and thus not have restrictions in plantar/dorsiflexion movements. It is also important to ensure that motion is not translated proximally and increasing injury risk at other joints. Assessing knee and ankle motion across various landing heights will provide valuable insight into the efficacy of an EAB in controlling ankle motion and ultimately play a role in injury prevention.

Methods

Twenty-two young adults (23.77 ±3.29 years) performed 3 drop landings in cross-training shoes (SHOD) and with cross-training shoes and EAB (TayCo AthleticX Brace, LLC) across 3 landing heights (20, 40, & 60 cm) randomized across separate days. Participants performed three sideways drop landings from each height and landed with feet apart at impact. Motion capture was used to calculate lower extremity kinematics using a modified plug-in gait marker set.

Results and Discussion

Significant differences were revealed across all three landing heights for sagittal plane knee motion and all three planes of ankle motion (*Table 1).* The effect of the EAB on landing revealed significant differences (*) for frontal and transverse plane ankle motion (*Figure 1).* No differences were revealed at the knee and no interaction effects were observed between the brace and the landing height.

Findings from the study indicated that while there was an incremental effect of height on ankle and knee motion, the EAB was able to significantly reduce ankle inversion/eversion and rotational motion, without significantly altering plantar/dorsiflexion or knee motion during the landings. An external ankle brace that allows for sagittal plane motion may be preferable, as the gait pattern will remain seemingly natural when compared to other, more restrictive braces.

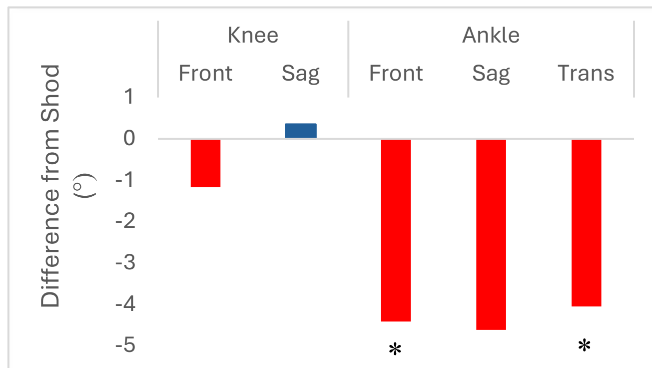

Figure 1: Percent differences in joint motion between Shod & EAB

Conclusions

The present study indicates that the EAB successfully reduced ankle inversion/eversion and rotational motion without altering joint motion up the kinetic chain. It is possible that the EAB can assist in injury mitigation through frontal and transverse ankle motion restriction without changing knee and hip kinematics when dropping from a height and landing sideways with feet apart.

Acknowledgments

Partial support for the study was provided by TayCo Brace LLC and Department of the Air Force AFX23E-PTCSO1

References

[1] Schmidt MD et al. (2005). *Inj. Prev.* **11**:163-168.
[2] Whitting JW et al. (2007). *Aviat Space Environ Med*, **12**: 1135-1142

Table 1: Maximum knee and ankle joint motion during drop landings across three landing heights (Bold indicates height sig. p≤0.05)

	Front_Knee			Sag_Knee			Front_Ank			Sag_Ank			Trans_Ank		
	20	40	60	**20**	**40**	**60**	**20**	**40**	**60**	**20**	**40**	**60**	**20**	**40**	**60**
EAB	4.59	3.96	4.09	47.83	59.12	66.40	6.16	8.14	10.20	96.78	99.86	103.23	21.93	21.23	20.56
Shod	5.18	5.27	5.69	50.84	60.47	67.61	9.59	12.61	15.55	99.41	104.21	110.10	26.51	25.34	24.01