Knee Ligament Replacement

Austin Peril/ aperil@asu.edu
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Abstract

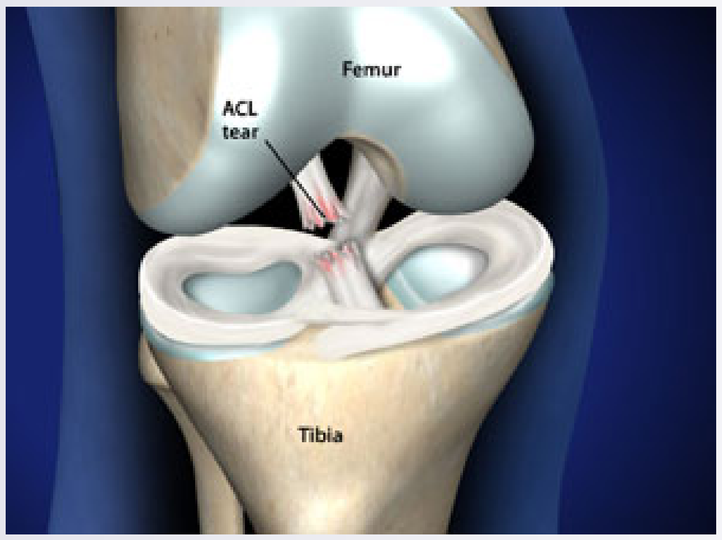
An artificial anterior cruciate ligament was created with a mix of 3D printing and molding. This ligament was created to replace torn ligaments and recreate the flexibility of the natural muscle, but have a higher durability.

Research Question

Can an artificial ligament be created to replicate the flexibility of a natural ligament yet be more durable?

Precedents and Prior Research

- Guillermo Ameer, a professor of biomedical engineering, has worked on developing 3D printed ligaments with the use of plastics and stem cells.
- These new ligaments could become more efficient in replacement surgery. Since the models are made with stem cells, there is no risk of rejection.
- These are also more durable due to the lack of singular tissues that make up the ligament.



Process

- The project started by examining ACL images to create a 3D replica. This replica was formed in AutoDesk Fusion 360.
- The replica was 3D printed and used to create a mold with Dragon Skin 30. This allowed the final product to be flexible.
- After the mold was created, holes were inserted into the final model to show the flexibility and durability of the final product.
- Due to material costs, only enough Dragon Skin was purchased to create 4 ligament models.

Results

The final ligaments were able to hold up to the bending and stretching tests that they were put under. These tests showed that the 3D created ligaments are just as durable, if not more that natural ligaments.

Conclusion

By holding up to the tests that were performed on the 3D printed/molded ligaments, the new ligaments were proven to be just as durable as natural ligaments. While bending or stretching the ligaments will not cause damage, there are possibilities of issues with the connection to the knee. Since the new ligaments were added to the knee, the connection would not be as strong as the original ligament.

References

ATWATER M. 2015. Artificial Ligament. May Revolutionize ACL Repair. Engineering.com

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What is the ACL?

The anterior cruciate ligament or ACL is one of the four major ligaments connecting the femur to the tibia at the knee. This ligament is close to the front of the knee and is often injured during athletic competition.

Why is artificial ligament replacement important?

The knee ligaments are incredibly important to the support and structure of the legs. Due to the amount of torque that the knee can endure these ligaments are often more susceptible to injury.

A common issue with knee replacement surgery is the reinjury of the new ligaments. There are scarring issues that may occur, causing permanent weakening of the ligament. The weakening allows the ligament to become re-torn at a much easier rate and can cause other mobility issues in the knee. By creating a more durable ligament through plastics these issues can be avoided.