CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
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Project Number
J0327

Project Title
The Effect of Fencing on the Knee

Abstract

Objectives/Goals
To determine how different factors, such as a greater distance between the foot and the hip, the mass of the fencer, and the height of the lunge impact the overall amount of force on the knee during a lunge, thus increasing the likelihood of an injury. The application to fencing will be proposed methods to minimize the potential injuries to the knee by understanding the causes that increase the stress to the knee.

Methods/Materials
Built knee model to simulate the effect of a fencing maneuver called a "lunge" and measure the force on the knee (Device to take actual measurements from the human knee is currently only available for a person lying down in a laboratory going through a fixed set of motions, with an arthrometer like KT1000, not for a person in active motion). Simulated the effect of upper body mass applying force on the lower body, thus applying stress on the knee, by measuring force on the knee caused by different drop heights, changing body mass and varying foot-hip distance.

Results
The most amount of force was applied with a drop height of 25 cm, a foot-hip distance of 17 cm, and a weight of 741 g. This resulted in 153.8 N of force. The second most amount of force occurred when a drop height of 22.5 cm was combined with a foot-hip distance of 17 cm, a weight of 741 g, and dynamic movement. The least amount of force occurred when there was a drop height of 20 cm, a foot-hip distance of 12 cm, and a weight of 505 g, yielding 63.6 N of force. The combination of all 3 factors had a significant impact in increasing the stress to the knee.

Conclusions/Discussion
The hypothesis, which was that a greater foot-hip distance, a higher drop height, and a heavier weight would result in a higher amount of force on the knee, is supported by the results. In order to minimize the possibility of knee injuries, a fencer should strive to minimize upper body mass, smoothly slide forward the leading foot in a horizontal motion instead of lifting the leg unnecessarily, and depend less on solely the reach of the leading leg.

Summary Statement
Understand the effect of different physical variables in fencing movement that would induce high force to the knee and propose ways to avoid them to reduce the likelihood of an injury.

Help Received
Neighbor and father helped with the use of power tools in knee model building and shopping for materials. Two scientists at Ask-A-Scientist Night, Ms. Sari Mahon and Mr. Matthew Bovyn advised me with the revision of the model. Mother advised on the color selections and arrangements of the display