Achilles Tendon Repair Bio-Tape Applicator

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Background

Achilles tendon ruptures occur in about 1 million athletes annually in the U.S. Surgical repairs result in lost elasticity and strength due to scar tissue build up caused by suture stress. Partnered with Dr. Freedman from the Wyss Institute, Biotape aids in elasticity retention and decreased scar tissue when applied after suture repair. Decreases stress on sutures and promotes healing.

Existing Solutions & Limitations

Current solution = manual application of the tape utilizing forceps with no standardized method. Application can be difficult. Limitation = No existing application device

Objective

Design a device to wrap the bio-tape around the Achilles tendon, while reducing variability between surgical procedures.

Solution

Our innovative solution combines device designs from other industries and applies them to the healthcare setting for surgical use.

Verification & Validation

Surface Coverage Area Verification

Device wraps bio-gel around painted tendon model, paint transfer quantified via ImageJ. 90% paint transfer = success.

Dimensions Verification: via caliper

Force Verification: Device’s generated force verified by this procedure:
- Establish upper / lower thresholds of force via manual application
- Repeat application with device, record range of generated forces
- Successful if the average generated force falls within the manual force threshold

Conclusion

Our innovative design provides a reliable, standardized method for surgeons to apply bio-adhesive tape to the Achilles tendon, facilitating performance of the bio-gel in reducing scar tissue and retaining tendon elasticity.

Societal Impact

Positively impacts surgical space, time, and procedures. Marketed to an estimated 7,700 podiatric surgeons* Potential use in ~8,200 achilles tendon rupture surgeries per year in the U.S. Decreased recovery time and post-op visits.

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References:
[1] Lawrence SJ. Midfoot and Hindfoot, Clinical Sports Medicine, Mosby, 2006; Chapter 70 (713-725).  

Constraints

- 1.1 Time: 9 months  
- 1.2 Budget: $900  
- 1.3 Intellectual Property: Designed only for the Wyss Institute’s biogel.  
- 1.4 Use in small surgical space  
- 1.5 Geometric Constraint: Tailored to pre-cut bio-gel patches

Requirements

- 2.1 Applicator Face: Must hold 8 cm x 5 cm biogel  
- 2.2 Device Properties:  
  - 2.2.1: Wraps non-uniform cylinder  
  - 2.2.2: Applies 1-4 min of pressure  
- 2.3 Biogel Application: Bio-gel must be flush with tendon  
- 2.4 Ease of Use:  
  - 2.4.1: Hand Held  
  - 2.4.2: Easily Repeatable  
  - 2.4.3: Less than 1 lb

Working Models & Prototype

- 1: Internal cables are put under tension  
- 2: Four panels curl up and around  
- 3: Device closes on itself