ANKLE BRACES MODIFY ANKLE POSITION AND KNEE MOMENTS AT IMPACT IN FEMALE ATHLETES

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INTRODUCTION
Wearing ankle braces reduces the incidence of ankle injuries by restricting the ankle joint position [1], specifically at the instance of impact. Several studies have examined the effect of bracing on the mechanics of the ankle, but little research has been done examining the associated biomechanical changes at the knee [2,3]. Although ankle injuries are common to both genders, females are at an increased risk for knee injuries than males [1]. The purpose of this study was to examine the effect of ankle braces on ankle kinematics, knee moments and joint stiffness during the impact phase of a drop jump in elite female athletes.

METHODS
Eight Canadian Interuniversity Sport (CIS) female basketball athletes were recruited for this study (age: 21.38 ± 2.23 years (mean ± SD), height: 171.5 ± 6.1 cm, mass: 67 ± 7.1 kg and 4.0 ± 1.3 years of CIS level experience). Each participant performed single legged forward jumps. For each jump, the participants dropped forward from a height of 30 cm, landed on their dominant leg and then jumped forward in a continuous motion. Each participant performed 10-15 jumps with and without ankle braces while wearing standard team running shoes. In the braced condition, participants wore identical lace-up ankle braces sized for them (ASO, Medical Specialties Inc., Charlotte, NC, USA). All braces were new. All participants were familiar with wearing this type of brace and did so regularly for all their practices and games.

Lower-body 3D kinematics were collected using an 8 camera motion capture system (F-20, Vicon Motion Systems, CO, USA, SR: 200 Hz) and ground reaction forces during the landing were synchronously recorded with a force platform (OR6-7, AMTI, Watertown, MA, USA, SR: 2000 Hz). Ankle kinematics of the jumping limb were obtained at the instance of touchdown. Inverse dynamics techniques were used to calculate knee moments. Ankle and knee stiffness values were obtained by calculating the first derivative of the joint moment-angle curve. Peak knee moments as well as sagittal ankle and knee stiffness values were calculated during the first 5% of ground contact. For each participant, data were averaged over 6 trials for each condition and two tailed paired t-tests were used to examine the main effect of brace with a significance level set at \( p<0.05 \).

RESULTS
Ankle brace application was associated with a significant mean difference in ankle position at impact, displaying an increase in ankle inversion of 3.32°, and as well as decreased plantarflexion of 5.34°. The ankle also displayed a shift from internal rotation at impact to an externally rotated position at impact, a shift of 4.64° (Table 1). Brace application was also associated with a significant change in knee moments at impact, including a 0.14 Nm/kg increase in knee abduction moment and a 0.48 Nm/kg increase in knee extension moment (Table 1). The ankle brace displayed a significant increase in sagittal plane stiffness (Control: -4.28 N·m/°, Brace: -4.85 N·m/°) at the ankle joint during impact, however, no associated changes in sagittal plane knee stiffness were observed.

DISCUSSION & CONCLUSIONS
Our current data indicates bracing has a significant ability to alter both the ankle joint kinematics and the knee joint moments at impact. We speculate that the change in ankle position, which occurs prior to impact, is caused by the increased ankle stiffness observed with the brace application. The added stiffness of the brace decreased plantarflexion and positioned the foot into an externally rotated position, a mechanism thought to reduce strain on the lateral ankle ligaments. However, the observation of increased ankle inversion (potential for increased lateral ligament injury) has not been previously reported within the brace literature. The observed changes in knee moments have the potential to increase injury risk. Specifically, increases in knee extensor and abduction moments are thought to increase strain on the anterior cruciate ligament. Clinically, this research provides new insights into how ankle braces affect highly trained athletic female populations with respect to ankle and knee dynamics at impact and offers information regarding the risk and reward involved with brace application decisions.

REFERENCES

| Table 1: Ankle position and knee moments occurring at impact for the brace and control conditions [mean (SD)] |
| --- | --- | --- | --- | --- | --- |
| | Frontal Plane | Sagittal Plane | Transverse Plane |
| Dependant Variable | Control | Brace | Control | Brace | Control | Brace |
| Ankle Position (Degrees) | -4.30 (4.68)* | -7.62 (5.78) | 20.42 (3.90)* | 15.08 (3.41) | -0.93 (2.36)* | 3.71 (1.95) |
| Knee Moment (Nm/kg) | 0.42 (0.21)* | 0.56 (0.18) | -2.06 (0.57)* | -2.54 (0.50) | -0.08 (0.07) | -0.04 (0.06) |

* Indicates significant difference between Brace and Control conditions