Tendon Adhesions: A Novel Method of Objectively Measuring Adhesions by Tendon Glide Through a Soft Tissue Envelope in a Rat Model

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Introduction: There have been decades of research & advancements in treatments, yet tendon adhesions remain a significant problem.

Promising animal studies with chemical modifiers and scar barriers haven't translated to success in human trials.

Previous studies have been limited by their inclusion of a spectrum of tendon injury, lack of standardized biomechanical testing, and subjectivity.

Tang, et al has the most accepted grading scale. (Image 1)

Table 1. Grading Criteria of Adhesions of the Tendons

Points	Feature of Adhesions
	Quantity
0	No apparent adhesions
1	Localized, longitudinal extension within 10 mm
2	Longitudinal extension between 10 and 15 mm
3	Extensive, longitudinal extension beyond 15 mm
	Quality
0	No apparent adhesions
1	Loose, elastic, and largely movable
2	Moderately dense, movable
3	Dense, rigid, and not movable
Total	Grading of adhesions
0	No adhesions
2	Slight adhesions
3, 4	Moderate adhesions
5, 6	Severe adhesions

Image 1

Purpose of Study: To advance research with scar barriers and other adhesion inhibiting treatments by creating a standardized, objective, biomechanical assessment method.

Methods: Thirty-six, 6 month old Sprague-Dawley male rats divided into 3 groups of 12. The left hindlimb was incised over the Achilles tendon, and the tendon dissected free from the surrounding soft tissue envelope.

Group A (n=12)

- Central 5mm of tendon was cut longitudinally and 1/3 the tendon width excised (Image 2)

Group B (n=12)

- The exposed tendon was irritated by rubbing the tendon with steel wool for 20 strokes (Image 3)

Group C (n=12)

- A running 5-0 silk suture was placed along a 5mm length of tendon (Image 4)

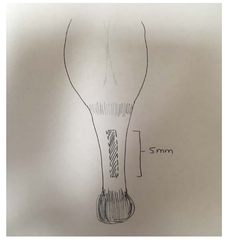

Image 2

Image 3

Image 4

- Rats maintained for 4 weeks to allow tissues to heal. After 4 weeks, terminal biomechanical testing occurred on bilateral hind limbs with the right side as the control (Group D) for each rat.
- Achilles transected transversely at gastroc-tendon junction
- Midfoot osteotomy to free calcaneus Achilles pulled through envelope at a fixed rate of 5mm/min & repeated on controls. (Image 5)
- Pair-wise comparison tests performed on 33 rats comparing peak forces needed to pull Achilles tendon from the soft tissue envelope with comparison to the control hindlimb.

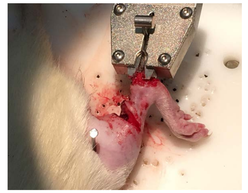

Image 5

Results:

PEAK FORCES

❖ Significant differences noted:

- between Group A (cut tendon) and controls (p=0.0014)
- between Group B (steel wool) and controls (p=0.0005)
- between Group C (silk suture) and controls (p=0.000005)
- NO statistical difference between experimental groups. (Image 6)

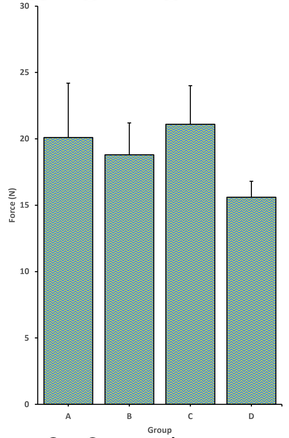

Image 6 : Comparison of Peak Forces
A: Cut Tendon
B: Steel Wool
C: Silk Suture
D: Controls

Discussion: All three methods of experimental manipulation increased adhesion around the rat Achilles tendon. These various methods may allow for the creation of different clinical scenarios with future scar barrier experiments.

Conclusion: Our study demonstrates a novel, objective method of biomechanical tendon adhesion assessment in a rat model that will allow for accurate testing of adhesion inhibiting treatments in future studies.

Disclosures: Funded by a Contracted Research Grant with Cook BioTech, Inc.