

PROPHYLACTIC ANKLE STABILIZERS AFFECT ANKLE BUT NOT KNEE OR HIP JOINT ENERGETICS DURING DROP LANDINGS

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INTRODUCTION

Lateral ankle sprains are one of the most common athletic injuries in sports involving jumping and landing. Many athletic coaches and trainers require their athletes to wear ankle support to reduce the risk of excessive inversion. However, the use of ankle stabilizers has been shown to restrict sagittal plane measures of dorsiflexion [3] with potential interference to the ankle's contribution of energy absorption. Recent changes in stabilizer design and materials are intended to provide support to the lateral ankle joint without restricting sagittal plane motion.

This study compared the effects of 4 ankle stabilizers on ankle, knee, and hip joint kinetics and energetics during soft and stiff landings. We hypothesized that wearing ankle stabilizers would alter the relative contribution of individual lower extremity joints to energy absorption.

METHODS

Sixteen female college students (age: 20.6 ± 1.0 y; ht: 1.66 ± 0.07 m; mass: 66.5 ± 10.8 kg) volunteered as participants. All were free of chronic or acute lower extremity injury for 6 months and were experienced in landing (volleyball or basketball).

Five soft and five stiff landings were performed in five bilateral ankle stabilizer conditions (no stabilizer, standard taping, lace-up boot, hinged boot, and stirrup style (total = 50 trials per subject)). Stabilizers and style conditions were randomized across participants. Participants performed two-legged landings off a 0.32m platform. The right foot landed fully on a force platform. Ankle, knee and hip joint moments of force and energetics were calculated using standard inverse dynamic techniques combining an optotrak system (200 Hz), force platform (1000Hz) and anthropometrics. Both

kinematic and GRF data were smoothed at 20 Hz [2]. Energy absorbed at a joint was calculated as the integral of the joint power time curve from initial contact until joint angular velocity = 0.

Each participant's five-trial mean value of the negative work at the ankle, knee and hip joints and the total work (\sum hip+knee+ankle) for each landing style/stabilizer condition was entered into a two-way repeated measures ANOVA ($\alpha=0.05$).

RESULTS AND DISCUSSION

Total work by the limb was, on average, ~ 2x greater in the soft landing conditions than in the stiff landing conditions (Table 1). Except for the hinged brace condition, total work was significantly decreased with ankle stabilization, but not to the extent of the change in landing style.

The amount of negative work at the ankle was greater in stiff than in soft landings. Work at the ankle was significantly reduced in all stabilizer conditions except for the hinged brace compared to the non-stabilized condition (Figure 1 & Table 1).

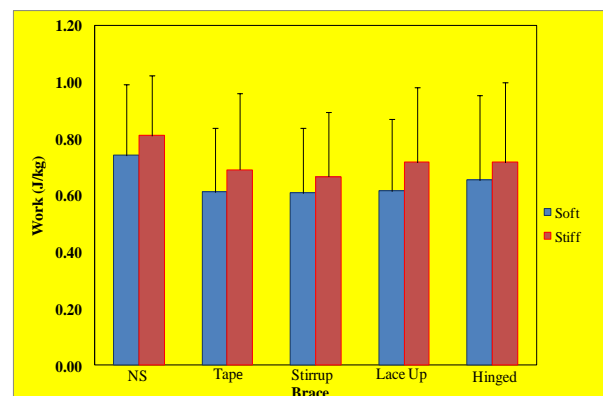


Figure 1: Negative work at the ankle joint.

There was a significant brace by style interaction at the knee for negative work. Knee work in the tape support was significantly less than the no support

condition, but only during soft landings. There was a main effect of style but not stabilizer at the hip (Table 2).

landings, the relative ankle contribution to total work was approximately double. However, in stabilized conditions, the relative contribution of the ankle joint was reduced relative to the no stabilizer condition. When stabilized, the ankle performed about 3.4% less work than the non-stabilized condition in the soft landing and about 6.3% less work than the non-stabilized condition in the stiff landing (Table 1). There was not a consistent increase in work at the knee or hip to make up for the reduced negative work at the ankle.

CONCLUSIONS

Despite changes in the materials and design, the use of ankle stabilizers adversely affects energy absorption by the ankle during drop landings. This supports our hypothesis that wearing ankle stabilizers would alter the relative contribution of individual lower extremity joints to energy absorption.

REFERENCES

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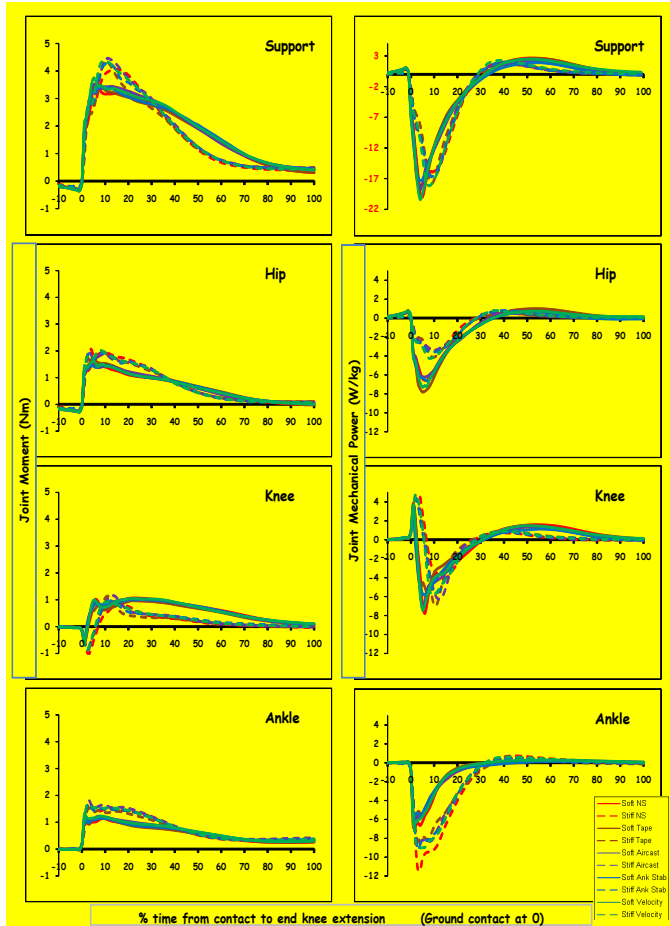


Figure 2: Grand ensemble (mean only) joint moments and powers for the stabilizer/landing style conditions.

Although the moment and power time-curves of our data differ from [2], most likely because of data-smoothing differences [1], the relative contribution of the joints still differed between soft and stiff landings, as in [2]. Although the negative work at the ankle was $\sim 8 \text{ J}\cdot\text{kg}^{-1}$ greater in stiff than soft

Table 1: Means and SDs of work and relative joint contribution to total work by the leg during landing

Impact Phase Powers	NS		Tape		Stirrup		Lace Up		Hinged	
	Soft	Stiff	Soft	Stiff	Soft	Stiff	Soft	Stiff	Soft	Stiff
Total Work	-2.61 ± 0.44 100.00%	-1.41 ± 0.21 100.00%	-2.44 ± 0.45 100.00%	-1.35 ± 0.28 100.00%	-2.42 ± 0.59 100.00%	-1.32 ± 0.34 100.00%	-2.58 ± 0.41 100.00%	-1.38 ± 0.24 100.00%	-2.55 ± 0.52 100.00%	-1.39 ± 0.28 100.00%
Work at Hip	-1.03 ± 0.49 39.28%	-0.29 ± 0.15 20.55%	-1.16 ± 0.51 47.37%	-0.32 ± 0.15 24.16%	-1.01 ± 0.57 41.56%	-0.29 ± 0.16 21.96%	-1.10 ± 0.51 42.79%	-0.32 ± 0.12 23.25%	-1.09 ± 0.52 42.95%	-0.33 ± 0.16 23.37%
Work at Knee	-0.85 ± 0.39 32.37%	-0.30 ± 0.16 21.88%	-0.67 ± 0.26 27.61%	-0.33 ± 0.13 24.72%	-0.81 ± 0.32 33.27%	-0.36 ± 0.19 27.41%	-0.86 ± 0.30 33.31%	-0.34 ± 0.15 24.68%	-0.80 ± 0.34 31.35%	-0.35 ± 0.10 25.34%
Work at Ankle	-0.74 ± 0.25 28.34%	-0.81 ± 0.21 57.56%	-0.61 ± 0.23 25.01%	-0.69 ± 0.27 51.13%	-0.61 ± 0.23 25.16%	-0.66 ± 0.23 50.64%	-0.62 ± 0.25 23.90%	-0.72 ± 0.27 52.07%	-0.65 ± 0.31 25.70%	-0.71 ± 0.28 51.29%

Mean and SD values are calculated from individual trials for each subject; work values are in $\text{J}\cdot\text{kg}^{-1}$