SAWBONES®

PRODUCTS RESEARCH

BIOMECHANICAL SPINE

SAWBONES®

Product Information and Research of our Biomechanical Spine

A Division of Pacific Research Laboratories, Inc.

www.sawbones.com

BIOMECHANICAL SPINE INFORMATION

MATERIALS

- Elastomers
- Epoxies
- Fibers

COMPONENTS

- T12 — Sacrum
- Solid 4th Generation Vertebrae
- Nucleus
- Annulus with Fiber
- Anterior Longitudinal Ligament (ALL) with Fiber
- Posterior Longitudinal Ligament (PLL) with Fiber
- Ligament Flavum (LF)
- Facet Capsule
- Transverse Spinous Ligament
- Intra and Supra Spinous Ligament

BENEFITS

- **Low Variability**
- **No Biohazard**
- **No Shelf Life**
- **Long Test Life**
- **Customizable**

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Grant Support: NIH SBIR

"Development and Validation of Instrumental Synthetic Mechanical Analog Lumbar Spine"

Phase II: #5 R44 AR054289-03

AVAILABLE BIOMECHANICAL SPINE MODELS

SINGLE LEVEL

#3429-3-2 — Individual composite L3 vertebrae with 10 PCF (0.16 g/cc) density solid foam cancellous core. Dimensions: a) 48 mm; b) 35 mm; c) 11 mm; Pedicle height 16 mm. Also available with 20 PCF solid foam cancellous, **#3429-3-5**.

#3429-3-5 — Individual composite L3 with 20 PCF (0.32g/cc) density solid foam cancellous core. Dimensions: a) 48 mm; b) 35 mm; c) 11 mm; Pedicle height 16 mm.

#3429-4-2 — Individual composite L4 vertebrae with 10 PCF (0.16 g/cc) density solid foam cancellous core. Dimensions: a) 52 mm; b) 36 mm; c) 14 mm; Pedicle height 16 mm. Also available with 20 PCF solid foam cancellous, **#3429-4-5**.

MULTIPLE LEVELS

#3430 — Potted T12 to sacrum, *no* cancellous foam. Also available in unpotted version, **#3430-1**.

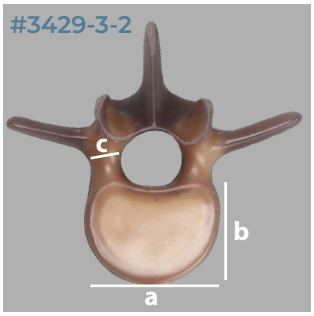
#3430-1 — T12 to sacrum solid cortical, *no* cancellous foam, *not* potted.

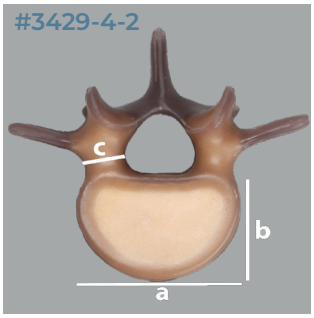
#3430-25 — Potted L2 to L5 solid cortical, *no* cancellous foam. Also available in unpotted version, **#3430-25-2**.

#3430-34 — Potted L3 to L4 solid cortical, *no* cancellous foam. Also available in unpotted version, **#3430-34-7**.

#3430-34-2 — Potted L3 to L4 with 10 PCF solid foam *with* cancellous core. Also available in unpotted version, **#3430-34-6**.

NOTE: Only L3 and L4 are available with cancellous core.





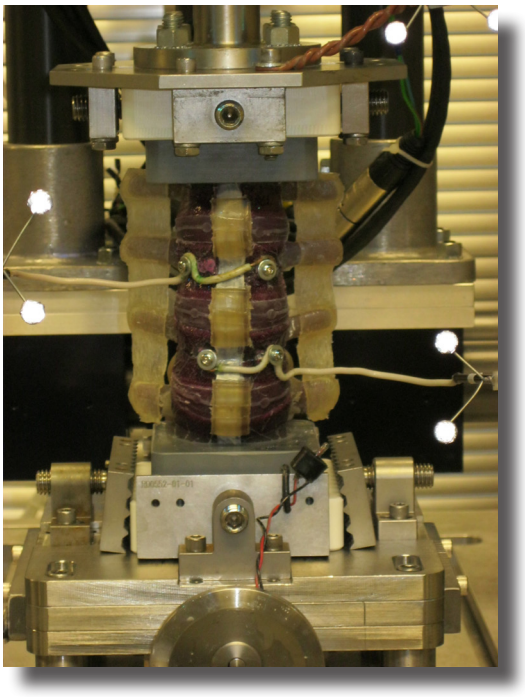
UNIVERSITY OF WASHINGTON IN THE APPLIED BIOMECHANICS LAB

Dr. Randal Ching

- 5 L2/L5 Multi-level segments tested in Spine Simulator with Vicon Motion Capture
- +/-10Nm in Lateral bending, Flexion-Extension, Axial Rotation
- Tuned to 2000N axial load and 8 mm displacement
- Human n=9 48-75 yrs, mean 65 yrs, 7 male and 2 female

RESULTS

- 6 out of 9 Stiffness values are within 1 standard deviation of human
  - *lower secondary stiffness in flexion*
  - *higher secondary stiffness in axial rotation*
- 3 out of 3 Range of motion values are within 1 standard deviation of human
- 3 out of 3 Neutral zone values are within 1 standard deviation of human
- 1 out of 3 Hysteresis values are within 1 standard deviation of human
  - *higher in flexion-extension and lateral bending*



POSTER PRESENTATION

Campbell, JR., Imsdahl, S. and Ching, RP.

Evaluation of a Synthetic L2-L5 Spine Model for Biomechanical Testing.

Canadian Biomechanics Society 2012.

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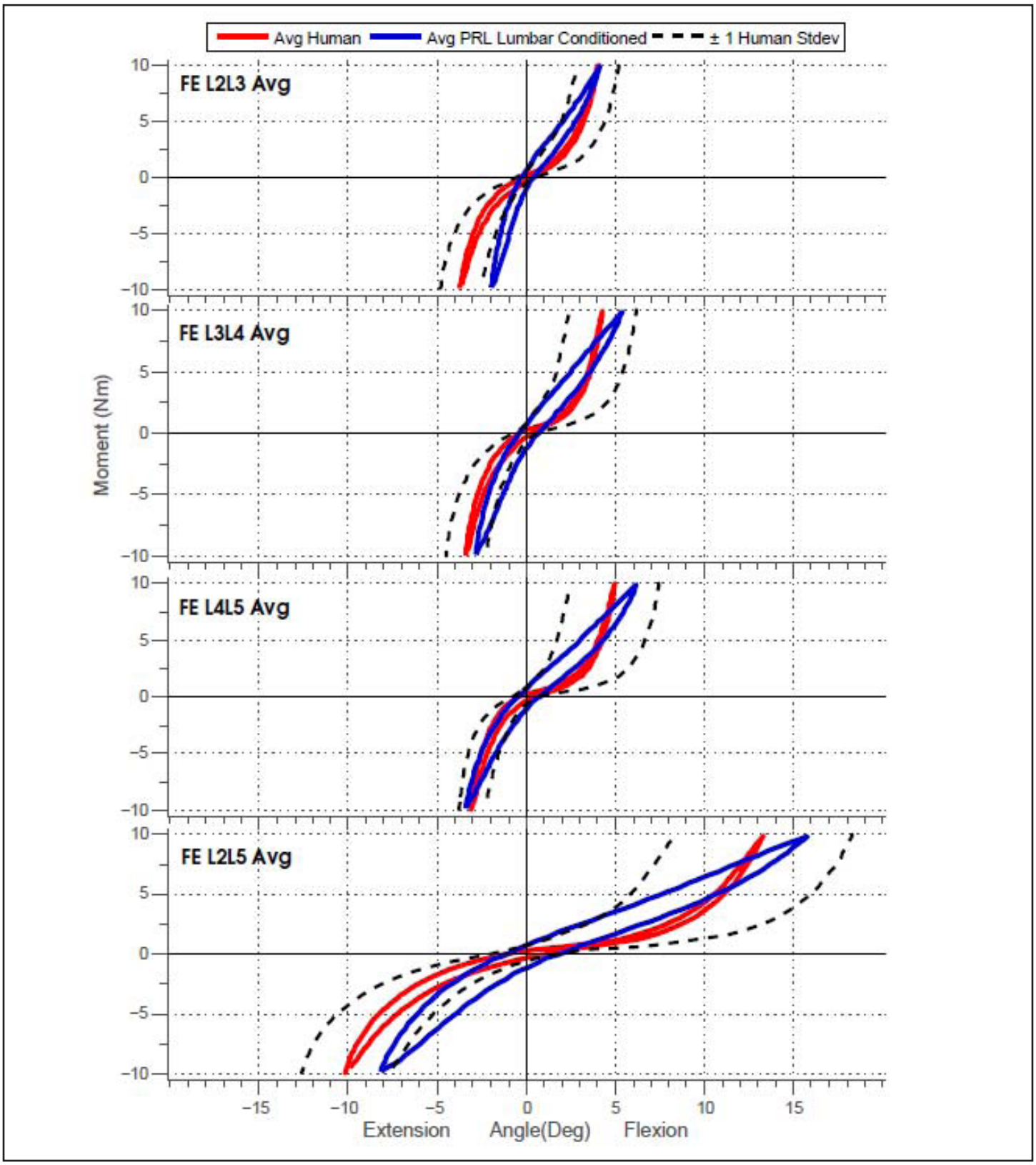
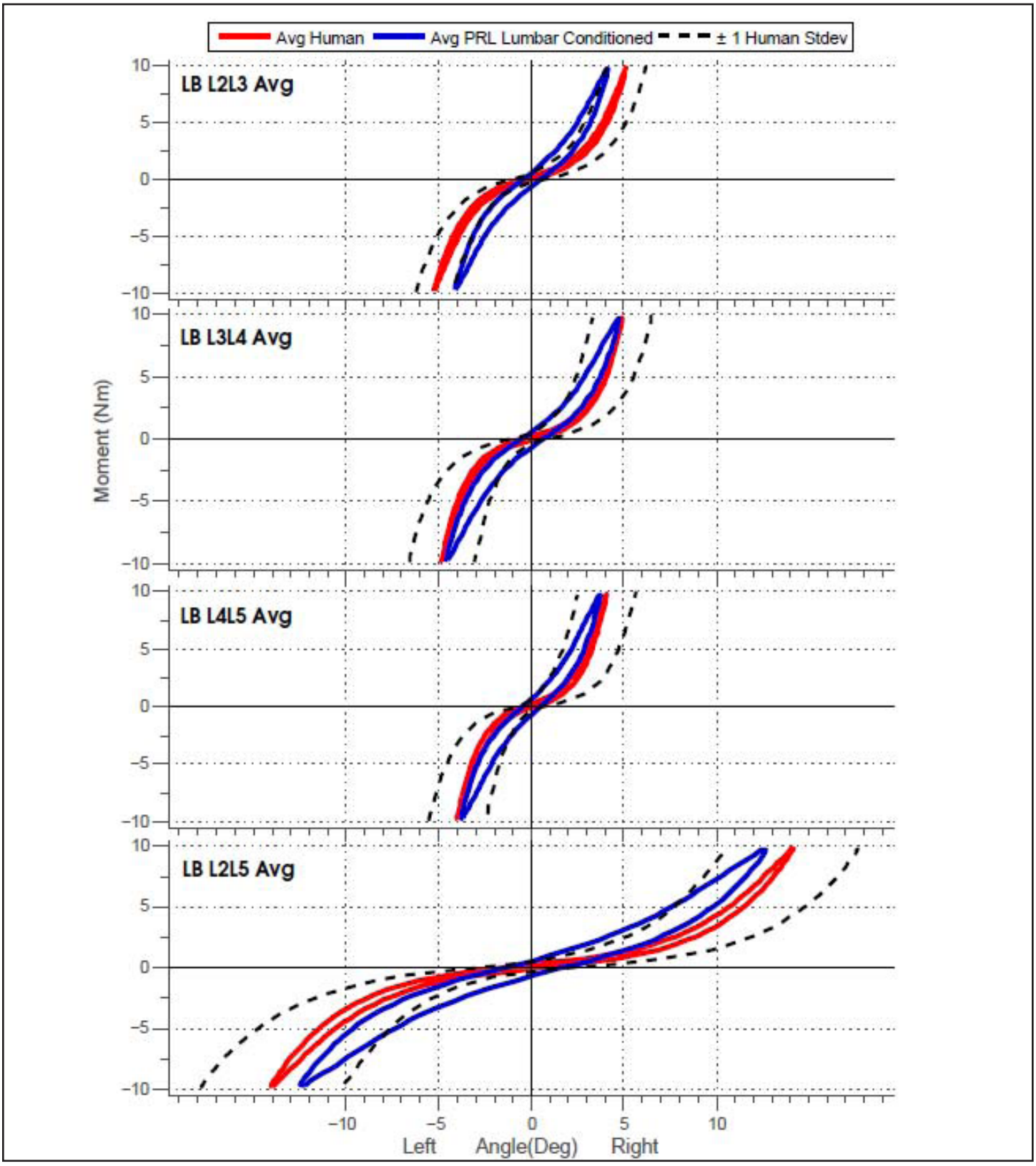
BIOMECHANICAL SPINE VS. HUMAN
FLEXION - EXTENSION



BIOMECHANICAL SPINE VS. HUMAN
LATERAL BENDING



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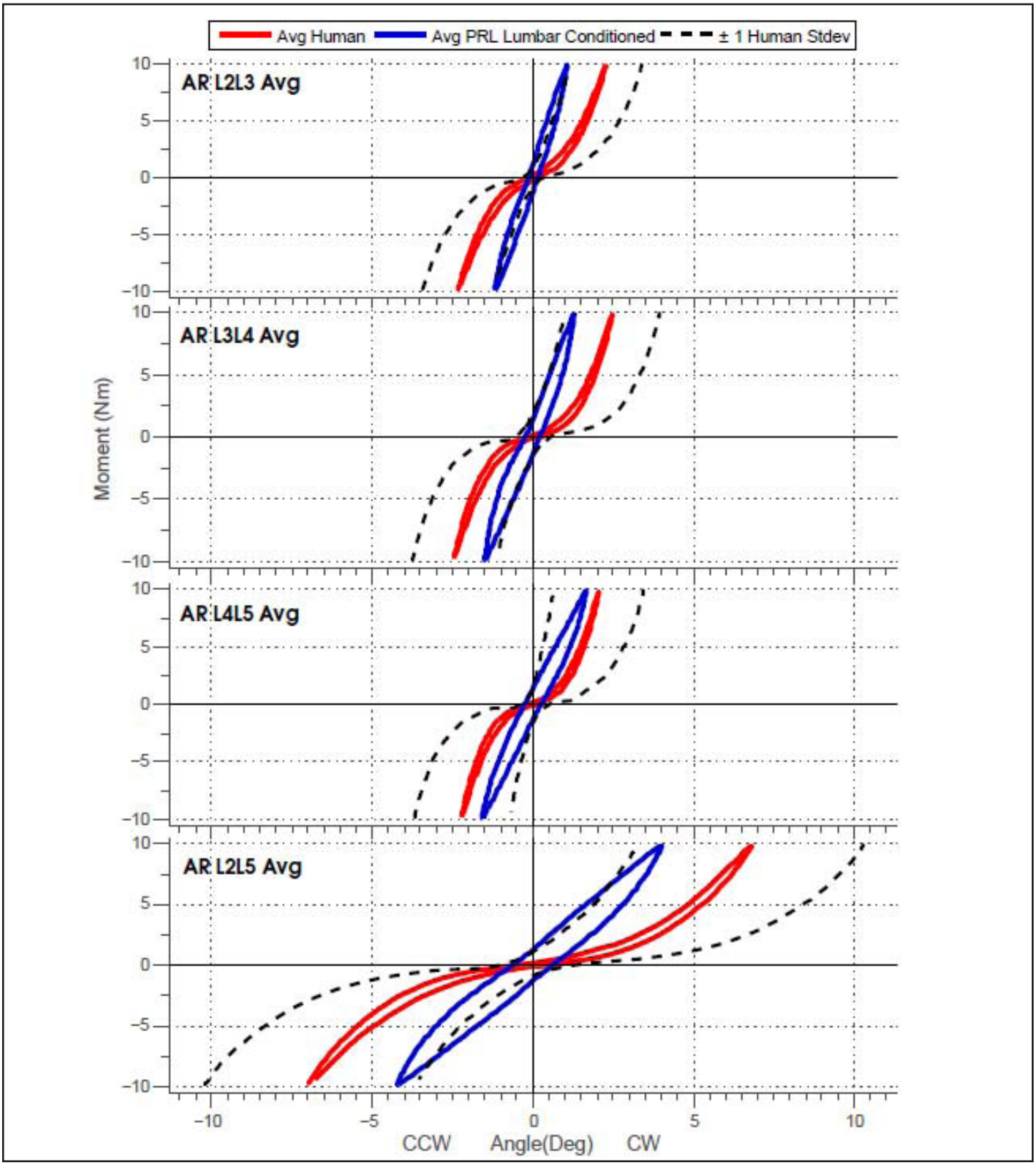
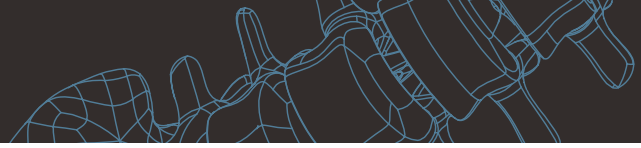
BIOMECHANICAL SPINE VS. HUMAN
AXIAL ROTATION





Sawbones Biomechanical Spine is *significantly* less variable than cadaver

L2-L5 Average Coefficient of Variation (%)

		Range of Motion	Secondary Stiffness	Neutral Zone Stiffness	Hysteresis	Neutral Zone
L2-L5	Sawbones	7	6	12	9	14
	Human	34	28	73	50	65

Individual Levels based on L2-L5 Motion Data Collected from L2, L3, L4 and L5 Average Coefficient of Variation (%)

		Range of Motion	Secondary Stiffness	Neutral Zone Stiffness	Hysteresis	Neutral Zone
L2-L3	Sawbones	9	11	8	11	14
	Human	31	29	69	49	57
L3-L4	Sawbones	19	20	26	21	20
	Human	41	31	93	53	87
L4-L5	Sawbones	14	19	15	22	28
	Human	34	28	73	50	65

Sawbones Biomechanical Spine L2-L5, n=5
Human L2-L5 avg age 65 (48-75 yrs), n=9

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UNIVERSITY OF WASHINGTON IN THE APPLIED BIOMECHANICS LAB

Dr. Randal Ching

- Single L3/L4 FSU in Spine Simulator with Vicon Motion Capture
- +/-10Nm in Lateral bending, Flexion-Extension, Axial Rotation
- Tuned to 2000N axial load and 2.3 mm displacement
- Human n=7 33-75 yrs, mean 60 yrs, 6 male and 1 female

RESULTS

- 6 out of 9 Stiffness values are within 1 standard deviation of human
  - *lower secondary stiffness in flexion, extension, lateral bending*
- 8 out of 8 Range of motion values are within 1 standard deviation of human
- 1 out of 3 Hysteresis values are within 1 standard deviation of human
  - *higher in flexion-extension and lateral bending*

POSTER PRESENTATION

Campbell, JR., Imsdahl, S. and Ching, RP.
Evaluation of a Synthetic Functional Spine Unit.
Northwest Biomechanics Symposium 2011.

UNIVERSITY OF KANSAS IN THE BIOENGINEERING LAB

Dr. Lisa Friis

- 7 L3/L4 FSU's tested in MTS Bionix
- +/-15Nm in Lateral bending, Flexion-Extension, Axial Rotation with 100N preload in all modes of bending
- Human n=5 38-69 yrs, mean 58 yrs, 3 male and 2 female

RESULTS

- 7 out of 8 Stiffness values are within 1 standard deviation of human
  - *higher rational stiffness*
- 3 out of 3 Range of neutral zone motion values are within 1 standard deviation of human
- Sequential Dissection of analogue FSU follows similar trends as human
- Variation is 3 to 6 times lower than human

POSTER PRESENTATION

Domann, J. Mar, D. Johnson, A. James, J. Friis, E.

The Analogue Spine Model.

North American Spine Society Annual Meeting 2011.

POSTER PRESENTATION

Domann, J. Mar, D. Johnson, A. James, J. Friis, E.

Effect of Soft Tissue on the Stability of an Analogue Spine Model.

North American Spine Society Annual Meeting 2011.

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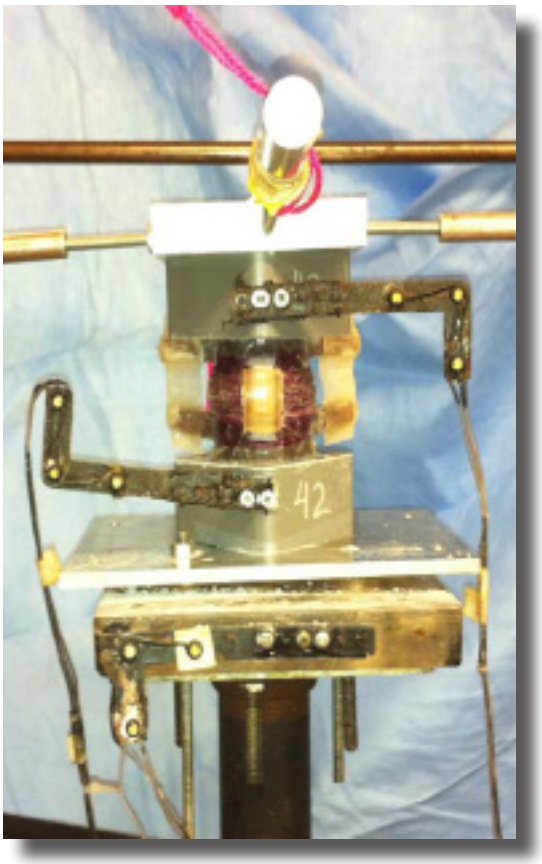
TESTED AT UNIVERSITY OF TOLEDO IN THE BIOENGINEERING LAB

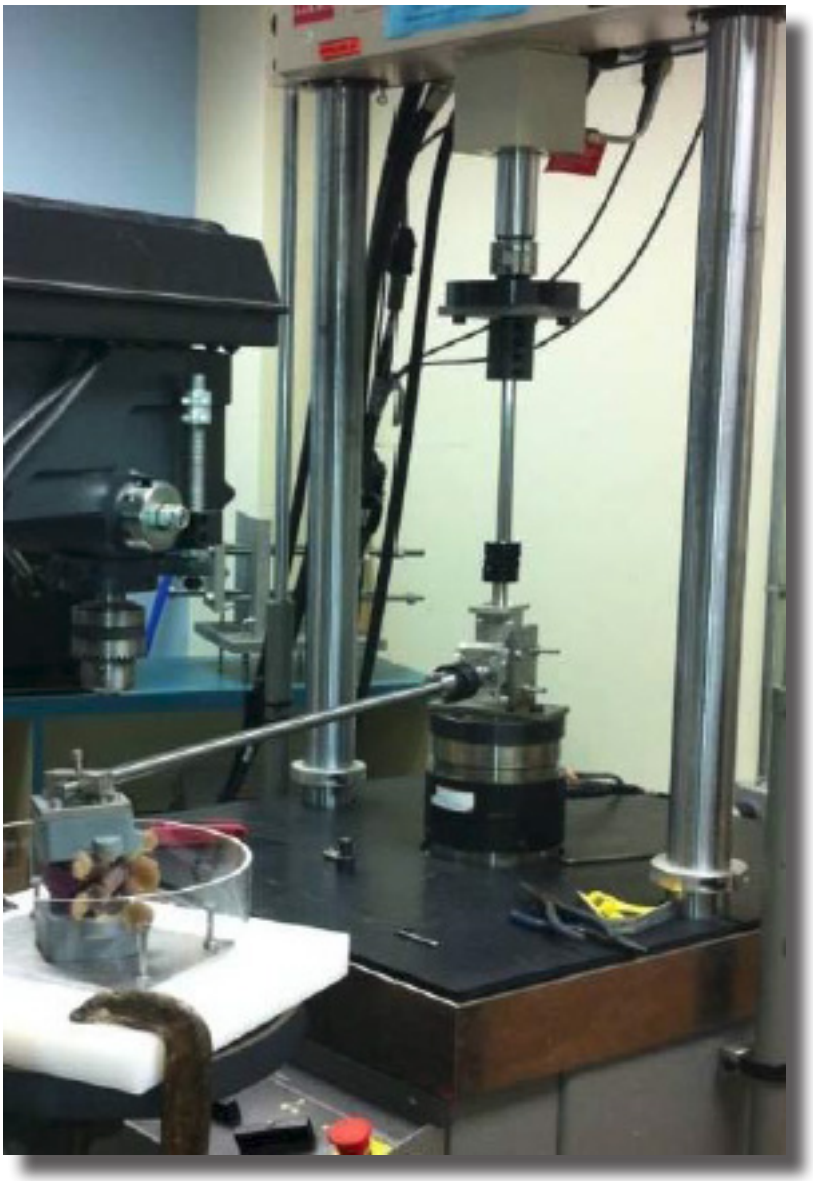
Dr. Vijay Goel

- 4 L3/L4 FSU's tested in Spine Simulator with Optotrak motion capture
- +/-10Nm in Lateral bending

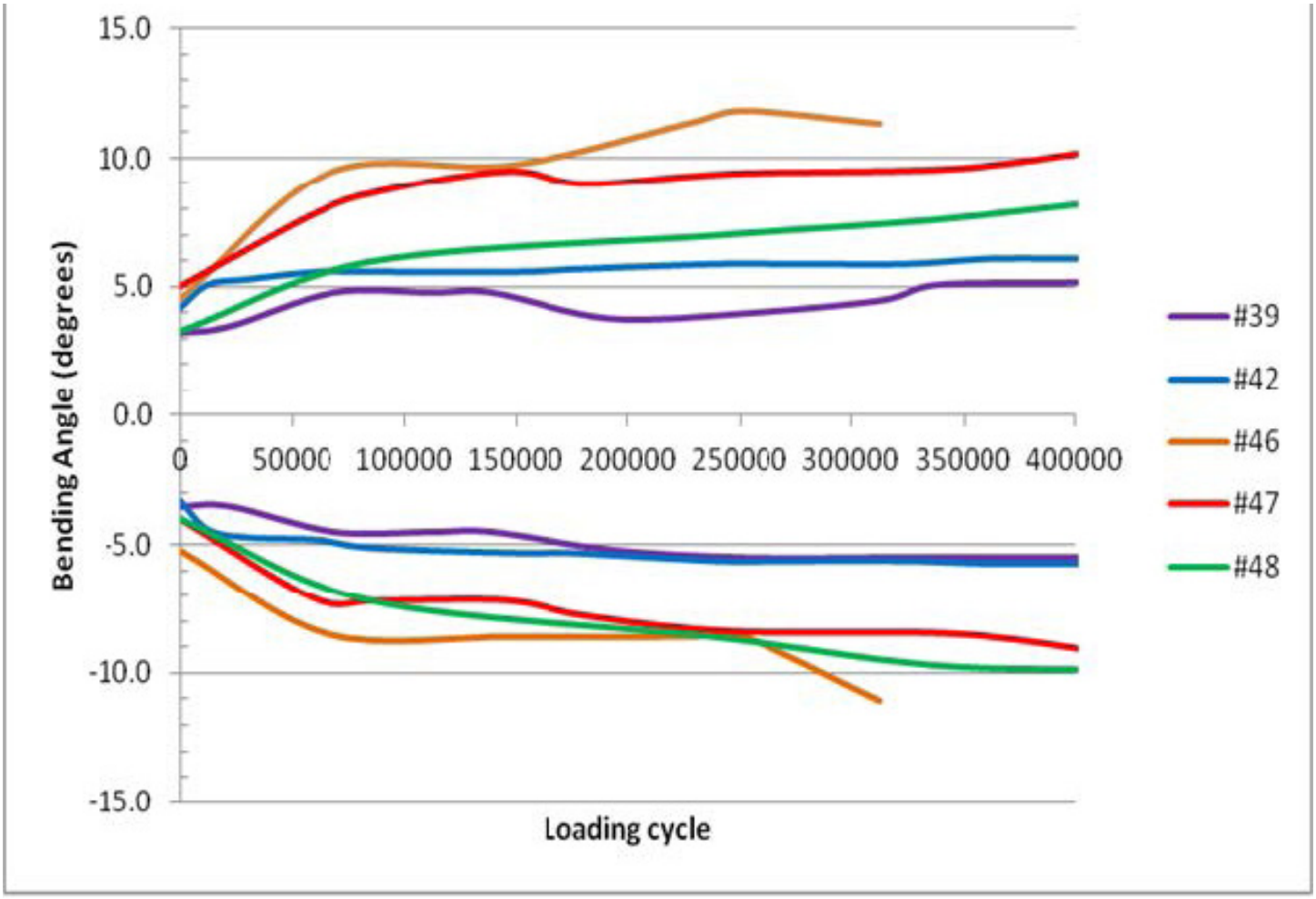
RESULTS

- Average 420000th cycle when motion has doubled
- Average 50000th cycle when motion has increased by 2 degrees





L3-L4 FSU LATERAL BENDING
1 Hz @ +/-10Nm



Lateral Bending Plot: 0 - 400000 cycles

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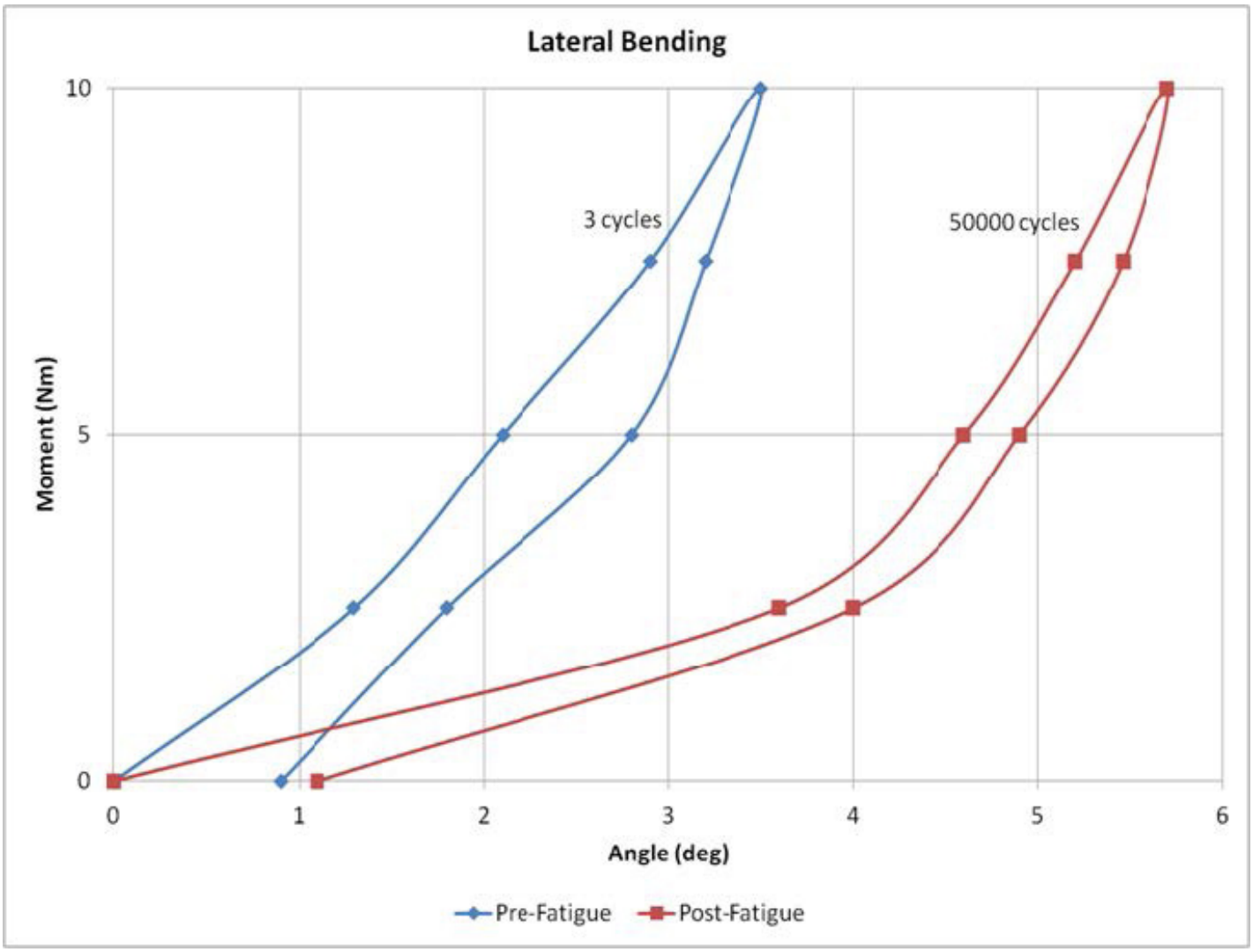
LATERAL BENDING L3-L4 FSU
BEFORE AND AFTER CYCLIC LOADING +/-10Nm @ 1 Hz



SAWBONES CUSTOMER COMMITMENT AND PRODUCT GUARANTEE

At Sawbones, we are committed to providing the highest level of service and product quality. If you are less than completely satisfied with the performance of our products for any reason, we will gladly honor a full refund or replacement.

Contact us anytime with suggestions on how we can improve our products or service.

ORDERING INFORMATION

Please provide the part number, description, and quantity for each item requested.

Indicate precise shipping instructions, if different than the billing address, and purchase order number when applicable.

Credit cards and bank transfers accepted. Please call customer service.

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