

THE INFLUENCE OF SOCCER CLEAT DESIGN ON ANKLE JOINT MOMENTS

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INTRODUCTION

Ankle joint injuries are very common in soccer and the most frequently occur in the lateral ligaments. There is evidence that high friction between shoe and surface is an important factor influencing ankle injury. Epidemiological studies have found that a greater torsional resistance between the shoe-surface interface is associated with greater prevalence of ankle and knee injuries in American football players (Blyth & Mueller, 1974; Lambson et al., 1996; Torg et al., 1971). In their studies, the risk of these injuries seemed to decrease if the rotational friction of the shoe-surface interface is reduced. However, the actual mechanism of injury is unknown. It was hypothesized that traction between shoe and surface influences joint moments and loads at the ankle. Thus, the purpose of this study was to investigate the influence of soccer cleat design on ankle joint moments.

METHODS

Twelve healthy recreational male soccer players participated in the study. Subjects performed a 45° medial cutting maneuver (V cut) after approaching the force plate at 4 ± 0.2 m/s. The right foot was planted on an infilled turf mounted force plate. Four different shoe conditions were collected and depicted in Figure 1: a) the Adidas “Supernova” running shoe; b) the Adidas “Copa Mondial” traditional soccer shoe (12 molded cleats: 4 on the heel with 1.2 cm tip diameter and 1.2 cm height, 8 cleats on the forefoot with 1.0 cm tip diameter and 1.0 cm height); c) the Adidas “World Cup” soccer shoe with six detachable aluminum cleats (2 on the heel with 0.9 cm tip diameter and 1.5 cm height and 4 on the forefoot with 0.9 cm tip diameter and 1.2 cm height; and d) the Adidas “Trx” multi-detachable cleated soccer shoe (9 blade type aluminum cleats : 2 on the heel with 1.6 cm height by 1.4 cm length and 0.5 cm width and 7 on the forefoot with 1.3 cm height by 1.1 cm length and 0.5 cm width).



Figure 1. Shoes used in this study from left to right: a) Adidas Supernova running shoe (“Nova”), b) Adidas Copa Mondial soccer cleat (“Copa”), c) Adidas World Cup soccer cleat (“World”), d) Adidas X-TRX Soft Ground soccer cleat (“Trx”).

Eight high speed cameras (Motion Analysis Corp.) were used to collect three-dimensional lower limb kinematics at 240Hz. Kinetic data were collected at 2400Hz with a Kistler force platform. Kintrak software program (Motion Analysis Corp.) was used to analyze both kinetic and kinematic variables. 8 trials for each shoe were collected and averaged. A repeated measure ANOVA with post hoc analysis was used to statistically compare differences between the four shoe conditions. An alpha level of $p < 0.05$ was used to determine significance.

RESULTS AND DISCUSSION

Significant differences between shoes were found for ankle plantar flexion moments. The Nova running shoe showed lower plantar flexion moments than the Copa ($p=0.001$) and the World Cup ($p=0.005$) cleats (Figure 2a). However, no other significant differences between shoes for ankle abduction and eversion moments were found.

The World Cup cleats tended to show higher ankle abduction moments than the two other soccer cleats and Nova running shoe (Figure 2b). Additionally, the decrease in the number of soccer cleats (Copa: 12, Trx: 9 and World: 6) tended to correlate with increased ankle abduction moments (Copa: 48.49 Nm, Trx: 50.97 Nm and World: 54.19 Nm). In the frontal plane, the Nova running shoe showed a trend towards higher ankle eversion moments than the three soccer cleats (Figure 2c). Furthermore, the increase in height of soccer cleats (Copa: front 1cm/heel 1.2cm, World: front 1.2cm/heel 1.5cm and Trx: front 1.3cm/heel 1.6cm) tended to correlate with increased ankle eversion moments (Copa: 50.15 Nm, World: 53.59 Nm and Trx: 54.50 Nm).

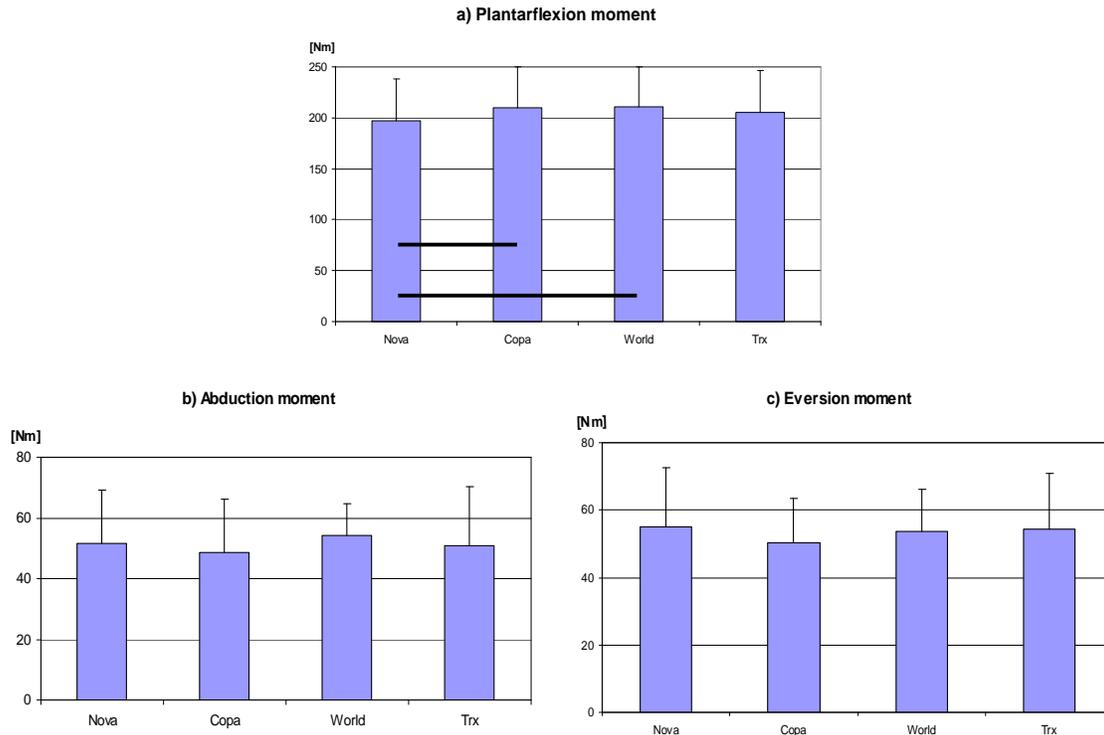


Figure 2. Ankle joint moments for the different shoes from top to down, left to right: a) plantar flexion moment, b) abduction moment and c) eversion moment (average and standard deviations) The horizontal lines indicate significant differences between conditions.

Although no statistical differences were found, the trends may be amplified in higher intensity movements. It is proposed that the small differences in moments observed during sub maximal maneuvers could approach the threshold of injury in game situations.

SUMMARY

Soccer cleat design affected plantar flexion moments during a 45° cutting movement. There were no significant differences found between cleat designs on abduction or eversion moments. However, it is proposed that the trends found could affect ankle injury rate in maneuvers of higher intensity than what was performed in the lab setting.

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