Ground reaction force data in basketball players with functional ankle instability.
A comparison between stable and unstable ankles during cutting movements

Dayakidis Michael, Boudolos Konstantinos
Sports Biomechanics Laboratory, Department of Sports Medicine and Biology of Exercise, Faculty of Physical Education & Sports Science, University of Athens, Greece

Introduction
Functional instability (FI) of the ankle joint is often the outcome of acute ankle sprains, a very common injury in basketball. Patients with FI complain for recurrent injuries with lateral ankle pain and face difficulties in sports and daily activities. Sprain of the lateral ligaments of the ankle may occur during quick cutting movements where the mediolateral (Fml), ground reaction force (GRF), component causes rapid inversion of the foot. Previous studies have provided information regarding the force characteristics in healthy basketball players (McClay et al 1994), and noticed the importance of muscle coordination in cutting movements (Neptune et al 1999), but no research was found in players with ankle instability. The purpose of this study was to examine whether basketball players with unilateral FI exhibit altered patterns of GRF associated with two cutting movements when using the unstable ankle, comparing with contralateral uninjured side and control joints of healthy individuals.

Methods
Fifteen male basketball players (1.92±0.05m, 92.6±11Kg), with self reported unilateral FI and seventeen age, height and basketball level matched controls, performed 3 v-cuts and 3 defensive side shuffles on 2 synchronised force platforms (Kistler, 9281B11&9681A), on a specially built floor apparatus. 3D GRF data was collected with BioWare software. Both ankles were tested and 3 experimental groups were formed: i) unstable ankles (group U=15 subj.), ii) unaffected contralateral ankles of FI players (group UC=15) and iii) healthy control ankles (group C= 34). Peak values for nine selected variables submitted to a one-way ANOVA for independent groups to test differences between groups. Paired t-test was used to examine differences within FI players, comparing stable and unstable ankle joint.

Results
Unstable ankles (U), had significantly greater first vertical force peak (Fv1), than group UC and lower relative time to peak (tFv1), than controls (C), during v-cut movement (fig.1&2). Inverting mediolateral force values (Fml) were similar in all groups. No significant differences were seen in GRF variables during lateral shuffling, when comparing FI ankles with contralateral uninjured sides and controls. Within FI players, in paired comparison, unstable ankles had significantly greater Fv1 (+0.79 BW), during v-cut, than the contalateral unaffected joints (table 1). No differences were found between UC and C joints in both cutting movements.

Table 1: Paired comparison. Mean differences unstable - contralateral unaffected ankles.

<table>
<thead>
<tr>
<th>Variable</th>
<th>v-cut</th>
<th>shuffle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fv1 (%BW)</td>
<td>+0.790 **</td>
<td>+0.038</td>
</tr>
<tr>
<td>Fv2 (%BW)</td>
<td>+0.210</td>
<td>+0.060</td>
</tr>
<tr>
<td>Fml1 (%BW)</td>
<td>+0.058</td>
<td>+0.055</td>
</tr>
<tr>
<td>Fml2 (%BW)</td>
<td>+0.053</td>
<td>+0.021</td>
</tr>
<tr>
<td>tFv1 (ms)</td>
<td>-5</td>
<td>-7</td>
</tr>
</tbody>
</table>

(**): significant difference (p≤0.01)
(+): higher value in unstable ankle
(-): higher value in contralateral unaffected ankle

Discussion/Conclusion
Altered force patterns in the vertical component of GRF were observed in ankles with FI during v-cut maneuvers. Unstable ankles demonstrated a rapid onset of high vertical GRF during the first ms post-impact, while the medial GRF was unchanged. Although the increased vertical forces are considered predisposing factors to repeated injury, this finding is likely a neuromuscular response making the ankle joint more stable avoiding excessive inversion forces. Further research with EMG and 3D motion analysis is needed to accurately describe the biomechanics of the unstable joint in cutting movements.

References