INTRODUCTION

Drop landings are commonly used to evaluate predisposed risks of lower extremity injuries. It has been shown that forces exceeding 12 times a person’s body weight can be experienced from these types of landings. Forces of that magnitude being repeatedly applied to the body can lead to a decrease in performance and injury [1]. Deployed military personnel often perform such landings when scaling obstacles in missions or dropping from a helicopter into a combat zone. Drops from helicopters can range anywhere from two feet if the helicopter is on the ground to six feet if the area is considered too dangerous to risk landing. The body’s ability to absorb and control the forces involved in such extreme landings is critical to prevent injury [1]. Previous studies have shown that knee valgus, ankle eversion, and foot pronation are risk factors in lower extremity injuries [1,2]. The research is vast concerning drop landings and proper landing mechanics in relation to injury. However, there is a lack of research on military personnel and the effects that their boots on landing mechanics. Therefore it was the purpose of our study to examine military personnel performing a drop landing under three different footwear conditions.

METHODS

Sixteen male (n=13) and female (n=3) military personnel (21±3 yrs, 79±12kg, 172±10cm) volunteered to participate in the study. All participants were currently involved with the military and were deemed free from injury six months prior to testing. Participants reported for testing prior to participating in any resistance training or vigorous activity for that day. At the testing facility, participants were prepared so that kinematic data could be collected using The MotionMonitor™ electromagnetic tracking system (Innovative Sports Training, Chicago IL). Participants had a series of five electromagnetic sensors attached at the following locations: (1) medial aspect of the pelvis at S1, (2) the distal/posterior aspect of the right lower leg, (3) the distal/posterior aspect of the left lower leg, (4) the proximal/posterior aspect of the right upper leg, and (5) the proximal/posterior aspect of the right upper leg [3]. Sensors were affixed to the skin using double sided tape and secured using flexible hypoallergenic athletic tape. Following the attachment of the electromagnetic sensors, a sixth sensor was attached to a wooden stylus and used to digitize the palpated position of the bony landmarks. To accurately digitize the selected bony landmarks, participants stood in the neutral anatomical position during the digitization process.

Following all set-up and pre-testing protocols, the drop landing protocol was explained to the participants and they were given an unlimited amount of time to become accustom to the drop landing height and procedure. Once the participants were familiar with the landing height, they were given a random order of footwear conditions in which to perform the drop landing. The three footwear conditions were: bare feet, tennis shoes, and issued military boots. All conditions had the participants wearing their own footwear. Once the footwear was randomly assigned, each participant performed three drop landings for each of the three footwear protocols. Participants were instructed to drop down from a 47cm box as if they were dropping out of a helicopter in combat. Each participant was instructed to land on a 40 x 60 cm Bertec force plate (Bertec Corp, Columbus, Ohio) which was anchored into the floor.

Raw data describing sensor orientation and position were transformed to locally based coordinate systems for each of the respective body segments. Euler angle decomposition sequences were used to
describe both the position and orientation of the torso relative to the global coordinate system. The use of these rotational sequences allowed the data to be described in a manner that most closely represented the clinical definitions for the reported movements [3].

Data from the third drop landing of each footwear condition were selected for analysis. The third trial was selected to assure that the participant was accustomed to the different footwear and landing surface.

RESULTS AND DISCUSSION

A repeated measures analysis of variance (ANOVA) was performed to determine if there were any differences in the degree of knee valgus when performing jump landings in bare feet, tennis shoes, and boots. There were no significant differences in knee valgus among drop landings in different footwear (p ≥ .05).

High risk activities such as landing from a jump have been linked to noncontact anterior cruciate ligament (ACL) injuries. The position of the lower extremity has been thought to be a major contributor to these injuries. It has been vastly reported that the position of knee valgus is the culprit of many noncontact ACL injuries. As previously discussed, limiting foot pronation has also been shown to decrease knee valgus. It is thought that by limiting the position of knee valgus during drop landings the incidence of injury could be reduced.

CONCLUSIONS

Our findings suggest that the rigid structure of military boots may not affect knee valgus during the drop landings. Previously, it has been stressed that athletes should be instructed on proper landing strategies in an attempt to decrease injuries, and this should be extended to all military personnel as well. Landing strategies are critical because the mechanics of landing direct the forces being absorbed. Improper transmission of forces up the kinetic chain may lead to lower extremity injury.

REFERENCES