Brace for It: The Effect of Q-angles on ACL Stress with Prototype and Development of Arduino Software to Create Smart Brace to Protect at Risk Patients

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The idea behind this project was to first research how the Anterior Cruciate Ligament(ACL) tore. Then discover who is at risk for this injury and why. A Quadricep angle(Q-angle) is the degree at which the hip is over the knee. At risk patients are likely to have wider Q-angles. The next step was to measure using a goniometer how Q-angles affected how much stress was placed on the ACL. This was tested both dynamically using a weighted pendulum to slam into the model leg and statically using a weight to hang from the model leg laying horizontal. There were four levels of the IV, the Q-angle of the leg, zero, ten, twenty, and thirty degrees. The DV, the stress on the ACL, was measured in pounds by attaching a digital force gauge to the end of the cable acting like the ACL. The final step was to see how this injury could be prevented to help the at risk patients. The hypothesis was that the higher the Q-angle the more stress on the ACL. The data supported the hypothesis for the dynamic impact testing. The average for zero degrees was three pounds, the average for thirty degrees was 4.66 pounds. The hypothesis was not supported for the static loading because there was no difference between the levels. Therefore a way to help prevent ACL injuries would be to build a brace that could sense dynamic impact and respond before the ACL tears. The Smart Knee Brace was created using the idea behind an airbag. An automated airbag contains a MEMS accelerometer (microelectronic mechanism) which allows this device to work at a very low cost while responding extremely quickly. A servo motor was used to pull up on a strap to provide additional stability for the knee and the ACL inside. The final prototype of this Brace contained a GEMMA arduino that is wearable and much smaller.

Awards Won:

Patent and Trademark Office Society: First Award of $1,500