

# **SUNFEST 2004: Final Presentation**

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McKay Orthopaedic Surgery Research Laboratory



## Two Projects

Primary: Mouse
 Intervertebral Disc
 (IVD) Imaging and
 Analysis Protocol
 Enhancement

 Secondary: Compression Testing Device

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# **Compression Testing Device**

### Wade Johannessen: project advisor

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# Background

- Graduate thesis...
  - Disc degeneration begins in the nucleus pulposus
  - Direct compressive testing is needed on both healthy and degenerated nucleus samples

### The Device

- Applies a load directly to the sample
- Using computer interface, measures and displays compressive force applied and sample displacement

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### Procedure

- Assemble parts
- Calibration
  - LVDT
  - Load sensor
- Create computer interface
- Test on various samples

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## LVDT calibration

Voltage vs. Position



## Currently and Future

All parts have arrived

Some remain to be assembled

Finish creating interface
Test



Mouse Intervertebral Disc Imaging and Analysis Protocol Enhancement

Chandra S. Yerramalli: project advisor

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# Background

### Former senior design project

- Premise: Create a mechanical model of the mouse IVD
- Use this information to then model the human lumbar disc

### • Designed a protocol which would:

Show both the gross disc and nucleus pulposus areas separately

- Calculate area measurements

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### Previous Project

### Block / Process Diagram



\* Copied from Patrick Antkowiak's slide presentation

## The Intervertebral Disc



http://www.nlm.nih.gov/medlineplus/ency/imagepages/19469.htm

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# My Project

- Protocol enhancement
  - Improving the sectioning, staining and imaging process
  - Add more measurements to the MatLab program

- Three Steps:
  - 1. Understanding the former protocol
  - 2. Devise improvements/ enhancements
  - 3. Execute new, improved protocol

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## Obstacles/Difficulties

- Working with soft tissues
- Finding out which methods for staining, sectioning, etc. worked best
- Working on two projects at once
- No programming experience

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Improving the sectioning and staining

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## Improving the MatLab program

- Original Outputs
  - Gross disc area
  - Nucleus area
  - Annulus area
  - Binary image of the disc and nucleus

- Current Outputs
  - All those mentioned before plus...
  - A plot of the major and minor axes of both the gross disc and nucleus, as well as the centroids of both
  - Length of all axes
  - "offset value": the distance between the two centroids
  - Aspect ratio (maj axis/min axis)

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Use the crosshairs and click points to select the entire disc Right-elick-the-mouse-when you have finished selecting the region 50 Now, de the same, this time outlining the nucleus. 100 150 200 250 300 350 400 450 100 200 300 400 500 600

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Finally, select the endpoints of the NP major axis, from left to right. Then hit ENTER.

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### But wait...

These clicks are at random

How do we know the resulting centroid plots, major and minor axes, and all the measurements based off them are valid?

- Short study
  - -15 trials of random clicks on the same disc
  - Compiled the function outputs for all trials
  - Took average and standard deviation measurements

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# Next Steps

- Explore other methods of calculating and plotting the axes
- Use this protocol in a study

Compare geometric properties and see if a correlation between that and mechanical properties exists

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# Takeaways

- Programming experience
- Dissection
- Familiarity with lab equipment
- Basic understanding of the spine and biomechanics in general
- How research is done
  - From idea to abstract to journal article
- Insight into future career path

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# Thank you!

- In the second second
- Everyone at McKay Orthopaedic Laboratory
- Penn Library staff
- My advisors
- ♦ SUNFEST
- ♦ You!



# Questions?

