**Background**
- The Anterior Cruciate Ligament (ACL) is one of the four main ligaments found in the knee.
- The ACL connects the femur and tibia, and prevents improper tibial rotation and translation [1].
- Approximately 150,000 - 200,000 anterior cruciate ligament injuries occur annually in the US [2].
- ACL injuries types:
  - Contact – 30%
  - Noncontact – 70%
- The noncontact injuries occur from ACL loading mechanisms.
- ACL loading mechanisms [3]:
  - Small knee flexion angle (< 30°)
  - Large ground reaction forces
  - Large quadricep muscle force compared to hamstring force
- Movements that lead to ACL loading:
  - Pivoting
  - Jumping
  - Rapid deceleration

**Problem Statement**
- What modifications can be made to current knee braces to further improve their ability to protect against knee ligament tears?
- How can certain mechanical properties of a knee brace decrease strain on ligaments?

**Solution**
- Creation of a mathematical model relating the amount of force needed to prevent ACL tears and the degrees of knee flexion.
- Use this mathematical model to create a device that offsets strain placed on the ACL to reduce the risk of ACL tears.
- The balance of forces equation shown below will be used to find the anterior shear force that needs to be countered by the brace.

**Mathematical Models**
- Subscript: s = forces in the shear direction.
- Generalized Balance of Forces Equation: \( \Sigma F_s = 0 = HAM_s - TF_s - GAS_s - ASF - PT_s + GRFs \) [4] - [26].

**Variables:**
- \( k = \text{Spring constant of the band (N/m)}, \ x = \text{displacement of band (m)}, \ F = \text{Force needed to be supplied by the band (N)} \) [27], [28].

**Formula:**

\[
F = k \cdot x
\]

\[
k = \frac{310 \text{ N}}{0.01 \text{ m}}
\]

**Conclusion**
- Using the findings from the mathematical model the spring coefficient necessary to counteract anterior shear that leads to ACL tears was found.
- Future work would consist of putting together the brace and confirming that the mechanism decreases forces in the ACL.

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**References**