Transverse Curvature Measurements of Lumbar Vertebral Bodies

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Background and Motivation

- A precursor to development of patient-specific spine implants is an accurate characterization of vertebral dimensions.
- Little literature has shown data pertaining to the transverse curvature of the vertebrae.
- The purpose of this work was to measure and characterize the major and minor diameters of the lumbar vertebral body.

Methods

- Dimensions were manually measured from 13 dissected human lumbar spine samples from 3 donor subjects using calipers.
- The vertebral body midsection major diameter could be directly measured from the samples
  - 3 independent measurements were recorded and averaged.
- The minor diameter could not be measured directly due to interfering vertebral structures. Measurement could be inferred based on the measured gap distance between the calipers and the vertebral face (Figure 1)
  - 3 independent measurements were recorded and averaged.

Research Objective:

Measure the Average Major and Minor Diameter of Lumbar Vertebrae

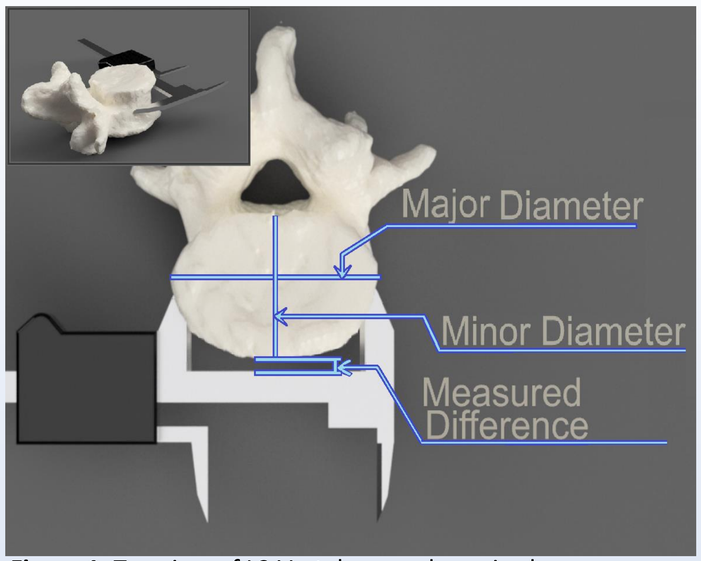

Figure 1. Top view of L3 Vertebrae and required measurements. The Isometric view depicts the point of midsection measurement.

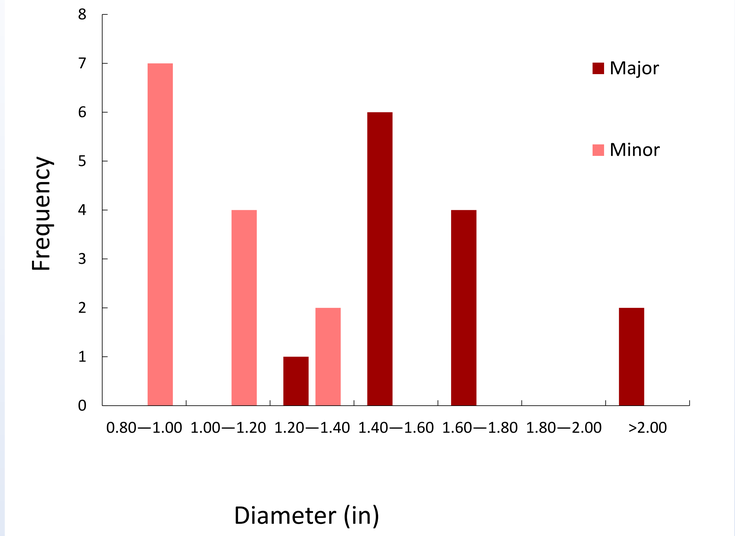

Figure 2. Distribution of Major and Minor Diameters of the sampled vertebral bodies.

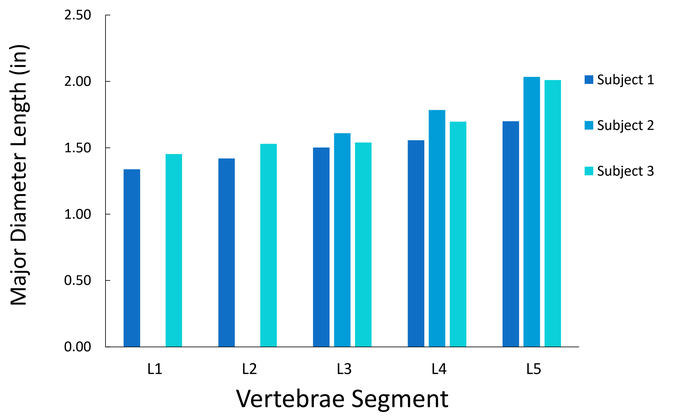

Figure 3. Variation of major diameter lengths for each vertebrae across subjects.

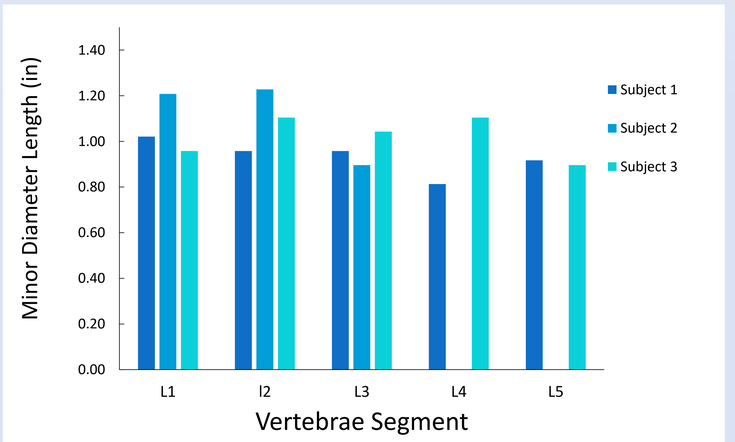

Figure 4. Variation of minor diameter lengths for each vertebrae across subjects.

Discussion and Conclusions

Despite the limitation of a small cohort of samples, lumbar dimensions at the same vertebral level were fairly consistent across specimens. On average, each vertebral level did not vary across different subjects more than 0.15 ± 0.14in and 0.14 ± 0.18in major and minor diameter, respectively. The biggest difference at the same vertebral level across different subjects in major diameter was 0.33in between subject 1 and 2 on L5. The biggest difference at the same vertebral level across different subjects in minor diameter was 0.42in between subject 1 and 2 on L4. As anticipated, the major diameter increased at vertebral levels located further inferiorly. Perhaps unexpectedly, minor diameter generally saw a coincident decrease at inferior vertebral levels. This contrasting change in curvature presents some difficulties for devices intended to fit a broad range of lumbar vertebral levels and should be considered when designing parametric devices for patient-specific application.

Significance:

These measurements can be incorporated into the design process for developing patient-specific implants.