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Project Title
The Impact on the Patellar Tendon When Squatting

Abstract

Objectives/Goals

This experiment was done to find the ratio of straining between the quadriceps muscle and the patellar tendon while decreasing the angle of the knee from 150 degrees to 30 degrees when squatting. The question that I addressed, was how much strain is put onto the patellar tendon and the quadriceps muscle when bending the knee at various angles.

Methods/Materials

The knee model, consists of three separate pieces of wood (representing the femur, tibia/fibula, and foot) that is hinged and attached to the frame via another block of wood (the hip). The hip was connected with casters giving it ease to move up and down along with a vertical support. A single spring represented the quadriceps muscle, while as the patellar tendon was represented by a nylon G guitar string. The guitar string is attached to the spring at one end and to a guitar tuning mechanism at the other. To measure the strain, I positioned the knee at various angles, resulting in pulling the quadriceps muscle and patellar tendon.

Results

From 150 degrees to 120 degrees, the patellar tendon to quadriceps muscle ratio was 2:1. At 90 degrees the straining on the patellar tendon started to plateau because it reached its maximum point in being strained and was starting to reach hyperextension. At 60 degrees both the patellar tendon and quadriceps muscle were proportional to each other and the ratio as 1:1. Out of the seven attempts to reach 30 degrees four of the G guitar strings (patellar tendon) broke.

Conclusions/Discussion

When the knee was bent from 150 degrees to 30 degrees while squatting, the patellar tendon was being strained to its maximum ability. At 60 degrees, both the quadriceps muscle and the patellar tendon were strained the same due to the plateauing in the patellar tendon. As the angle decreased to 30 degrees, the patellar tendon tended to rupture easily on the knee model, while as the quadriceps muscle was not at its maximum peak of straining.

Summary Statement
I created a knee model that showed the strain of the patellar tendon when set at angles from 150 degrees to 30 degrees in a squatted position.

Help Received
I designed, built, and performed the experiments by myself, and my father helped me drill the holes in the model.