The Effect of Work Boots on Center of Pressure Location at the Knee in Static Kneeling

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INTRODUCTION

- Steel toe work boots are required in occupations in the construction industry, however, the inflexible boot soles restrict movement of the foot.¹
- Occupational kneeling increases the risk of both patellofemoral and tibiofemoral osteoarthritis.²,³,⁴
- Further examination of the kinetics of kneeling is necessary to better understand the potential injury risk; however, most studies have neglected to account for the effects of wearing work boots on the location of the ground reaction force at the knee.

PURPOSE:

To determine the difference in center of pressure (CoP) location at the knee between shod and barefoot static kneeling.

HYPOTHESES:

1. The CoP will not change in the medial-lateral direction.
2. The CoP will move proximally along the long axis of the tibia in the shod condition.

METHODS

- 15 young, healthy, males with size 10 feet participated (age: 23.3 ± 1.8 years; body mass: 80.3 ± 9.9 kg; height: 175.9 ± 4.4 cm; tibial width: 9.4 ± 0.7 cm; tibial length 36.2 ± 2.0 cm).
- Kinematics of the sacrum and dominant leg were obtained using a 3D motion capture system (Optotrak Certus and 3020, NDI, Waterloo, ON, CA) sampled at 64 Hz.
- Force data were also collected and sampled at 2048 Hz (OR6-7, AMTI, Watertown, MA, USA).
- In the shod condition participants wore Caterpillar® 7” steel toe work boots.
- Participants completed five 10-second trials in both conditions.
- CoP was calculated under the knee of the dominant leg and calculated as an average over the five trials and across all participants.

RESULTS

- Force data were also collected and sampled at 2048 Hz (OR6-7, AMTI, Watertown, MA, USA).
- In the medial/lateral direction (x), CoP was normalized as a percentage of tibial width and measured as a distance lateral to the medial tibial plateau (MTP).
- In the longitudinal direction (y), CoP was normalized as a percentage of tibial length and measured as a distance proximal to the tibial tuberosity (TT).

DISCUSSION

1. The CoP is located over the medial compartment of the knee, more so in the shod condition.
2. The CoP is located above the tibial tuberosity in kneeling, possibly near the patella and patellar tendon.

- These findings have important implications for modeling occupational kneelers as the CoP location is significantly different between barefoot and shod kneeling.
- A CoP location farther from the joint center of rotation in the frontal plane, as occurs in the shod condition, would increase the moment arm of the ground reaction force thereby increasing the adduction moment. Greater knee adduction moments in gait have been associated with osteoarthritic populations.⁵
- Future research is necessary to determine if the location of the ground reaction force in kneeling loads soft tissue (patellar tendon, meniscus) or bony surfaces (tibia, patella, femur), as this will affect injury risk.

REFERENCES