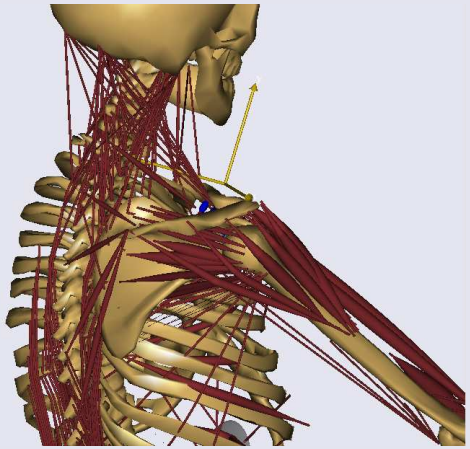
A lumbar spine model with facets joints and a dynamic stabilization device

Dr.-Ing.Sebastian Dendorfer

AnyBody Technology, Aalborg, Denmark



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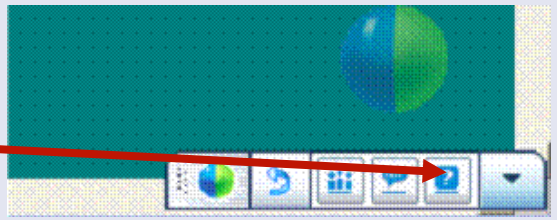
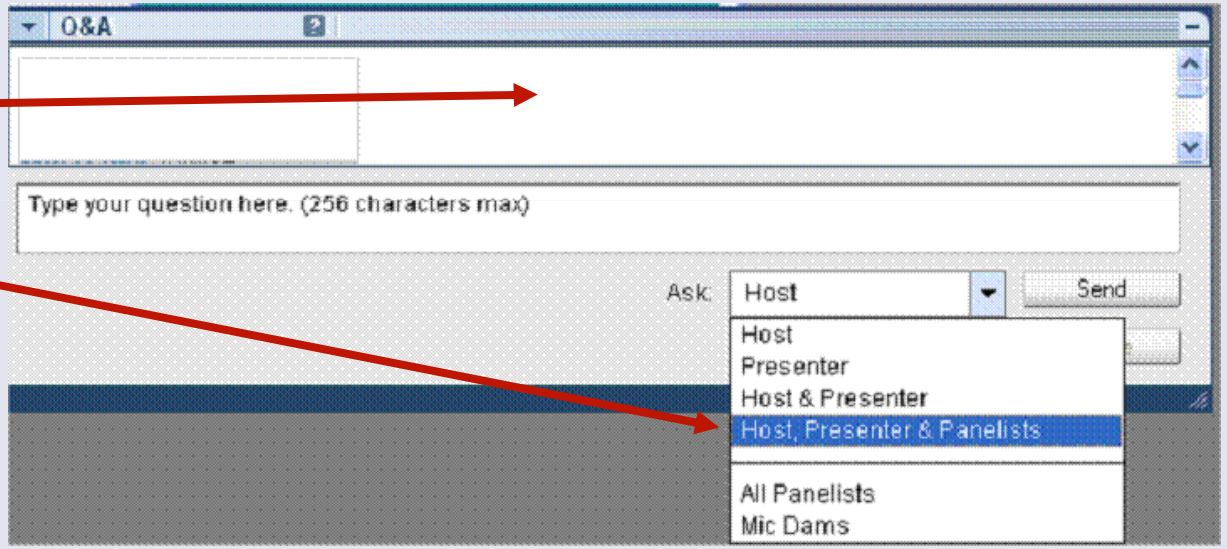




Notice the answer displays next to the question in the Q&A box. You may have to scroll up to see it.

Presenters

Sebastian Dendorfer
(Presenter)

Arne Kiis
(Host/Panelist)

Agenda

- The AnyBody Modeling System
- Spine Model
- Validation
- Dynamics stabilization device
- Workflow Mimics-AnyBody-ANSYS

AnyBody Technology

- Software licenses
- Consulting
- Training
- Support

ANYBODY TECHNOLOGY

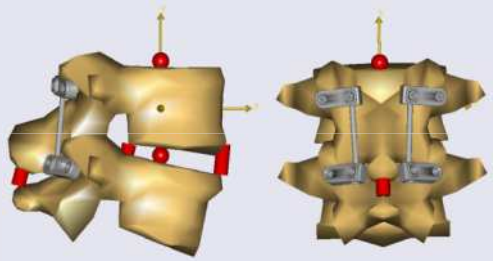
AnyBody Modeling System

- Developed for musculoskeletal analysis
- Self-contained system
- Fully developed and supported in-house (since 2001)
- Open body model (since 1997)
- Multi-level model validation
- Interfacing to
  - Motion capture
  - Medical image based bone and muscle data
  - Finite element software

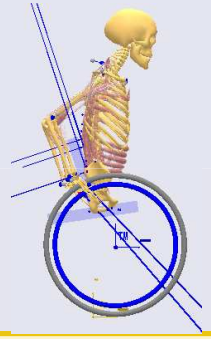
ANYBODY TECHNOLOGY

Product design optimization

Ergonomic analysis and documentation



ANYBODY Modeling System

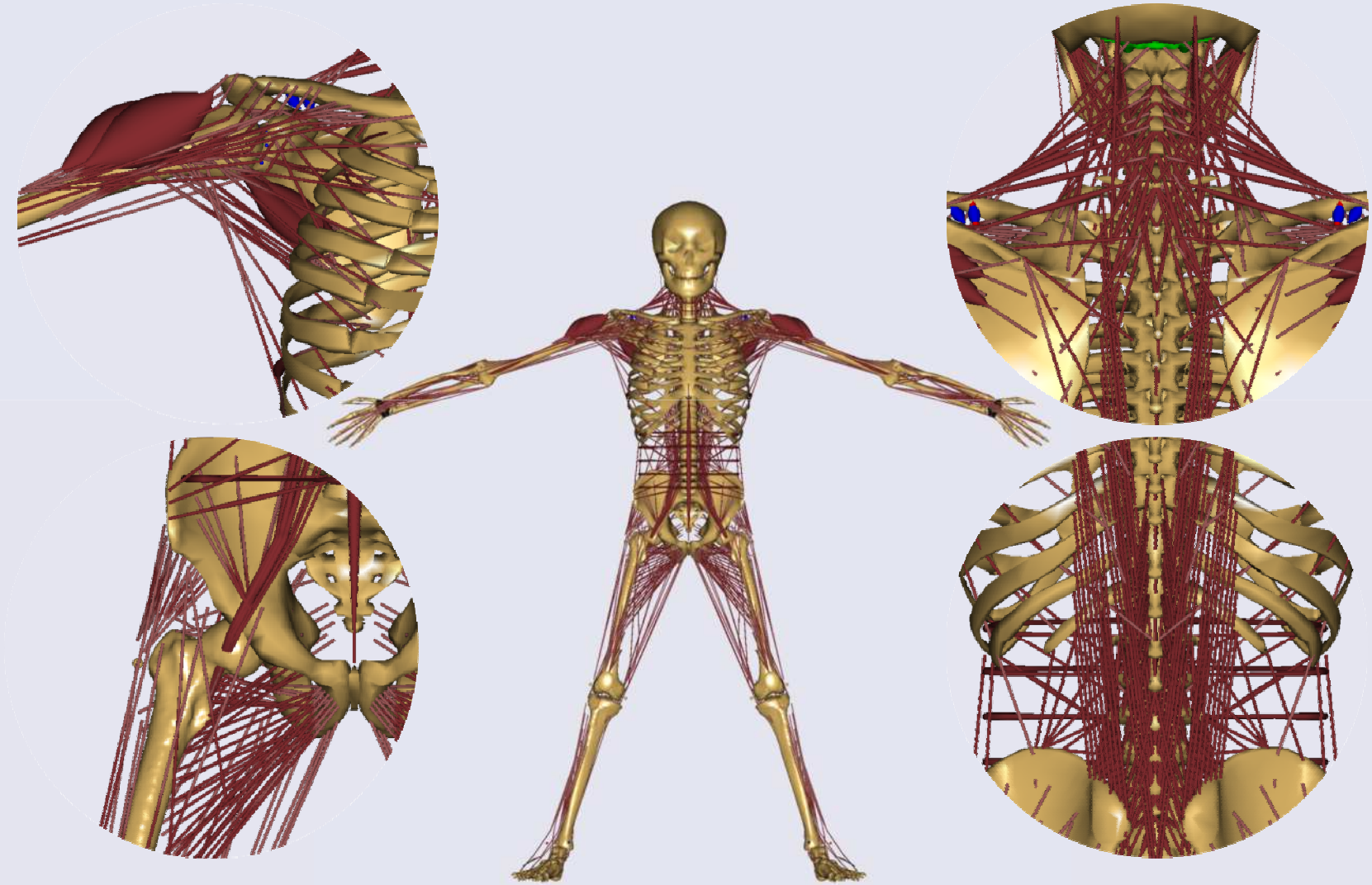


In-vivo load cases for Finite Element Analysis

Pre-op planning and post-op evaluation

ANYBODY TECHNOLOGY

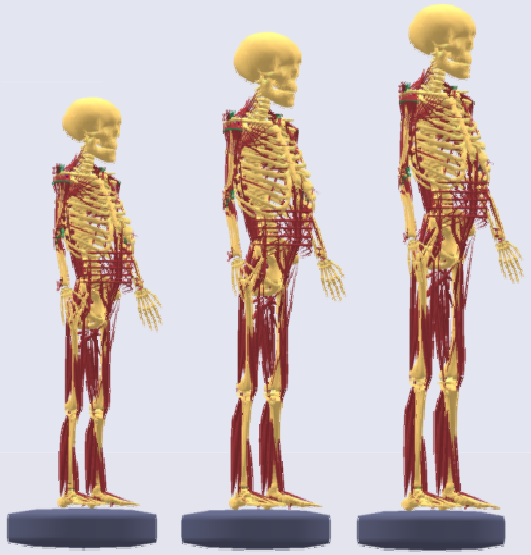
Unique open body model library

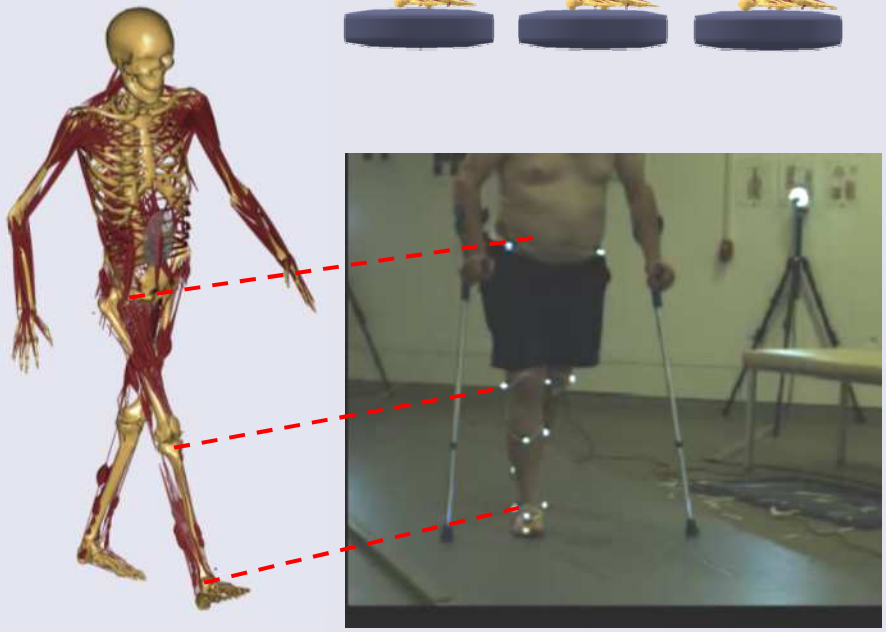


Body model customization

Increasingly patient specific

- Anthropometric scaling
- Automated scaling
- Strength calibration
- Bone shape matching
- Effects of surgical procedure
- Muscle physiology
- …





New and recently added features

- Subject specific modeling
- Contact modeling
- Force dependent kinematics
- Enhanced user interfacing tools
- Finite Element interfacing

Related webcasts:

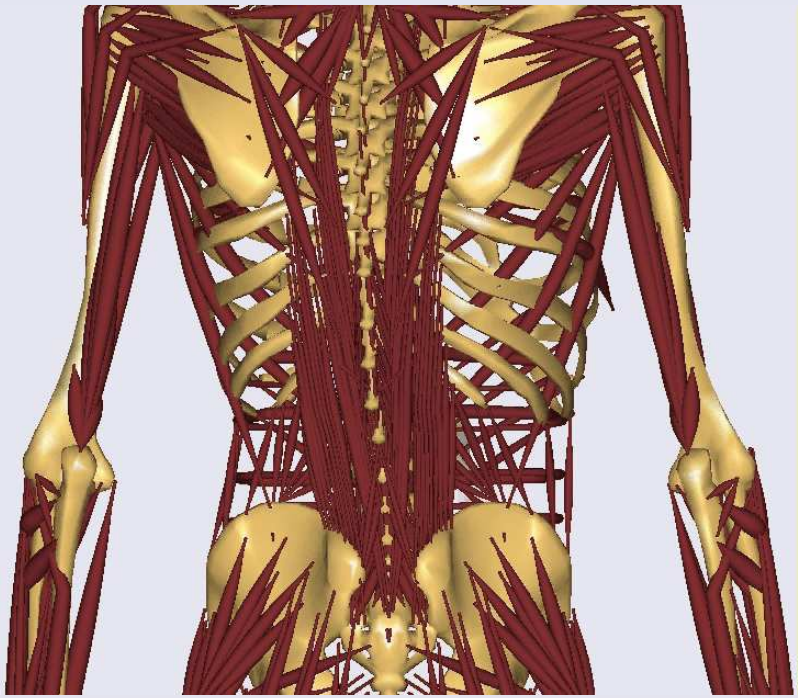
- Streamlining gait analysis with the AnyBody Modeling System v.5, Soeren Toerholm, January, 26th
- Patient-specific morphing of musculoskeletal models. Prof. John Rasmussen, March, 1st

Spine models

Cervical spine

- 7 vertebra
- 136 muscle fascicles

De Zee et al. 2007: J. Biomech.40, S284



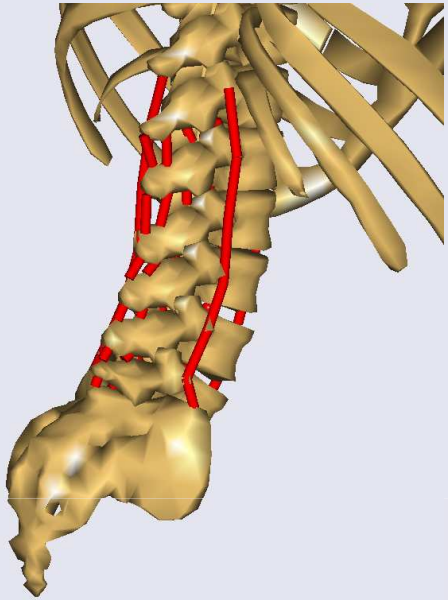
Lumbar spine

- 5 vertebra
- 188 muscle fascicles
- ligaments (intertransverse, anterior/posterior, ligamenta flava, interspinous, supraspinous)
- Intra abdominal pressure
- facet joints

Hansen et al. 2006: Spine 31, 1888-99

De Zee et al. 2007: J. Biomech. 40, 1219-27

Spine models



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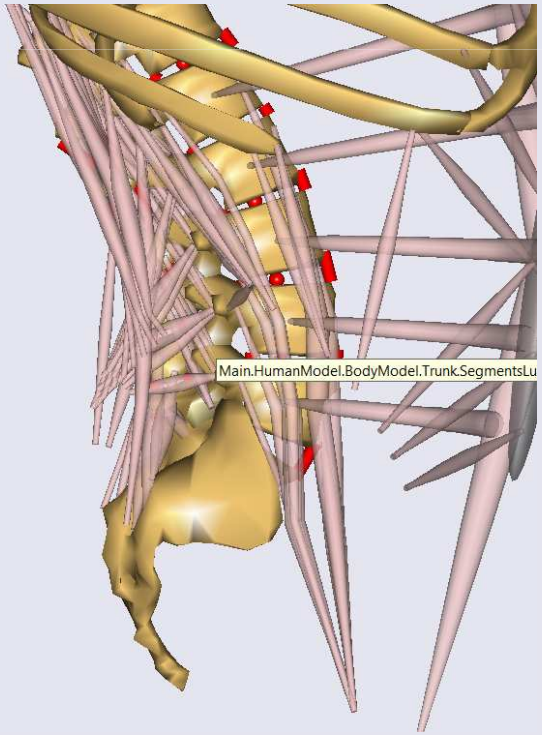

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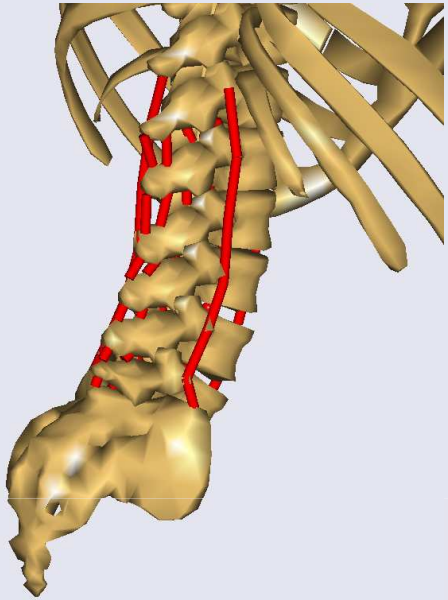

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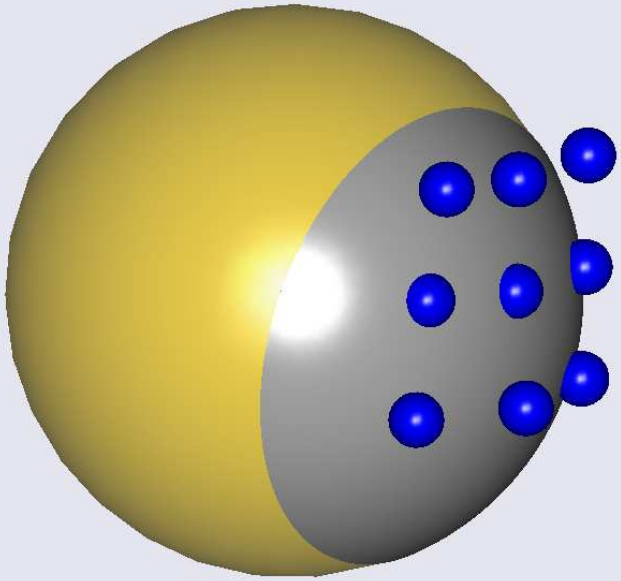

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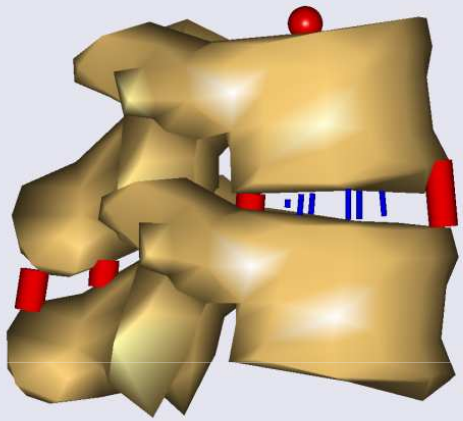
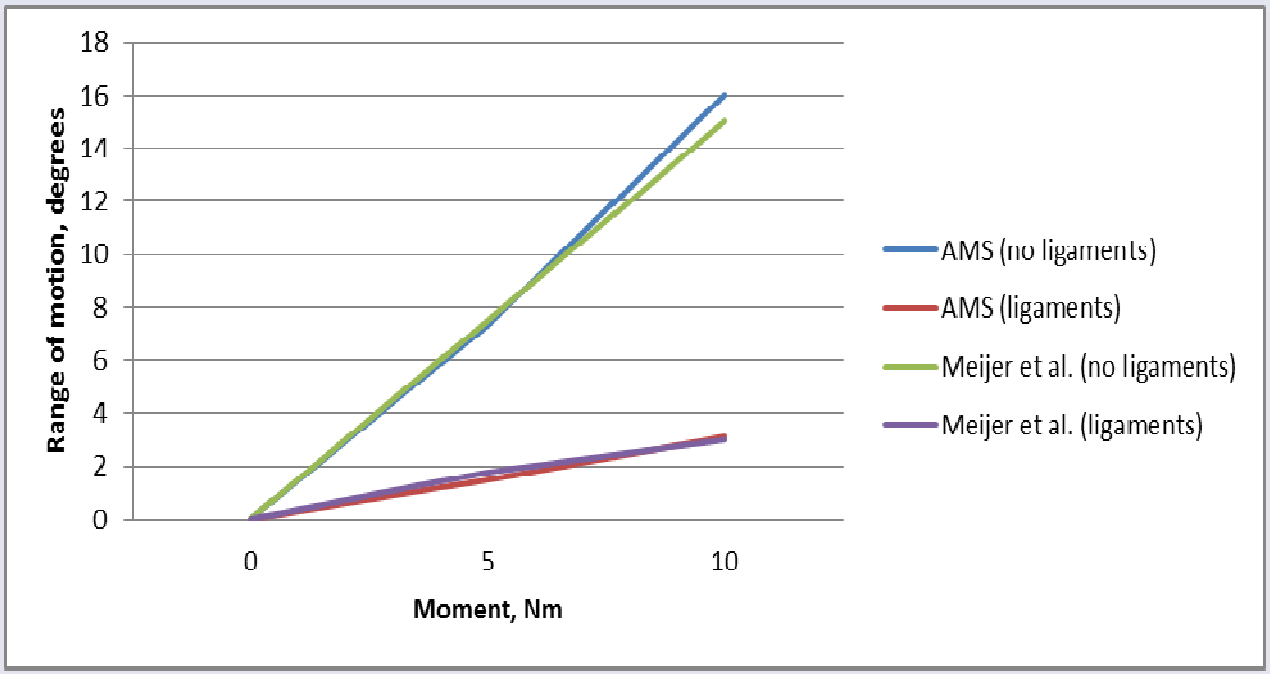
Spinal motion segment validation



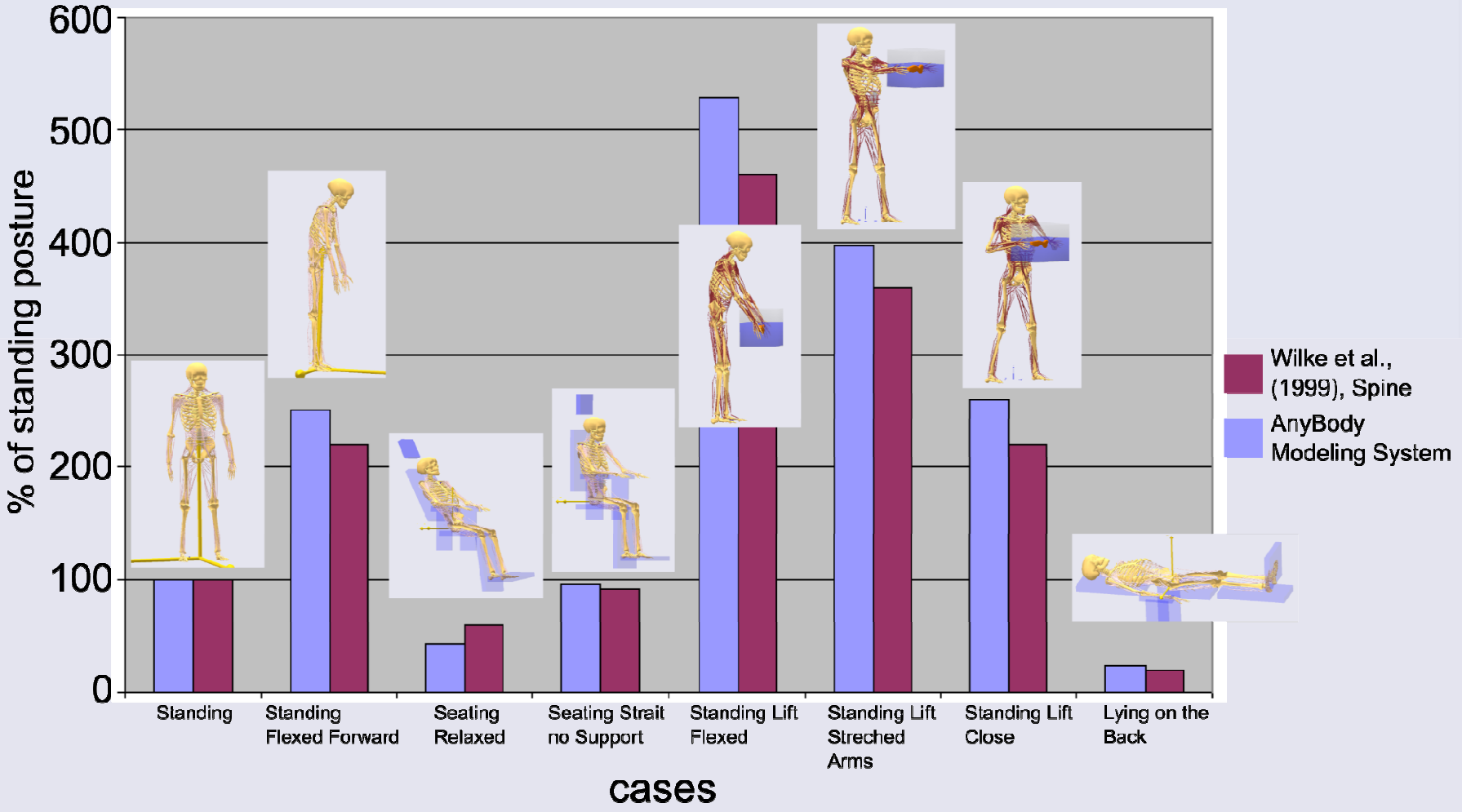
Comparison of motion in one spinal motion segment between a validated FE model and AnyBody model

January, 13th-16th ORS meeting, Long Beach, CA: Galibarov, P. et al., Two Computational Models of the Lumbar Spine: Comparison and Validation, POSTER #: 0786



Meijer *et al.* J Biomech, Vol. 43(8), 2010, pp. 1590-1597..

Spine pressure validation



Rasmussen, J. & et al. (2009), 'Validation of a biomechanical model of the lumbar spine. "International Society of Biomechanics 12th congress, Cape Town, RSA.'.

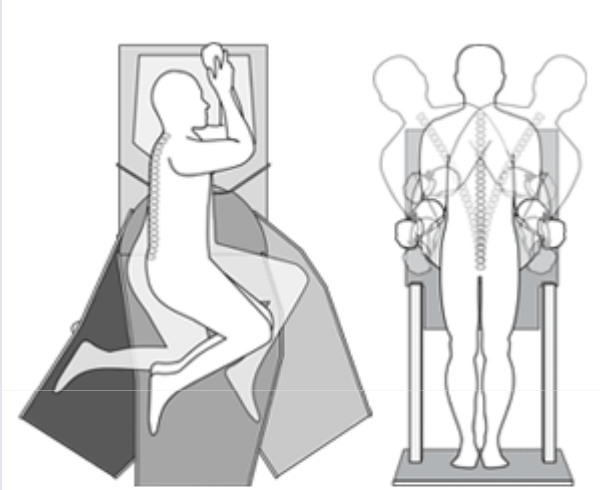
Ongoing validation and improvements

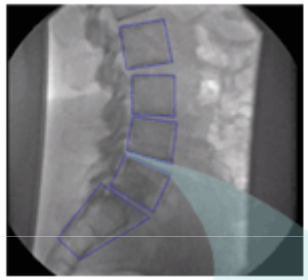
Spine kinematics

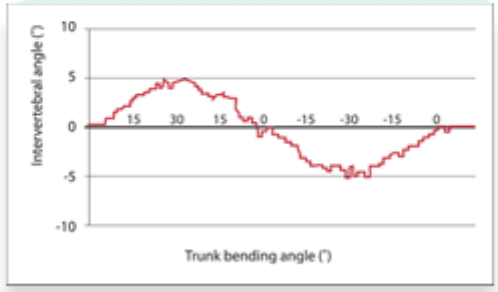
- Healthy
- Degenerated
- Instrumented
- Passive stiffness

New disc implementation

- SpineFX project





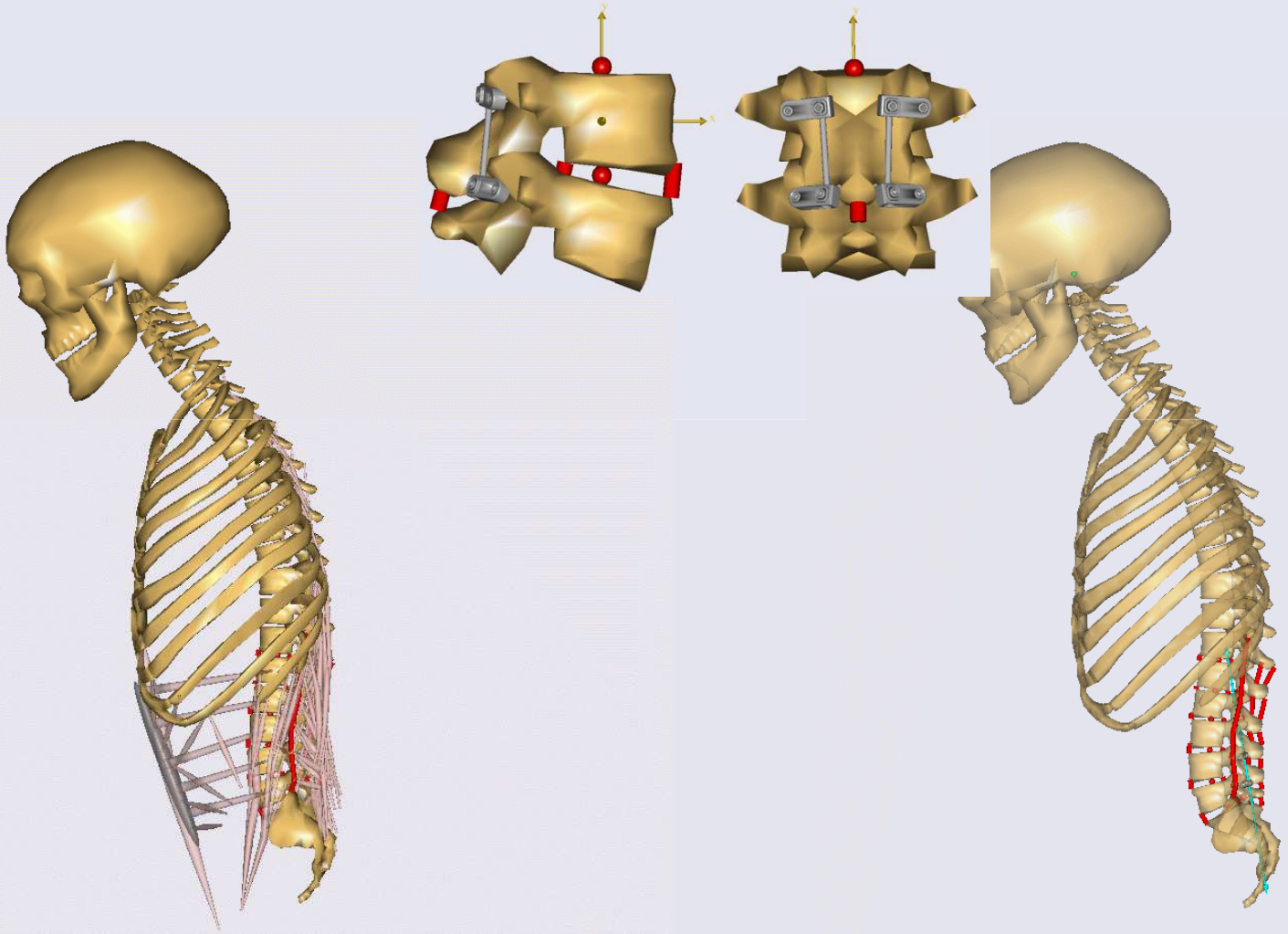


www.orthokinematics.com

SpineFX Initial Training Network

SEVENTH FRAMEWORK PROGRAMME

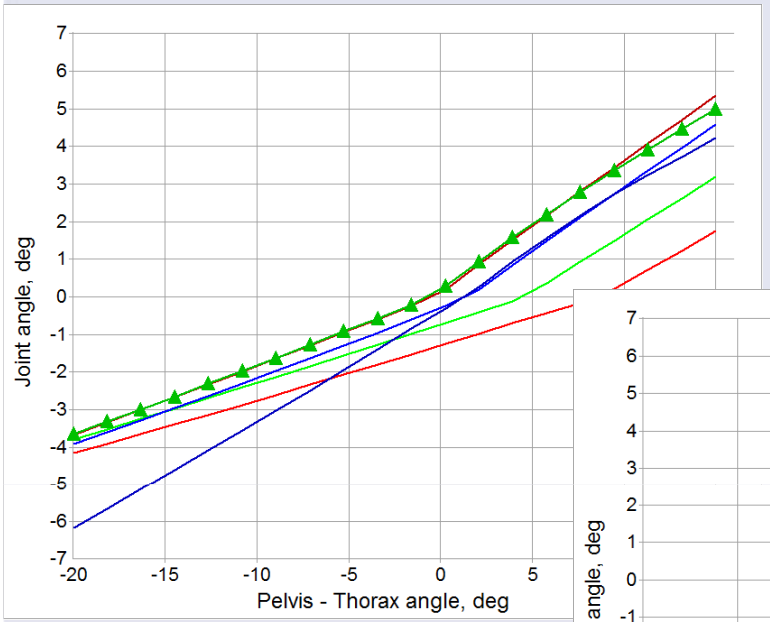
Posterior dynamic stabilization



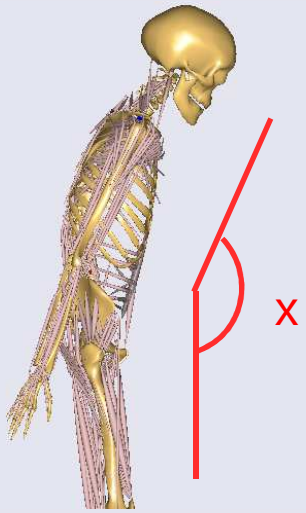
Healthy spine

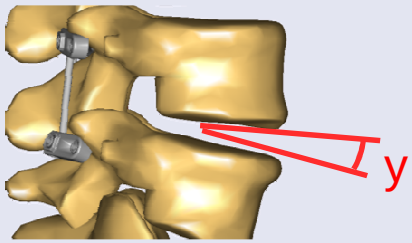
Stabilization device spanning L4-L5

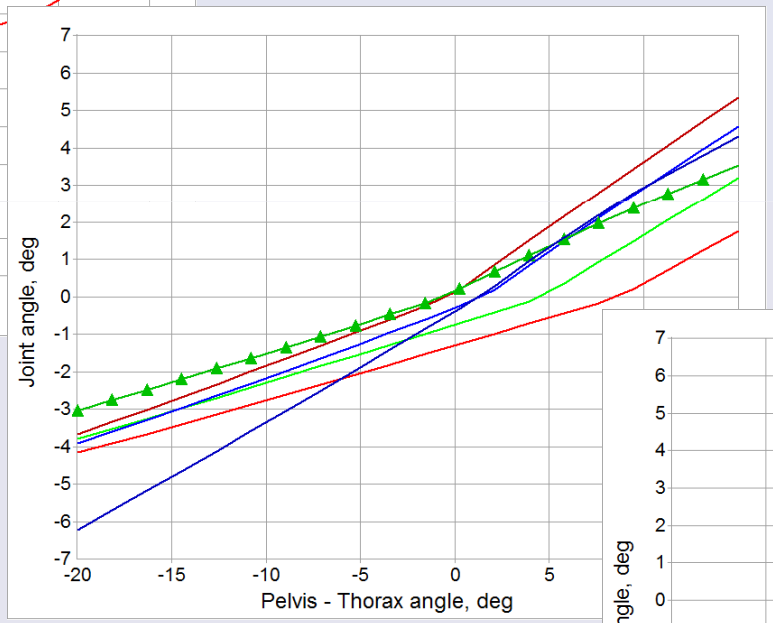
Altered spine kinematics



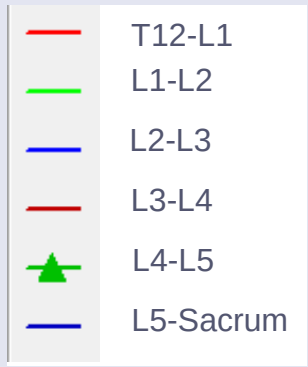
Healthy spine



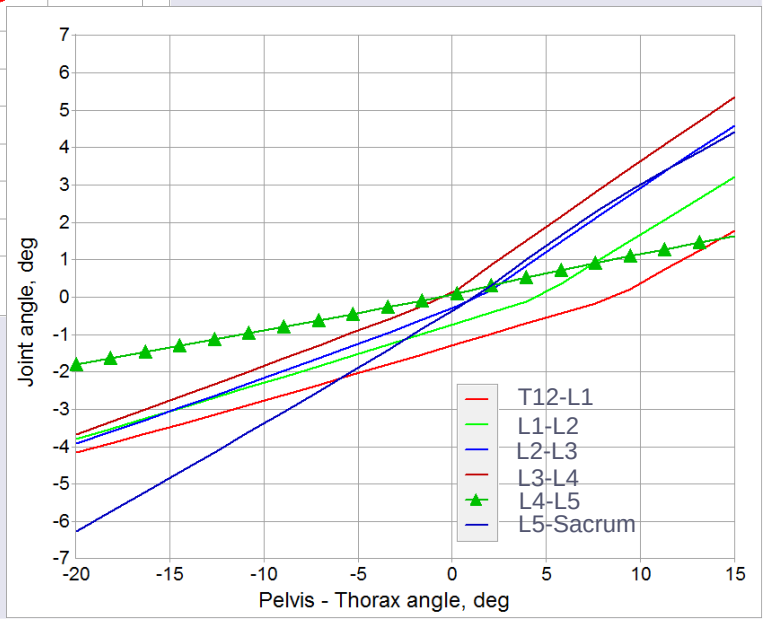




Stabilization device spanning L4-L5, stiffness 5 N/mm

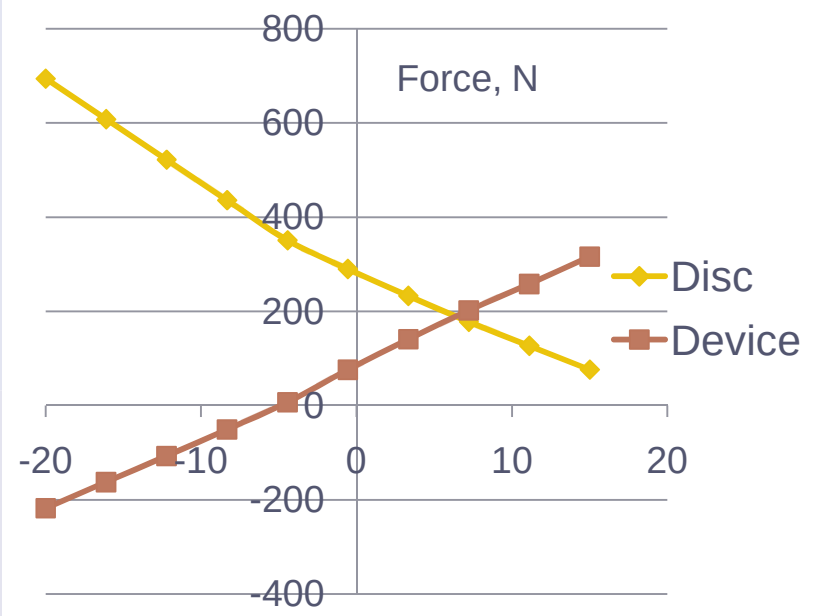


Stabilization device spanning L4-L5, stiffness 25 N/mm



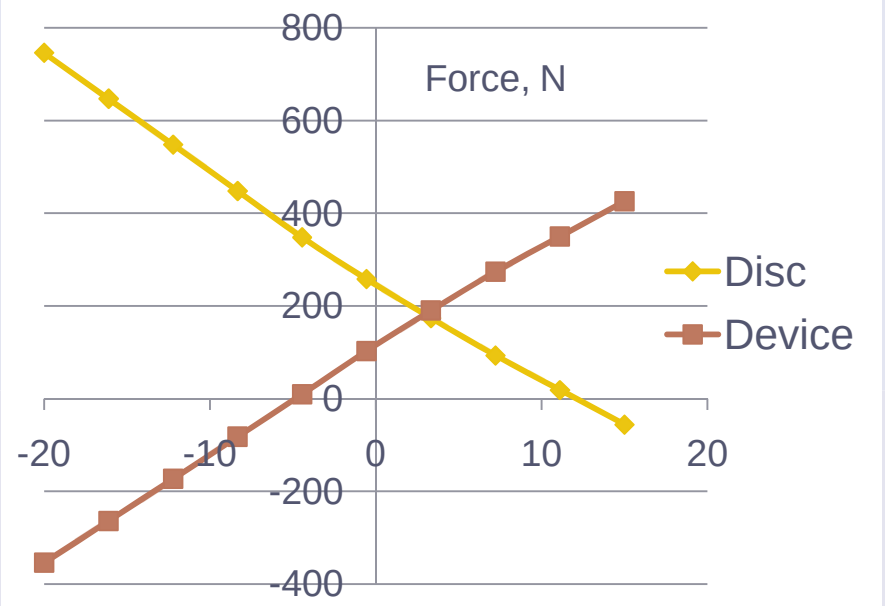
Anterior/posterior load sharing

Device stiffness 5 N/mm



Flexion-Extension, deg

Device stiffness 25 N/mm



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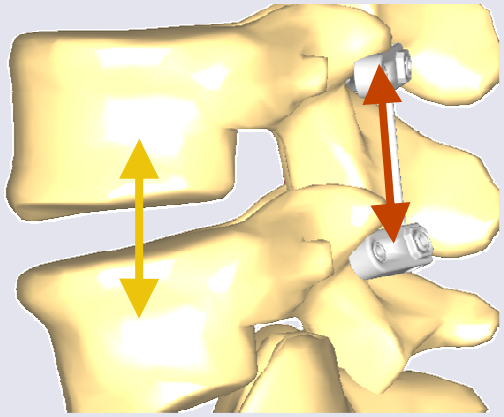
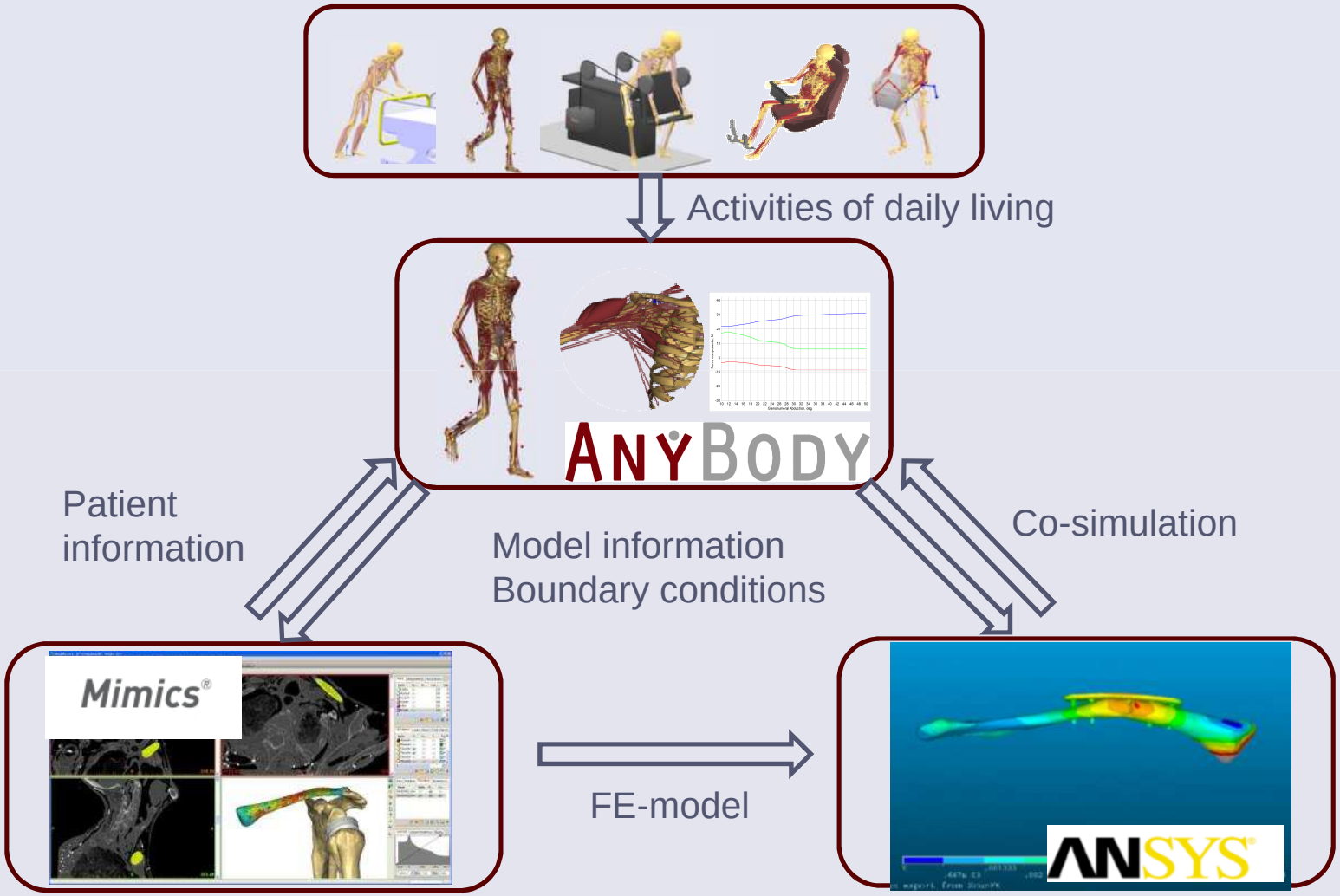
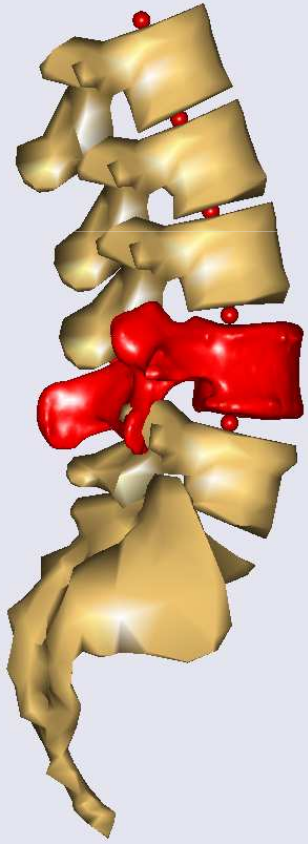
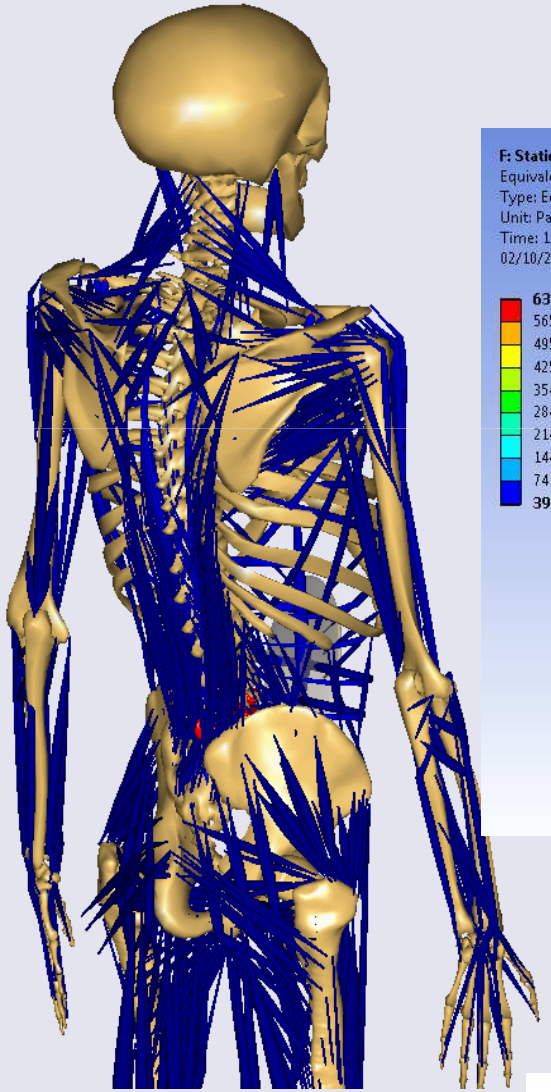


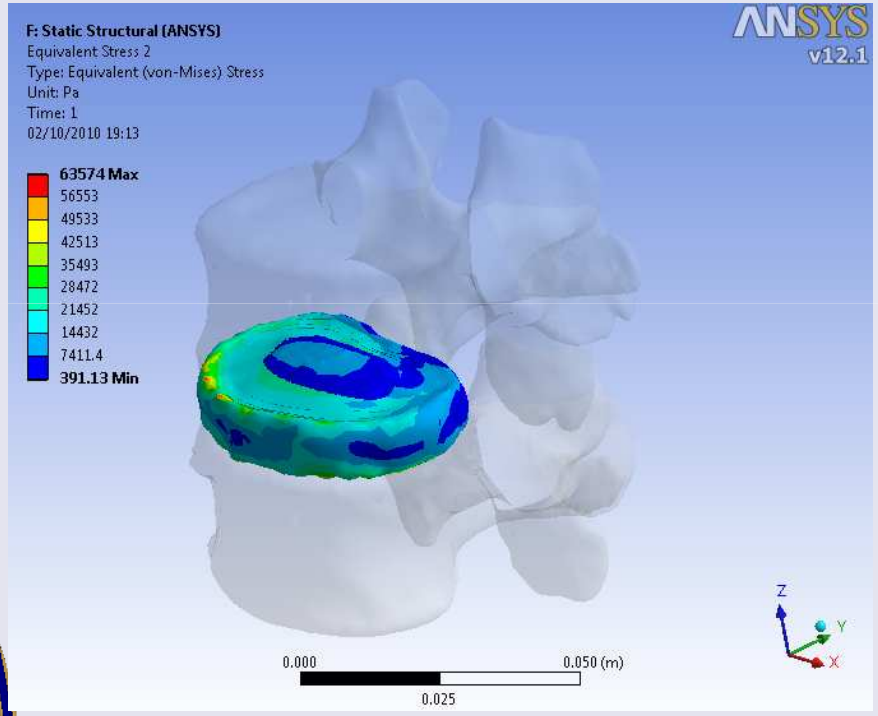
Functional patient based modeling



Patient specific disc biomechanics







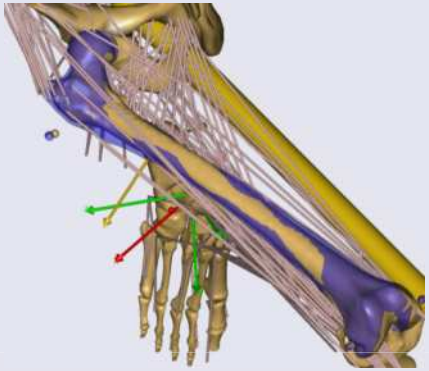
Materialise › ANYBODY TECHNOLOGY › ANSYS

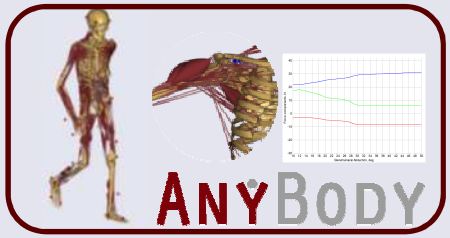
Workflow

1. Create patient specific model
2. Impose activity of daily living
3. Analyze muscle and joint forces
4. Output dynamic in-vivo forces / motion (ANSYS APDL)

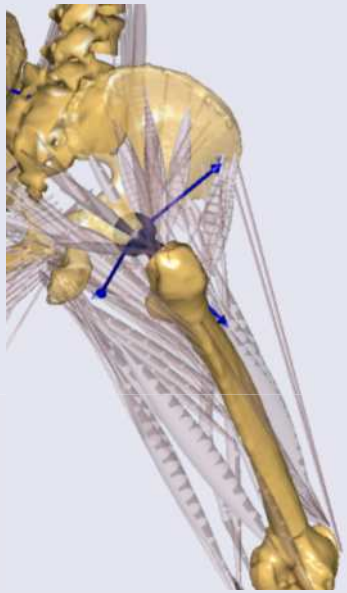
Mimics – AnyBody interfacing

- .stl geometry
- Bony landmarks
- Muscle attachment points
- Muscle geometries

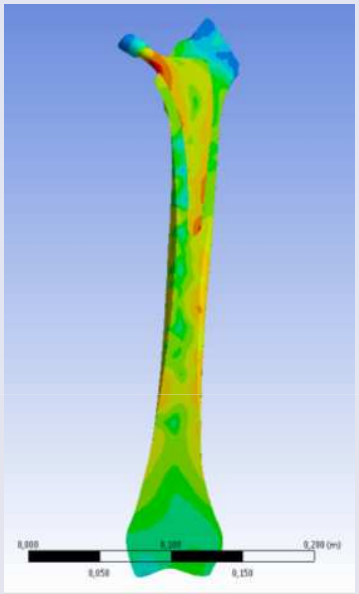


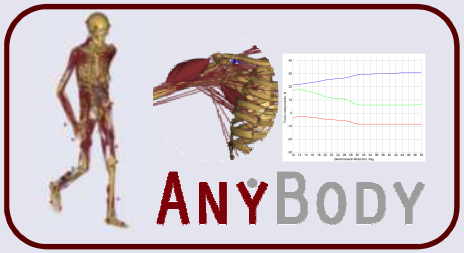


AnyBody - ANSYS interfacing



- APDL / text files
  - Forces
  - Motion
- .stl file





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Announcements

- Webcasts
  - Streamlining gait analysis with the AnyBody Modeling System v.5, Soeren Toerholm, January, 26th
  - Patient-specific morphing of musculoskeletal models. Prof. John Rasmussen, March, 1st
- Conferences
  - Pre-ORS Computational Methods in Orthopaedic Biomechanics, Long Beach, CA, January, 11th
  - ORS meeting, Long Beach, CA, January, 13th-16th Booth #1136

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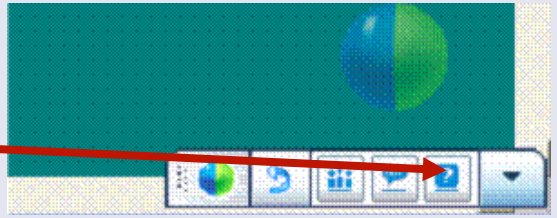

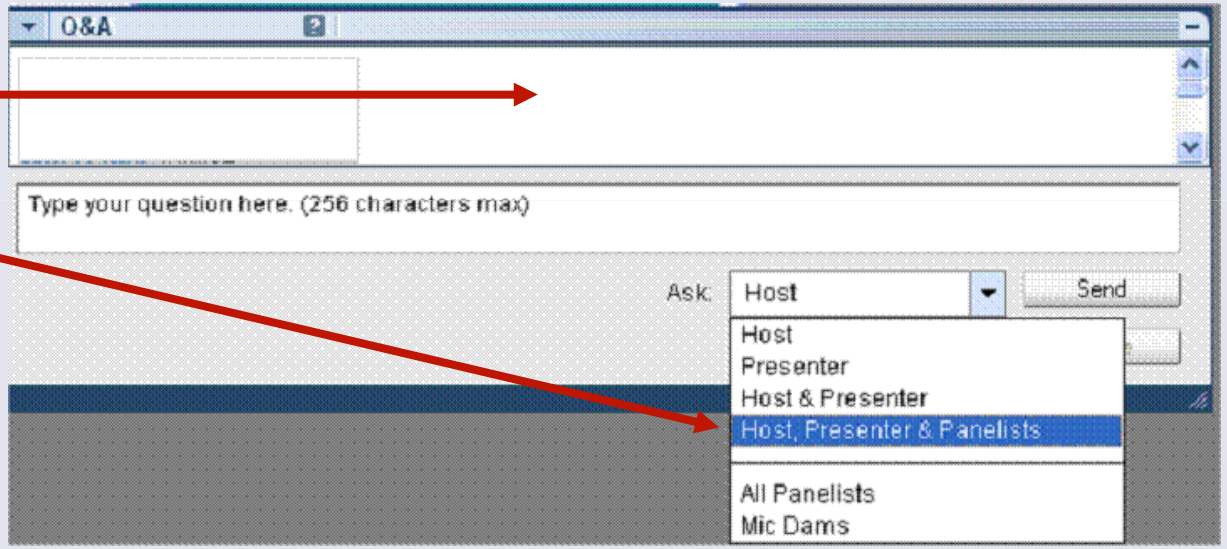

Force dependent kinematics (FDK)

- Allows to free up drivers on selected degrees of freedom
- Motion will depend on the forces acting on the segment
- New feature in V 5.0