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MUSCULOSKELETAL INNOVATIONS

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

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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.**

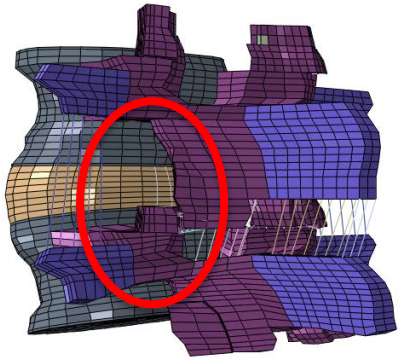
Project Aims

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

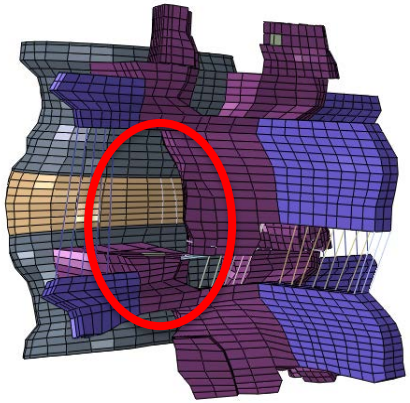
Hypothesis: PEVF will provide better segmental stability than traditional approach

FEA Models

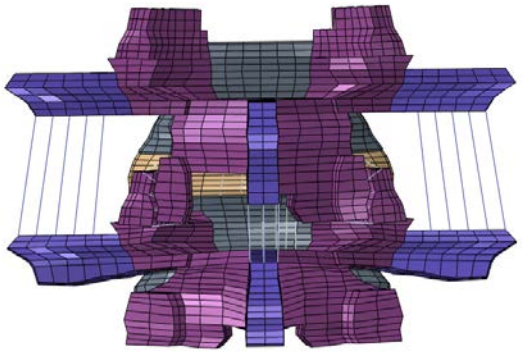
Finite element modeling- L4-L5 motion segment



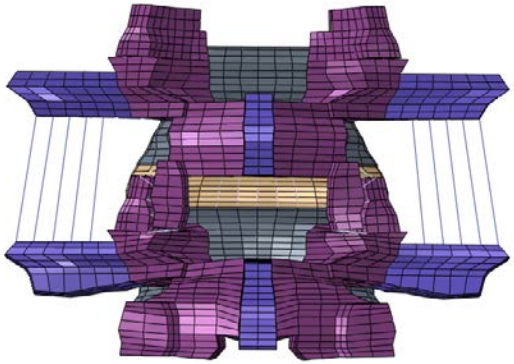
1. 50% PEVF
(50% resection of
the superior articular process)



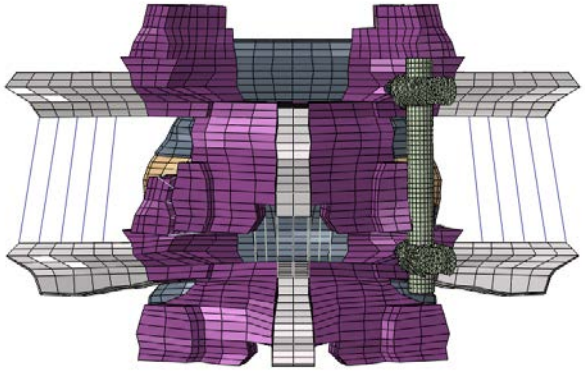
2. 100% PEVF
(100% resection of
the superior articular process)



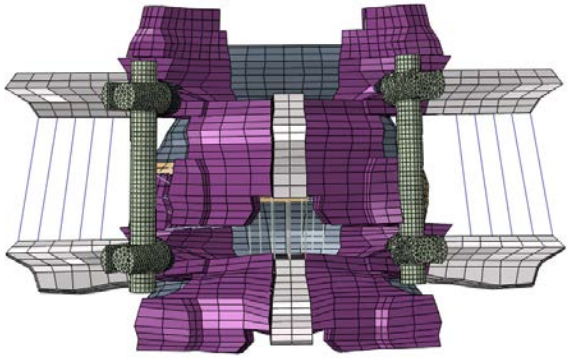
3. MIS laminectomy



4. OPEN laminectomy



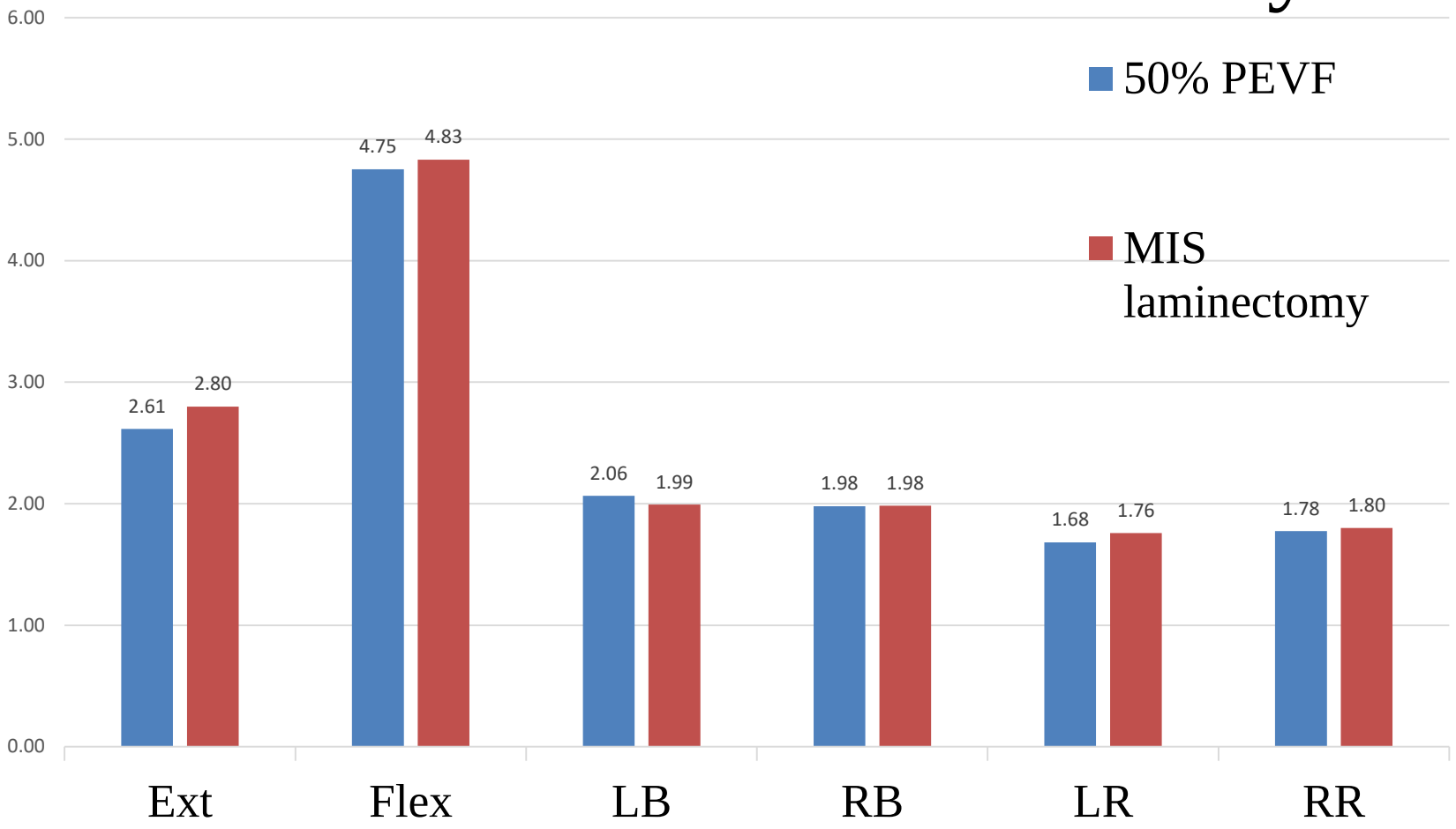
5. Unilateral TLIF



6. Bilateral TLIF

ROM Results

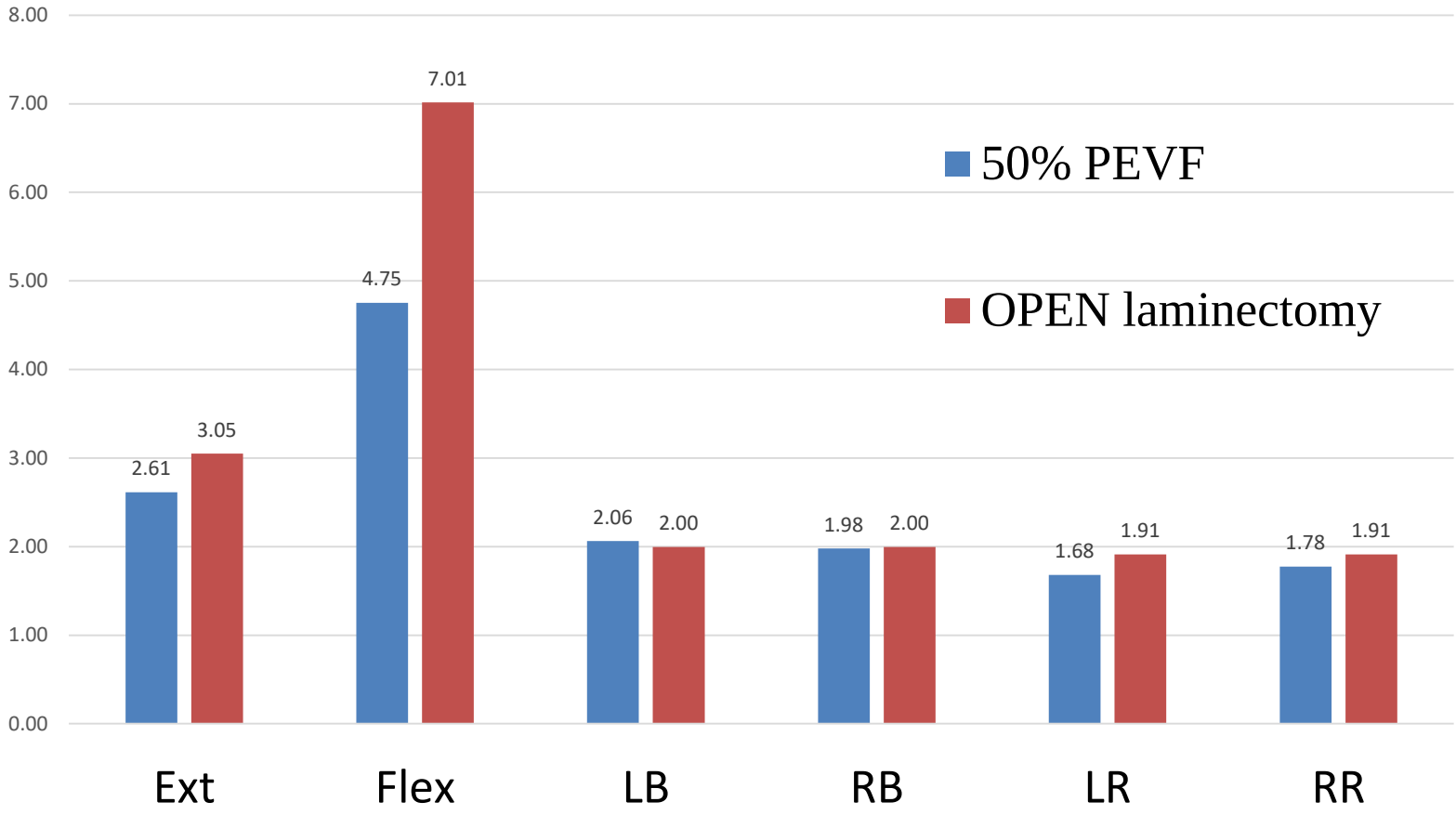
50% PEVF vs MIS laminectomy



ROM of 50%PEVF is less than MIS laminectomy except LB

ROM Results

50% PEVF vs open laminectomy

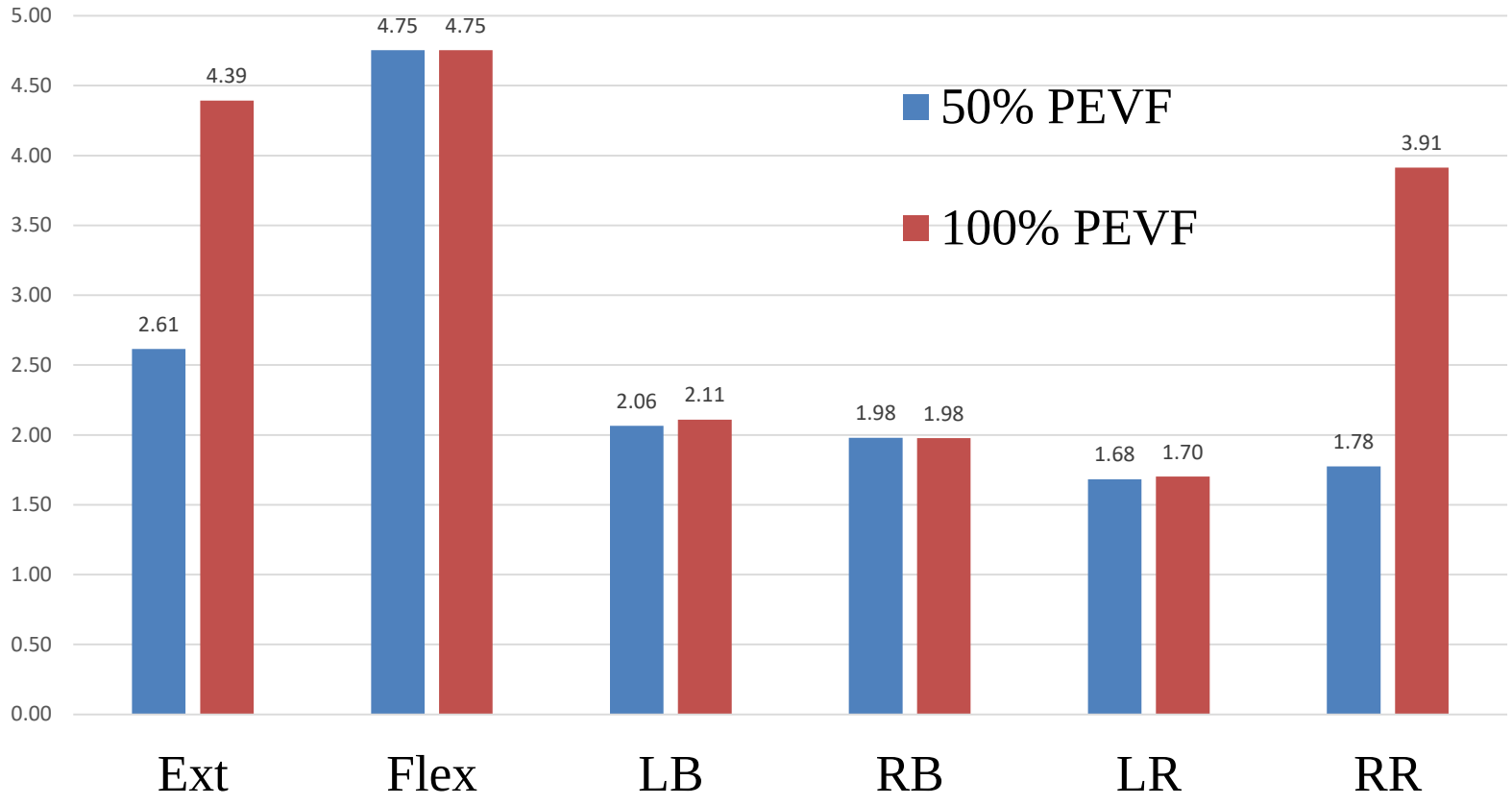


ROM of 50%PEVF is less than OPEN laminectomy except LB

ROM of 50%PEVF decreased by up to 32% (FLEX) compared to open laminectomy.

ROM Results

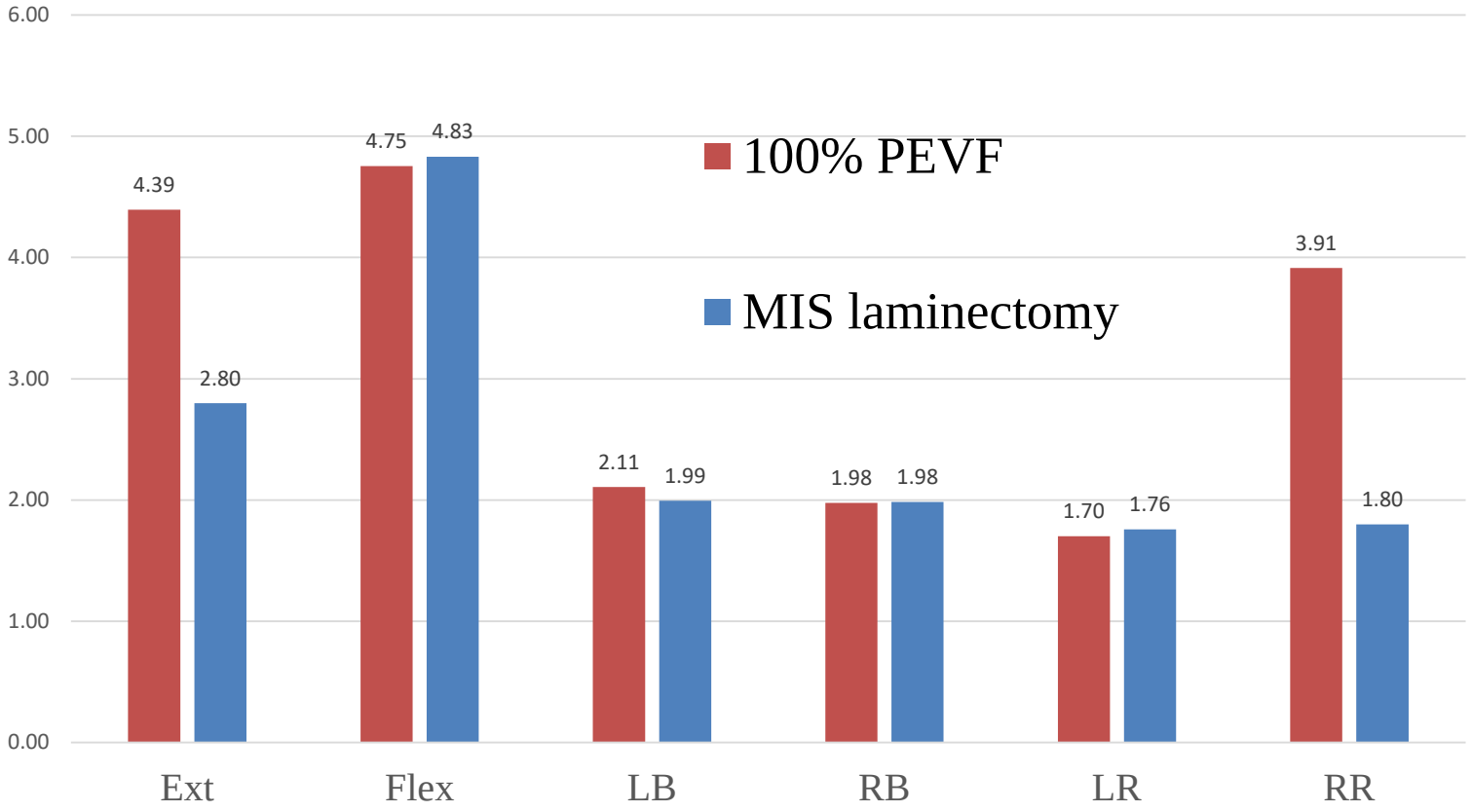
50%PEVF VS 100%PEVF



ROM of 50%PEVF decreased by 40.5%(EXT), 2.4%(LB), 1.2%(LR), and 54.5% (RR) compared to 100%PEVF.

ROM Results

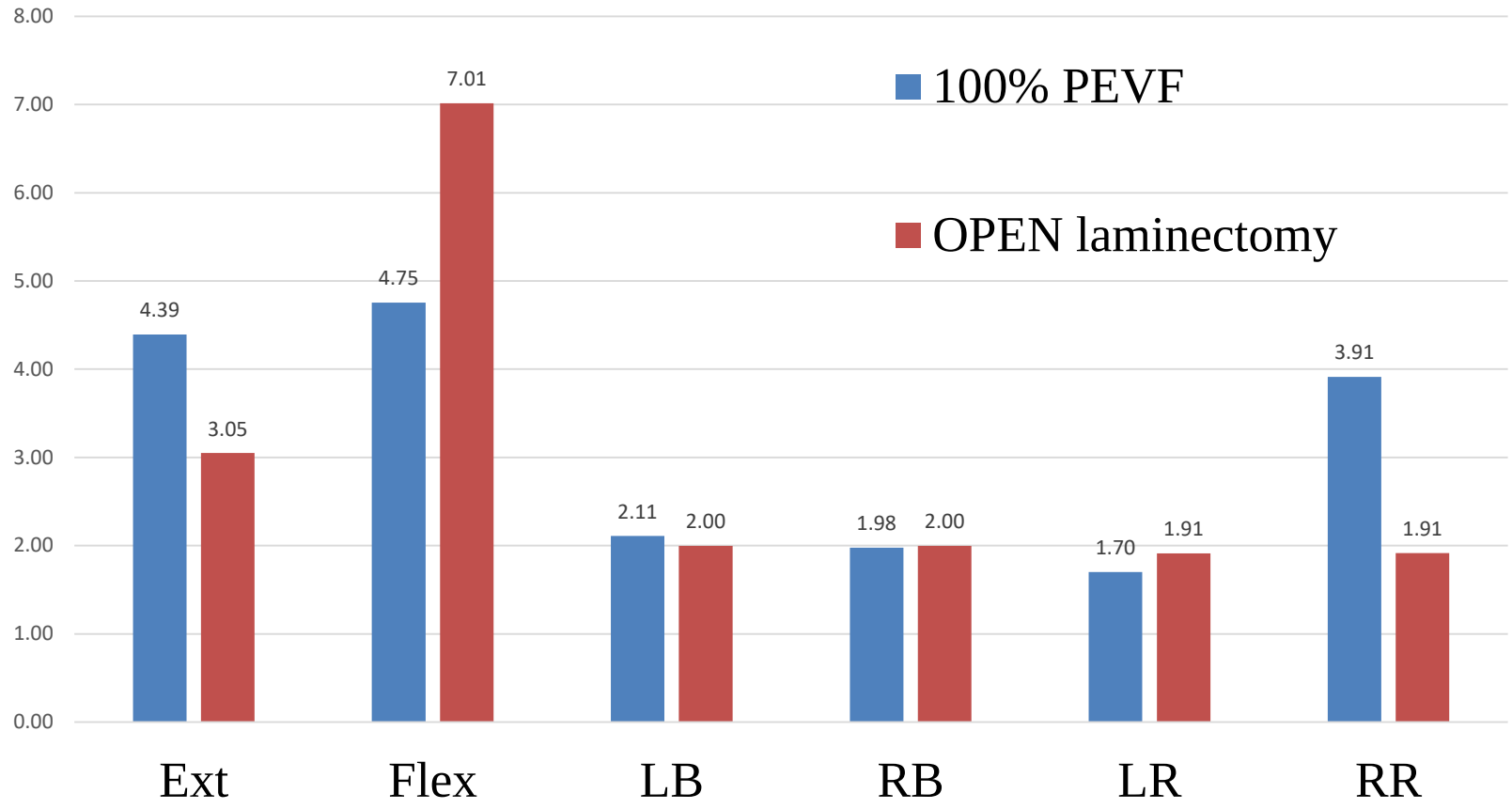
100% PEVF VS MIS laminectomy



ROM of 100%PEVF is more than MIS laminectomy except FLEX and RB
ROM of 100%PEVF increased by up to 117% (RR) compared to MIS laminectomy.

ROM Results

100%PEVF VS OPEN laminectomy

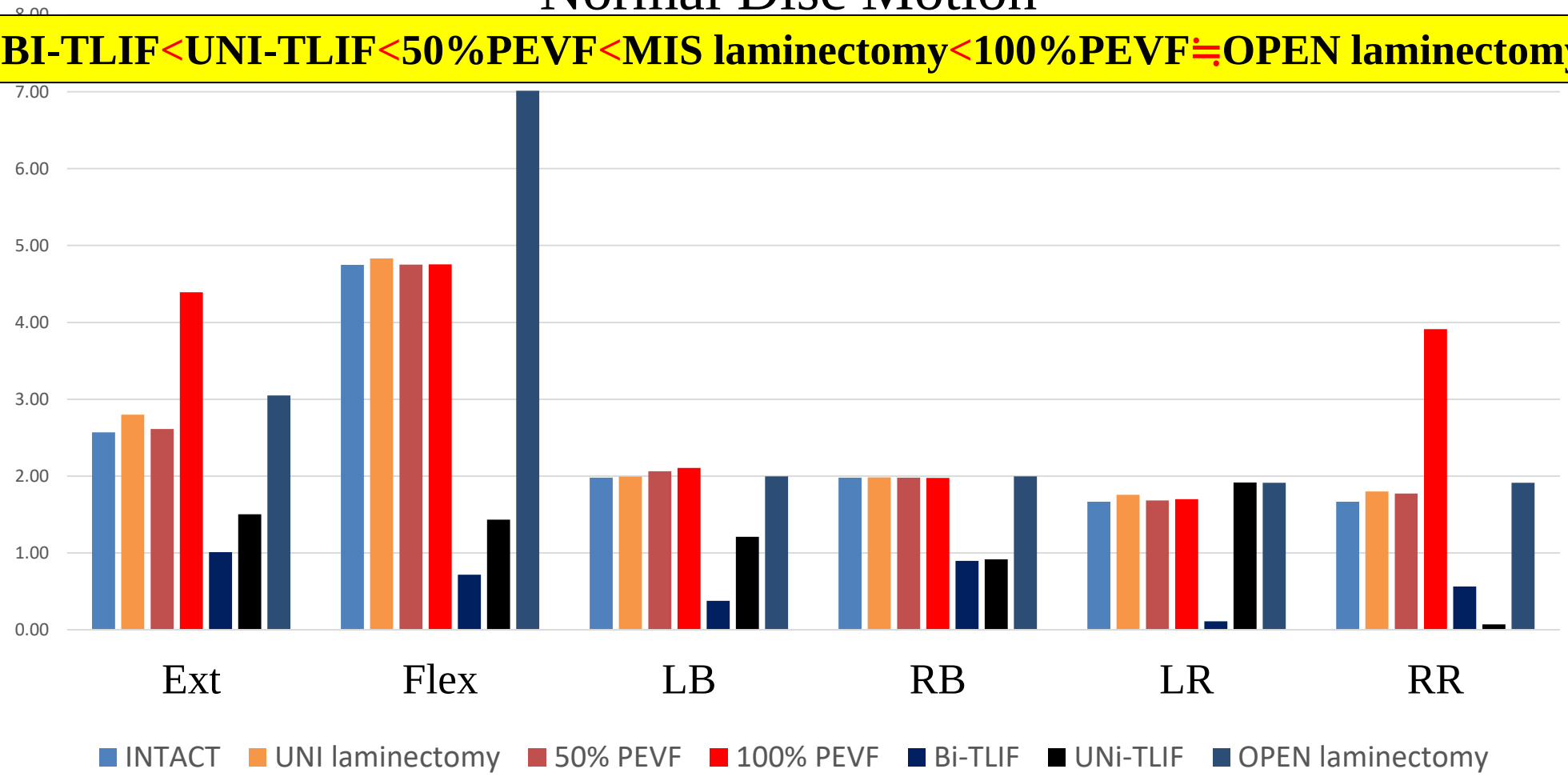


ROM of 100%PEVF increased by 43.9%(EXT), 5.5%(LB), 104.7% (RR) and decreased by 32.2%(FLEX), 1.0%(RB), 11.0(LR) compared to INTACT.

ROM Results

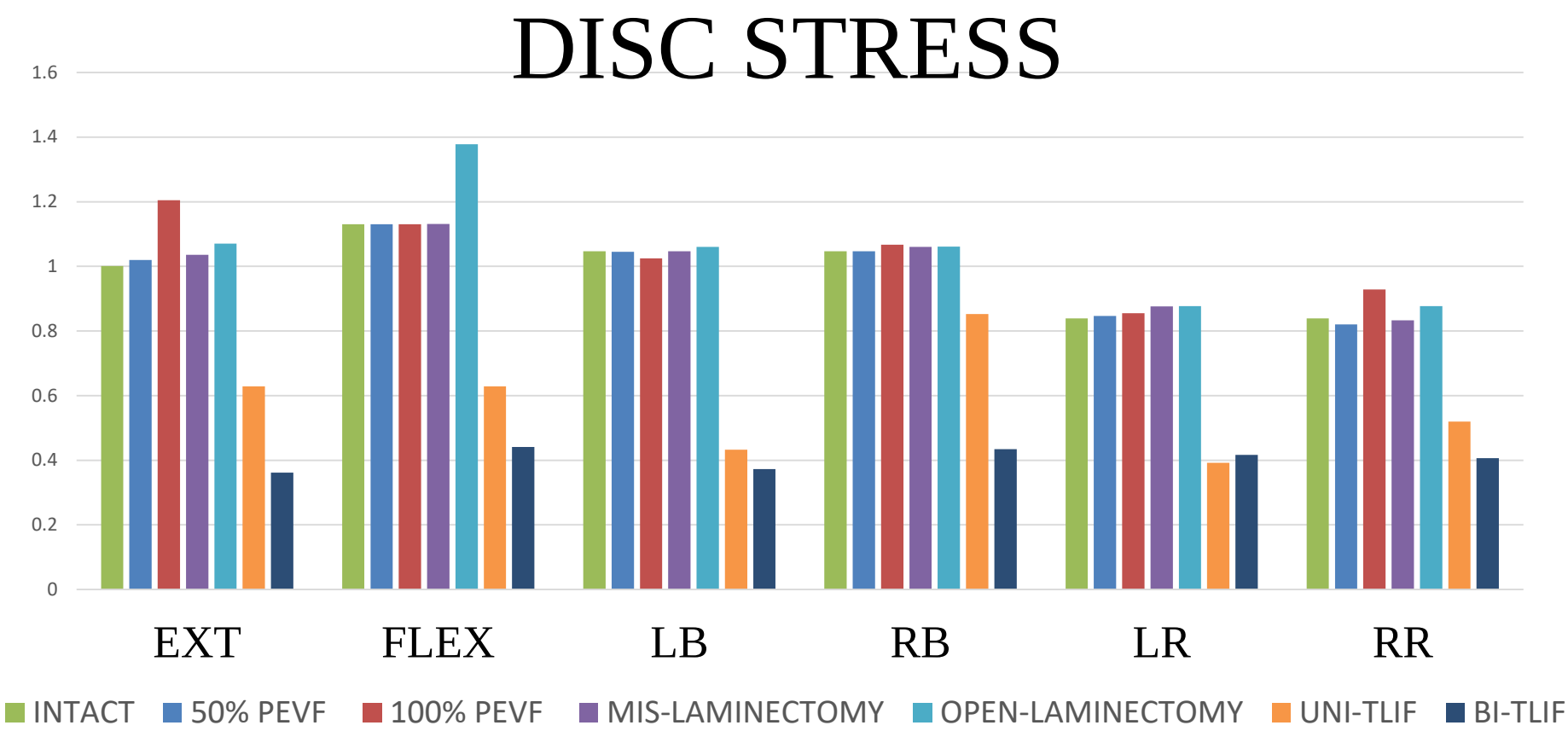
Normal Disc Motion

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



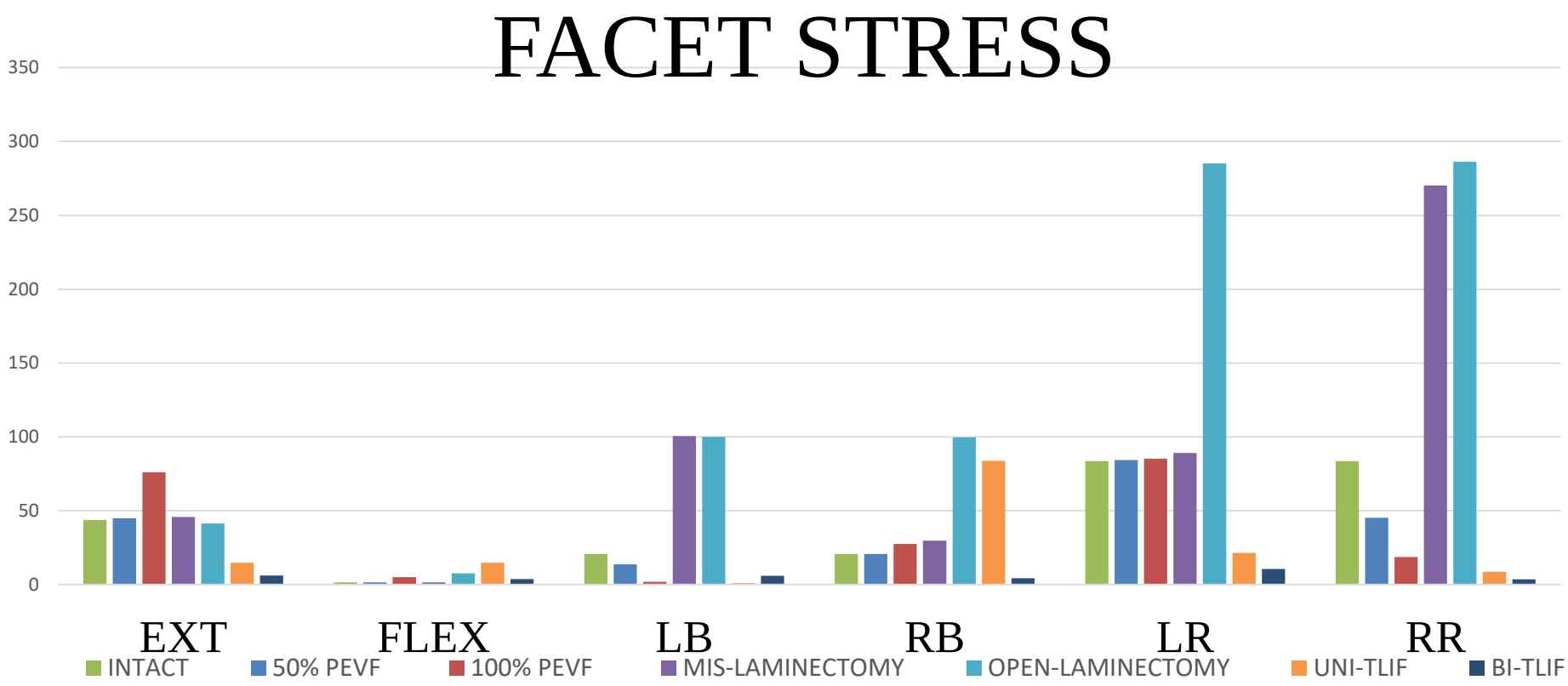
Out of all the scenarios without instrumentation, the lowest instability surgery is 50%PEVF.

DISC STRESS Results



DISC Stresses for the PEVF and Laminectomies are comparable

FACET STRESS Results



Lamniectomy simulations produced average higher stresses than PEVF

Conclusions

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

- The highest instability surgery is 100%PEVF or open laminectomy.

- Annular von mises stresses for the PEVF and Laminectomies are comparable.

- Laminectomy simulations produced average higher facet von mises stresses than PEVF.

- 50%PEVF will provide better segmental stability than traditional approach

Milestones & Timeline

- Develop and validate disc collapse models–January 2018
- Finish analysis for disc collapse models- February 2018
- Develop and validate expandable cage models- February 2018
- Finish/perform all analysis–March 2018
- Data analysis, publications, and final report–June 2018

Acknowledgements

- ECORE Team
- CDMI