# LUMBAR SPINE MODEL FOR ANTHROPOMETRICS AND TECHNOLOGIES ASSISTING SPINAL INTERVENTIONS

Nathanial Maeda, EIT; Jason Carey, PhD, P.Engg
Department of Mechanical Engineering, University of Alberta, Edmonton, AB, T6G 2G8
Contact: nathanial.maeda@ualberta.ca

## Summary

Anthropometrics is the study of body measurements (Fig. 1), and they would be an effective tool for creating spine models, investigating the effects of spine dimensions on pathologies, and developing assistive technologies. However, anthropometrics have not been completed for the spine since no complete vertebral description exists to measure spinal structures. A fully parametric lumbar spine model was developed to fill this gap in literature.

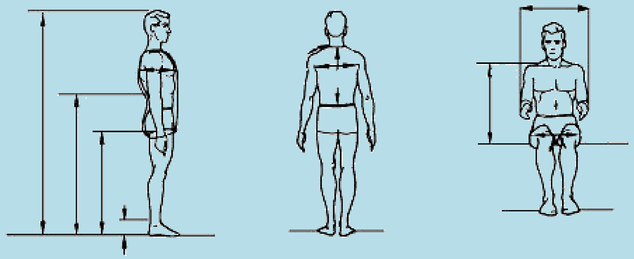


Figure 1: General anthropometrics [1]

## Purpose

Develop a solid model of the lumbar spine that includes the following criteria:

- Fully parametric and scalable to any shape and size of individual.
- All vertebral structures  dimensioned independently.
- Dimensions are easy to measure.

## Methods and Materials

Solid model development using SolidWorks 2013 (Dassault Systems).

1. Elliptical bodies comprised each vertebral structure.
2. Dimensions were deduced from the elliptical description.
3. Ellipses coordinate systems related to a global coordinate system (Fig. 2).
4. Lumbar spine: intervertebral discs were created (Fig. 3) and the lumbar lordosis was defined from an ellipse.
5. All dimensional values were approximated from literature [2].

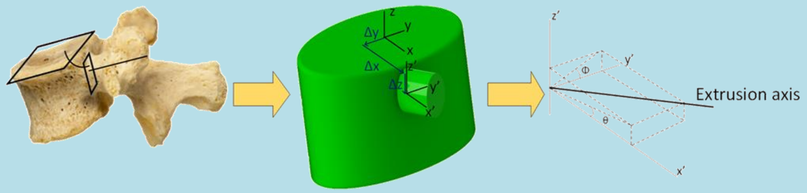
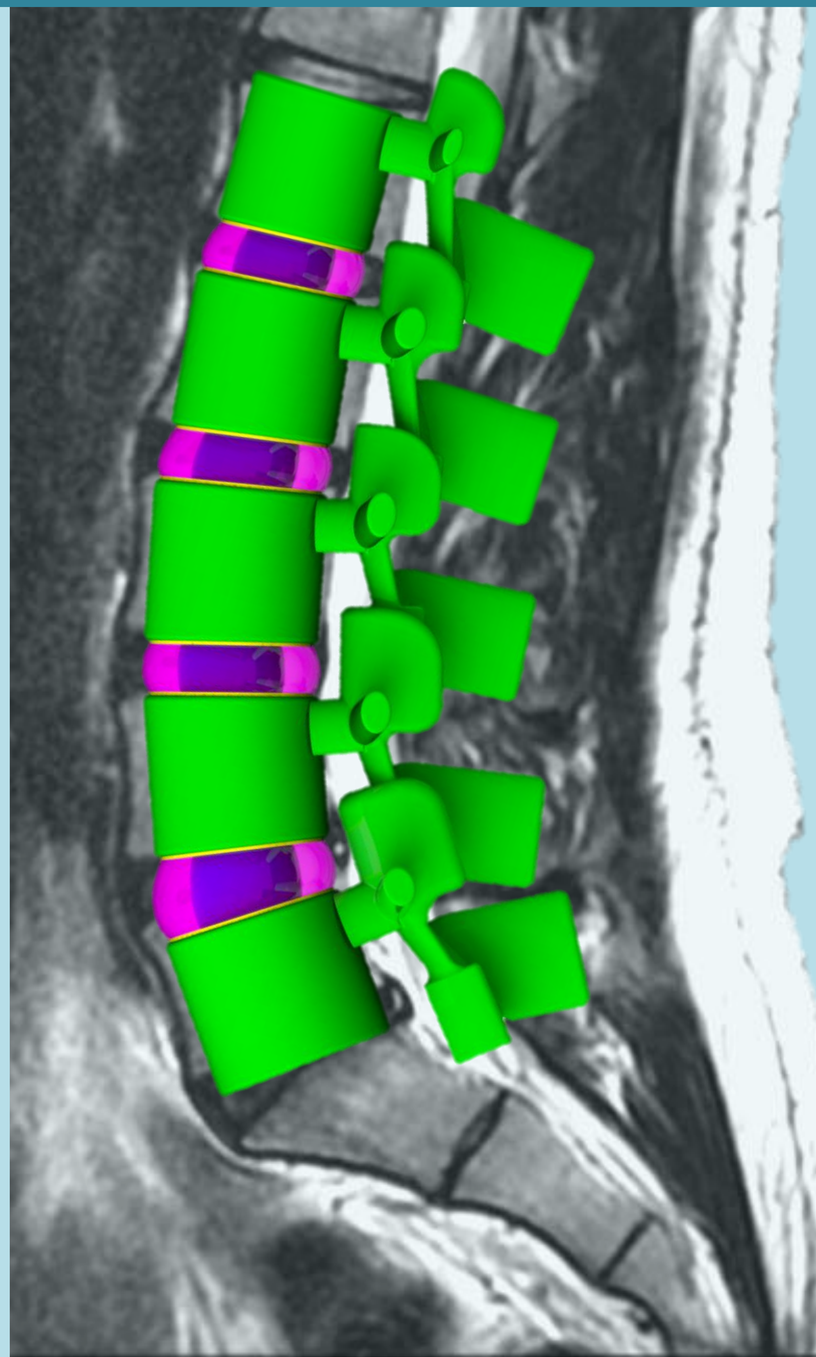



Figure 2: Vertebral structure coordinate system



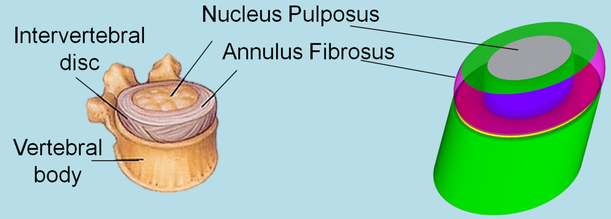



Figure 3: Intervertebral disc modelling

## Results and Discussion

- The proposed model is the most comprehensive description of the posterior elements to date (Fig. 4).
- Dimensions are easy to measure from the elliptical bodies.
- Model may be scaled to any individual and applied to many situations, such as real-time simulation during spinal interventions.
- Effective measurement basis for anthropometrics.
- Further development is necessary including: custom software to automatically measure spine structures from magnetic resonance imaging data, and finite element techniques for real-time simulation.

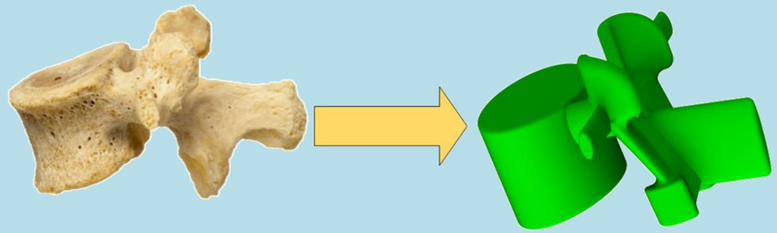


Figure 4: Vertebral solid model

## Conclusion

The proposed spine model has furthered understanding of spine geometry by simplifying the complex vertebral structures using elliptical descriptions. Nonetheless, geometric understanding may still be increased through continued study of spine anthropometrics using the proposed model as a measurement basis. Furthermore, clinical spine simulations may be developed from the proposed model and used to develop assistive technologies for spinal interventions, such as scoliosis bracing.

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**References:** [1] Winter, DA (2009), *Biomechanics and Motor Control of Human Movement.* [2] Panjabi MM et al (1992), *Spine (Phila Pa. 1976),* vol. 17, pp. 229-306