

# Characterizing the Mechanical Response of the Extra Fibrillar Matrix of the Annulus Fibrosus

Syrena Huynh

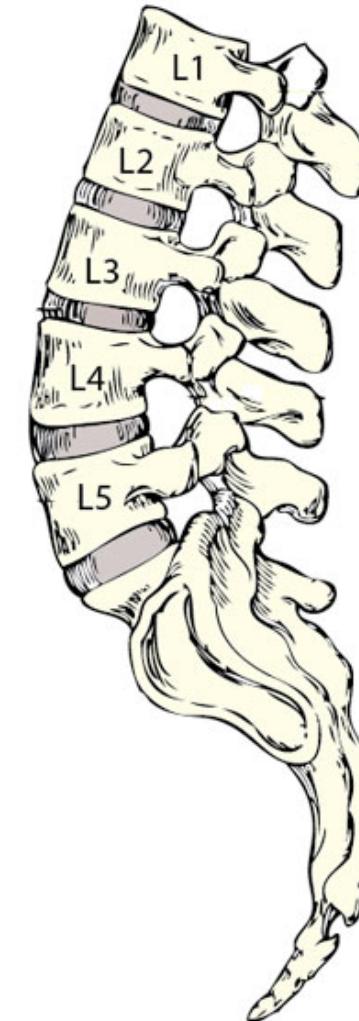
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SUNFEST Scholar

Dr. Dawn Elliott and Dr. Daniel Cortes

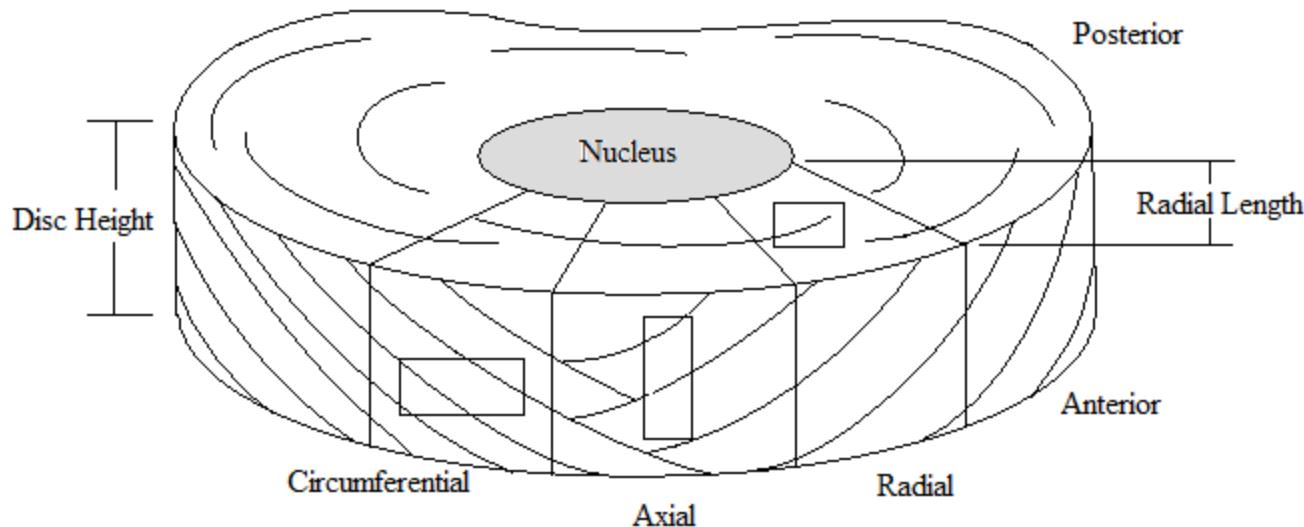
# Background

- The Basics
  - Structure
  - Function
- The Problem
  - Back pain
- The Solution
  - Finite Element Models



# Objectives

- Evaluate/ refine current models
- Collect data
- Test with regional distinction
- Develop parameters



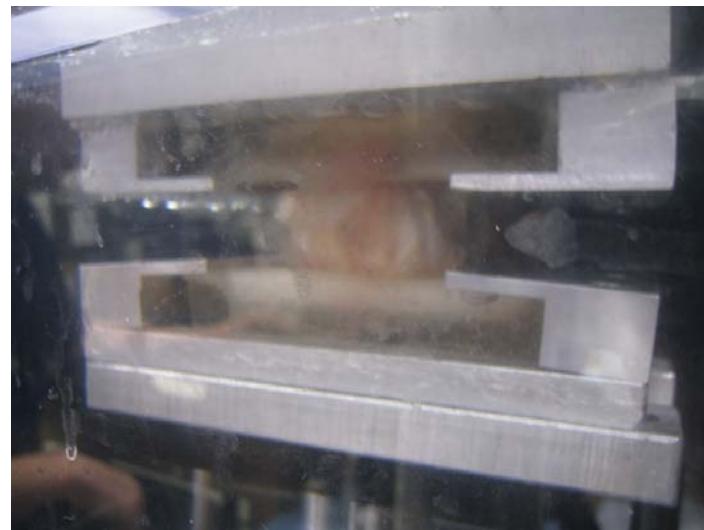
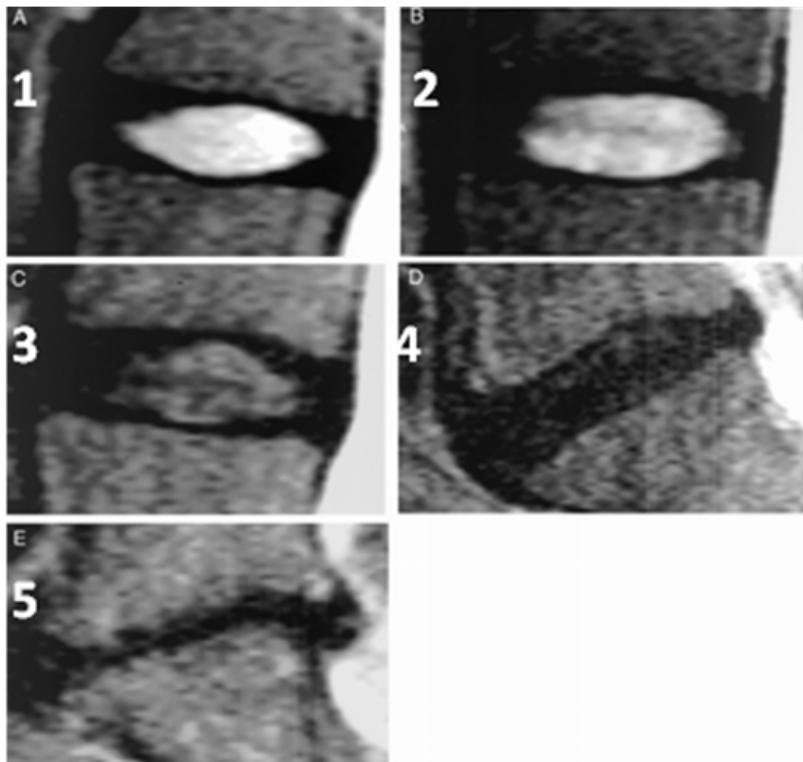
# Outline

- Confined Compression
- Tensile Loading

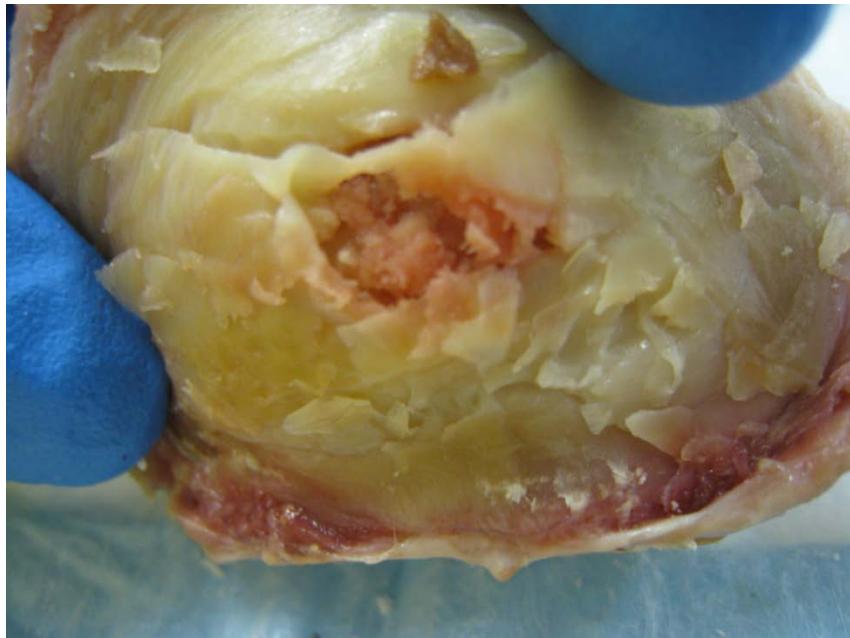
# Key Terms

- Annulus Fibrosus (AF)
- Outer Annulus fibrosus in the anterior region (OAA)
- InnerAnnulus fibrosus in the anterior region (IAA)
- Outer Annulus fibrosus in the posterior region (OAP)

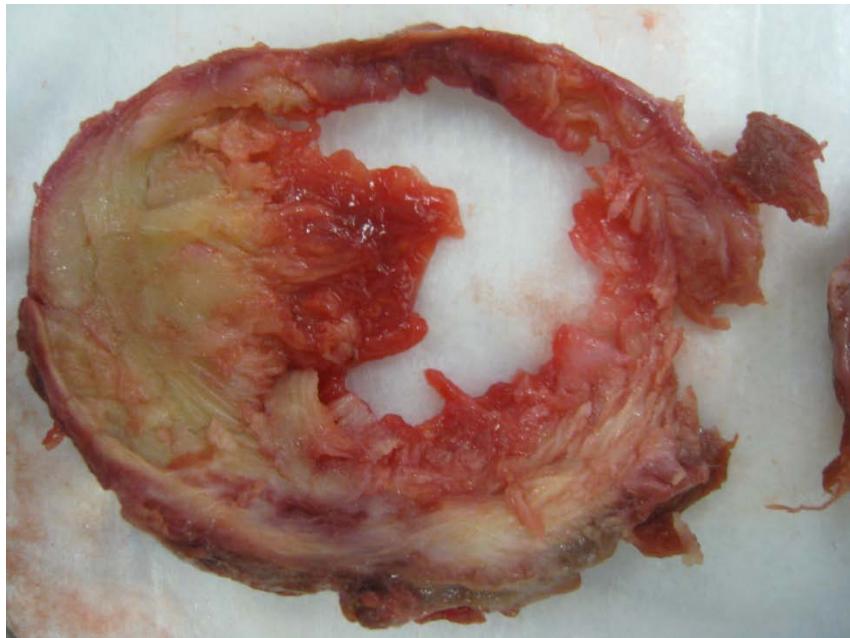
# Methods - Imaging and Motion Segments



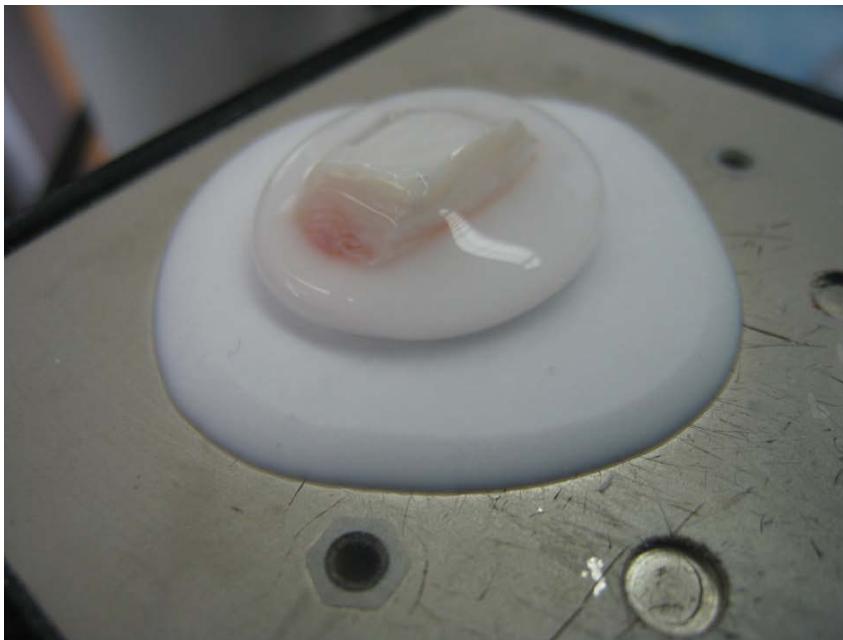
# Methods - Dissection



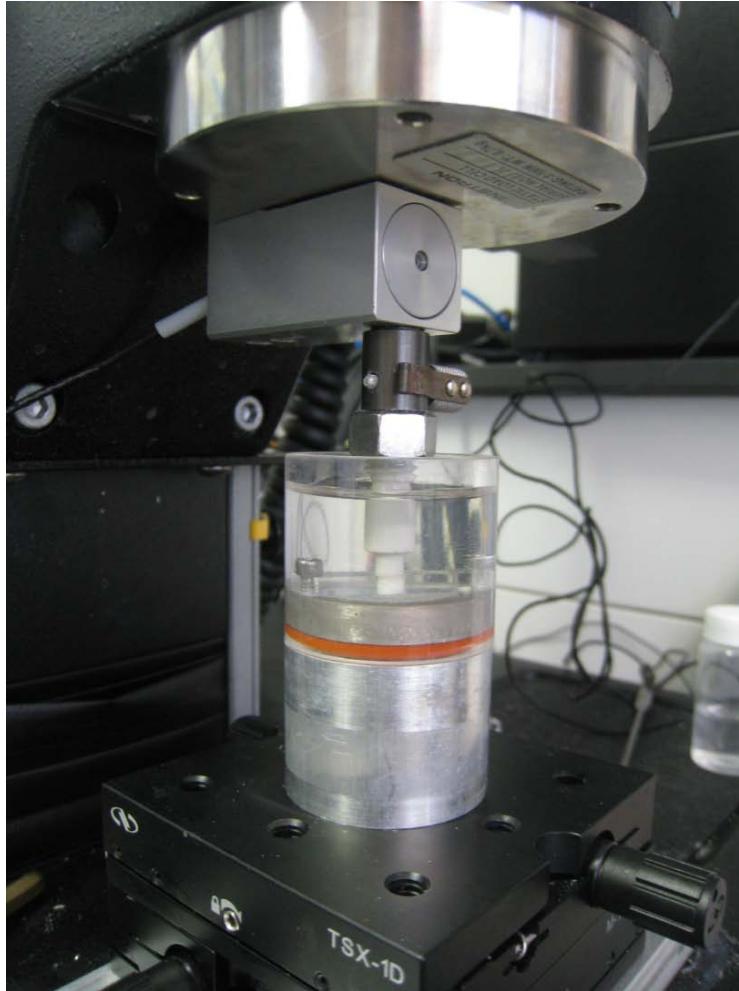
# Methods - Dissection



# Methods - Microtoming



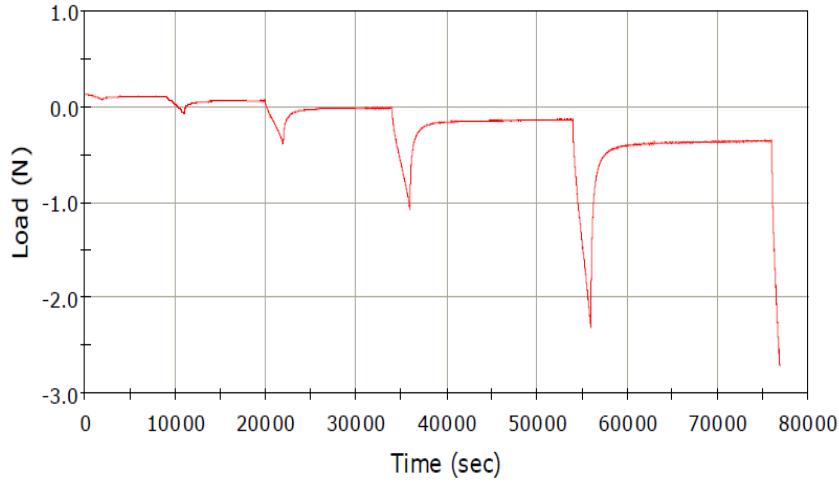
# Methods- Confined Compression



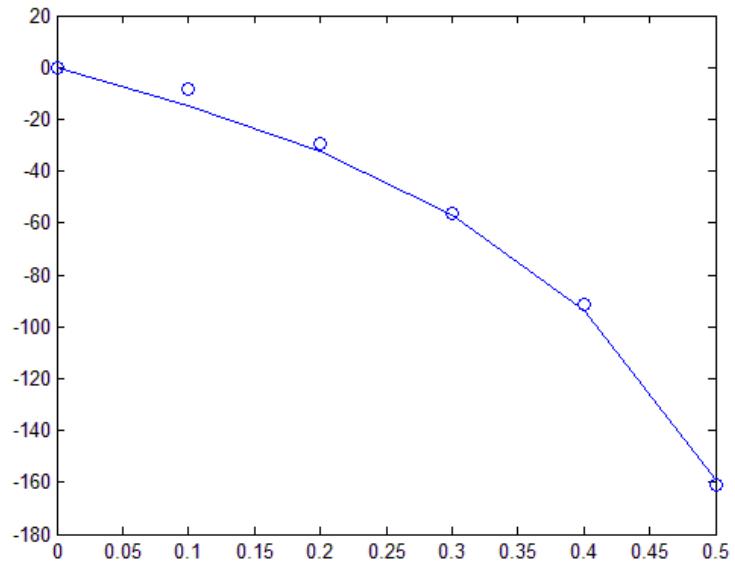
- Swelling
- Punching
- Precondition
- Ramps

# Data Analysis

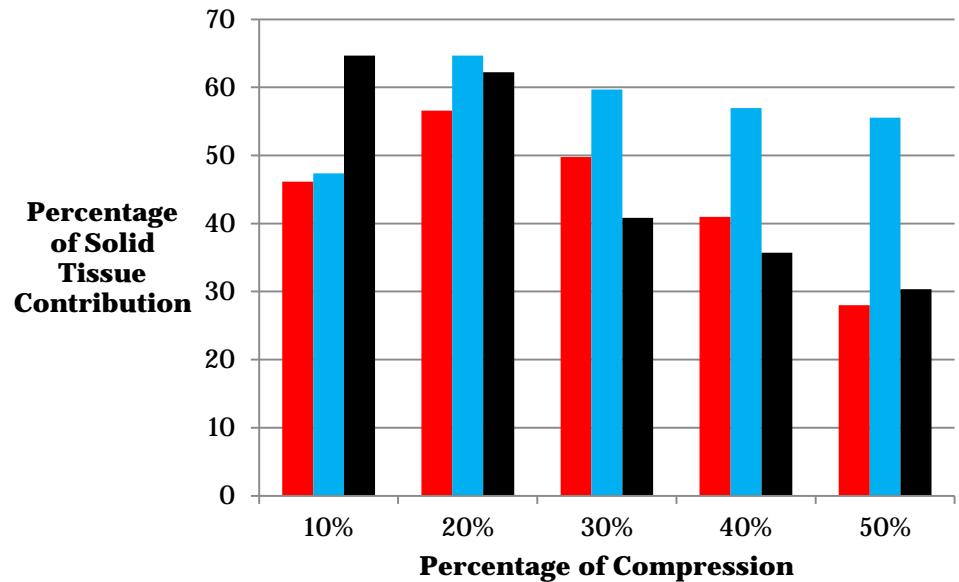
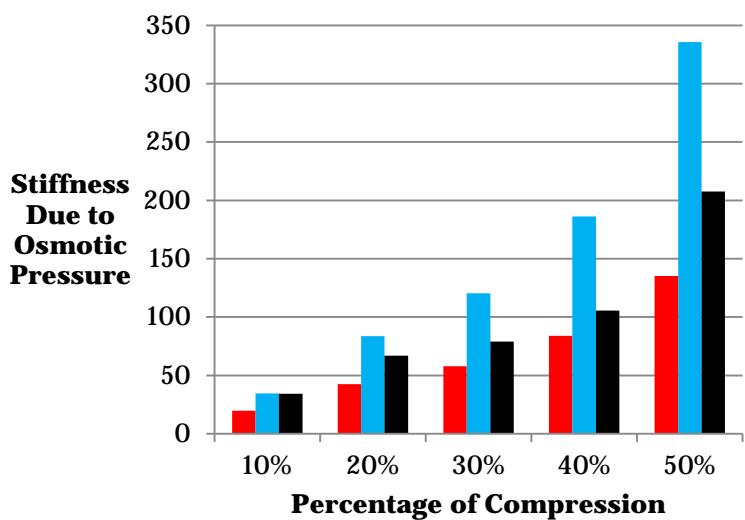
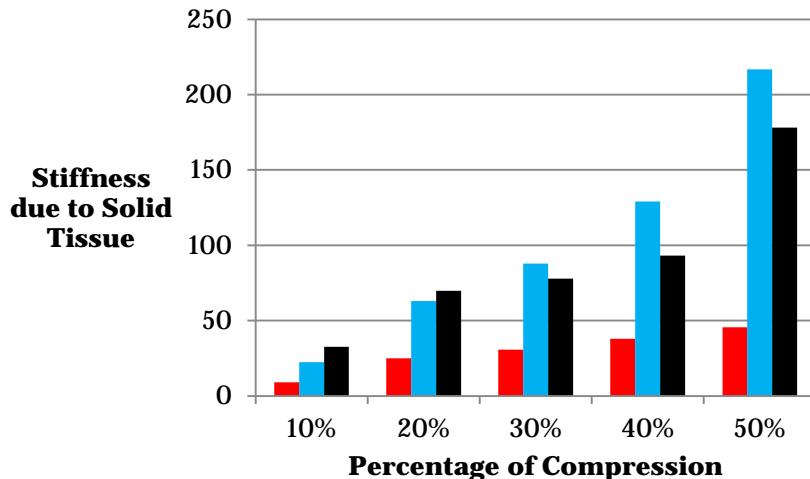
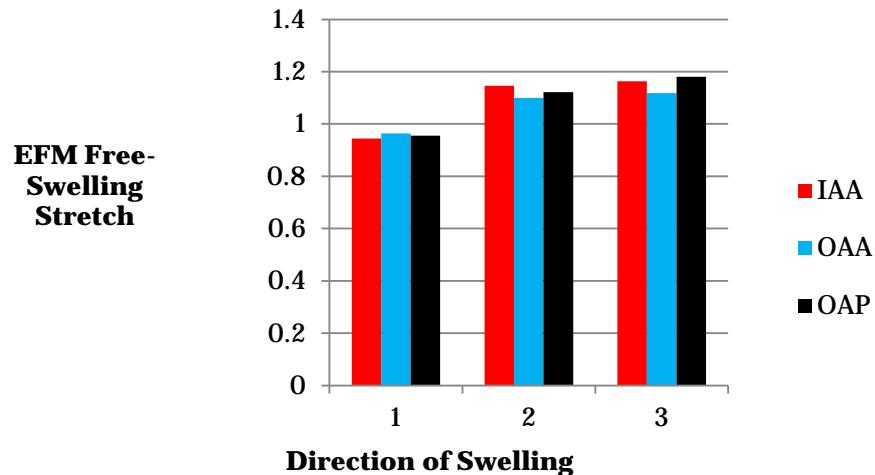
## Ramp cycles



## Curve Fitting

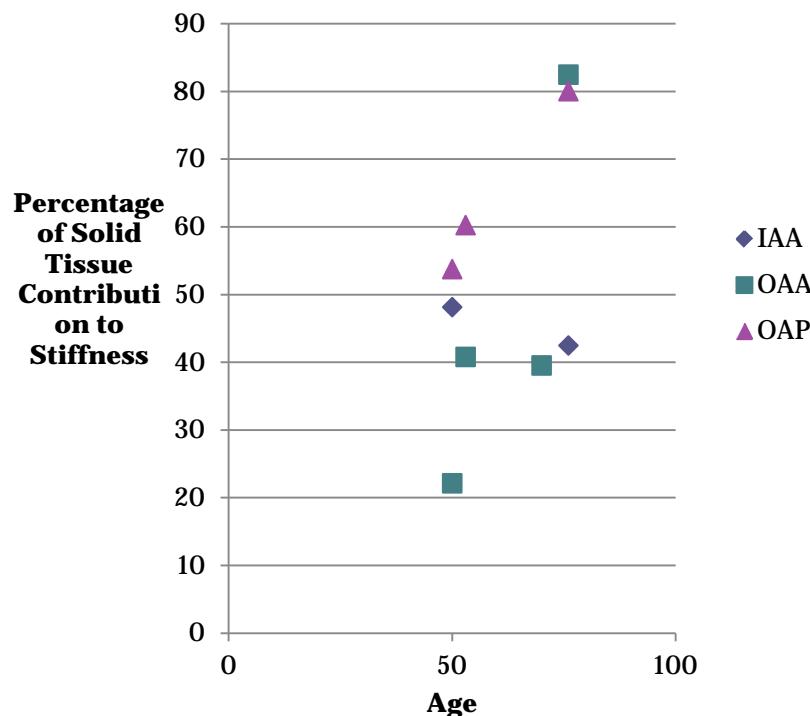


# Results - Confined Compression

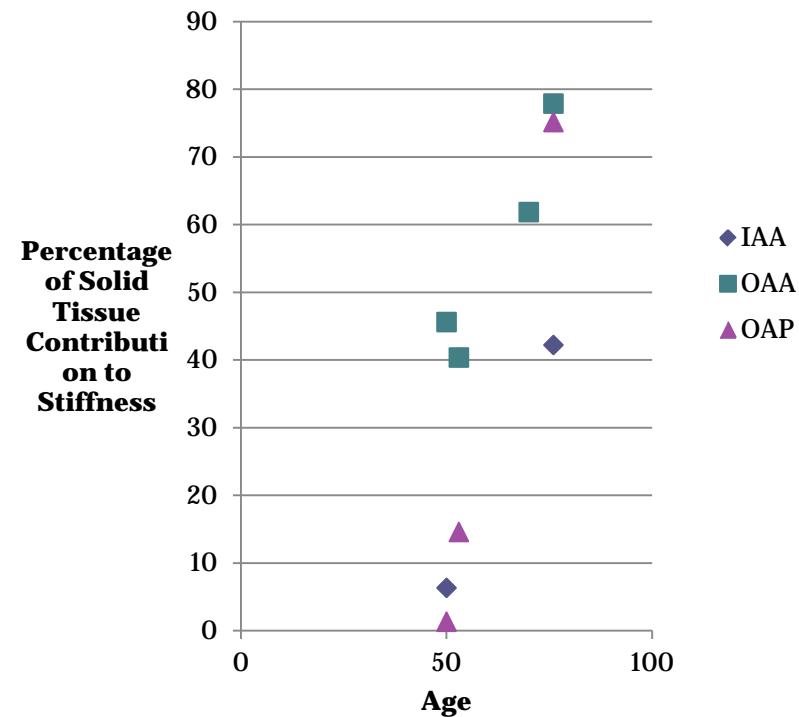


# Results - Confined Compression

**First Ramp**



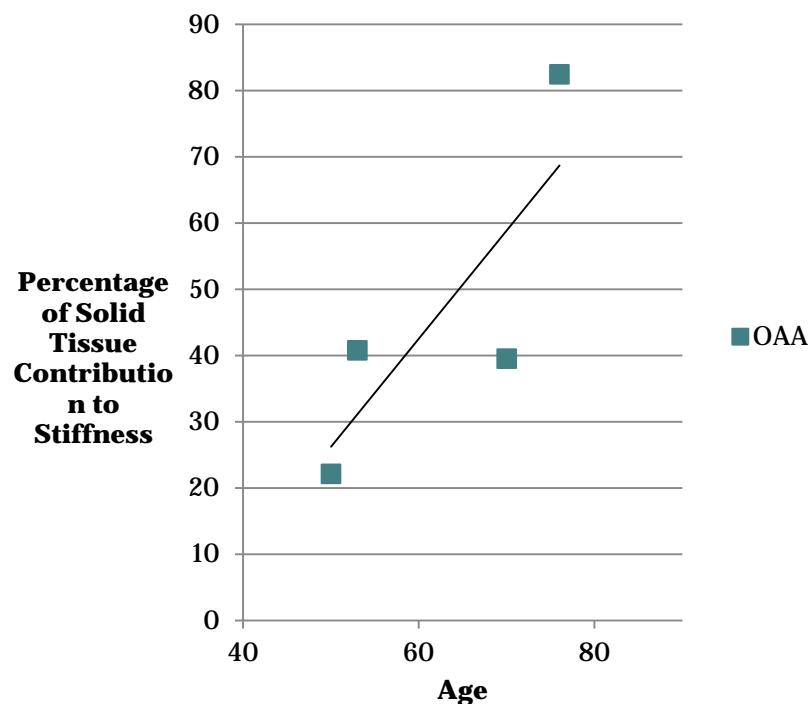
**Fifth Ramp**



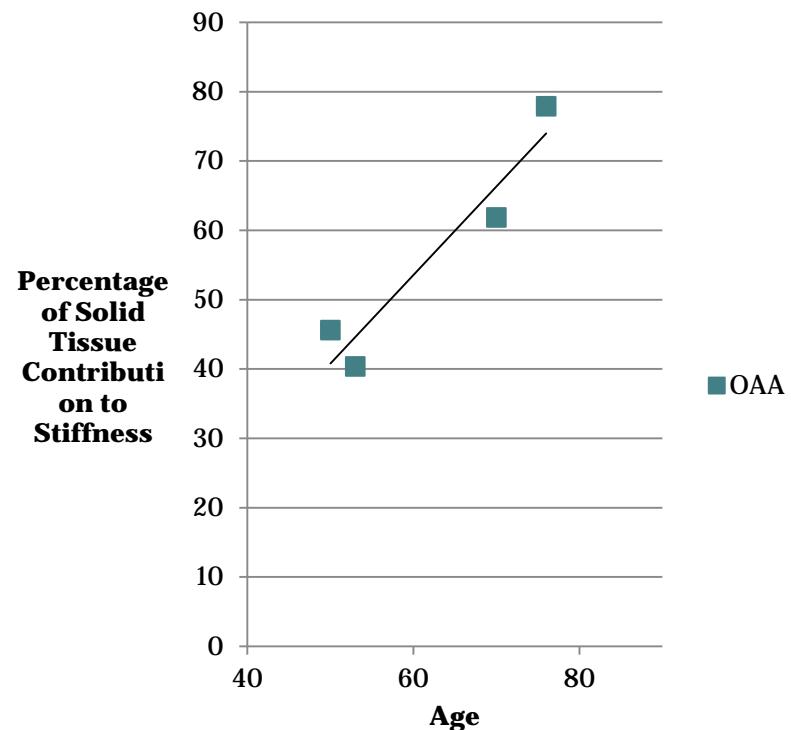
- Annulus Fibrosus (AF)
- Outer Annulus fibrosus in the anterior region (OAA)
- InnerAnnulus fibrosus in the anterior region (IAA)
- Outer Annulus fibrosus in the posterior region (OAP)

# Results - Confined Compression

## OAA- 10% Compression



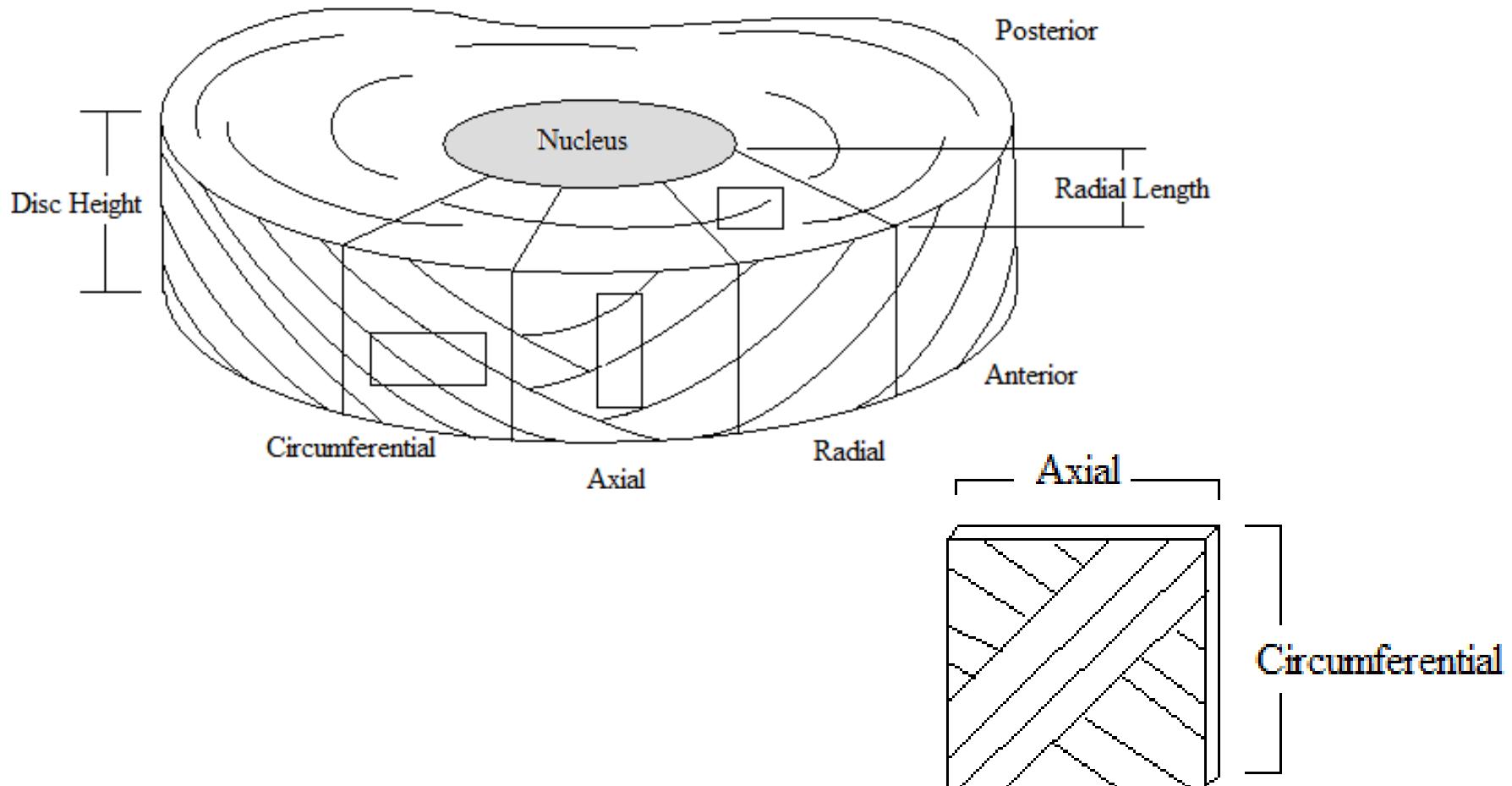
## OAA – 50% Compression



- Annulus Fibrosus (AF)
- Outer Annulus fibrosus in the anterior region (OAA)
- InnerAnnulus fibrosus in the anterior region (IAA)
- Outer Annulus fibrosus in the posterior region (OAP)

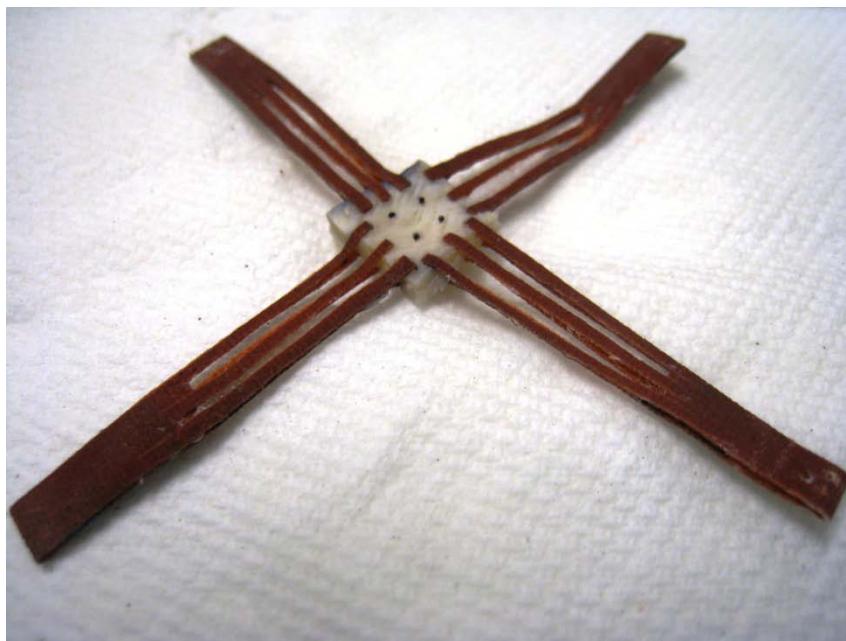
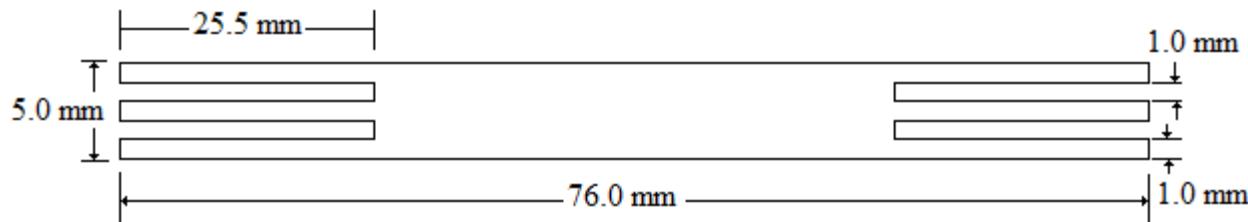
# Methods- Tensile Loading

## Sample Preparation



# Methods- Tensile Loading

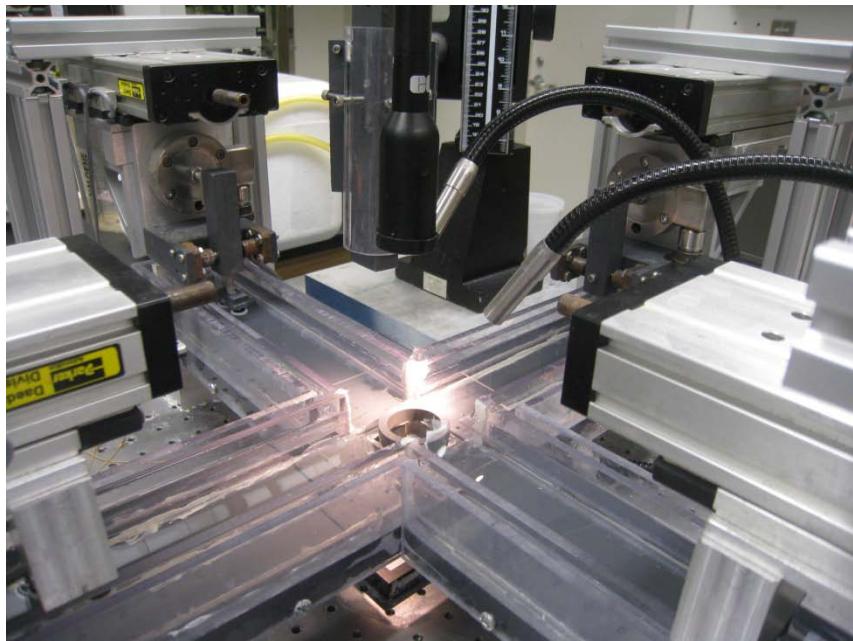
## Sample Preparation



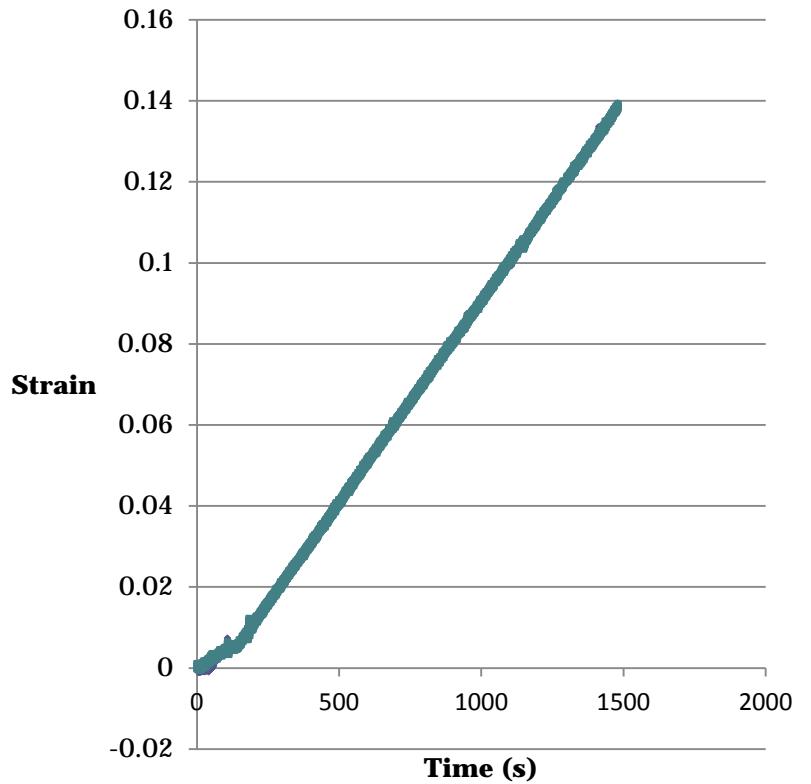
- Microtoming
- Swelling
- Fingers and markers

# Methods- Biaxial and Uniaxial Loading

## Apparatus and Preconditioning



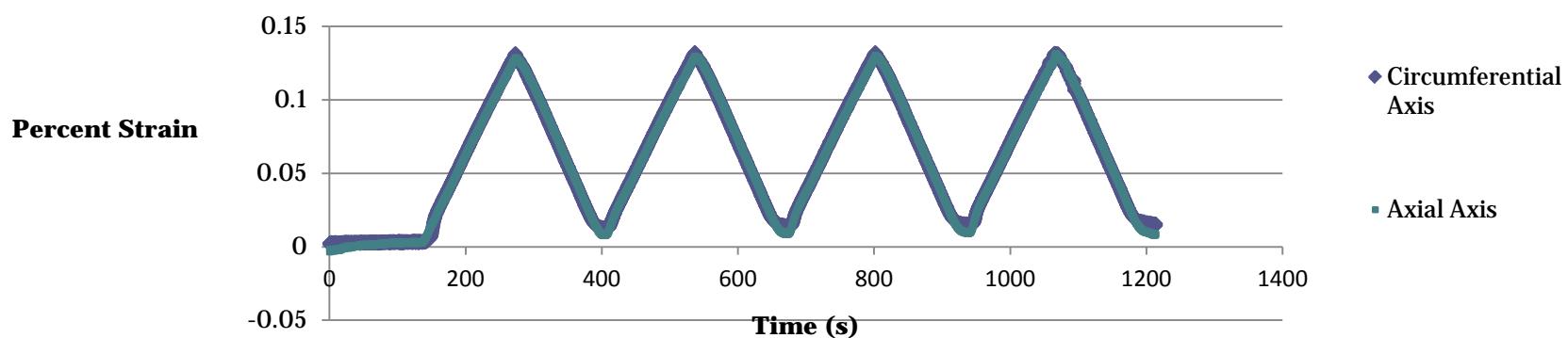
## Strain Profile for Preload



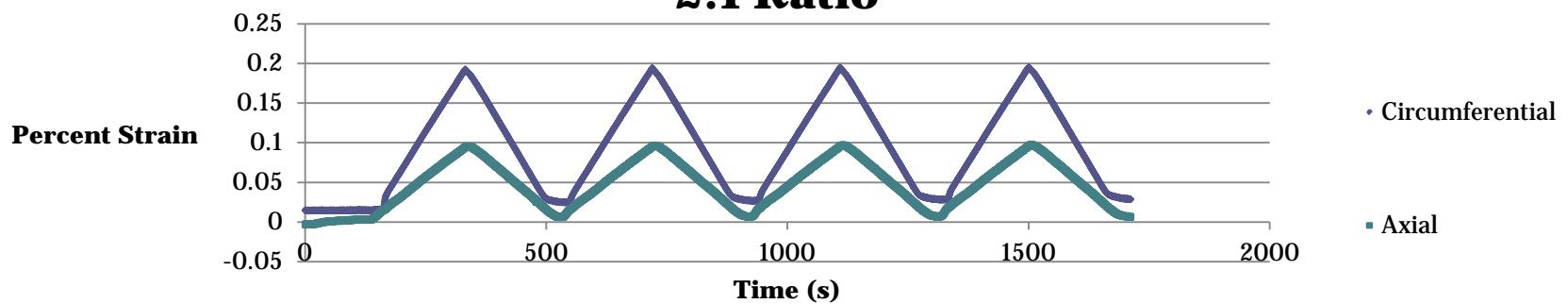
# Methods- Biaxial and Uniaxial Loading

## Ratio Tests

### 1:1 Ratio

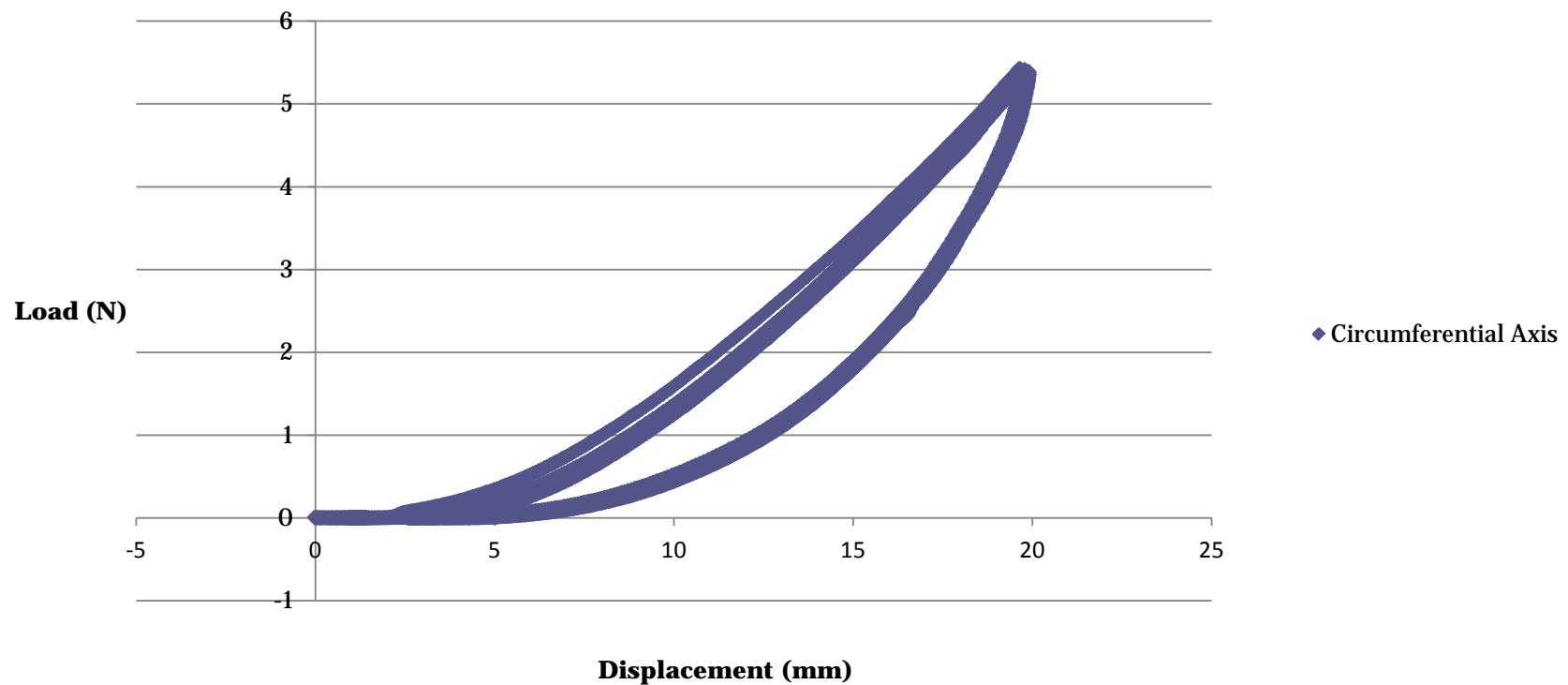


### 2:1 Ratio



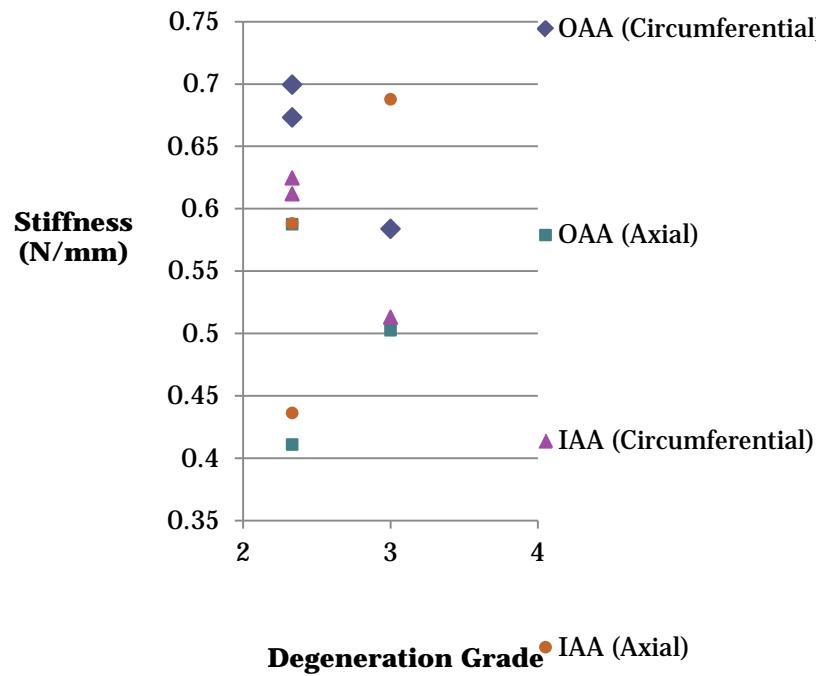
# Data Analysis - Tensile Loading

## Circumferential Axis

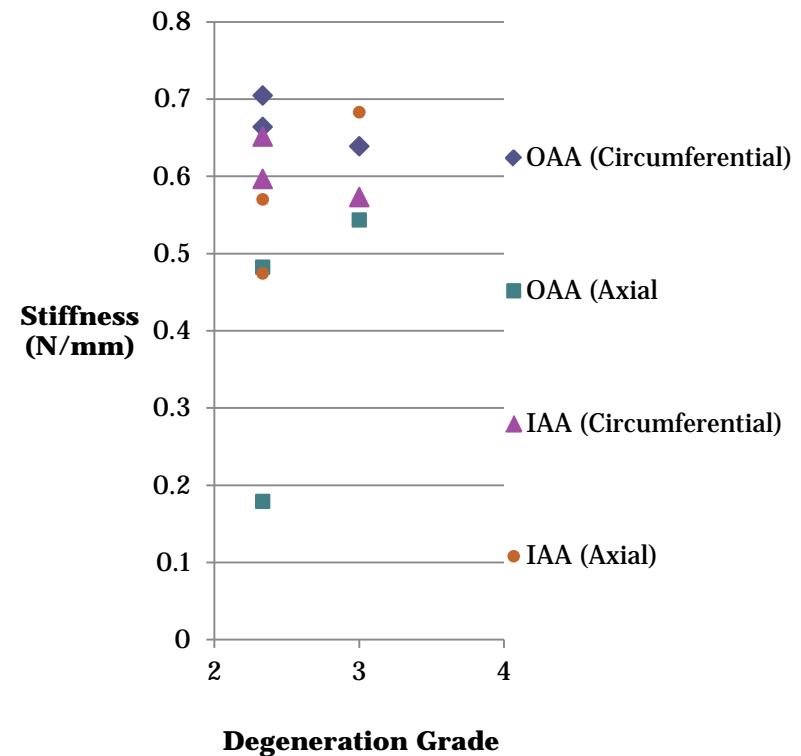


# Results - Tensile Loading

**2:1 Ratio**

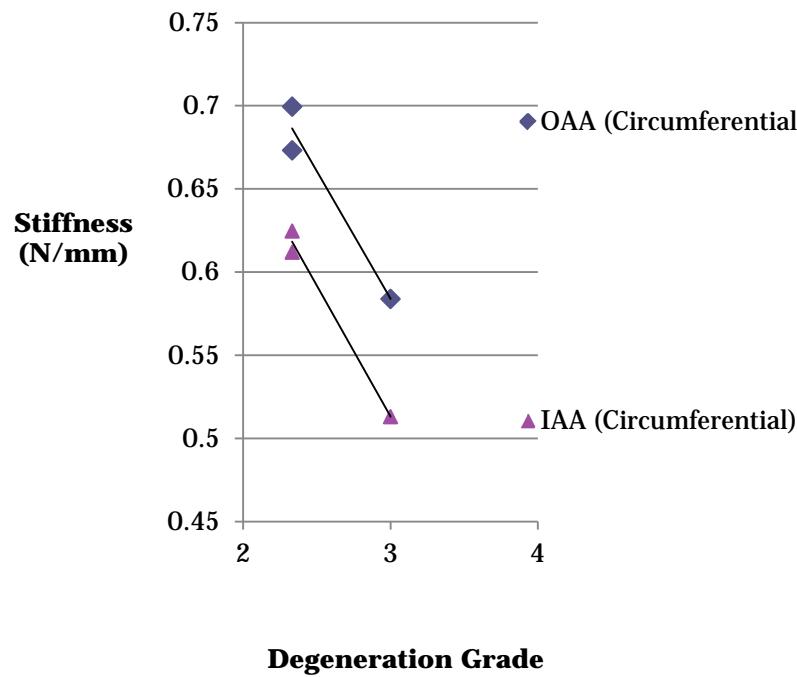


**1:1 Ratio**

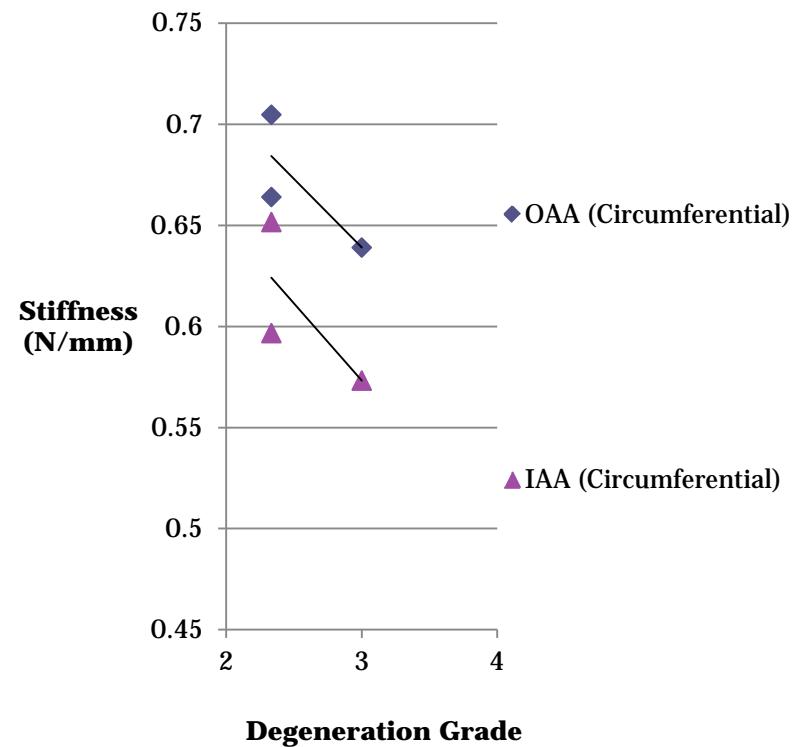


# Results - Tensile Loading

**2:1 Ratio**



**1:1 Ratio**



# Conclusions and Future Work

- Protocol Development
- Distinction between regions
- Noticeable trends
- Limitations
- Parameters for finite element models

# Acknowledgements

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Dr. Daniel H Cortes

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National Science Foundation

# % Solid Contribution vs. Degeneration

