CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Arjun M. Miklos

Project Number

35810

Project Title

Just for Kicks: The Biomechanics of Kicking a Soccer Ball

Abstract

Objectives/Goals

Using elastic bands of different widths with a model leg that I constructed, the scientific question that I asked was, which set-up of elastic bands could allow a model leg to kick a soccer ball the greatest distance? The purpose of this project was to learn about the biomechanics of the human leg and also to understand how prosthetic legs can be made. The applications of this experiment include fine tuning the design of prosthetic limbs for active individuals who would like to pursue sports.

Methods/Materials

I designed and constructed a model leg (built with wood and metal rods) and used elastic bands of varying lengths to mimic muscles at the model hip and knee joints. I used the model leg to kick a soccer ball and measured the distance traveled by the ball, monitored the coordinated extension of the leg using the slow-motion camera on the iPhone 5s and measured tension of the bands used in the model hip and knee joints for each experiment using a fish scale. Tension at the model hip joint varied from 22-28kg while tension at the model knee joint varied from 0-4.5kg. Results were tabulated, graphed and analyzed using Microsoft Excel.

Results

My data showed that the maximum distance kicked was achieved with a hip tension of 28kg and a knee tension of 4 Kg. The average distance kicked was 44.6 feet. By studying the different films of the kicks, I found that when the leg was fully extended at impact, the distance the ball was kicked was greatest, both with a 28 Kg and a 22 Kg hip tension.

Conclusions/Discussion

The longest distances kicked were achieved with maximum strength of elastic bands at the model hip, thus, maximum hip force. However, the set-up with the most tension at the knee did not have the greatest average distance because at impact, the knee was bent much more at the time of impact than in the other configurations. I found that having a well coordinated and timed kick is crucial; the hip provides most of the kicking force, whereas the knee forces provided coordinated extension, a timing that is critical. By conducting this experiment, I learned about how the different muscles of the leg work together, and how in making a prosthetic leg, the muscles need to be very coordinated.

Summary Statement

I designed and constructed a model leg (based on the size of my own leg) and used elastic bands of varying lengths to mimic muscles at the model hip and knee joints in order to ask the question, which set-up of elastic bands could allow a m

Help Received

My father helped me construct the model leg and my mother helped me with my poster board.