Title

A Pilot Project: Mechanical Damping and the Spine

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Purpose and Design

Purpose:

A knee loading modality is reported to stimulate bone formation in the loaded tibia and femur, but its potential effect on a bone remote to the loaded bone has not been examined.

A question addressed herein was: does knee loading strengthen **mechanical properties** of trabecular bone in the spine?

Design:

Using **ovariectomized (OVX) and sham OVX control mice**, knee loading was applied daily for 4 weeks. Administration of salubrinal was employed as a positive control for systemic effects.

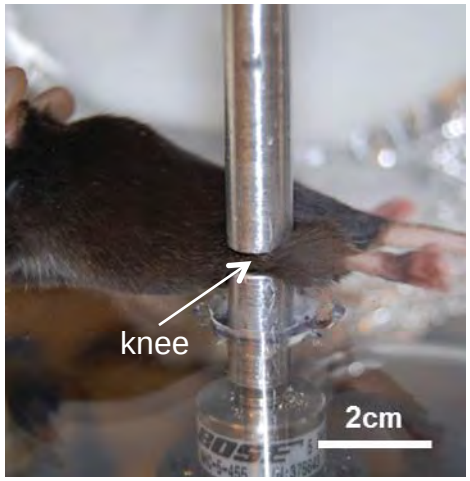
Approach:

Mechanical properties of **L5 vertebral body** was characterized, focusing on:

- stiffness (Young's modulus)
- **damping** (dissipation energy)
- fracture behaviors (yield and ultimate strengths)

Methods

A



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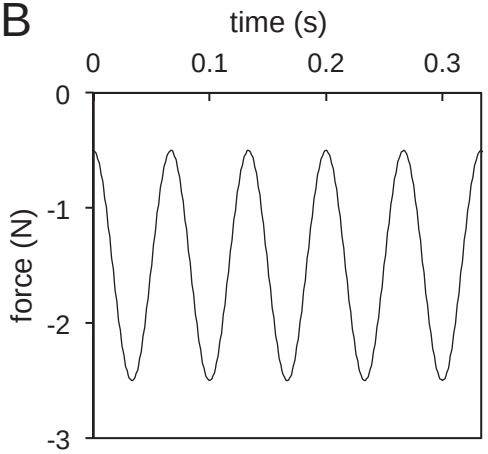

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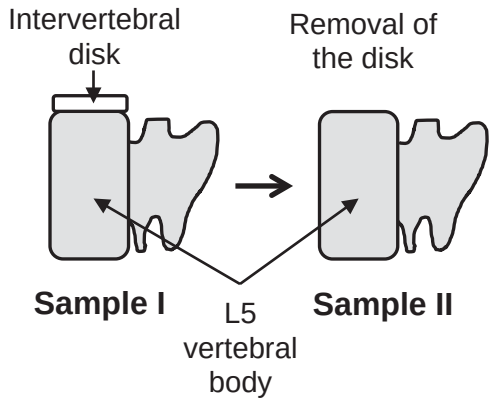

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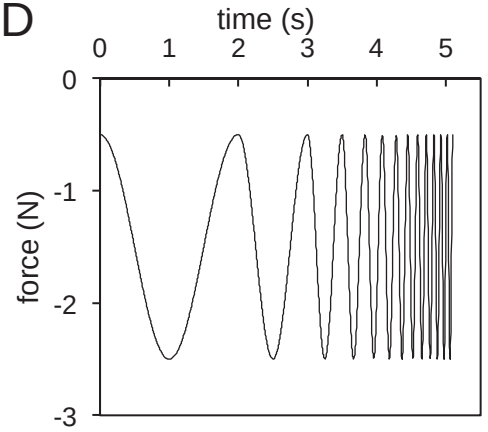
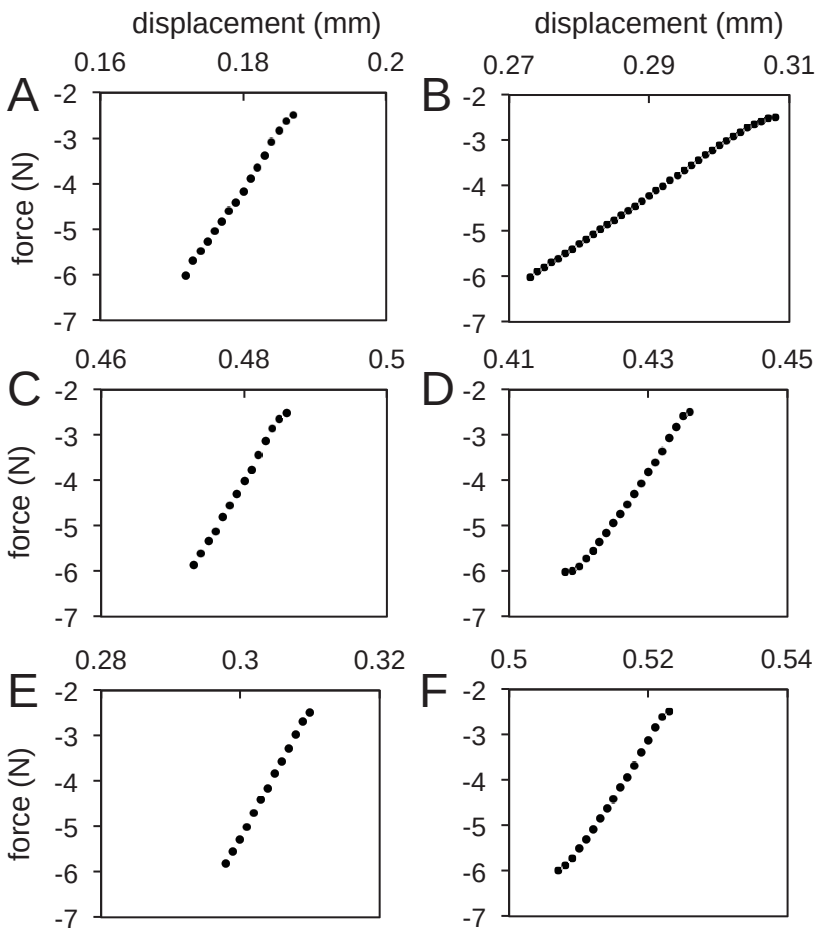
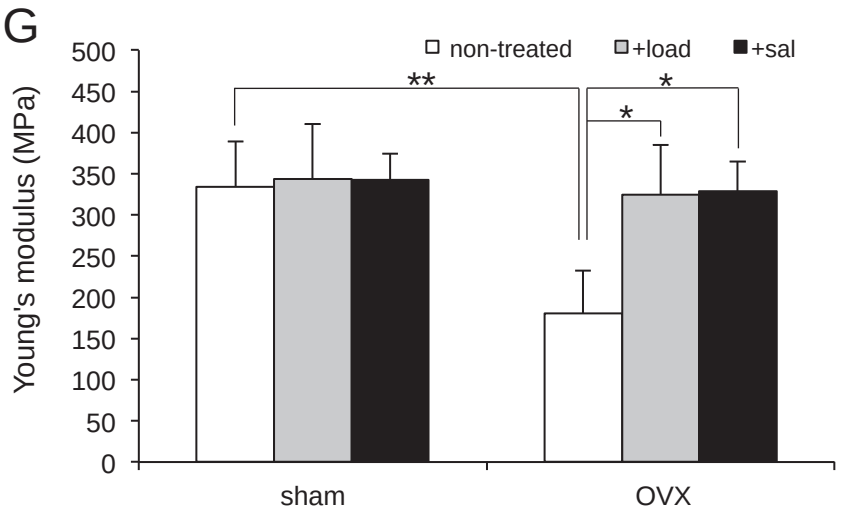
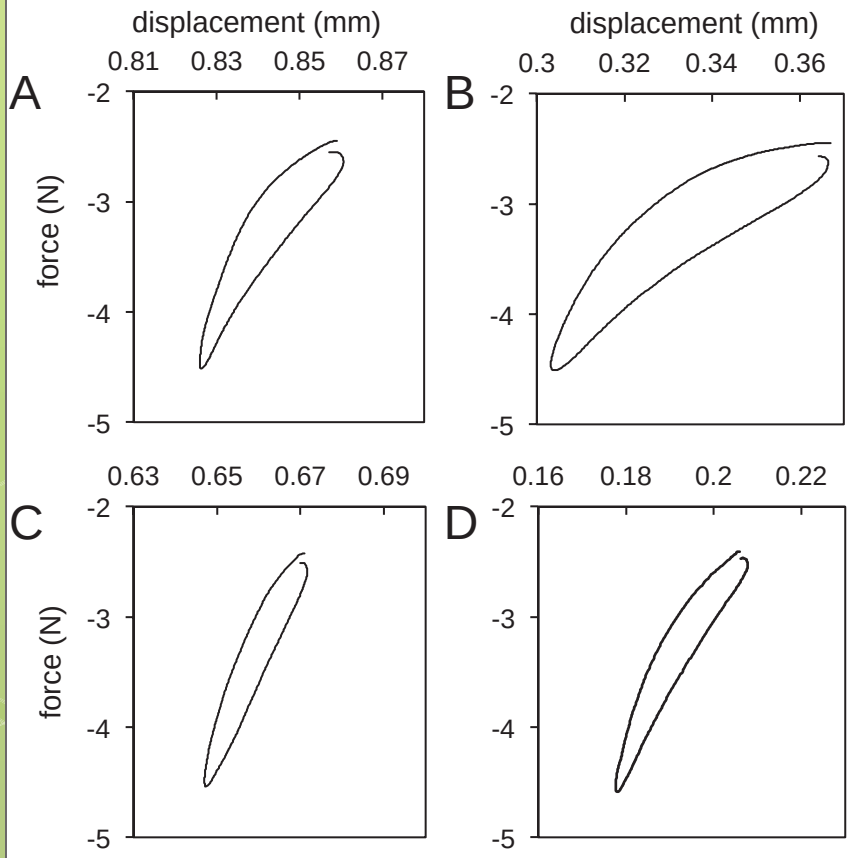


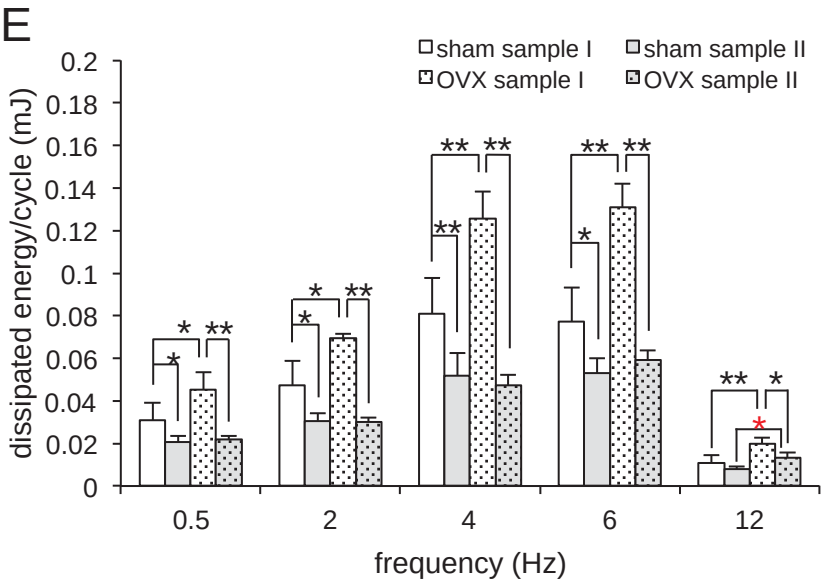
Young's Modulus (rigidity)



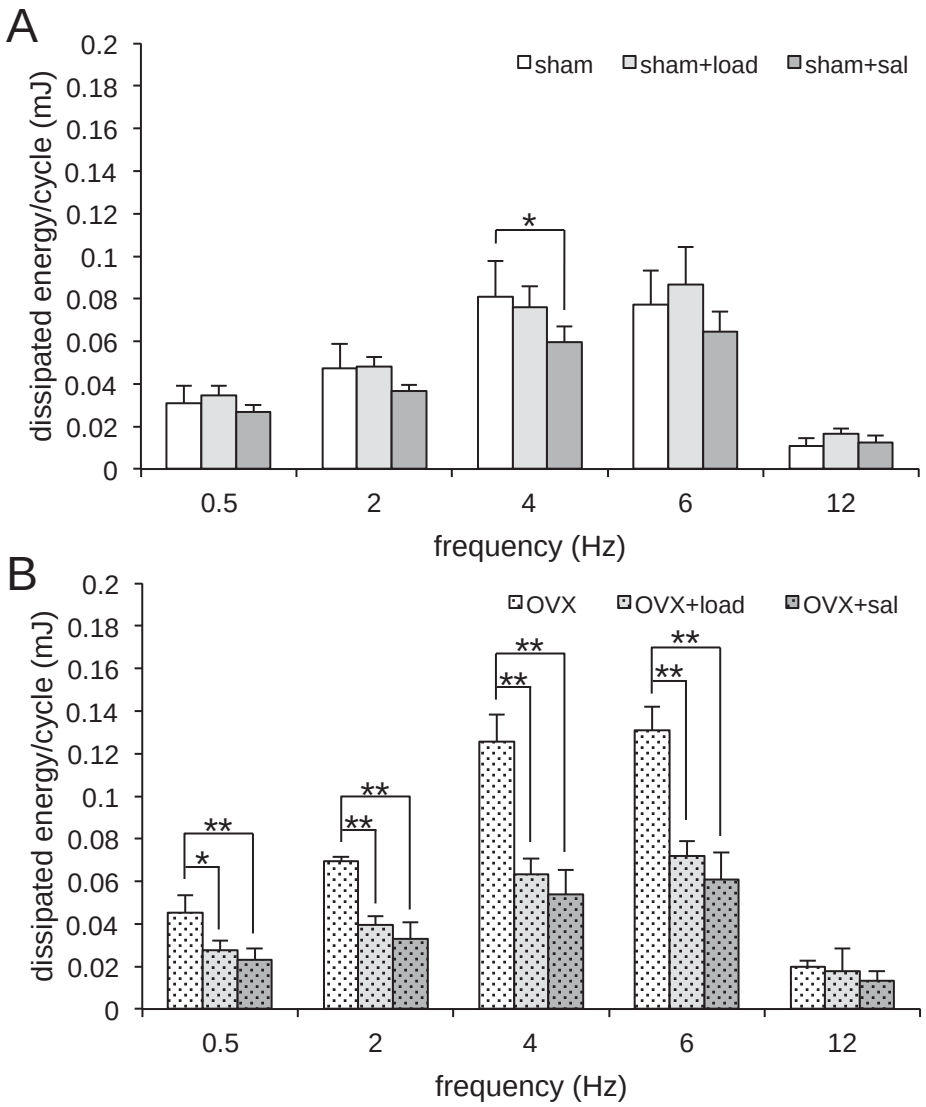


Dissipation Energy (Sham and OVX)

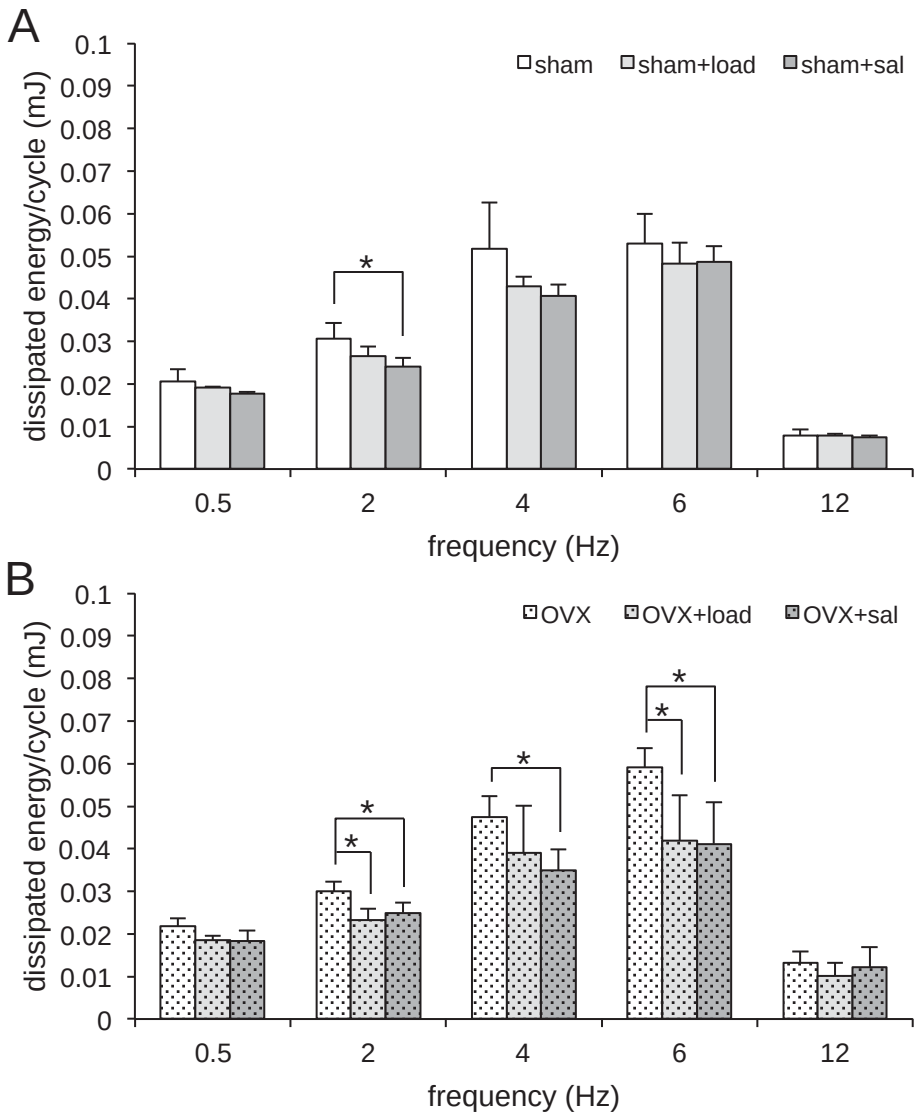




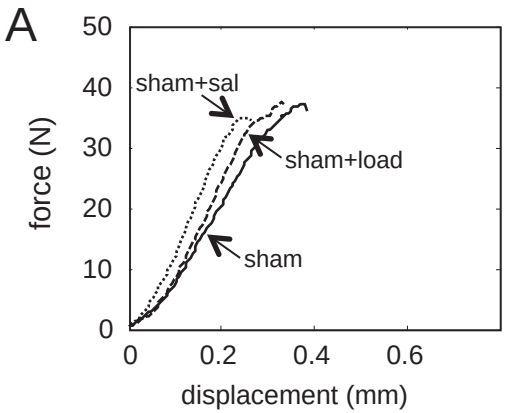
Dissipation Energy (with disk)

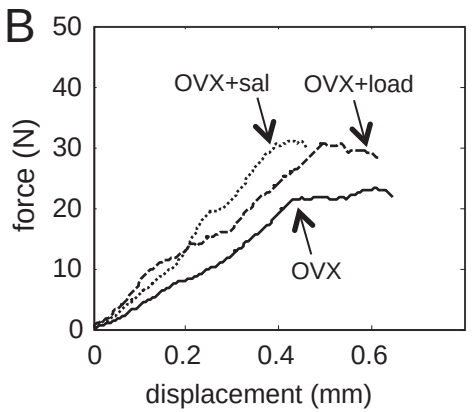


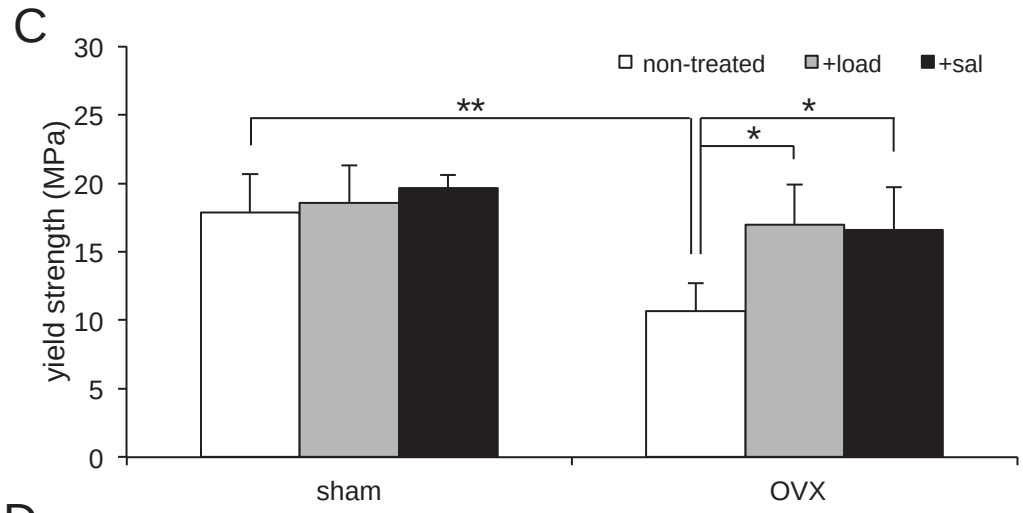
Dissipation Energy (without disk)

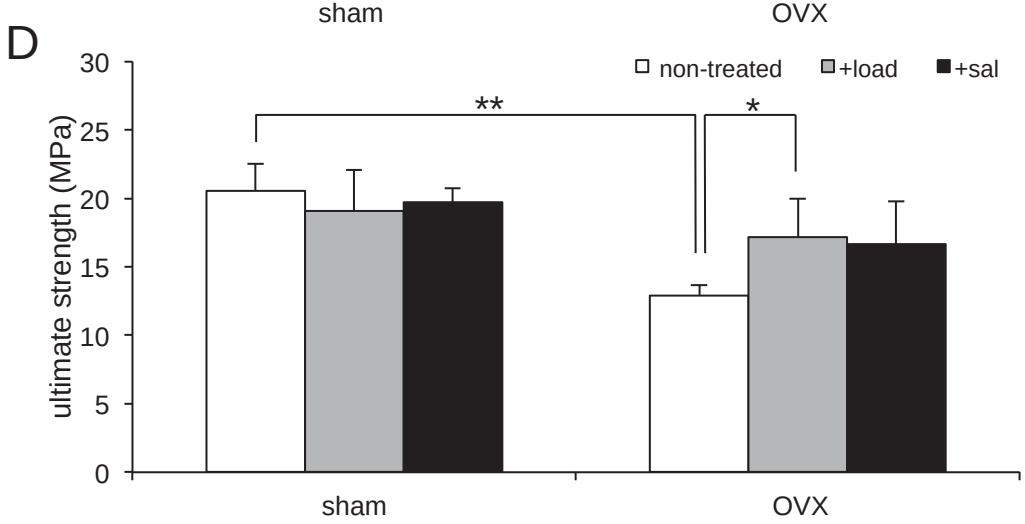


Mechanical Strength









Summary

Summary:

The results showed that knee loading increased **Young's modulus** of the L5 vertebral body of OVX mice by 80% as compared to sham loaded controls.

Knee loading reduced **dissipation energy** by 40-45%, in which bone contributed a significant portion (50-70%) to the damping capacity of the spine in a frequency dependent manner.

In a compressive failure test, OVX animals treated with knee loading exhibited an increase in **yield strength** (60%) and **ultimate strength** (33%).

Conclsion and Impact

Conclusion:

Both **knee loading** and administration of **salubrinal** increased stiffness and strength, and decreased damping of trabecular bone in the L5 vertebral body.

The results provide supporting evidence that knee loading is capable of inducing loading effects in not only the **loaded** but also **non-loaded** bones.

Impact:

Back pain is a major problem in the Occupational Safety and Health field. This pilot project contributes to our basic understanding of the role of mechanical loading to the spine.

Acknowledgement

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Thank you!

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Main Menu

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