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# Biomechanical Evaluation of the Newly Developed Decompression Surgery: Transforaminal Ventral Facetectomy

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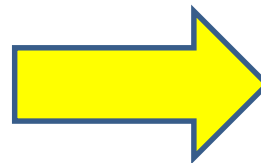
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University of Toledo

# Background: PEVF

- Percutaneous Endoscopic Transforaminal Ventral Facetectomy (PEVF)
    - *Sairyo et al. J Med Invest 2017*
  - Using the PEVF, foraminal and lateral recess stenosis can be simultaneously performed.
  - Ventral aspect of the facet joint is removed.
- However, the biomechanical effects of the PEVF are not clear.**



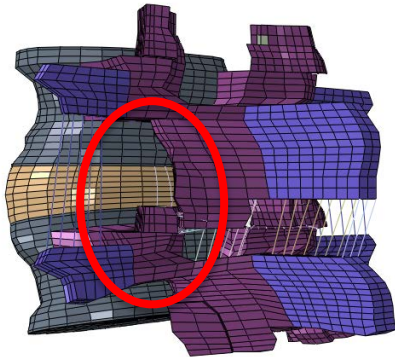
# Project Aims

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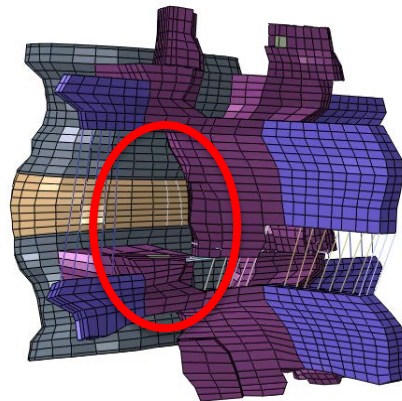
**Aim:** Elucidate the biomechanical effects of the PEVF using the finite element approach

**Hypothesis:** PEVF will provide better segmental stability than traditional approach

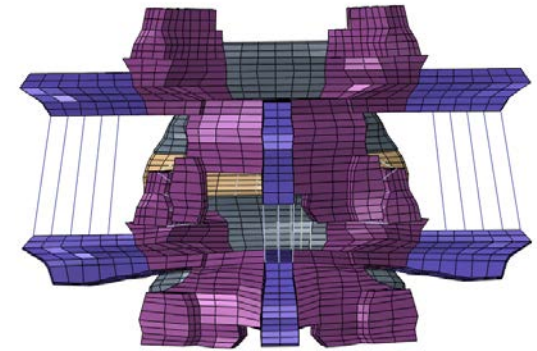
## Finite element modeling: L4-L5 motion segment



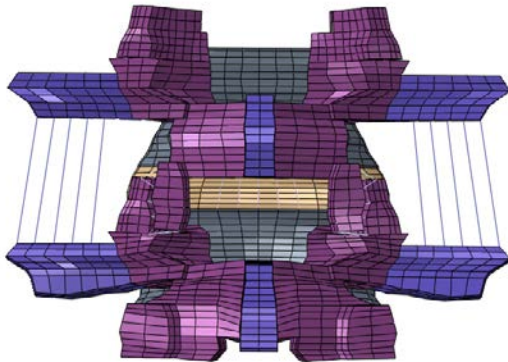
1. 50% PEVF  
50% resection of the superior articular process



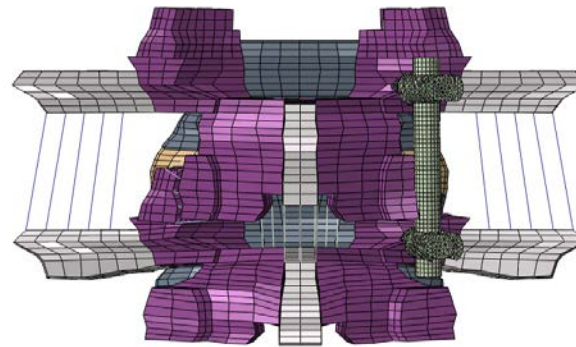
2. 100% PEVF  
100% resection of the superior articular process



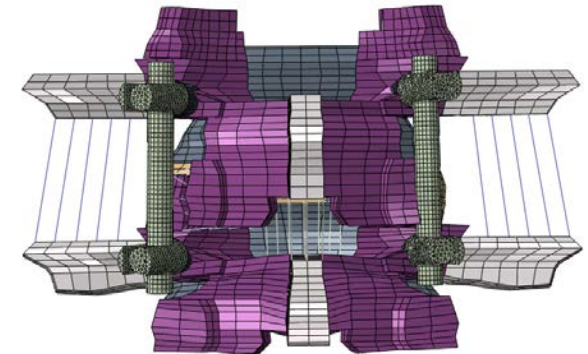
3. MIS laminectomy  
Resection of the medial parts of the facets the adjacent lamina on the procedure side



4. OPEN laminectomy  
Resection of the medial parts of the facets, the adjacent lamina on both sides



5. Unilateral TLIF



6. Bilateral TLIF

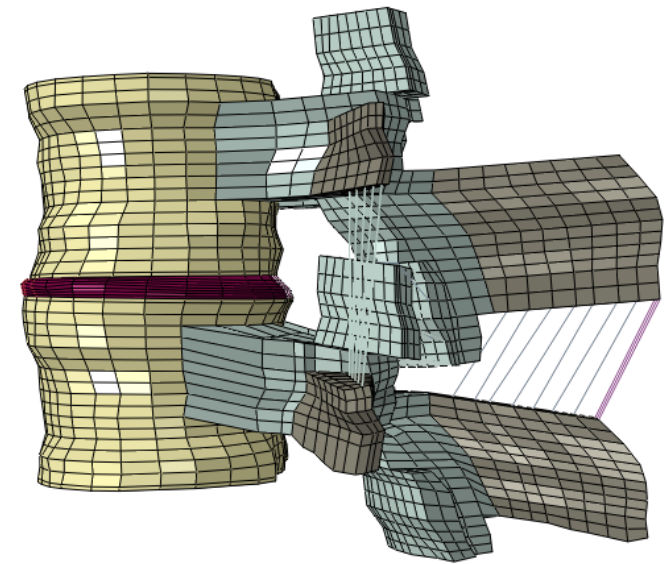
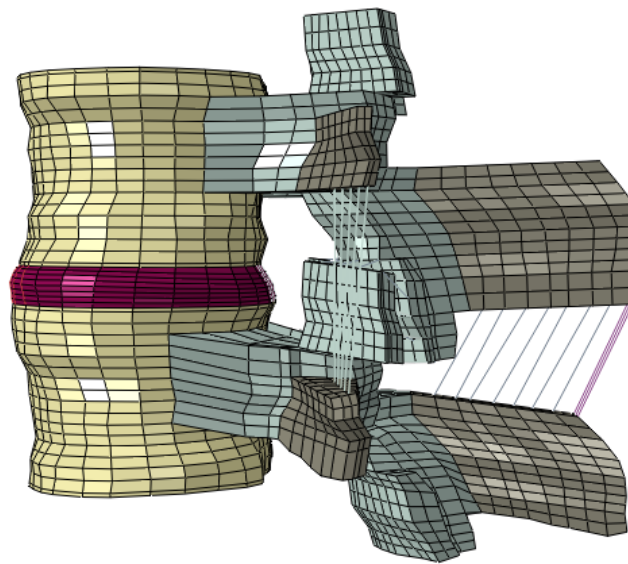
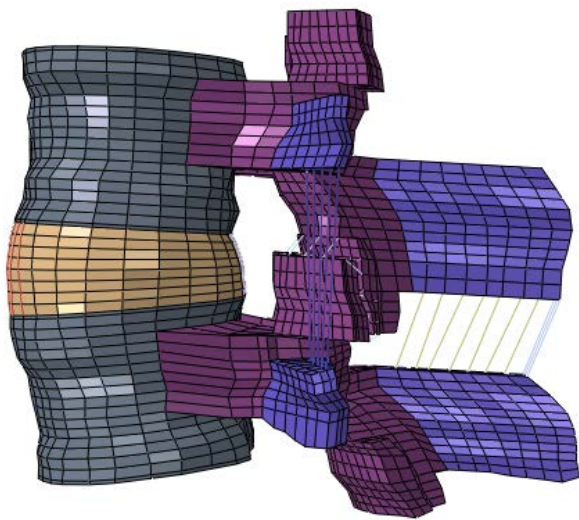
# Disc Degeneration Models

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NORMAL DISC

50% DISC COLLAPSE

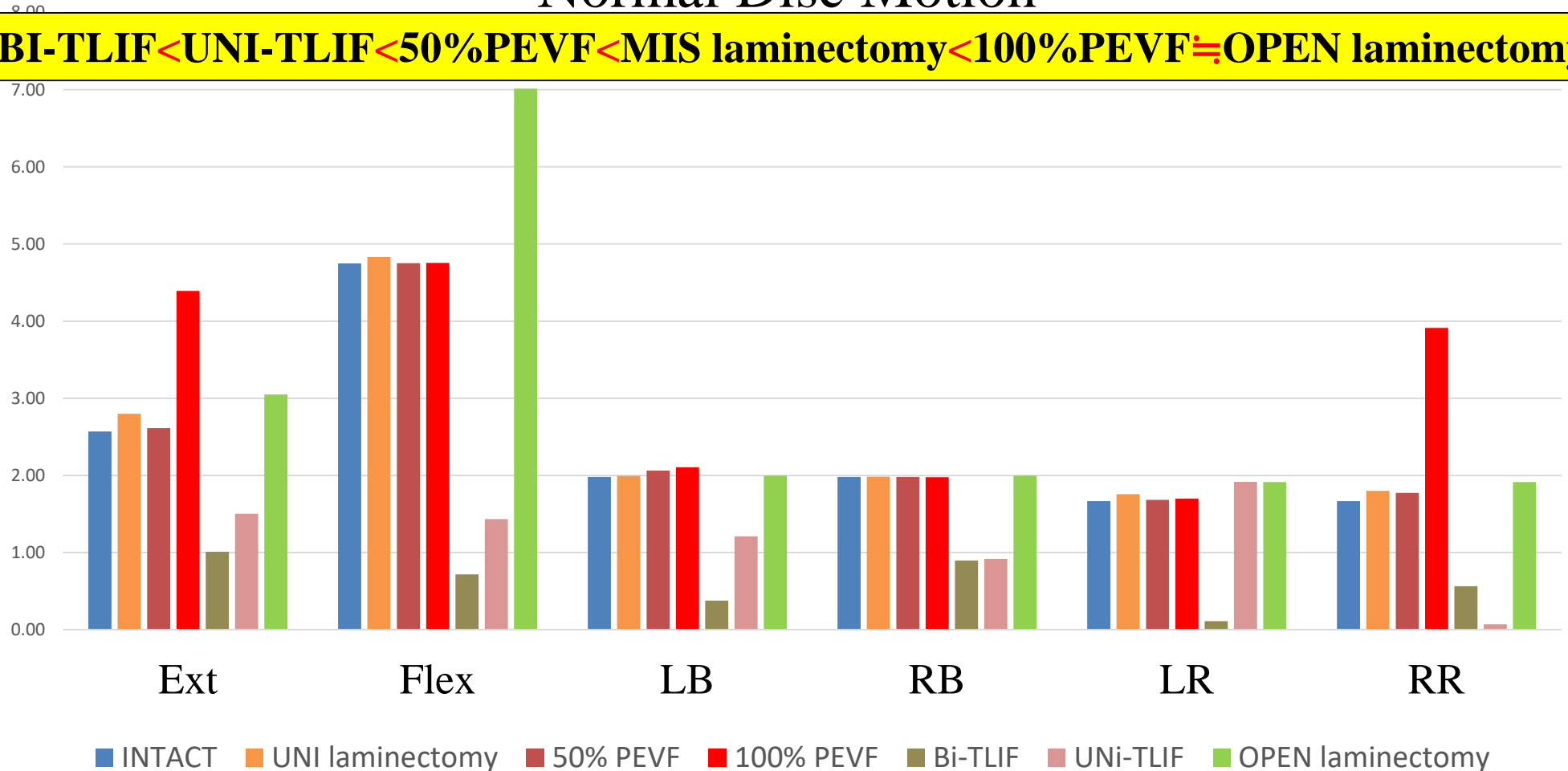
80% DISC COLLAPSE



# ROM Results

## Normal Disc Motion

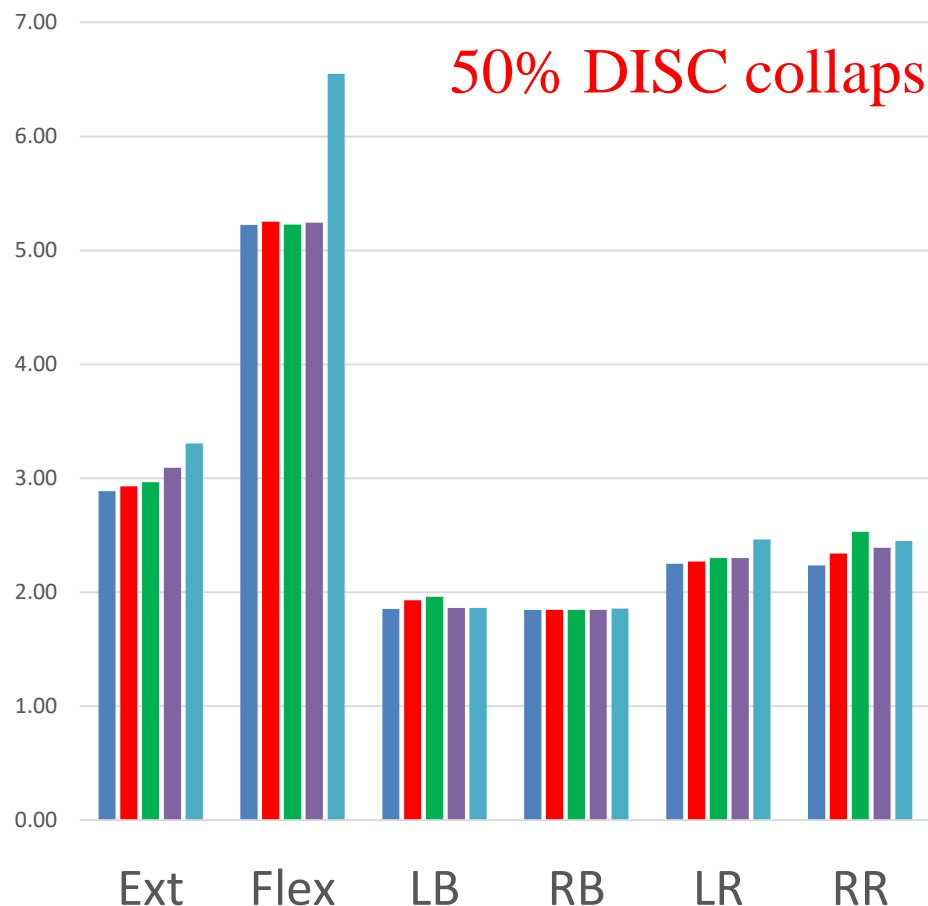
**BI-TLIF < UNI-TLIF < 50%PEVF < MIS laminectomy < 100%PEVF ≅ OPEN laminectomy**



Out of all the scenarios without instrumentation, the lowest instability surgery is 50% PEVF.

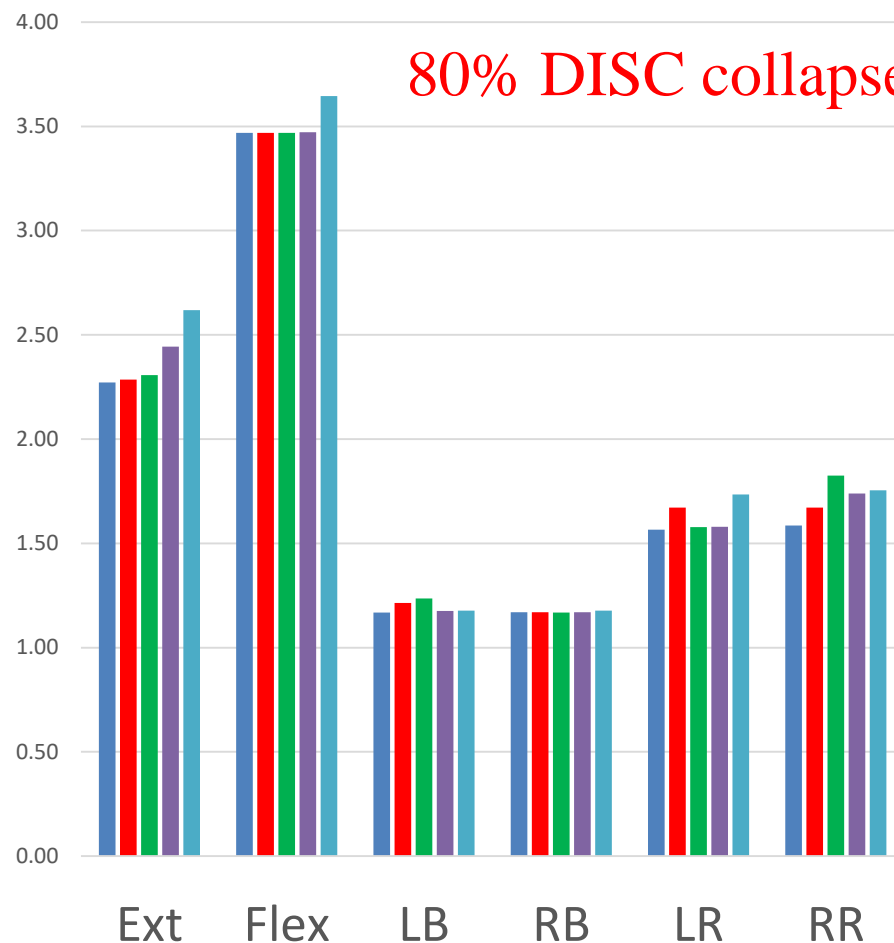
# ROM Results

50% DISC collapse



- INTACT
- 50% PEVF
- 100% PEVF
- MIS-LAMINECTOMY
- OPEN-LAMINECTOMY

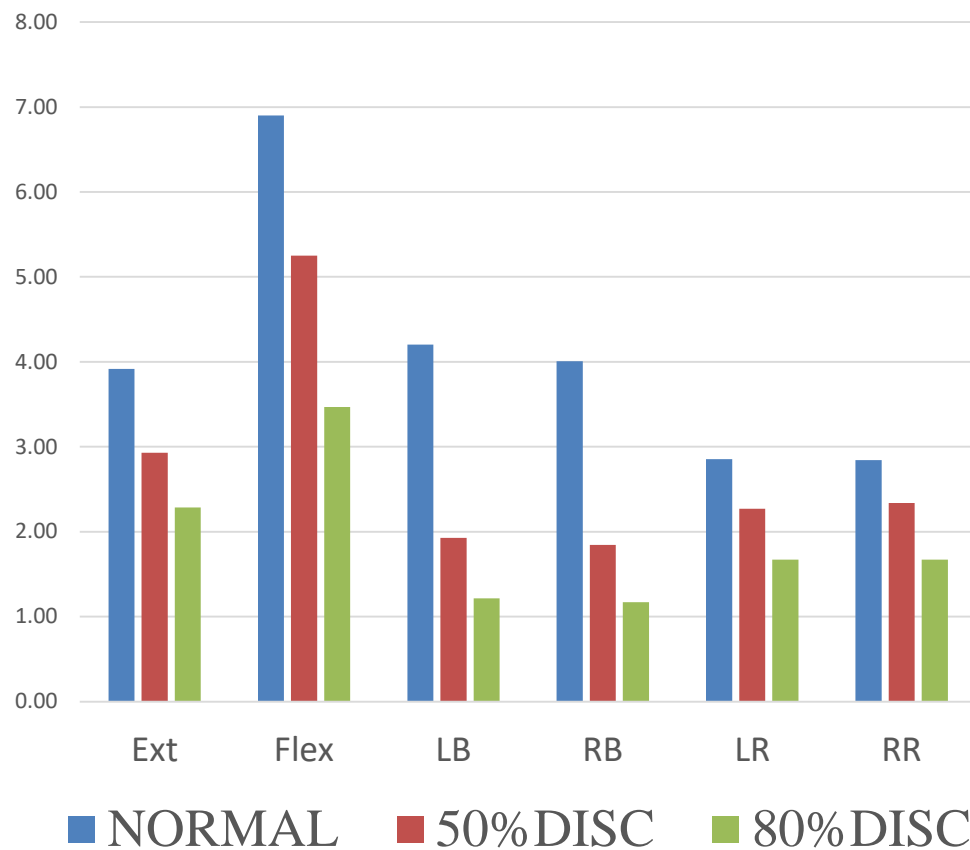
80% DISC collapse



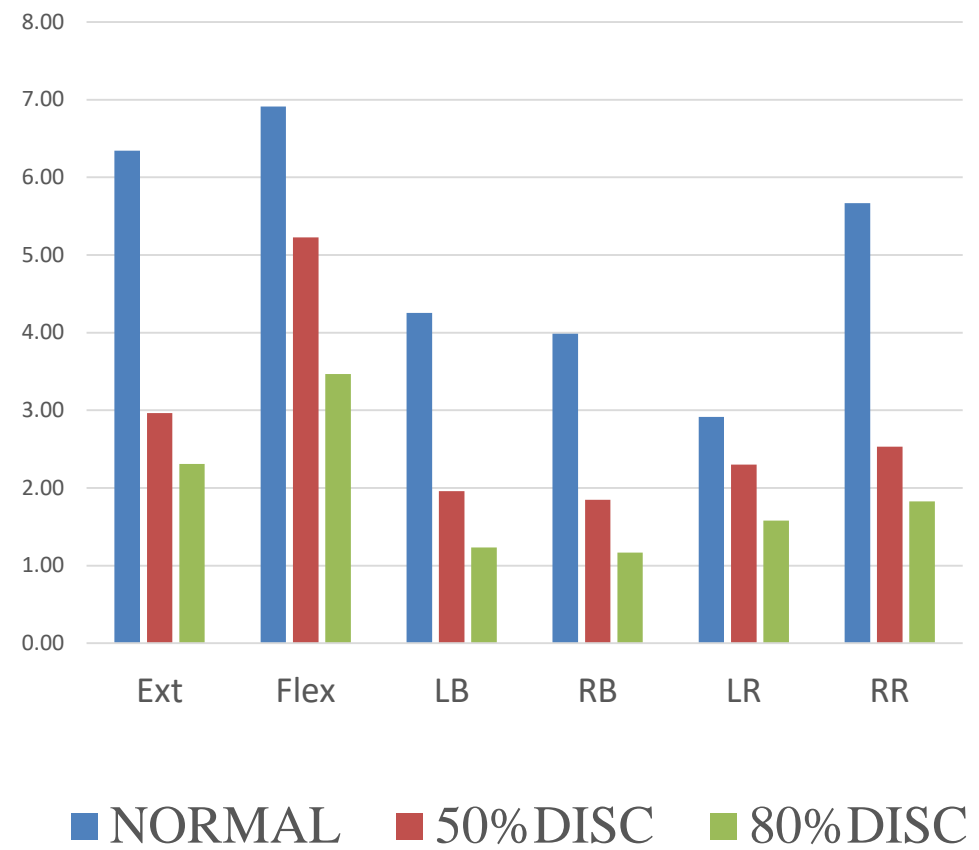
- INTACT
- 50% PEVF
- 100% PEVF
- MIS-LAMINECTOMY
- OPEN-LAMINECTOMY

# ROM Results

## 50% PEVVF



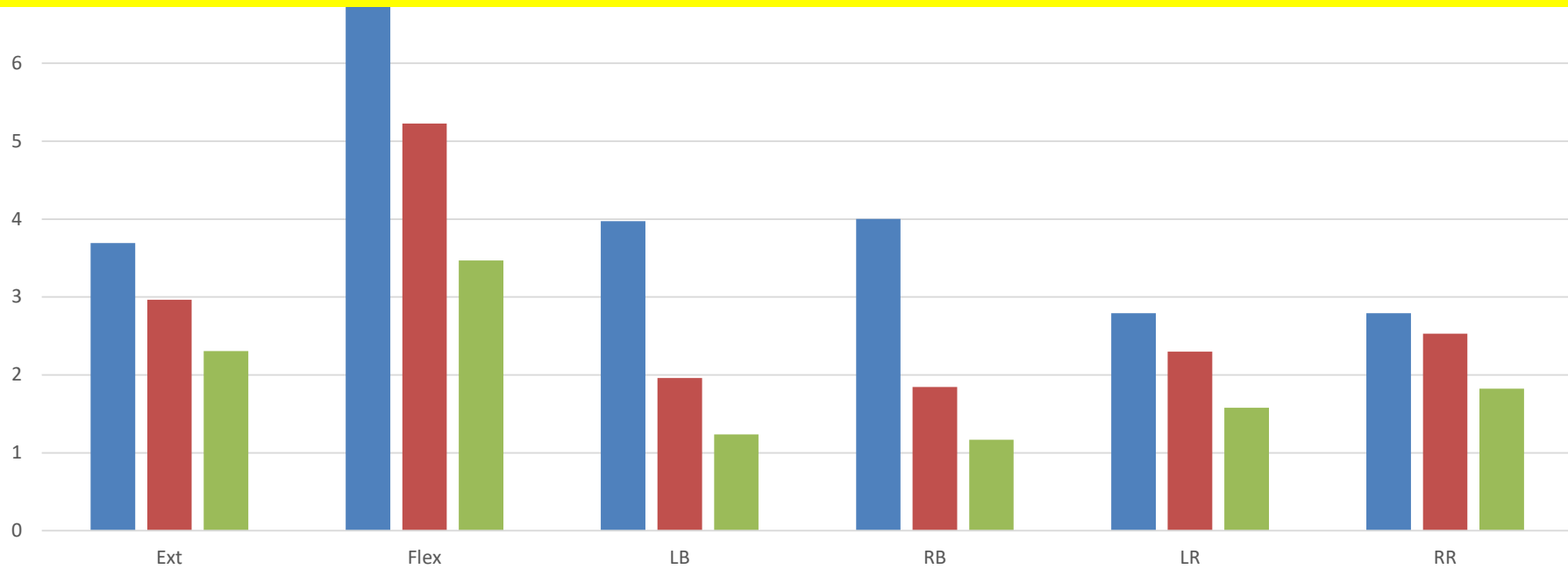
## 100% PEVVF





# ROM Results

INTACT(NORMAL DISC) vs 100% PEVVF(50% PEVVF,80% PEVVF)

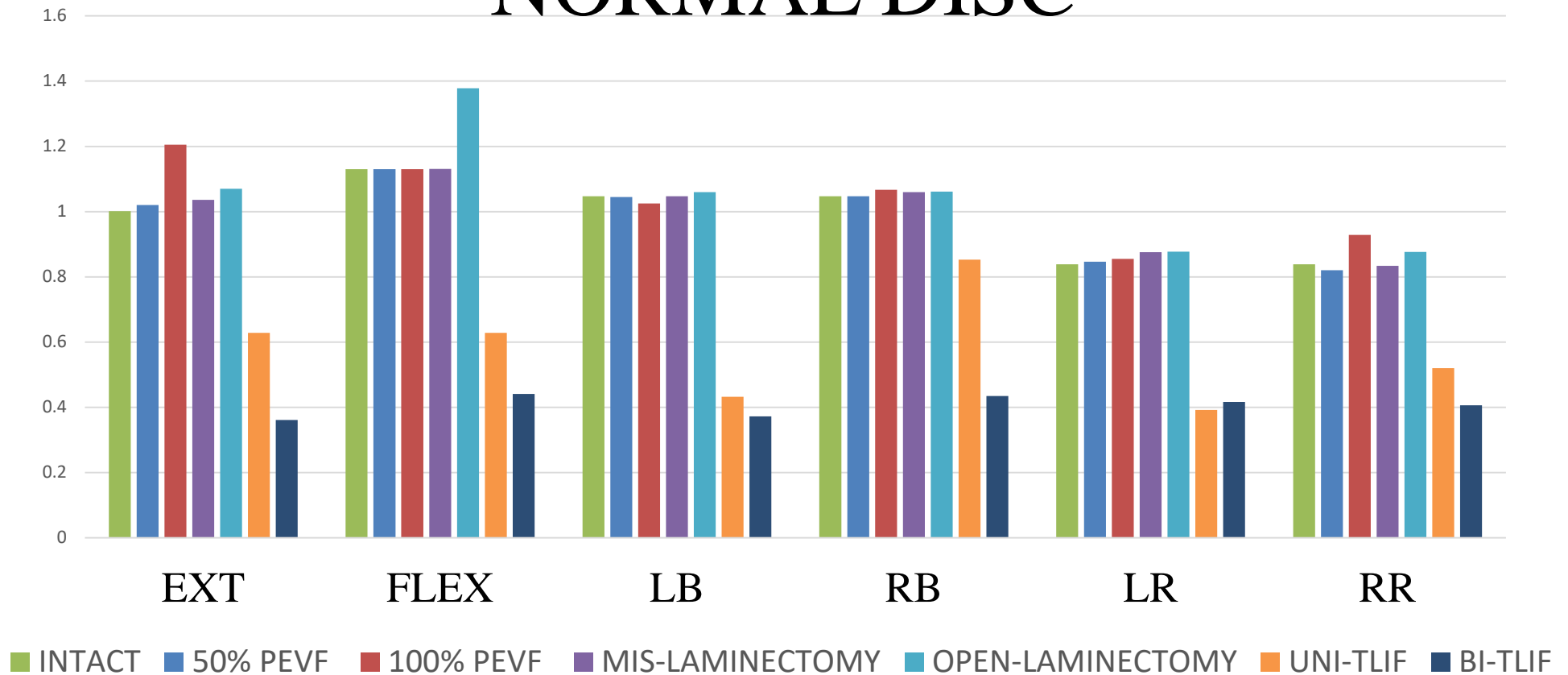


■ INTACT(NORMAL) ■ 100%PEVVF(50%DISC) ■ 100%PEVVF(80%DISC)

INTACT (NORMAL DISC) > 100% PEVVF(50% and 80% disc collapse)

# Results: Disc Stress

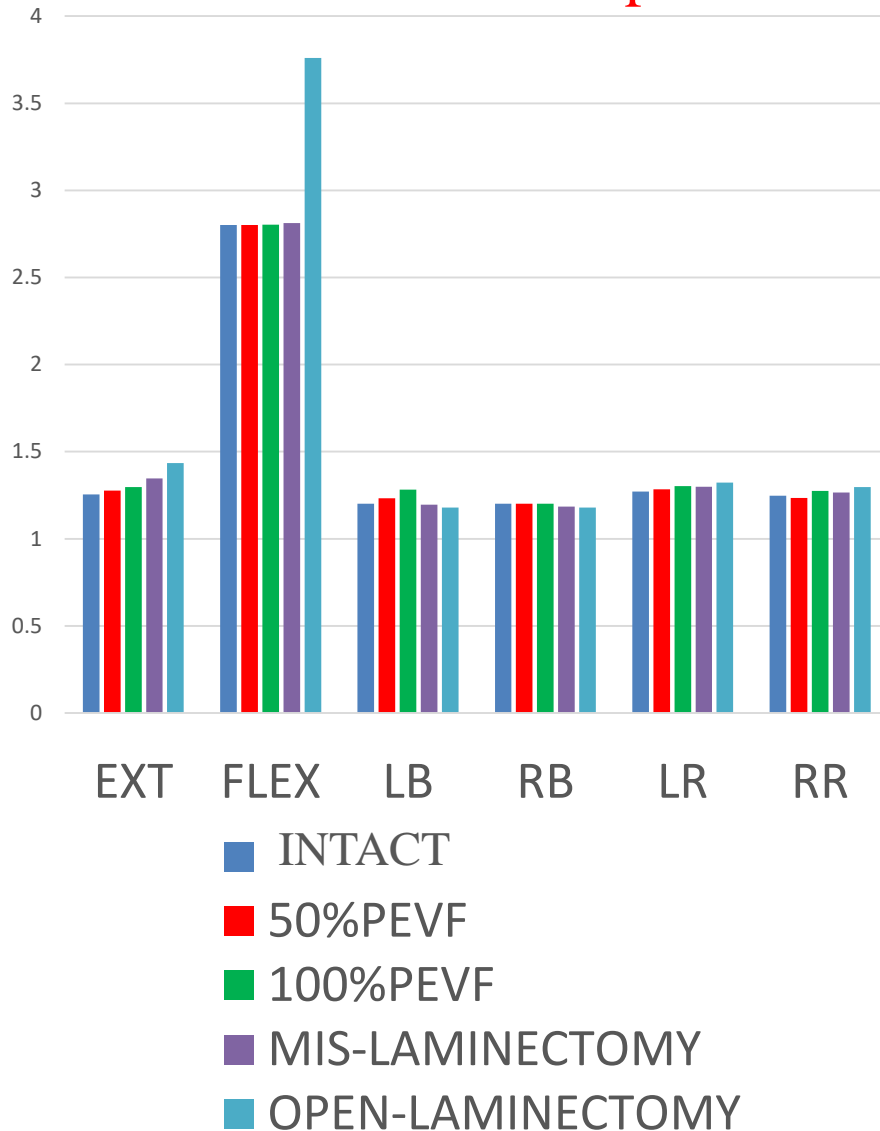
## NORMAL DISC



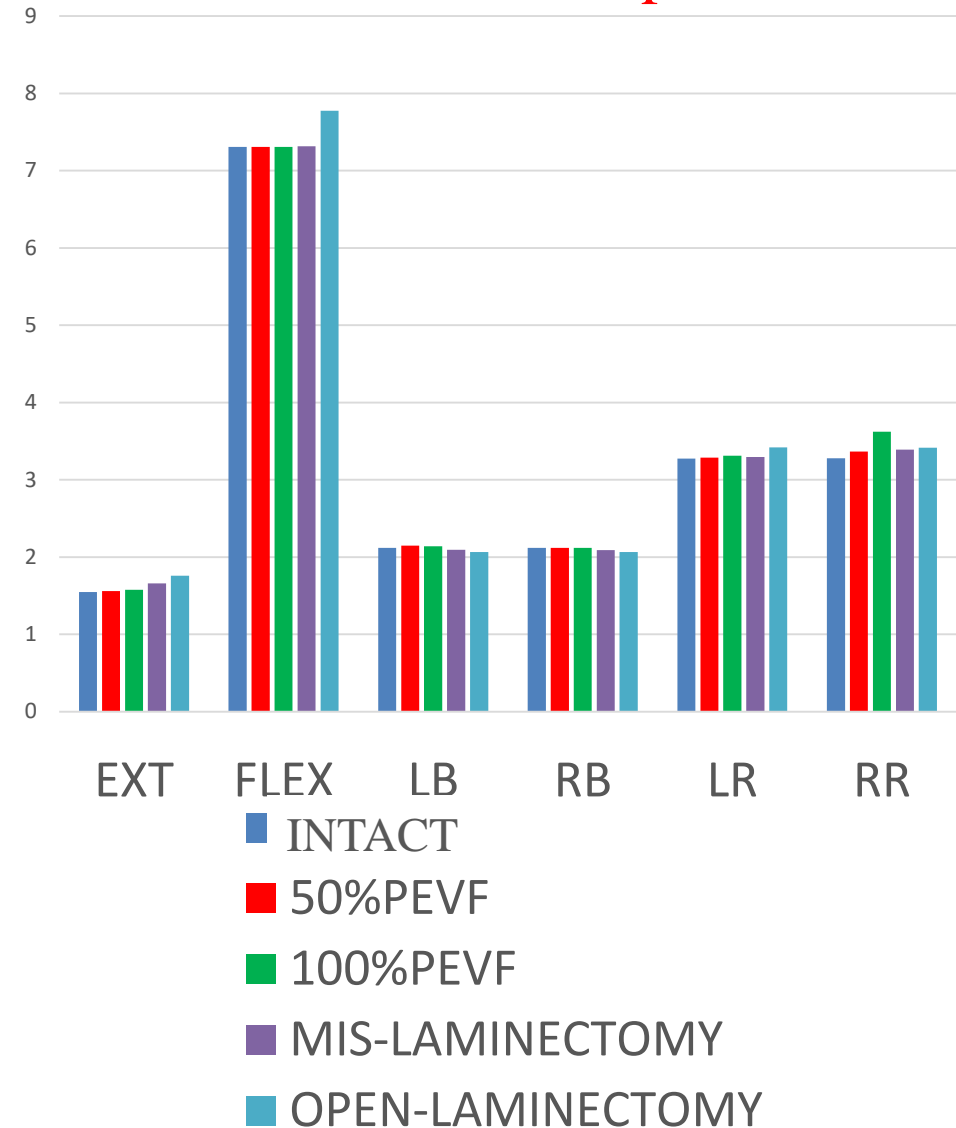
The lowest disc stress is with 50% PEVF in NORMAL DISC

# Results: Disc Stress

50% Disc collapse

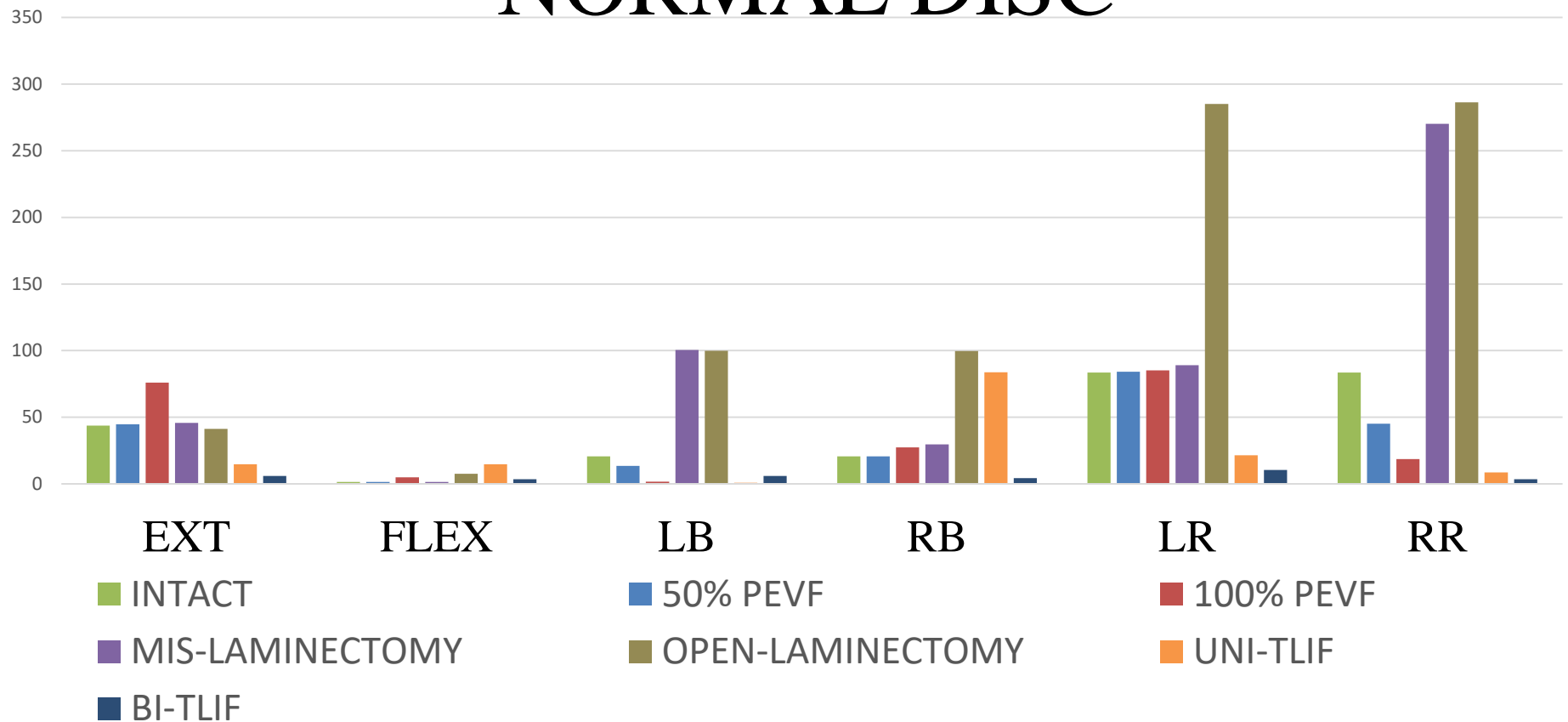


80% Disc collapse



# Results: Facet Stress

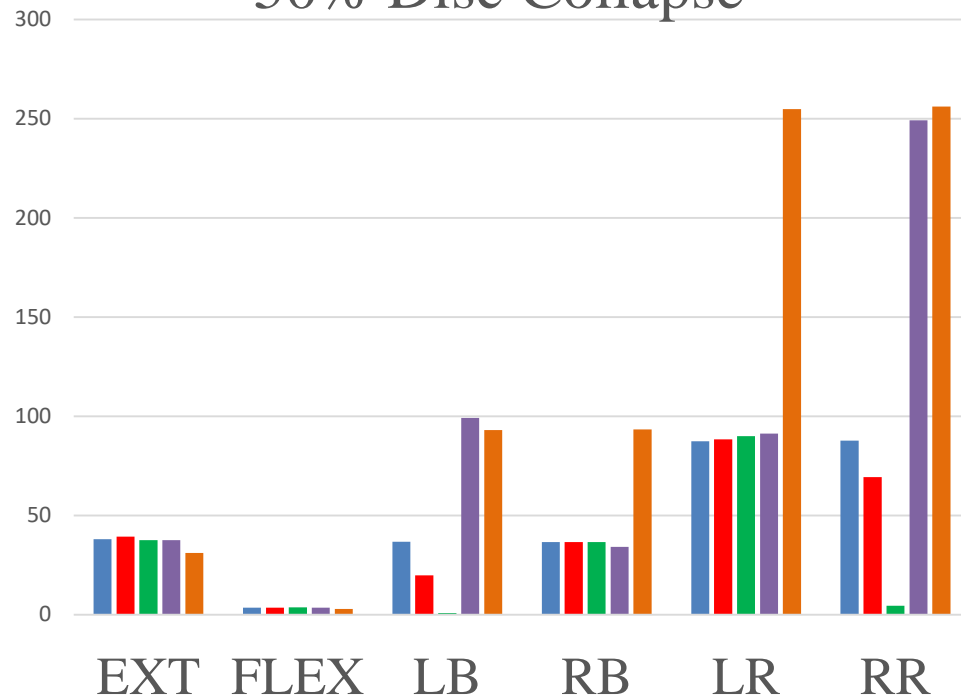
## NORMAL DISC



Laminectomy simulations produced average higher stresses than PEVF

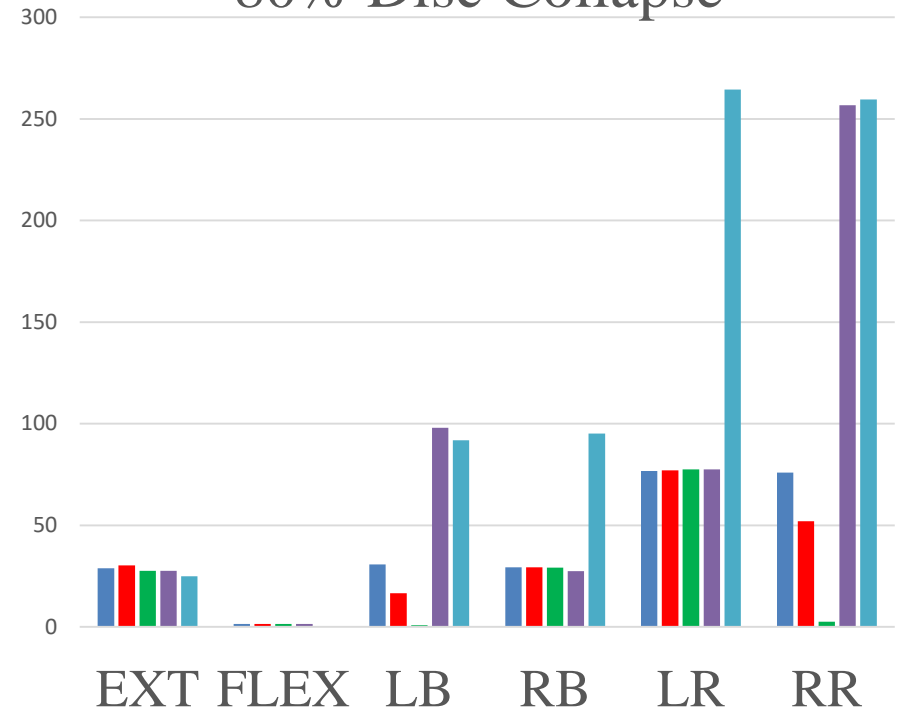
# Results: Facet Stress

## 50% Disc Collapse



- INTACT
- 50% PEVF
- 100% PEVF
- MIS-LAMINECTOMY
- OPEN-LAMINECTOMY

## 80% Disc Collapse



- INTACT
- 50% PEVF
- 100% PEVF
- MIS-LAMINECTOMY
- OPEN-LAMINECTOMY

- Out of all the scenarios without instrumentation, the lowest instability surgery is 50% PEVF.
- The highest instability surgery is 100% PEVF or open laminectomy.
- ROM after PEVF in 50% and 80% disc collapse models decrease when compared with normal disc.
- Even 100% PEVF can be effective in 50 and 80% disc collapse models because ROM of 100% PEVF in disc degeneration model are lower than ROM of intact model in normal disc.
- The lowest stress of disc is with 50% PEVF in all the cases.
- Facet stress with 50% PEVF are less than conventional laminectomy (MIS-laminectomy and open-laminectomy) in all the scenarios.
- These low values of annulus and facet stress in 50% PEVF may prevent subsequent degeneration of discs and facet joints.

# Conclusion

- 50% PEVF is the lowest instability surgery.
- Even 100% PEVF may be effective in 50% and 80% disc collapse patients.
- 50% PEVF could be effective in minimizing degeneration of disc and facet after surgery.

# Milestones & Timeline

- Develop and validate expandable cage models and PEVF+fixation model- April 2018
- Finish/perform all analysis–May 2018
- Data analyses, publications, and final report–June 2018



# Acknowledgements

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- ECORE Team
- CDMI
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