



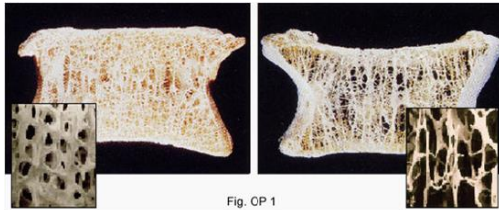
Regional Variation of Trabecular Bone Properties within the Post-Industrial Human Lumbar Vertebrae



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1. Introduction

Human Vertebral bones are composed of trabeculae, a sponge-like network of calcified rods and plates that change compressive strength with applied loading.



Stress from habitual weight bearing is known to increase bone mineral density (strengthen trabeculae) in other bones over time.

Overuse of one upper limb is thought to asymmetrically distribute weight onto the fourth lumbar vertebrae (L4), due to the attachment and asymmetry of muscles utilized in upper limb use.

This study examines a skeletal population of post-industrial factory workers, thought to habitually overuse one arm.

Understanding regional weight-bearing properties of the lower back can help to explain the effects of arm-use and the prevention of lower back pathologies, such as osteoporosis and bone fractures.

2. Methods

1. The L4 vertebrae of thirteen post-industrial males were micro-CT scanned at the Cleveland Clinic.
2. The 3D CT images were then cropped, reoriented, and halved into left and right sections using MicroView software.

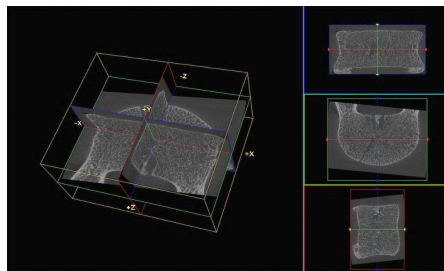


Figure 1: This image shows a 3D, micro-CT image of L4 in Microview software.

3. A centered, spherical section of each bone half was selected for trabecular analysis.

4. Quant 3D software was used to calculate the bone volume (BV/TV), number of trabecular rods (Tb. N), and trabecular thickness (Tb.Th), and degree of shape and orientation (Tb. I and E) in each half the L4 bones.
5. A paired t-test was performed to statistically determine whether a difference in trabecular properties exists between left and right halves of the L4 bone.

3. Results

As predicted, left-right asymmetry exists within the fourth lumbar vertebrae for this sample population.

A paired t-test confirmed, with 95% confidence, that the trabecular bone volume (Tb. TB/TV) differs significantly between left and right regions of the bone ($p=0.003$).

However, significant differences were not found among other variables, such trabecular isotropy (Tb. I), trabecular elongation (Tb. E), Trabecular thickness (Tb.Th), and trabecular number (Tb. N.)

Trabecular bone volume values were greater on the right side of the L4 bone

Variable	Region	Mean	SE Mean	Standard Deviation	Max	Min	P-Value
Tb.BV/TV	Left	0.20816	0.00654	0.02356	0.25063	0.17071	0.003
	Right	0.21632	0.00804	0.02897	0.26603	0.17596	0.003
Tb. I	Left	0.6211	0.0415	0.149	0.7499	0.1565	0.974
	Right	0.6227	0.0478	0.1724	0.7886	0.179	0.974
Tb. E	Left	0.2676	0.0385	0.1388	0.6861	0.1607	0.791
	Right	0.2811	0.0442	0.1593	0.7192	0.1014	0.791
Tb.Th	Left	0.14962	0.00349	0.01259	0.17277	0.13354	0.082
	Right	0.15254	0.0026	0.00939	0.16756	0.13739	0.082
Tb. N	Left	1.3471	0.0497	0.1792	1.6304	1.0504	0.427
	Right	1.273	0.108	0.389	1.733	0.154	0.427

Table 1: Trabecular bone composition quantification, showing a significant left-right difference between trabecular bone volumes

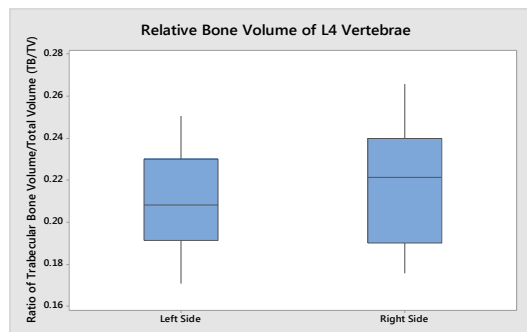


Figure 1: Relative bone volume differences between left and right regions of the L4 vertebrae

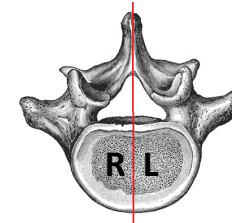
4. Conclusion

In this sample of post-industrial males, the trabecular bone volume between left and right bone regions differs significantly.

This suggests that a correlation may exist between unilateral, weight-bearing activities of the upper limb and asymmetrical vertebral strength.

In noting a correlation such as this, lumbar spine complications such as fractures or osteoporosis may be reduced by increasing weight bearing activities in the non-dominant arm.

Further bone morphology studies will be conducted in the future to determine the right/left handedness of individuals within this population to better understand trabecular asymmetry within the lumbar vertebrae.



5. Acknowledgements

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6. References

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