ALTERED ANKLE JOINT POSITIONING DURING JUMP LANDING IN SUBJECTS WITH FUNCTIONAL ANKLE INSTABILITY (FAI)

[1]Eamonn Delahunt, [1]Kenneth Monaghan, [1]Brian Caulfield
[1]University College Dublin School of Physiotherapy, Republic of Ireland
eamonn.delahunt@ucd.ie

INTRODUCTION

FAI, a subjective feeling of ankle instability or, recurrent symptomatic ankle sprains (or both), has been reported to be the most common and serious residual disability following ankle sprains. Single leg landings from a jump are one of the frequent mechanisms of injury to the lateral ligament complex of the ankle joint. To date, there have been no thorough investigations into the kinetic and 3D kinematic patterns of subjects with FAI during jump landing. The purpose of this study was to undertake a comprehensive analysis, of the kinetic and 3D kinematic patterns associated with jumping landing in a group of subjects with FAI, with the aim of determining whether changes in the neural control of movement and dynamic stability of the ankle joint exist in the these subjects.

METHODS

Eleven subjects with unilateral FAI (8male, 3 female) and 13 control subjects (5 male, 8 female) volunteered to participate. Inclusion criteria in the FAI group were based on the criteria used by Caulfield and Garrett [1].

CODA mpx 30 infrared light emitting diodes were attached to the involved lower extremity in the FAI group and the left lower extremity in the control group and were used to provide information pertaining to 3D segment angular displacement and angular velocity. Ground reaction force was measured by a Bertec force-plate. Subjects stood 1m in front of a force-plate with the test leg relaxed and non-weight bearing. The subject then used the contralateral leg to propel him/herself from the start position to land on the test leg on the centre of the force-plate. A jump was deemed unusable if the subject required any form of correction following landing such as touching the floor with the non-test limb or correcting their position on the force-plate. Each subject performed 10 single leg jumps onto the force plate.

Average values for hip, knee and ankle joint 3D angular displacements and velocities were calculated for each subject. Group mean time averaged profiles (500ms pre initial contact (IC) – 500ms post initial contact) were calculated. Differences in FAI and control group time averaged profiles were tested for statistical significance using independent two-sided t-tests. Magnitudes and timing of peak medial/lateral, anterior/posterior and vertical forces were identified for each jump and individual and group mean profiles subsequently calculated. One-way ANOVA was used to test for significant differences in timing and magnitude of peak forces. Furthermore, magnitudes of medial/lateral, anterior/posterior and vertical components of GRF were averaged over time following initial contact for each subject and group mean profiles were calculated. Differences in FAI and control group time averaged profiles were tested for statistical significance using independent two-sided t-tests. The level of significance was set at $p<0.05$ for all analyses.

RESULTS AND DISCUSSION

FAI subjects exhibited a significant increase in ankle joint supination during the period 70ms pre IC to 30ms post IC ($p<0.05$). They also exhibited a significant increase in knee joint flexion from the time period 95ms pre IC to 5ms post IC ($p<0.05$). No statistically significant differences were noted for angular velocities during these times ($P>0.05$). No statistically significant differences in the timing, magnitude or time averaged profiles for any of the components of GRF were noted post IC ($P>0.05$).

Prior to IC with the ground, the process of neuromuscular preparation for the subsequent ground contact is essential to the stability of the ankle joint [2]. Inappropriate positioning of the ankle joint prior to IC could increase the potential for injury. Following IC, the line of action of the GRF is dependent upon the position of the foot in relation to the centre of gravity and inertia [2]. If the ankle joint is held in a more supinated position when IC occurs, an external inversion load is placed upon the ankle joint, thus increasing the potential for a hyperinversion injury.

If the evertor musculature of the ankle joint cannot counteract this external inversion load or if a poorly executed landing occurs, hyperinversion and subsequent injury to the lateral ligament complex of the ankle joint is likely to occur.

CONCLUSION

The disordered positioning of the ankle joint observed in subjects with FAI is likely to result in repeated injury to the chronically unstable ankle, due to the potentially injurious external inversion load created by an excessive supinated position of the ankle joint upon IC.

REFERENCES

1. Caulfield B, et al.. Clin Biomech **19**, 617-621, 2004.
2. Tropp H. J Athl Train **37**, 512-515, 2002.

ACKNOWLEDGEMENTS

This study was supported by the Irish Research Council for Science, Engineering and Technology.