ARTICULATED FIGURE SKATING BOOTS CAN REDUCE IMPACT FORCES

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INTRODUCTION

Overuse injury rates in the sport of figure skating have been escalating over the past few years. These rising rates of stress fractures, tendonitis, and cartilage damage are due to a combination of the increasing time that skaters spend practicing difficult multiple revolution jumps and the state of the current equipment. The stiff, above ankle leather skating boot that is used in figure skating severely restricts ankle motion and inhibits lower extremity shock absorption, magnifying the already high ground reaction forces seen in skating jump landings. An articulated skating boot may reduce high landing forces and loading rates by increasing muscular involvement and absorption time. The purposes of this study were to design a functional articulated figure skating boot and to test its effectiveness in allowing skaters to land with lower peak impact forces.

METHODS

Foot motion from 40 subjects was analyzed to determine two important parameters in the design of the articulated boot: 1) The ideal location for an ankle articulation that would constrain motion to the sagittal plane, and 2) the amount of anterior ankle skin movement that must be accounted for by the tongue of the boot during a full range of motion. These parameters were used by Jackson Ultima Skates, inc. (Waterloo, ON) to manufacture prototype articulated skating boots. Jumps from nine competitive figure skaters who trained in standard boots and in prototype articulated boots were then analyzed. Tests consisted of off-ice simulated jump landings onto a force plate and on-ice axels, double toe loops and double axels. A repeated measures ANOVA was used to determine significant differences (alpha=.05) in kinetic and kinematic variables between the two boot types.

RESULTS

Analysis of the off-ice simulated jump landings revealed a significant decrease in peak heel transient force ($p=0.047$), time between toe and heel strike ($p=0.025$), loading rate ($p=0.048$), and total lower extremity joint flexion ($p=0.036$) as well as significant increases in ankle ($p=0.032$) and boot contact angles ($p=0.006$) with use of the articulated boot. Analysis of the on-ice jumps did not reveal any consistent significant differences between boot types.

DISCUSSION

The off-ice results suggest that the increased ankle motion allowed in articulated skates can be successfully used to lower peak ground reaction forces and loading rates provided that the skater train the ankle musculature to act appropriately. These results did not translate to on-ice jumps in this study because the skaters did not make use of the articulation when jumping. Greater adaptation and training time in the articulated boots is likely needed to fully utilize the benefits of the articulation.