

SNOWBOARDER'S FRACTURE: CHANGING JOINT MECHANICS BY FOOT POSITION DURING A SIMULATED LANDING TASK

Uwe G. Kersting and Paul R. McAlpine

Department of Sport and Exercise Science, University of Auckland,
Auckland, New Zealand

INTRODUCTION: A high proportion of fractures to the lateral process of the talus (LPT) has been reported in snowboarding, which accounted for 34% of all ankle fractures (Kirkpatrick et al., 1998). A fracture to the LPT is an injury unique to snowboarders and is often misdiagnosed by physicians as an anterolateral ankle sprain. LPT fractures often involve the articular surface of the subtalar joint and it has been shown that misdiagnosis may lead to severe degeneration of the ankle joint and long term morbidity (Boon et al., 1999).

The mechanism of this injury has been studied intensively. LPT fractures are high impact injuries, landing after aerial manoeuvres is thought to be the major cause of LPT fractures (Boon et al., 1999). In a cadaver study no fractures to the LPT were recorded under purely dorsalflexed conditions but in six of the eight specimens fractures occurred with the addition of 20° external rotation. An axial load of 2200 - 8900 N was required to produce a fracture (LPT) in this position. It was proposed by Boon and colleagues that the subsequent 'opening' of the ankle joint seen with heel inversion and external rotation of the talus results in the lateral process shifting upwards on the posterior articular process of the calcaneus.

The purpose of this study was to simulate a snowboard landing in the laboratory with using an inverse dynamics approach to calculate effective joint loading for different binding alignments. It was hypothesised that the 'stance' chosen will affect loading and that an optimum foot alignment will help to minimise joint load.

METHOD: Ten experienced snowboarders participated in this study. Subjects were required to complete a simulated landing on a snowboard mounted upon two BERTEC force plates. Loading was provided by a weighted backpack worn by the subject and the movement task was designed to mimic landing an aerial manoeuvre as closely as possible. Three conditions were used in this experimental design. The conditions were defined by foot position on the snowboard, foot angles and the amount of 'forward lean' set on the achilles support located on the back of the binding. Five trials were collected for each condition. Standard Stance-standard setup used by many beginners and snowboard rental companies. 'Duck' Stance-a wide stance characterised by externally rotated feet.

'Duck' Stance with Forward lean-as duck stance with 'forward lean' set at binding 3D kinematic data was recorded using an EVA highres system (Motion Analysis). Twenty six reflective markers were affixed to bony landmarks on the lower extremities to define the foot, shank and thigh segments. A standard 158 cm snowboard was cut into two pieces and bolted to the force plates to allow correct simulation and freedom of adjustment of the bindings. Force data was recorded under each foot to allow the calculation of individual ankle joint forces. All inverse dynamic calculation was carried out using the Kintrak software (Version 6.0, Motion Analysis).

FINDINGS: Pilot data demonstrates changes in effective joint torques and forces of over 20% within subjects. These alterations vary considerably between individuals.

REFERENCES:

- Boon, A.J., Smith, J., & Laskowski, E.R. (1999). Snowboarding injuries: general patterns, with a focus on talus fractures. *The Physician and Sports Medicine*, 27(4), 94.
Kirkpatrick, D.P., Hunter, R.E., Janes, P.C., Mastrangelo, J., & Nicholas, R.A. (1998). The snowboarders foot and ankle. *The American Journal of Sports Medicine*, 19(2), 271-277.