ASSOCIATIONS OF NAVICULAR DROP MEASURES WITH LOWER-LIMB DYNAMICS DURING STANCE PHASE OF RUNNING

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INTRODUCTION

There are conflicting evidences on whether navicular drop measure, is a predisposing factor for lower-limb injuries. It was suggested that navicular drop could increase medial stresses on the knee and ruptured the anterior cruciate ligament [1]. DeLacerda, [2] reported that a navicular drop of 8.9 mm led to shin splints while one of 12.9 mm predisposed the anterior cruciate ligament in runners [3]. Though these findings suggest a link between navicular drop and lower-limb running injuries, there is, little evidence to suggest association of navicular drop with the abnormalities in lower-limb dynamics parameters by which running injuries could occur. We hypothesized that there are relationships between navicular drop measures and a) maximum magnitude of rearfoot eversion, and tibial internal rotation, (b) peak ankle inversion moment, (c) peak adduction moment during the stance phase of running.

METHOD

Sixteen able-bodied men volunteered. The navicular drop was measured using the method proposed by Loudon et al. [4]. For the measurement of kinematics and kinetics parameter, rearfoot and tibia were modeled as two rigid segments. Nine reflective skin markers, 16 mm in diameter, were attached to the right foot and tibia. Six cameras (Motion Analysis Corporation, Santa Rosa, USA) were arranged along two arcs on the left and right sides of a force plate (960Hz, AMTI, Model OR6-5) placed in the middle of a 10 m runway. Ten running trials were performed in a barefoot condition. Subjects ran at a cadence of 170 steps per minute controlled by means of a metronome. Three-dimensional joint rotations were calculated according to Grood and Suntay (1983) and segment inertial parameters were obtained from the adjustments to Zatsiorsky-Seluyanov's parameters as outlined by De Leva (1996). A Newton-Euler inverse dynamics approach was applied to calculate ankle and knee moments. Pearson coefficients with simple linear regression analysis was performed to determine whether the rearfoot and tibia rotation angles as well as ankle and knee joint moments correlated to the navicular drop measure.

RESULTS

The level of correlation between navicular drop measure and tibial internal rotation magnitude was significantly correlated ($r=-0.53$, $p=0.01$) but not to rearfoot eversion magnitude ($r=-0.19$; $p=0.23$). These findings explain in part that high tibial internal rotation could contribute to low navicular drop measure during the stance phase of running. Finding suggests that 28% of the variability in the tibial internal rotation could be explained by variance in the navicular drop measure variable.

Significant positive correlations were found between navicular drop both peak adduction moment at the knee ($r=0.62$, $p<0.05$) and peak ankle inversion moment ($r=0.60$, $p<0.05$). Results show that high adduction knee moment and ankle inversion moment could be associated with high navicular drop measure during stance phase of running. Navicular drop explained about 36% of the variability in the knee adduction and ankle inversion moments.

CONCLUSIONS

Low navicular drop measure could be a predisposing factor for increasing tibia rotation while high navicular drop measure is associated with increasing peak moments at the ankle and knee. These findings suggest a link between navicular drop measures and the type of abnormalities in lower-limb dynamics parameters.

REFERENCES

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