Data Analysis

MUSCLE DISUSE

Optimal fiber length is the length at which the fiber develops the greatest active tension; by altering the optimal fiber length of muscles in the body it is possible to model muscle disuse and even atrophy. Using the optimal fiber length setting command, I was able to run a loop that proportionally increased the optimal fiber length of all the muscles in the model. Then I ran the forward simulation and tested and compared the results from the original model an increase of 1.1 to 1.4 by the optimal fiber length. According to the gathered data, the angle of the subtalar joint increases proportionately with an increase of the optimal fiber length, therefore proving that with an increase in muscle disuse, the severity of ankle injuries will increase significantly, as an increase in the subtalar angle is proportional to the damage to the ankle joint.

Weight

Next, I tested how an increase in weight can affect ankle injuries. I proportionately changed the the mass of the torso in the user interface. I multiplied the torso’s weight by 1.1, 1.2, 1.3, and so on until 2, to reach. By doing this I was able to create ten models with different torso masses. I ran a forward simulation of the drop for each model. After gathering the data for each model, I was able to graphically analyze the data. From the data gathered, I was able to clearly conclude that with an increase in weight, the damage done to the ankle increased, as the subtalar angle had a clear increase; in the original model, the subtalar angle increased from 47.5 degrees to 55 degrees in the model with twice the heaviness. Using the graph, we can see that with each interval of increase from 1.1 of the original model to twice the original model, the subtalar angle increases at each interval.

Effective Methods

In this graph, we can see that in the original unassisted simulation, the subtalar angle went as high as 50 degrees. Considering that the range of the subtalar joint is between 20 to 61 degrees and that injury occurs after an ankle inversion of 25 degrees, the damage dealt to the ankle would be severe. However, by using the co-activation of muscles the ankle was able to reduce its ankle inversion to 42 degrees; however, this angle is still well over the angle of injury. Next, I tried to lower this angle by using an ankle foot orthotic, which improved the angle considerably. By using a soft AFO, I was able to lower the angle to 40 degrees, but along with co-activation, I was able to reduce it to 32.5 degrees, a major improvement. After testing the soft AFO, I multiplied its transitional stiffness in each direction by ten to create a much stiffer AFO. After simulating I found that it was able to keep the subtalar angle to 20 degrees, in order to protect the AFO well under its threshold of 25 degrees. But along with muscle co-activation,the stiff AFO was able to control the ankle inversion under 10 degrees. While the numbers of the stiff AFO may be astounding, it would not be very comfortable to wear such a stiff AFO; furthermore it would cost much more to produce an AFO that is stiff.