

# Biomechanical Properties of Skin

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## Introduction and Background

### Current Knowledge:

Collagen fibers arrangements within skin tissue determine its strength and its anisotropic behavior.

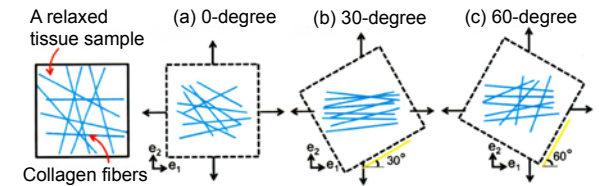
### Current Limitations:

How subjecting skin to stretching changes its biomechanical properties is unknown. Subjecting skin to stretching could reduce the anisotropic properties of skin, creating uniform material properties benefiting many medical applications.

**Objectives:** Determining the directional mechanical characteristics of skin tissue is key to understanding how the collagen arrangement affects the mechanical properties of skin tissue.

- To investigate the relationship between collagen fiber orientation and tissue strength via biaxial testing.
- To understand why subjecting skin to stretching has directional mechanical properties. Primarily, the difference in anisotropic properties are determined by comparing non-stretched and stretched samples.

- Collagen fibers are distributed randomly within skin tissue.
- When stretched, fibers align in a preferred direction, which causes the anisotropic properties.

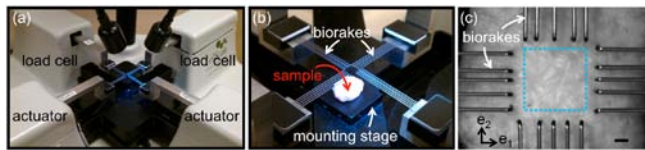


## Methods and Results

### Directional Mechanical Properties via Biaxial Testing

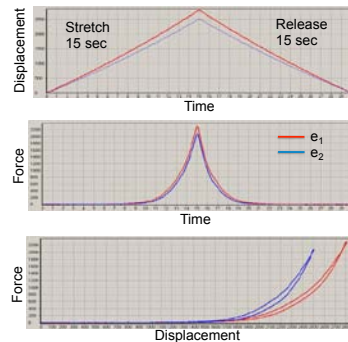
#### Equipment:

- Biaxial testing was conducted via a BioTester 5000.
- Porcine epidermis 4 mm square skin samples were tested bi-axially.



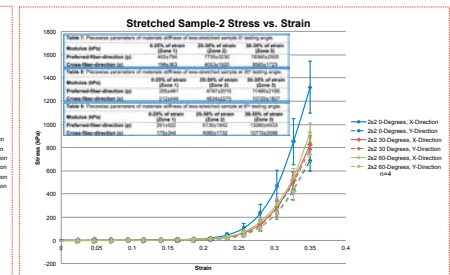
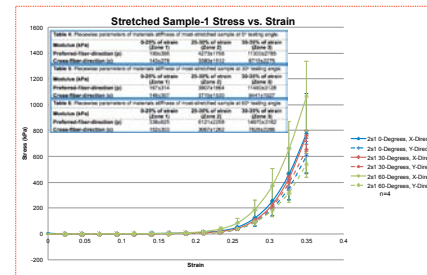
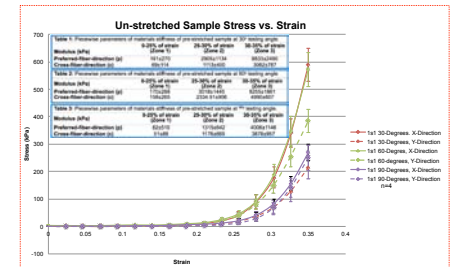
#### Procedure:

- Skin samples were stretched from 0% strain to 35% to 0% over 30 second time period.
- 3 different skin samples were considered:
  - Un-stretched
  - Stretched 1, experienced the most stretch
  - Stretched 2, experienced less stretch
- Stretched samples were subjected to stretching for 24hrs in balloon tissue expander.
- Each sample was tested five times at 0 degrees, 30 degrees and 60 degrees. Only tests 2-5 were considered.



### Directional Mechanical Properties in Skin Tissues

- Corresponding stress and material stiffness was calculated for each samples' rotation.
- Samples' mechanical properties become most anisotropic and non-linear in Zone 3.
- Comparing material stiffness of the preferred and cross-fiber directions in Zone 3 indicate reduced anisotropic properties.



## Discussions and Conclusion

- Reducing anisotropic properties, which eliminates weaknesses, occurs after skin tissue experiences an expansion processes. The expanded skin better serves patients in need of skin graft operations. The current study provides new methods for determining and comparing the directional mechanical properties of skin tissue.
- The collagen fiber distribution in skin tissue becomes more homogeneous by subjecting samples to stretching, indicated by the similar material strengths in the X and Y directions from the results of biaxial testing; however, preferred collagen alignment directions still exist.
- Longer periods of stretching may have a more significant affect on the reduction in anisotropic properties.