Altered neuromuscular function during postural control in unstable ankles and copers

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INTRODUCTION
Ankle sprains are common injuries that often transpire during physical activity, and often lead to CAI (1). The star excursion balance test (SEBT) is one of the most commonly used tests to measure neuromuscular deficits for CAI compared to healthy by utilizing maximal reach distance.

An electromyogram (EMG) has been used to explain the reach distance deficits among the CAI and coper populations compared to healthy. Only one study (2) has looked at the three populations while using an EMG during the SEBT but, only measuring the peroneal longus (PL) and tibialis anterior (TA) activation in the PL direction. However, there have been no studies to measure the muscle activation for the medial gastrocnemius (MG), PL, and TA among the three populations during the A, PM, and PL directions of the SEBT.

METHODS
60 subjects participated. (20 CAI; (169 ± 9 cm, 73 ± 11 kg, 22 ± 2 yr, 20 Coper; (170 ± 9 cm, 72 ± 15 kg, 23 ± 2 yr, 20 healthy; (168 ± 8 cm, 66 ± 12 kg, 22 ± 3 yr). Each participant performed a 5 minute warm-up on a stationary bike. Subjects then performed the SEBT in first the A then either the PM, or PL directions. This was performed 3 times beginning with and A direction and counterbalancing the other directions. Maximum reach distance (MRD) was measured and normalized by the subjects’ leg length. Mean amplitudes (MA) for each muscle were also calculated and normalized by the recorded MVIC in each direction of each subject.

Separate two-way analyses of variance (ANOVA) for normalized MRD (NMRD) and normalized MA (NMA) of TA, PL, and MG were calculated to investigate group effects (healthy, coper, CAI) and direction effects (A, PM, PL). Post-hoc comparisons using Fisher’s Least Significant Difference were performed to assess specific difference when there was a significant difference among population groups or direction groups.

RESULTS AND DISCUSSION
Table 1 displays the results. There was a significant interaction for NMRD(F2,171=3.60, p=0.01) in only PL direction. Post hoc comparisons revealed that coper has greater NMRD than both healthy(p=0.00) and CAI(p=0.01), and healthy is also greater than CAI(p=0.01). There were main group effects for NMAs of TA(F2,171=4.93, p=0.01), of PL(F2,171=12.59, p=0.00) and of MG(F2,171=10.64, p=0.00).

EMG mean amplitude for TA activation showed that CAI and healthy were greater than coper in the PL and PM directions compared to A direction. This may be caused by the increased strength and range of motion in dorsiflexion. EMG results for PL activation showed that both CAI and coper were greater than healthy. As expected from the mechanism of an ankle sprain, damage to the PL leads to decreases in eversion strength. Thus, PL activation must increase to compensate. EMG results showed that MG activation was greatest in CAI compared to coper and healthy in the A and PL directions but, not the PM direction. From the decreased dorsiflexion, the foot is in a more plantar-flexed position which leads to more MG activation.

Our study demonstrates a greater NMRD for coper than healthy, conflicting with previous recorded results from other studies showing no difference between coper and healthy. Coper may have developed a coping mechanism that allows them to develop more strength after an injury, and also prevents them from developing CAI. Healthy individuals never sustain an injury so their bodies do not need to recruit more motor neurons to help compensate for potential deficits. This recruitment mechanism may allow coper to perform the SEBT better than healthy.

CONCLUSIONS
Copers are able to perform the SEBT better than healthy and CAI. Because of their history of injury, copers have developed a coping mechanism strategy for the TA, MG, and PL muscles compared to healthy during MRD of the SEBT.

REFERENCES

Table 1: Normalized reach distance and mean amplitude for TA, PL, and MG among the three populations in the A, PL and PM directions

<table>
<thead>
<tr>
<th></th>
<th>Healthy</th>
<th>Coper</th>
<th>CAI</th>
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<tbody>
<tr>
<td></td>
<td>A</td>
<td>PL</td>
<td>PM</td>
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<tr>
<td>MRD</td>
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