EFFECTS OF FUNCTIONAL ANKLE INSTABILITY ON ANKLE JOINT COMPLEX MOMENTS DURING A LATERAL HOP MOVEMENT

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INTRODUCTION

Ankle joint complex (AJC) injuries are common during sports and activities (Garrick, 1977). Following an AJC injury, many patients are classified with functional ankle instability (FAI), with increased predisposition to re-injury (Ekstrand & Gillquist, 1983; Freeman et al., 1965). Many studies have suggested that impaired proprioception and/or motor control might be important factors (Bahr et al., 1994; Freeman, Dean & Hanham, 1965; Robbins et al., 1997). A possible mechanism of FAI is that individuals may experience different AJC moments during tasks that are commonly associated with injuries. The purpose of the current study was to assess AJC moments in persons with FAI versus normals during a lateral hop movement.

METHODS

**Subjects:** Two groups: 1) Normal—No prior AJC injuries (n=6) and 2) previously injured subjects (n=6) with functional ankle instability. FAI was defined as two or more AJC sprains or one AJC sprain with chronic symptoms such as pain and/or instability, with no AJC fracture or surgery. No AJC sprain for at least 3 months. No other lower extremity injury that required surgery or prolonged rehabilitation. All subjects signed an informed consent and the Conjoint Health Research Ethics Board of the University of Calgary approved the study.

**Instruments:** Two force platforms (Kistler, 9286, Winterthur, Switzerland and AMTI, OR6-5, Watertown, MA) recorded kinetics at 1200 Hz during the lateral hop movement. In addition, kinematics and muscle activity were recorded with eight cameras integrated with a motion analysis system and electromyography. Only ankle joint complex moments are presented here.

**Design:** Cross-sectional, observational, data collection during the task.

**Task:** The lateral hop movement consisted of multiple lateral-medial hops over an obstacle (width 72.5cm, depth 25.5cm, height 14.3cm) onto adjacent force platforms.

**Procedure:** Each subject was instructed to perform as many lateral hops as possible during the 6-s trial. At least 15 trials were recorded for each leg. The middle 5 trials were used for analysis to minimize a learning effect and/or fatigue.

**Outcome Measures:** Impact AJC moments (IM) and maximal AJC moments (MM) during contact of the lateral hop movement. The IM was the first peak within 5 ms and 50 ms of ground contact. MM was the maximal moment following the IM. The external moments were expressed with respect to adduction, dorsiflexion, and inversion directions to simplify their interpretation.

**Data and Statistical Analysis:** Raw force plate data were processed for the lateral hop movement, and the AJC moments were calculated (EVA V5.00 and Kintrak-V6.2.2, Motion Analysis Corp., Santa Rosa, CA). Means and standard deviations were calculated for each outcome measure in the medial and lateral directions.

RESULTS

Table 1 includes the impact AJC moments. Data were not included if an IM did not occur in at least 50% of the lateral hops for that subject.

<table>
<thead>
<tr>
<th>AJC Moment</th>
<th>Lateral Direction</th>
<th>Medial Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FAI</td>
<td>Normal</td>
</tr>
<tr>
<td>Dorsiflexion</td>
<td>-1.6 (0.9)*</td>
<td>-0.7 (0.6)</td>
</tr>
<tr>
<td>Inversion</td>
<td>0.7 (0.7)</td>
<td>0.7 (0.3)</td>
</tr>
<tr>
<td>Abduction</td>
<td>-0.3 (0.2)</td>
<td>-0.5 (0.2)</td>
</tr>
</tbody>
</table>

* Mean (SD); Units: N-m kg⁻¹

**DISCUSSION**

Potentially, disrupted AJC control mechanisms affect FAI. The increased predisposition of AJC injuries associated with FAI raised the possibility of having altered AJC moments during tasks that have increased risk for injury. AJC position at the time of injury has been most commonly ankle joint plantarflexion, subtalar joint inversion, and external rotation of the tibia on the fixed foot while moving laterally. Therefore, the ability to minimize the AJC moments in the plantarflexion, inversion, and addition direction during lateral activities may be affected with FAI. It was hypothesized that greater AJC moments may be responsible for the chronic AJC symptoms and increased injuries associated with FAI. Moving laterally, there were trends in the results that the AJC impact dorsiflexion moments and maximum inversion moments were higher in the FAI group. While moving medially, the AJC impact dorsiflexion moments and maximal inversion moments were higher in the FAI group. These results suggested that altered AJC impact and maximal moments in each of the directions may be related to an increased risk of injury, but more data will be needed to confirm these preliminary findings.

In conclusion, differences were observed in the AJC impact and maximal moments in the medial and lateral directions during a lateral hop movement. Further analysis, with more subjects, will determine if the observed differences are statistically and clinically important. In the future, combining the AJC moments with other outcome measures, including ground reaction forces, kinematics, and EMG during the lateral hop movement would further elucidate altered control mechanisms of FAI.

**REFERENCES**


**ACKNOWLEDGEMENTS**

**Funding:** Alberta Provincial CIHR Training Program in Bone and Joint Health, University of Calgary Sport Medicine Centre Markin Endowment, Wood Professorship in Joint Injury Research, Canada Research Chair, Canada Foundation for Innovation.