Dynamic Postural Stability Deficits Exist in Mechanically Lax Individuals but not those with Perceived Functional Ankle Instability

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INTRODUCTION

Lateral ankle sprains are among the most frequent athletic injuries. Lateral ankle sprains have been reported to recur at a rate in excess of 80%, and chronic ankle instability (CAI) is a frequent and serious pathologic consequence of sprains that develops in up to 50% of those with a history of ankle sprain [1]. These individuals often present with feelings of “giving way” and reports of sudden instability, which are characteristic of CAI. Contributing factors to CAI are debated, but contemporary theories include failure of the dynamic restraint mechanism resulting from proprioceptive deficiencies and/or excess mechanical ligamentous laxity [2]. The purpose of this study was to determine if differences exist in dynamic postural stability among healthy controls, copers, functionally unstable ankle individuals, and those with both functional instability and mechanical ankle laxity.

METHODS

A total of 93 individuals participated in this study. Participants were physically active and participated in at least 90 minutes of physical activity per week. Subjects were considered to have Functional Ankle Instability (FAI) with a history of mild to moderate ankle sprain at least 12 months before the study that required immobilization or non-weight bearing status for 3 days and the Cumberland Ankle Instability Tool (CAIT) score of ≤ 26, indicating poor function [3]. Subjects were included in the mechanical laxity group (MAI) using the same criteria as the FAI group plus mechanical laxity as indicated by an instrumented arthrometer (LigMaster Version 1.26, Sport Tech, Inc, Charlottesville, VA). MAI subjects’ were considered mechanically lax with ≥29.4° of inversion based on previous literature [4]. Inclusion for ankle sprain copers included a history of ≤2 ankle injuries and a CAIT score of ≥ 28, indicating good function. Healthy controls had no history of ankle injury, and had CAIT scores of 29 or 30, indicating excellent function [3].

Participants completed the University’s Institutional Review Board approved consent document prior to participation, and then completed ankle injury history and CAIT questionnaire documents. Participants were assessed for their maximal vertical jump height using a Vertec© jump trainer (Sports Imports, Columbus, OH), which was then set to 50% of that maximum as a target height. For the test trials, participants jumped off 2 legs at a distance of 70cm from a forceplate. Participants raised one arm to touch the target height, land on the test leg, and tried to "stick the landing," balancing for approximately 5 seconds after the landing [5]. Both limbs were tested in a randomized order.

Ground reaction force (GRF) data were transferred and reduced in MatLAB (version 7.0; the MathWorks, Natick, MA). Ground reaction forces were scaled to body weight. The first 3 seconds of data after initial ground contact (>10N) were analyzed. Stability index scores were calculated for anterior-posterior (APSI), medial-lateral (MLSI), vertical (VSI), and composite (DPSI), stability indices, according to previously established calculations [5]. Stability indices capture the ability to transition from a dynamic to a static state, which is important in sports and can be a possible mechanism of injury.

One-way ANOVA’s (α<0.05) were conducted on each of the stability index scores among the four groups. When significant differences among the
groups were found, Tukey’s post-hoc tests (α<0.05) were utilized to identify specifically where differences were seen.

RESULTS AND DISCUSSION

A summary of demographic data and dependent variable can be seen in Table 1. Significant differences were seen among the groups in the MLSI (F=3.438, p=.020) and DPSI (F=3.162, p=.029) variables. Specifically, for MLSI measures follow-up tests showed the MAI group had significantly higher (worse) scores than the coper group (p=.018). In DPSI composite (Figure 1), the MAI group had higher (worse) scores compared to both coper (p=.038) and FAI (p=.040) groups.

![Figure 1: Composite Dynamic Postural Stability Index Among Each of the Four Groups (* Denotes Significant Tukey’s Post-Hoc Test p<0.05)](image)

The results demonstrate those who suffer from both mechanical and functional ankle instability have worse dynamic postural stability, compared to copers who have a history of ankle sprain but no complaints of instability. This seems particularly true in the medial-lateral GRF component. Cadaveric studies have demonstrated excess anterior tibial translation, internal rotation and supination when the anterior talofibular ligaments and calcaneal fibular ligaments are severed [6]. This alteration in range of motion may cause subsequent functional imbalances in those with mechanical ankle laxity. The results also indicate those who perceive they have deficiencies in functional tasks via self-reported questionnaires perform comparatively to both ankle sprain copers and healthy subjects. This finding is especially important, and may provide greater rationale for dichotomizing FAI and MAI groups in prospective investigations. It is interesting to note that the healthy controls were not significantly different compared to the MAI group, although they were trending in the same direction as the other results. We believe this may be attributed unequal sample sizes and insufficient power.

CONCLUSIONS

Mechanically lax subjects exhibit dynamic postural deficits compared to those with a previous history of ankle sprains. Future studies may warrant separation of mechanically lax subjects from the larger pool of CAI subjects.

REFERENCES


<table>
<thead>
<tr>
<th>Gender (M/F)</th>
<th>Age (yr) ± SD</th>
<th>Height (cm) ± SD</th>
<th>Mass (kg) ± SD</th>
<th>CAIT ± SD</th>
<th>Ankle Sprain History ± SD</th>
<th>APSI ± SD</th>
<th>MLSI ± SD</th>
<th>VSI ± SD</th>
<th>DPSI ± SD</th>
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<td>Healthy</td>
<td>13/19</td>
<td>20.2±1.3</td>
<td>168.1±8.7</td>
<td>67.8±11.8</td>
<td>29.8±0.4</td>
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<td>Coper</td>
<td>13/4</td>
<td>22.1±4.1</td>
<td>175.8±10.5</td>
<td>75.3±12.9</td>
<td>29.0±1.1</td>
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<td>0.11±0.02</td>
<td>0.24±0.20</td>
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<td>FAI</td>
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<td>20.2±5.1</td>
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<td>MAI</td>
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<td>168.7±8.4</td>
<td>68.9±13.1</td>
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<td>0.11±0.04</td>
<td>0.57±0.62</td>
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Note: Bold indicates significant difference among groups (α<0.05)