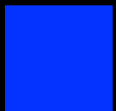


FUNCTIONAL ANATOMY AND BIOMECHANICS OF THORACIC SPINE

Hakan BOZKUS, M.D.
VKF American Hospital
Department of Neurosurgery



AMERİKAN
HASTANESİ

World Federation of Neurosurgical Societies

X. International Course on Clinical Neurosurgery

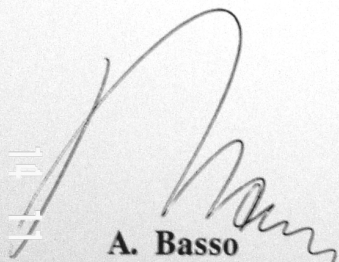
Hannover - Germany May 18th - 24th, 1995

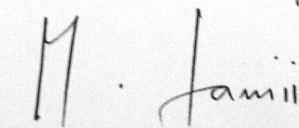
DIPLOMA

This document is to certify that our colleague

Hakan Bozkus, M.D.

has participated in the above mentioned course of our Continuing Education Project.


A. Basso
President of WFNS

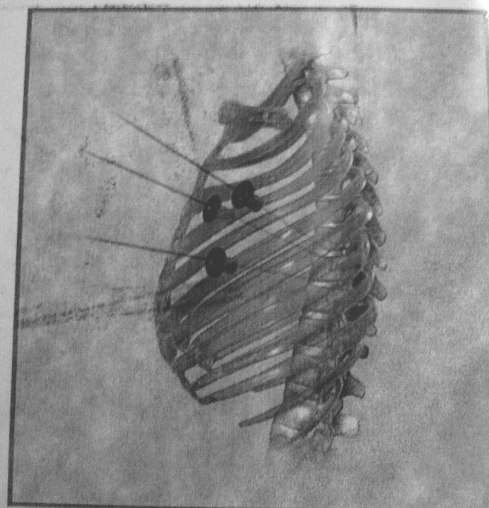

M. Samii
Course Director

Barrow Neurological Institute®
St. Joseph's Hospital and Medical Center
CHW

350 West Thomas
Phoenix, AZ 85013
602.406.3000 Fax

Thoracoscopic Spine Workshop

Anterior Approaches to
the Thoracic Spine



January 27 & 28, 2003

Barrow Neurological Institute
Phoenix, Arizona

BARROW
Neurological
Institute

Faculty

Dean Karahalios, MD
Indianapolis Neurosurgical
Group
Indianapolis, IN

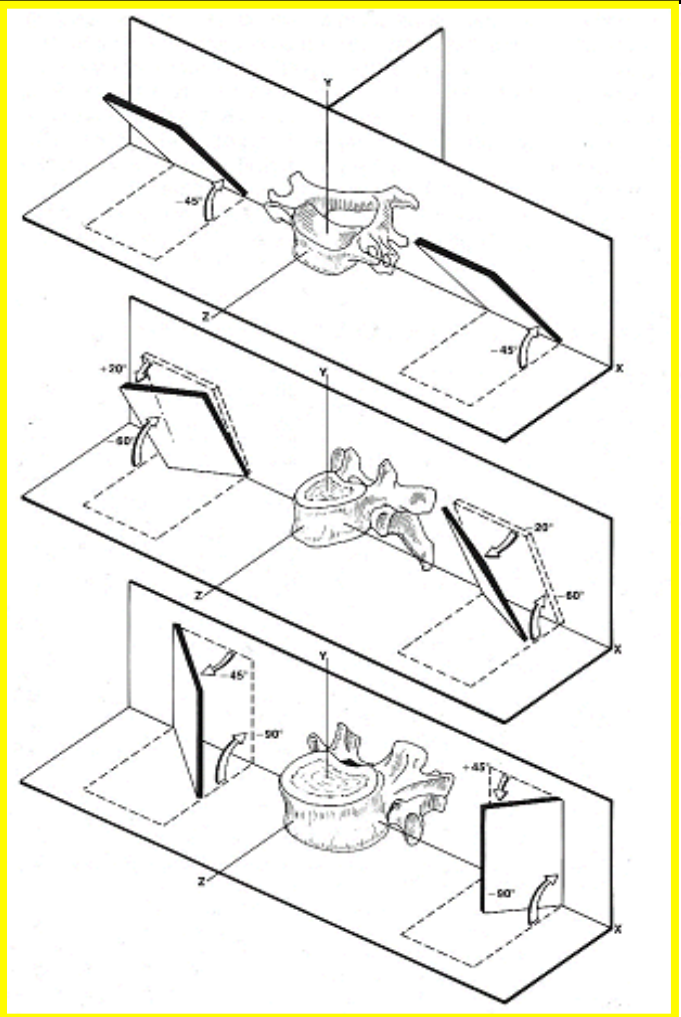
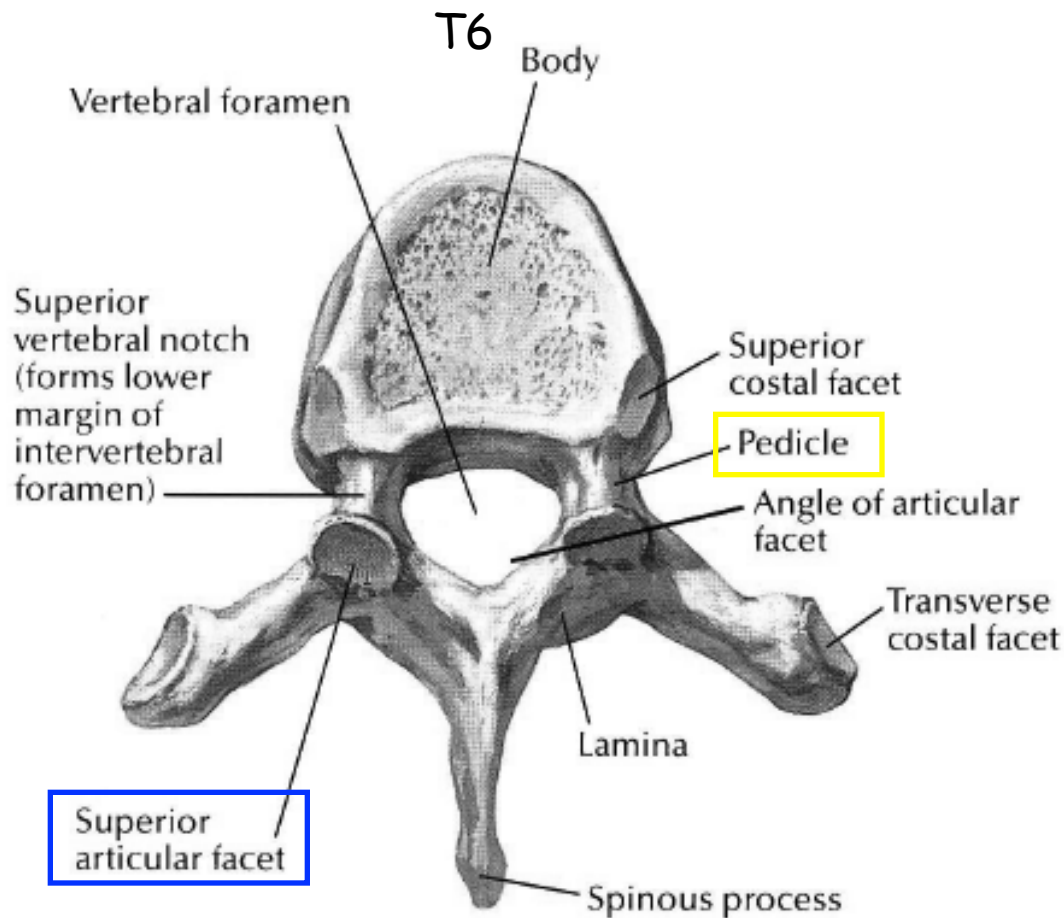
Daniel Rosenthal, MD
Head and Chairman
Klinik für Neurochirurgie
Klinikum der Johan Wolfgang
Goethe Universität
Frankfurt am Main, Germany

Hazan Bozkus, MD
350 W. Thomas Rd.
Phoenix, AZ 85013

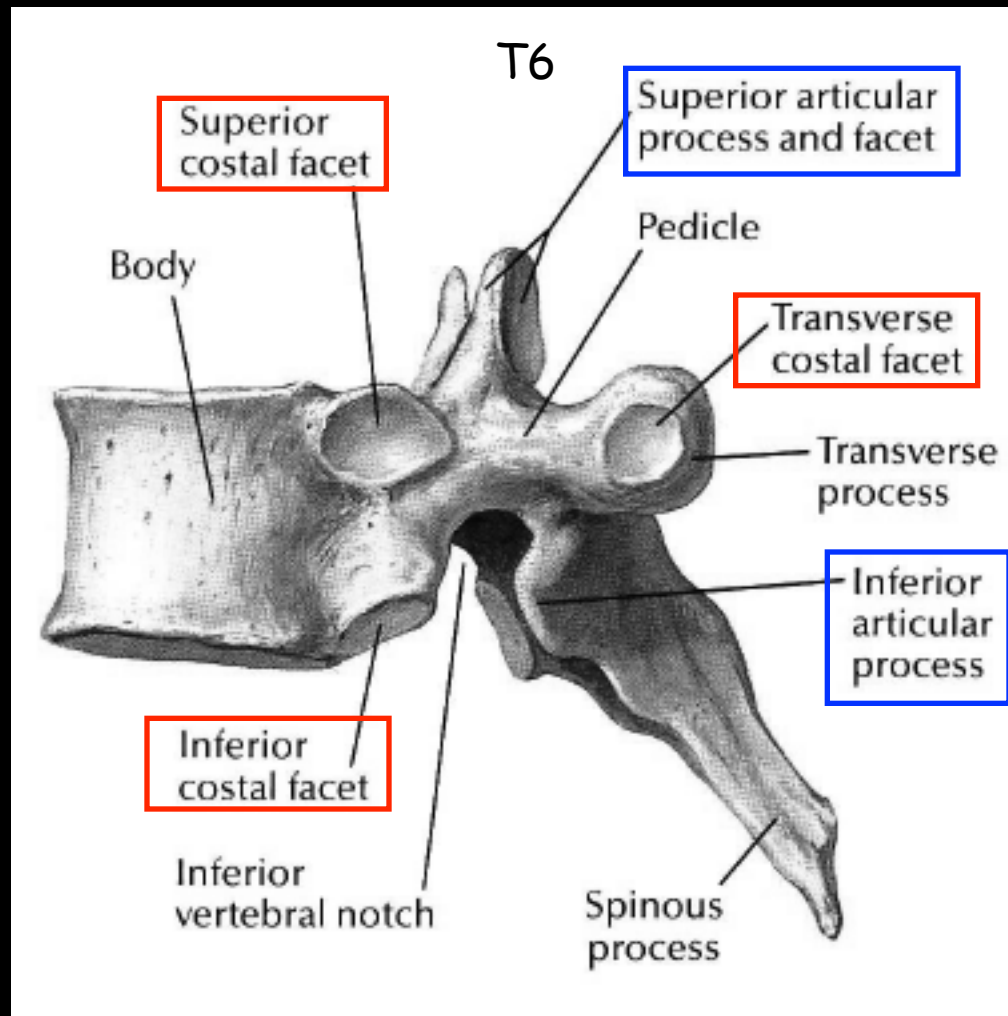
Thoracic Spine

- Upper thoracic spine (T1-4) - cervicothoracic junction
- Midthoracic spine (T4-10)
- Lower thoracic spine (T10-12) - thoracolumbar junction

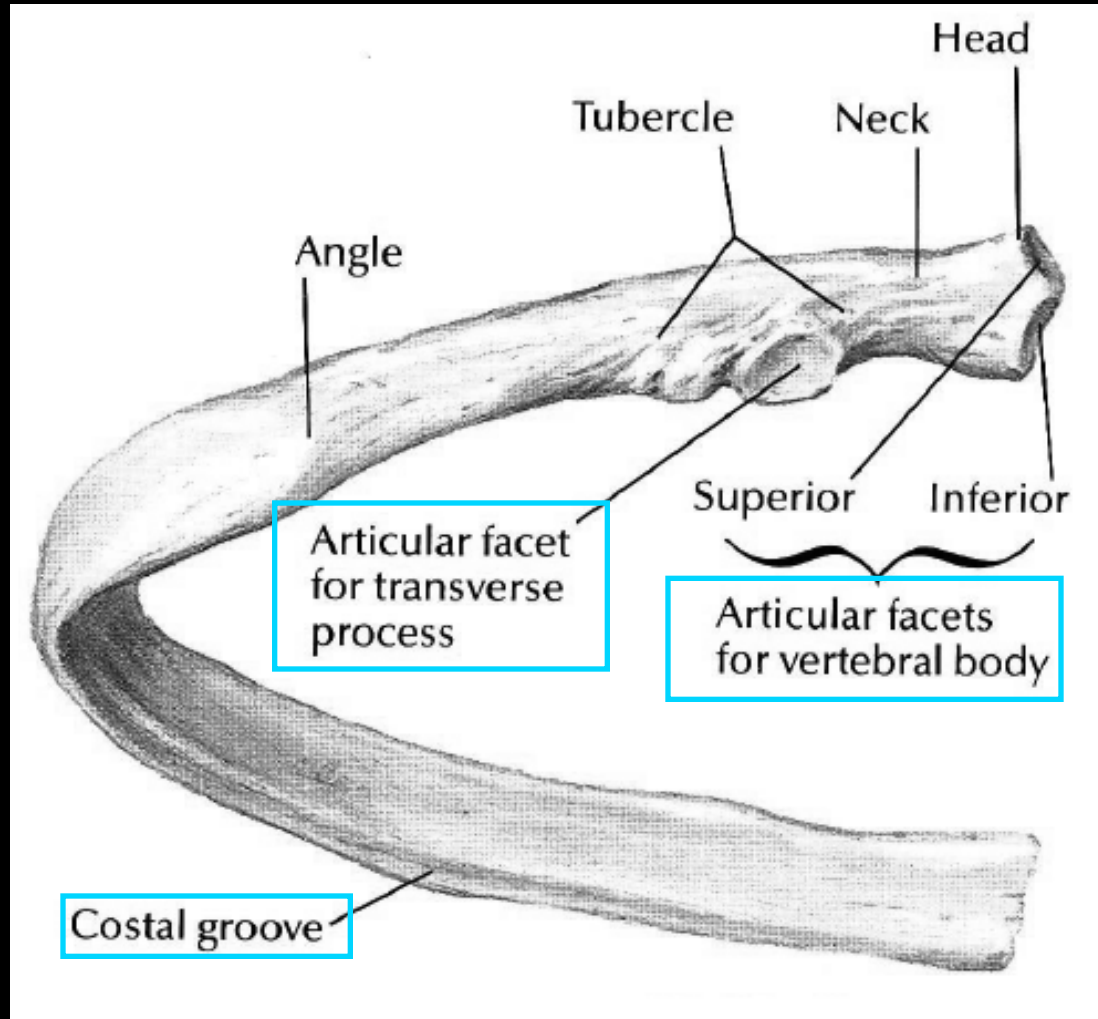
Axial View



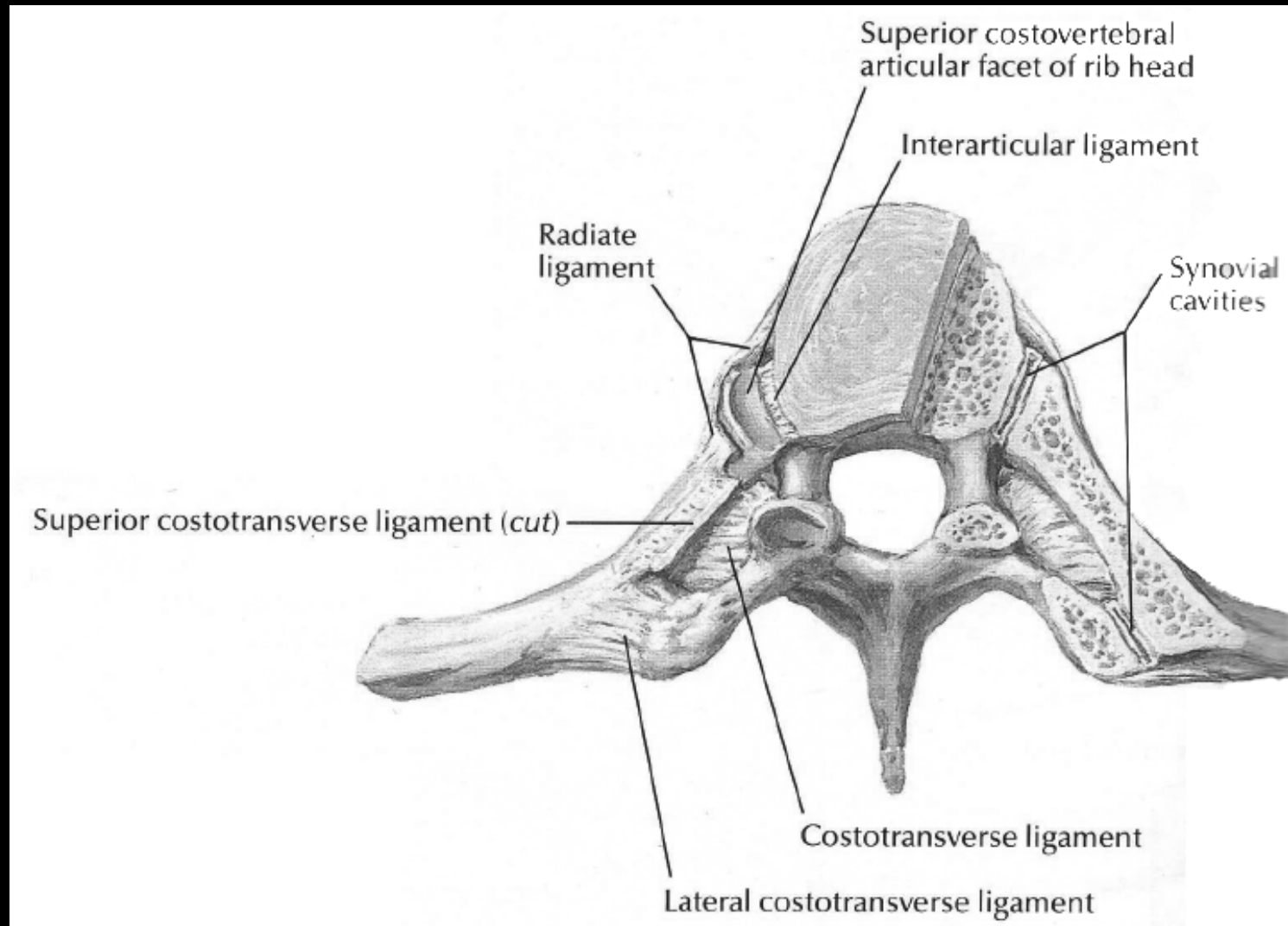
Sagittal View



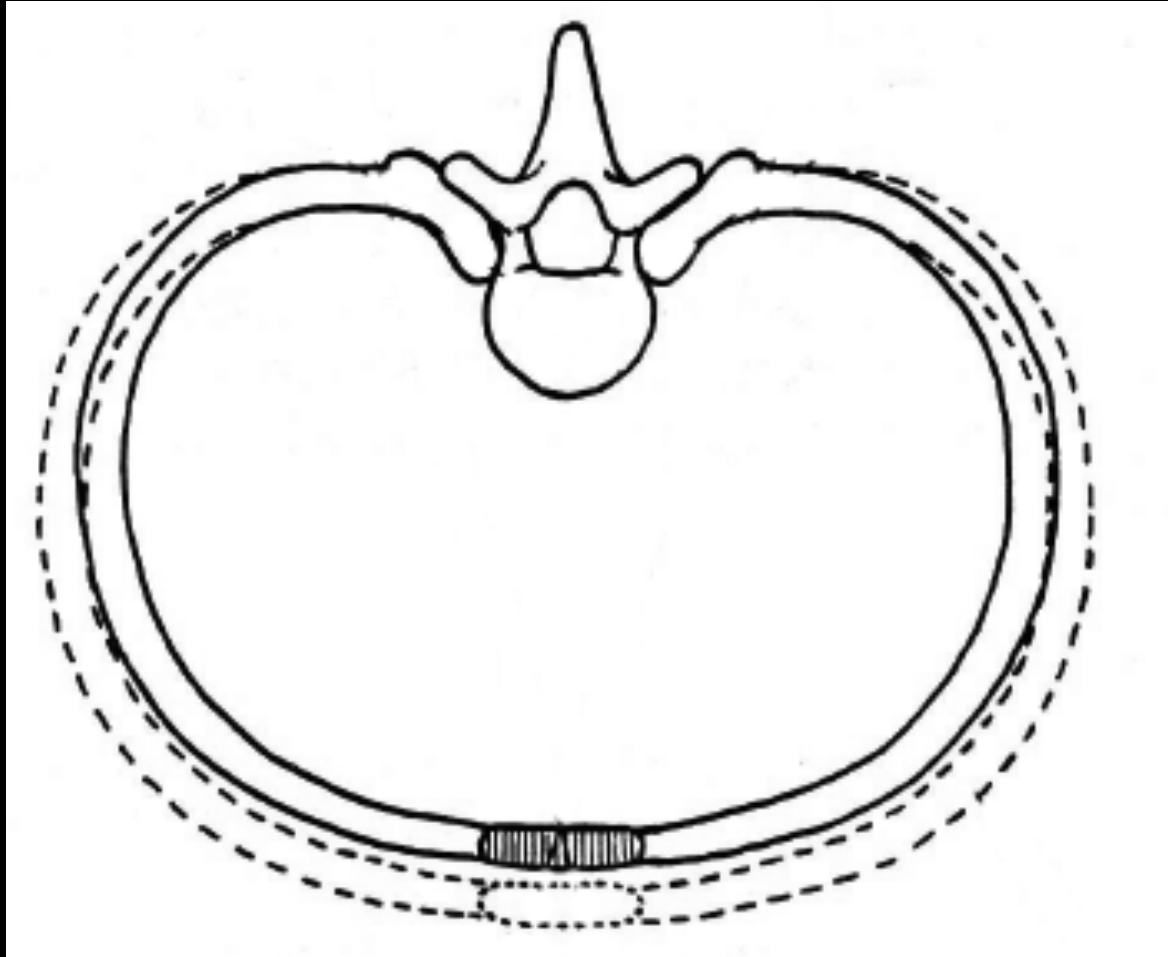
Rib Anatomy



Costovertebral/ Costotransverse Ligaments



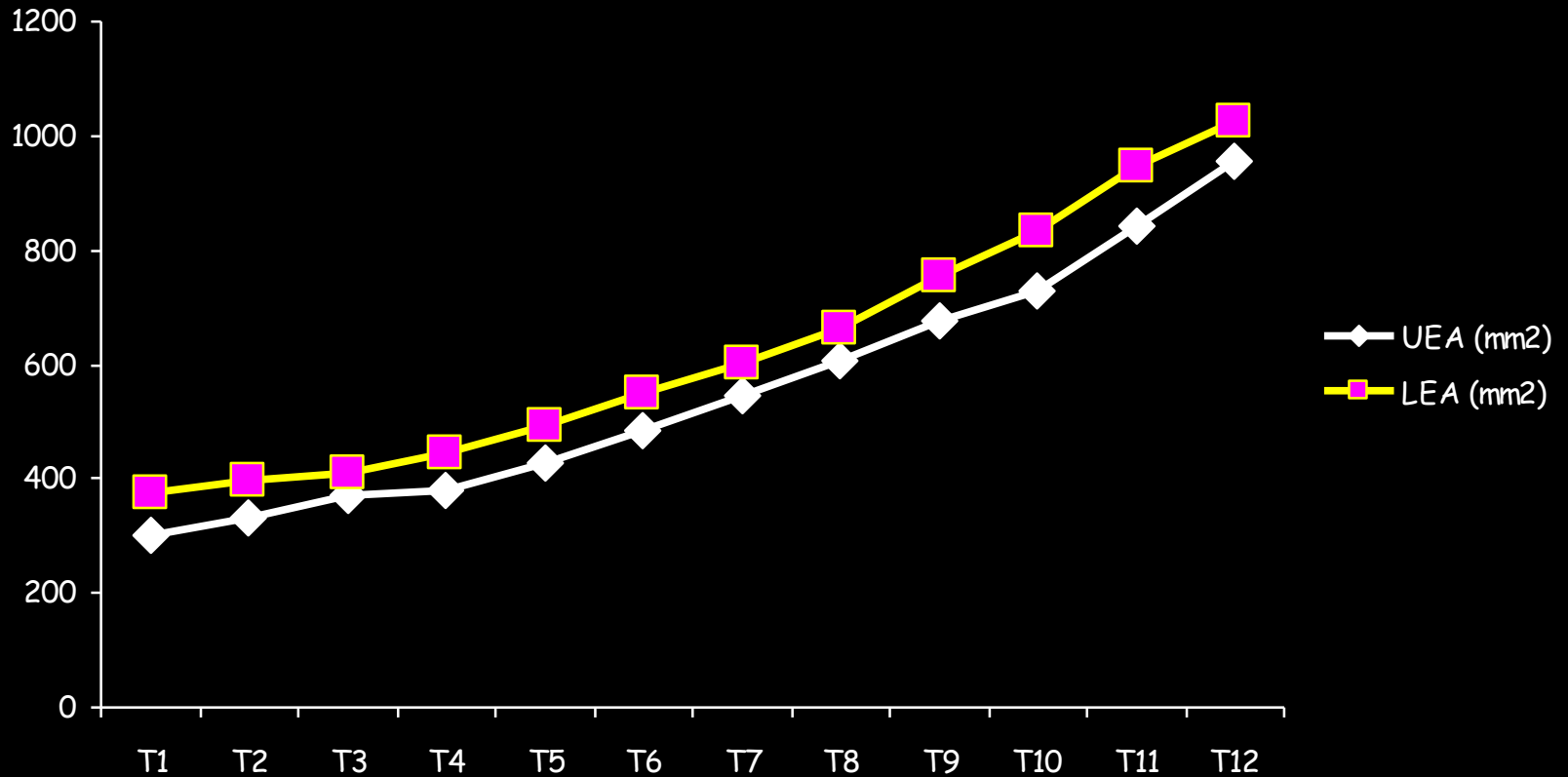
Fourth Column of Spine



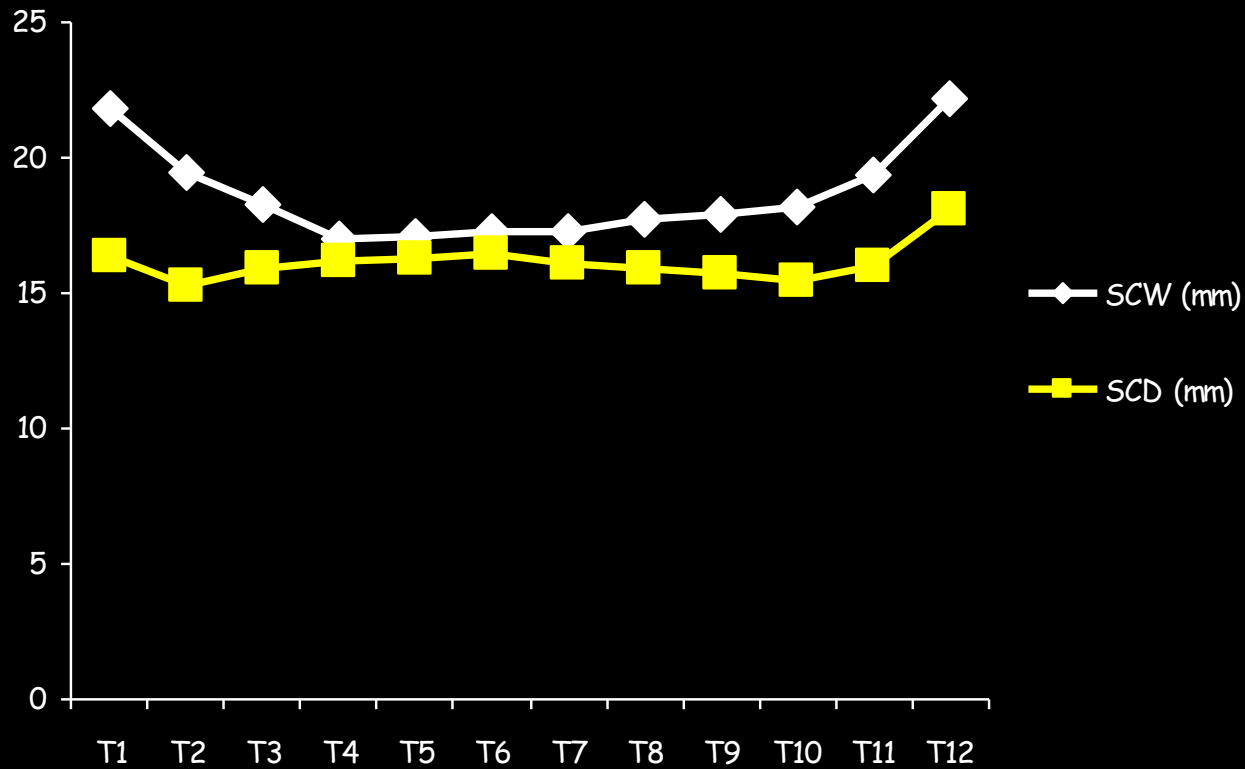
Berg EE, Spine 1993



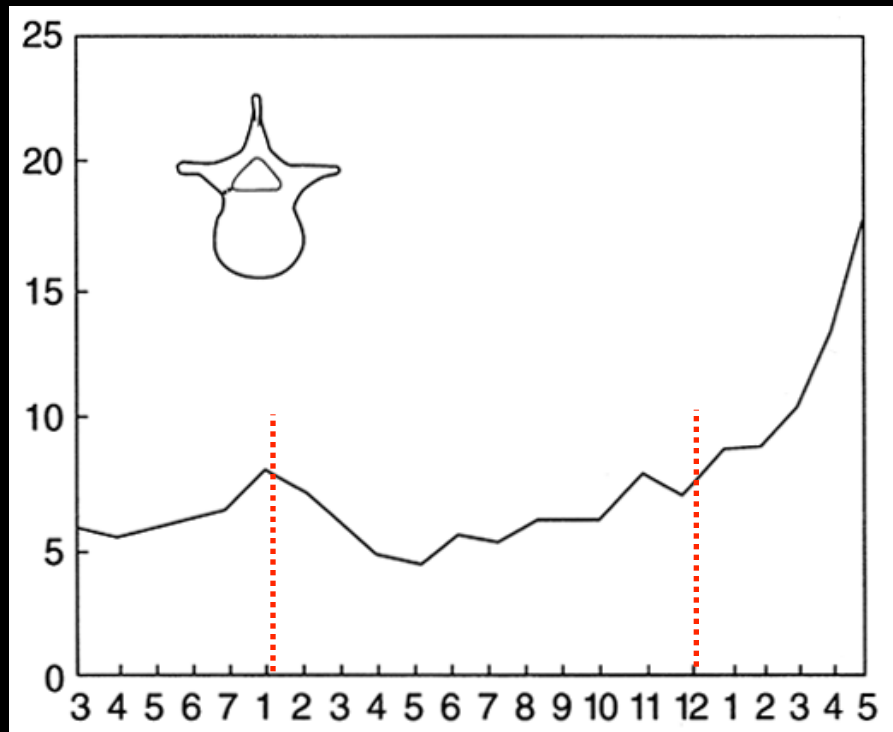
Endplate Area



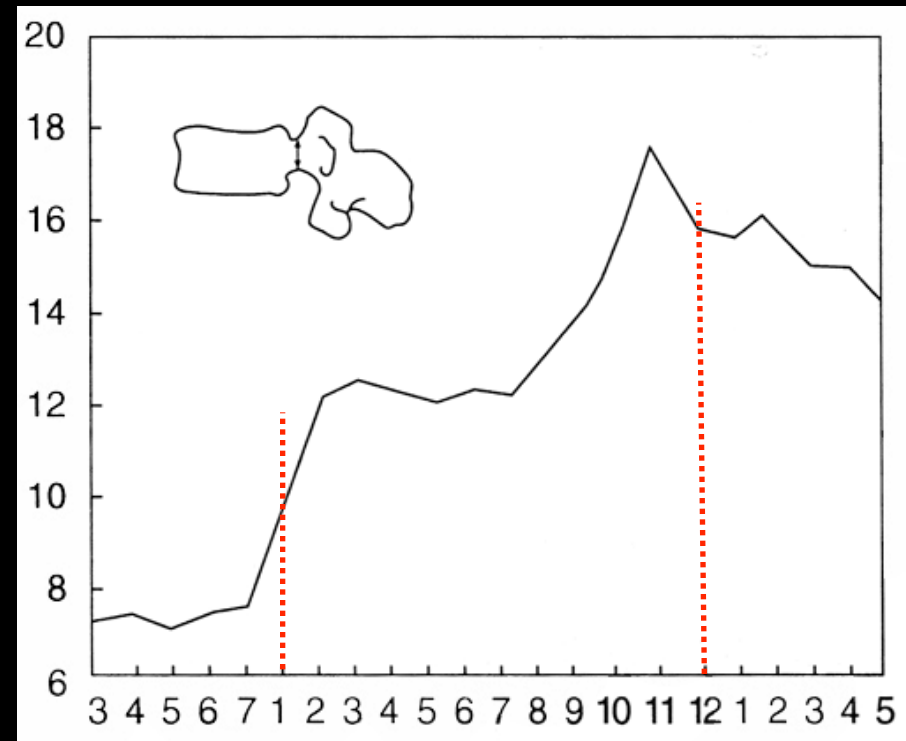
Spinal Canal Diameter



Pedicle

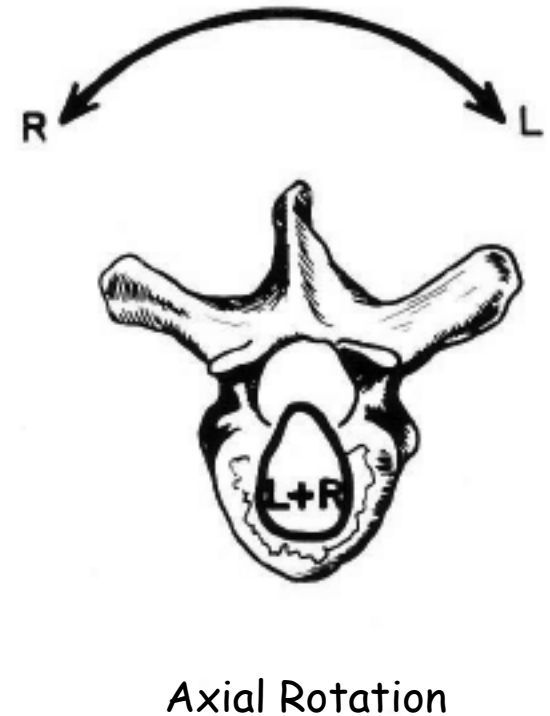
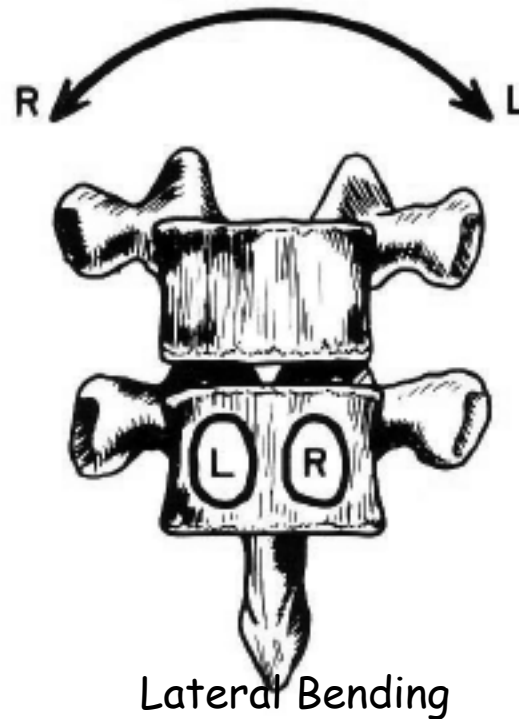
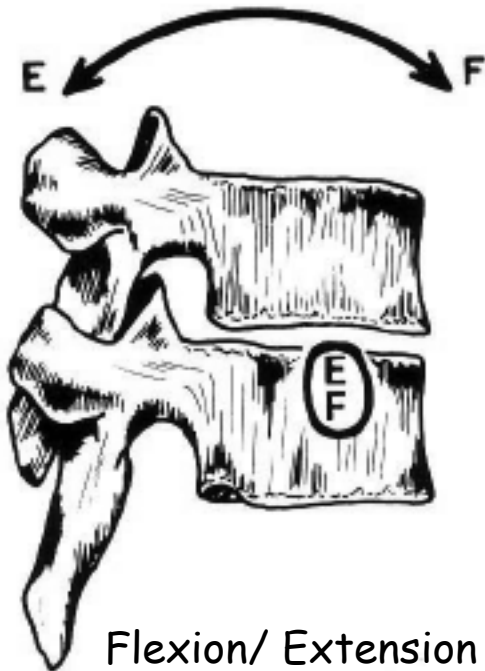


Transvers diameter



Sagittal diameter

Range of Motion (ROM)



6 degree of freedom

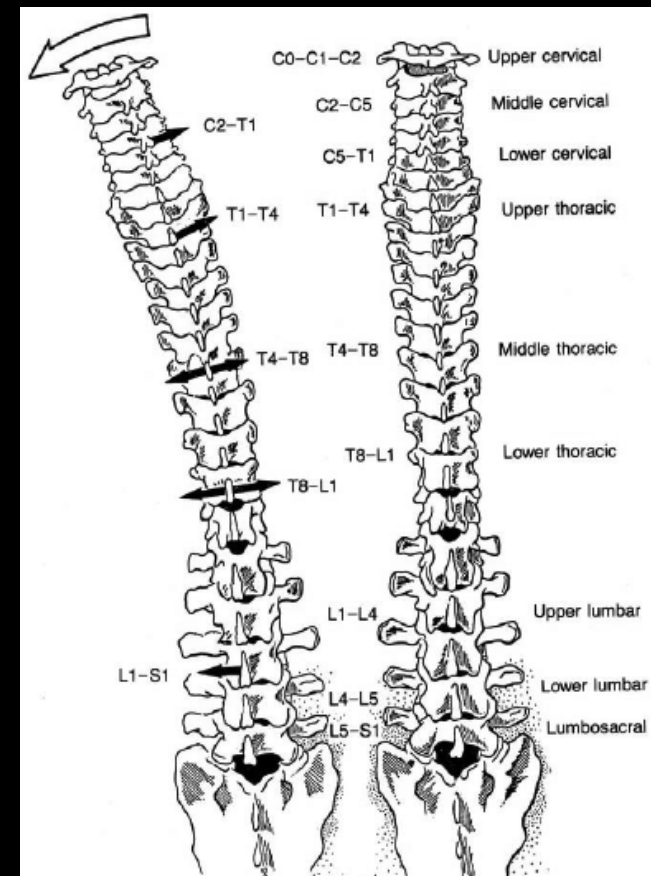
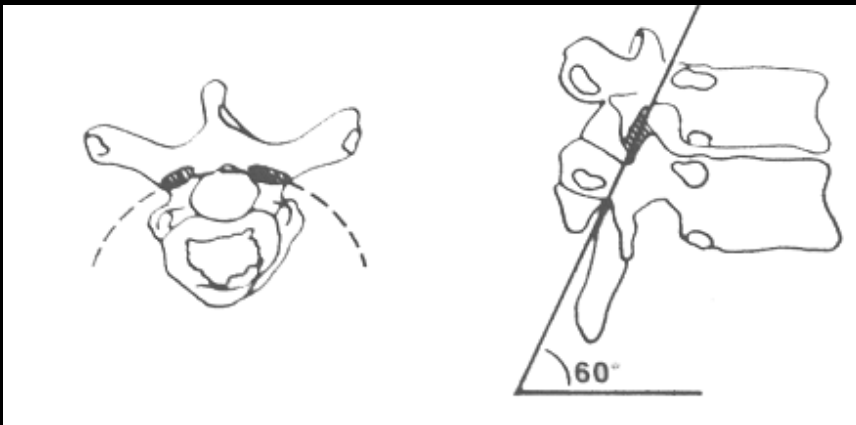
ROM

- ROM of thoracic spine under physiological moment (± 1.5 Nm)

	upper	middle	lower
- Flexion-Extension	4°	6°	12°
- Lateral bending	12°	12°	14°
- Axial rotation	16°	14°	4°

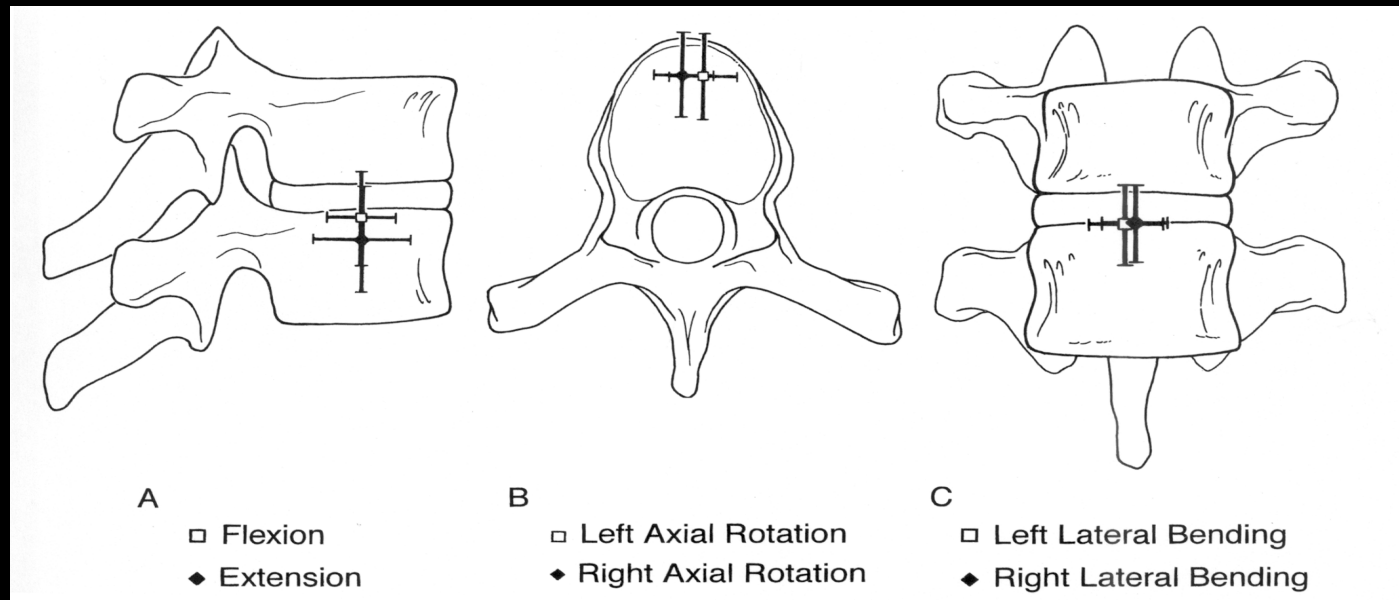
Coupling Motion

- Coupling motion mostly occurs at upper and middle thoracic spine.
- Axial rotation and lateral bending.



Biomechanics

- IAR is located at similar localization during flexion-extension, axial rotation and lateral bending.
- There is slightly difference between right and left axial rotation IAR's. (Average 3.7 ± 2.9 mm)

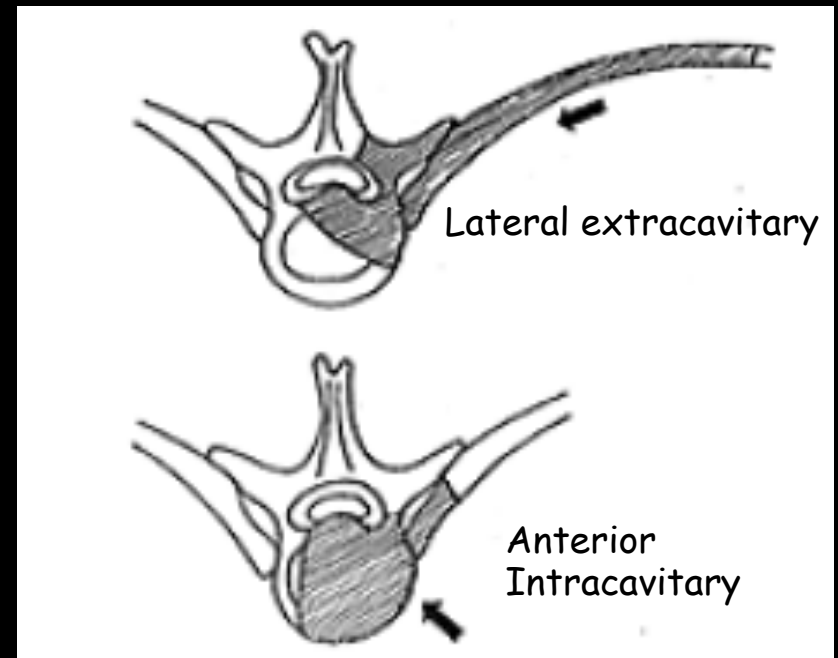
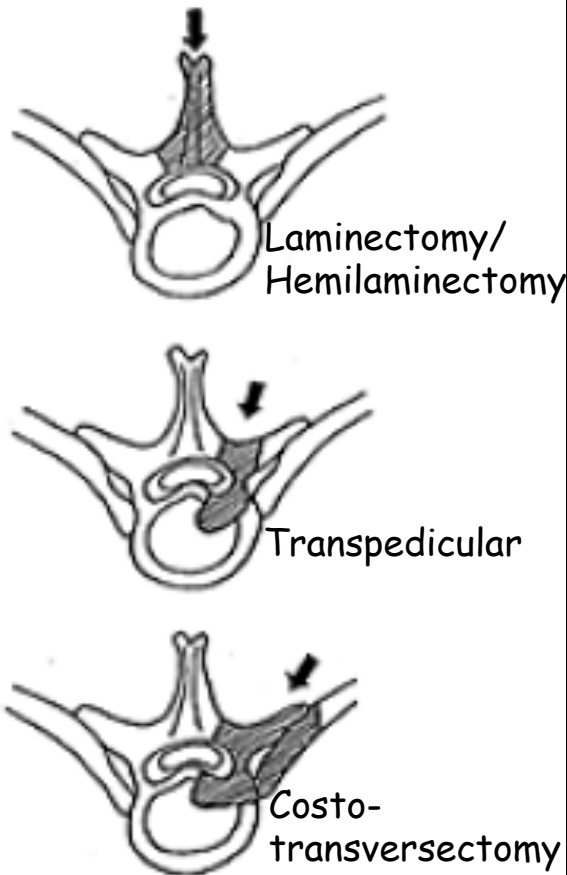


Failure Loads for Ligaments

- Weakest ligament is PLL !

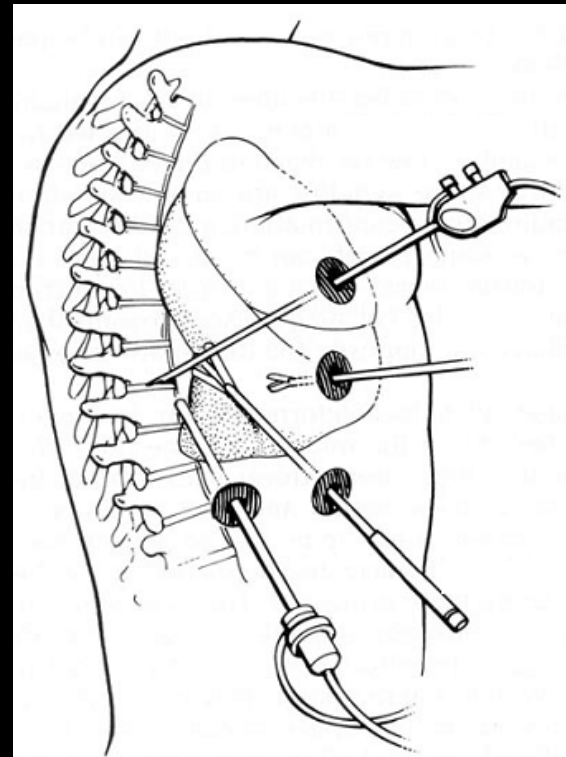
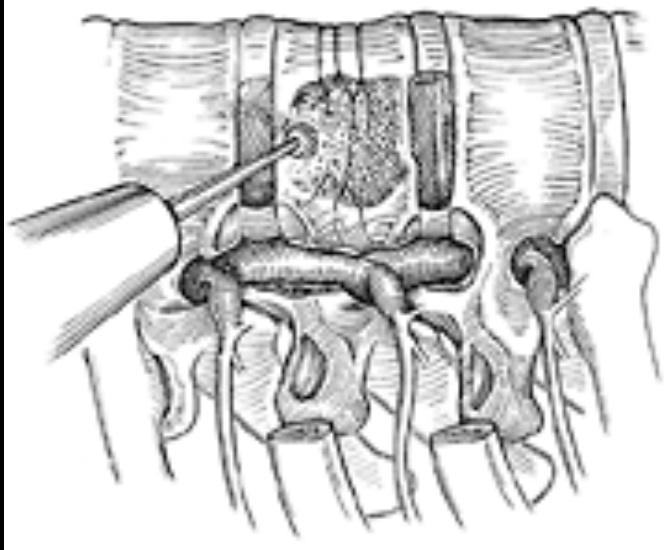
- ALL	295 N
- PLL	106 N
- LF	200 N
- KL	168 N

Surgical Approaches for Thoracic Disc Herniation

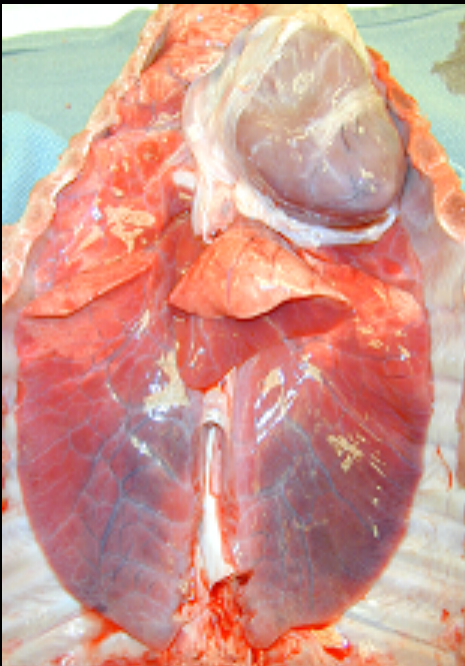
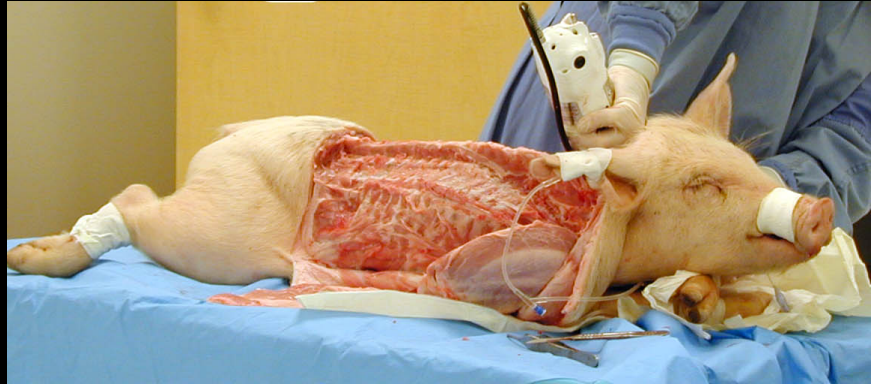


Anterior Approach

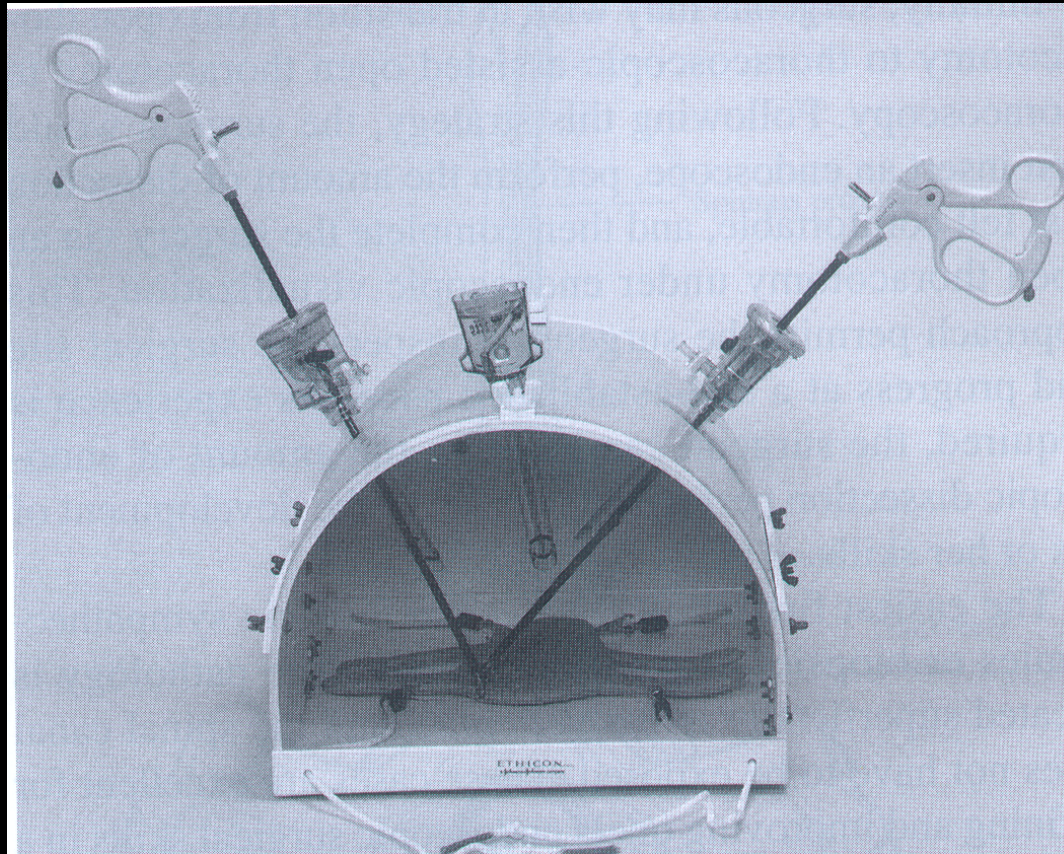
- Thoracotomy
- Thoracoscopic (VATS)



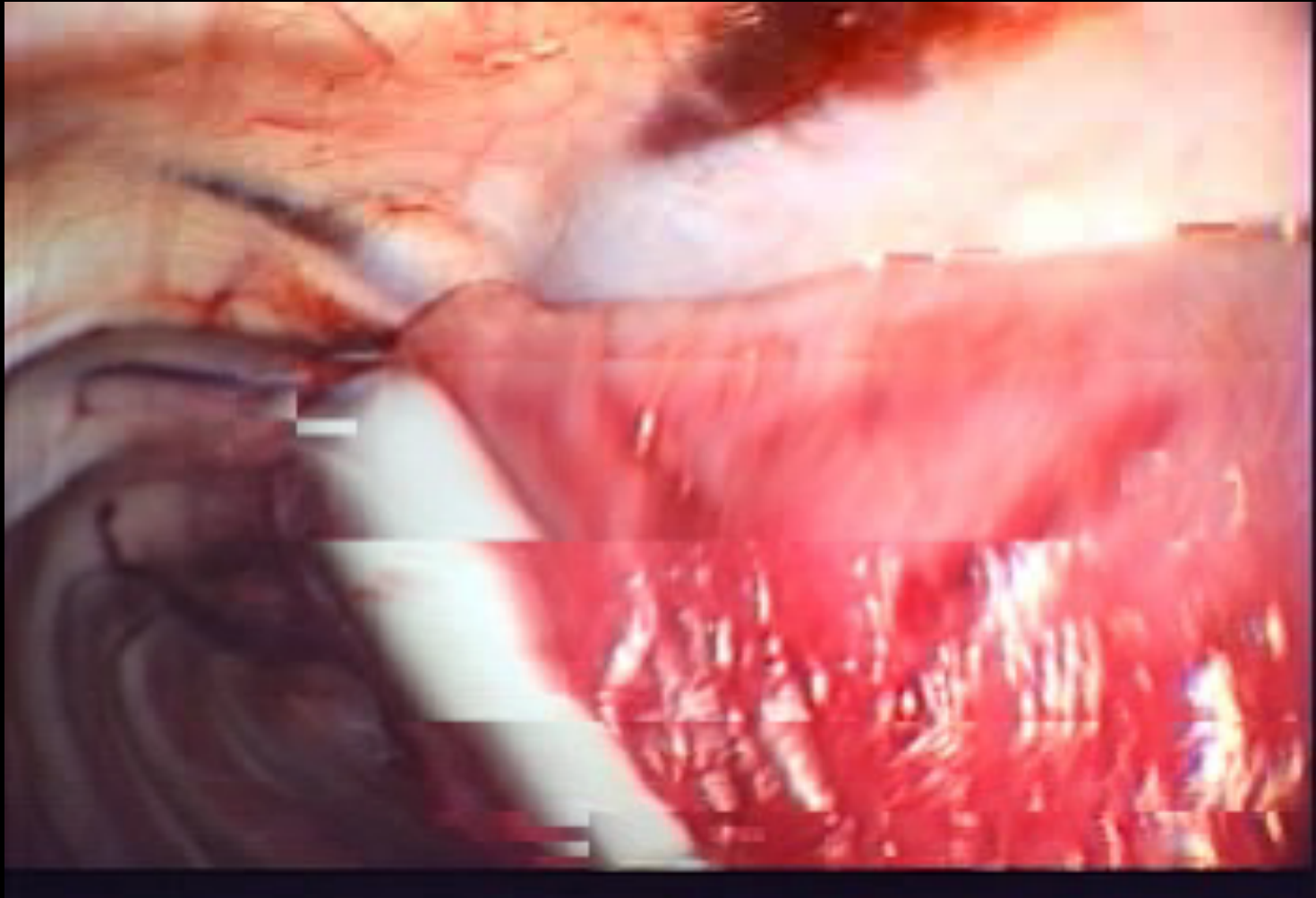
Thoracotomy



Thoracoscopy



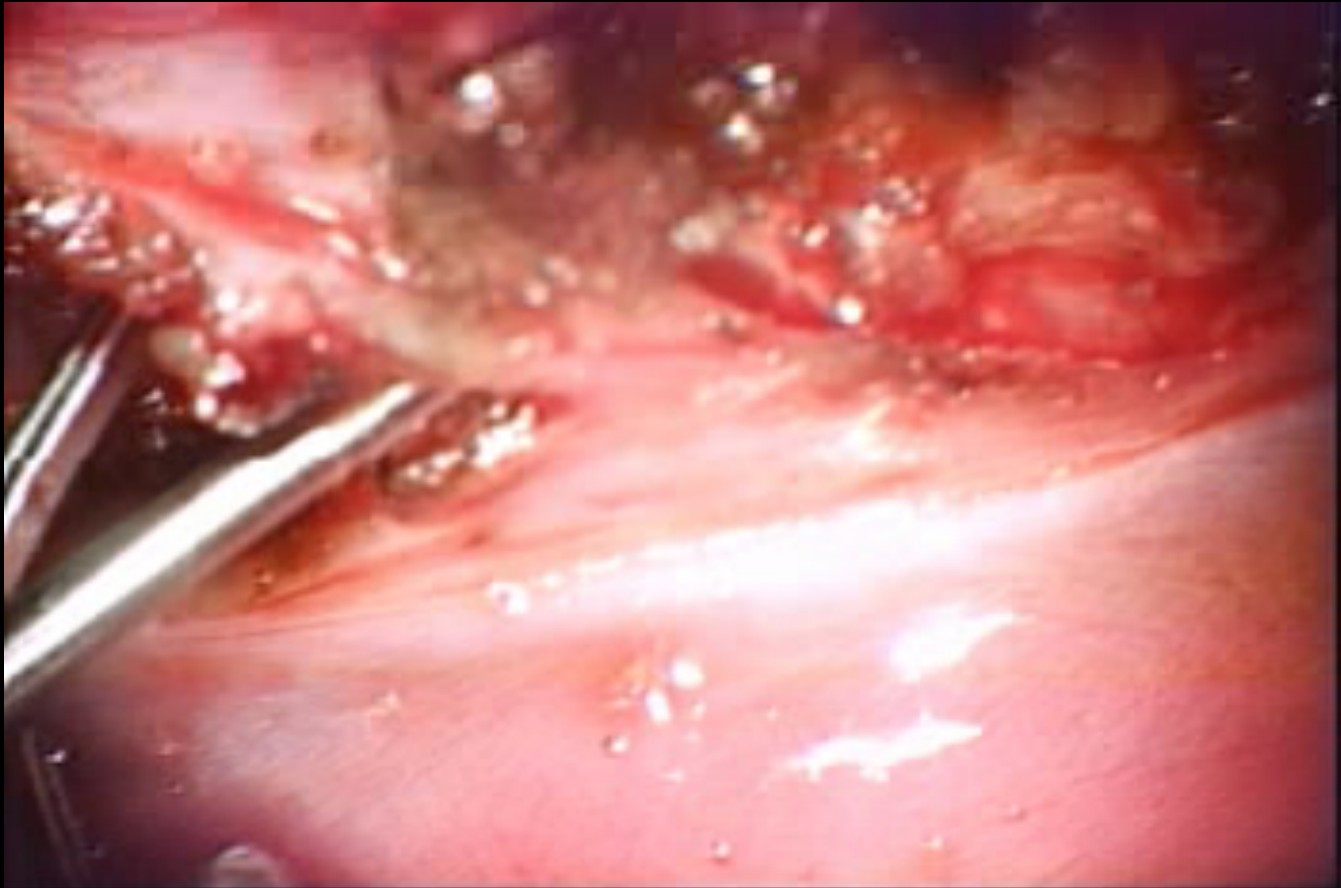
Thorax Anatomy



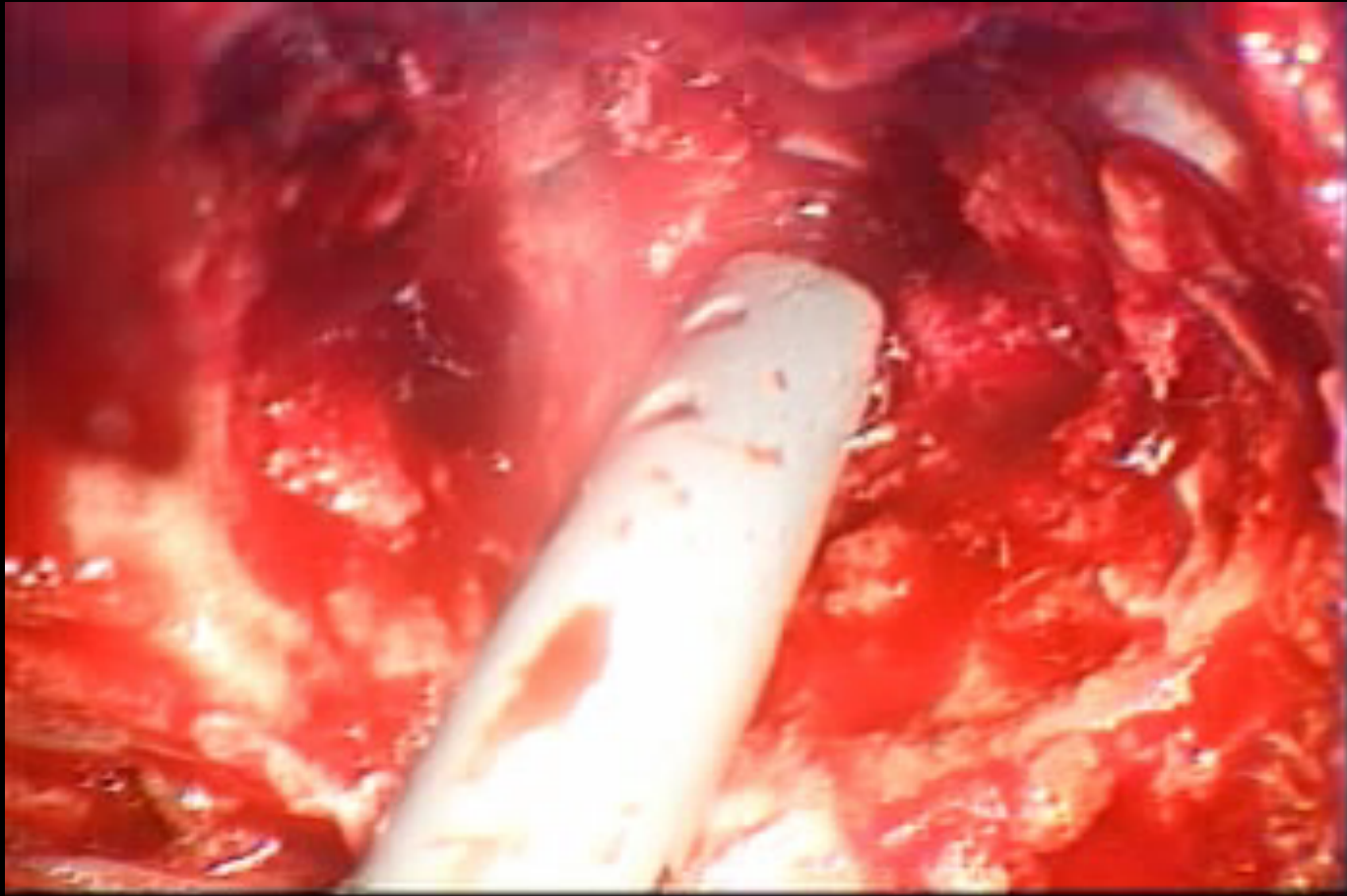
Intercostal Anatomy



Intercostal Anatomy



Thoracic Discectomy





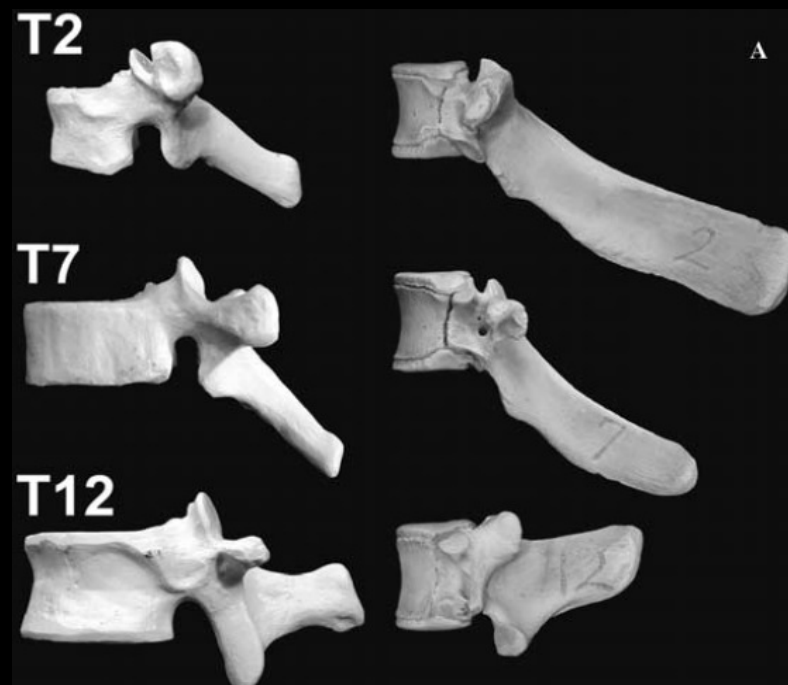
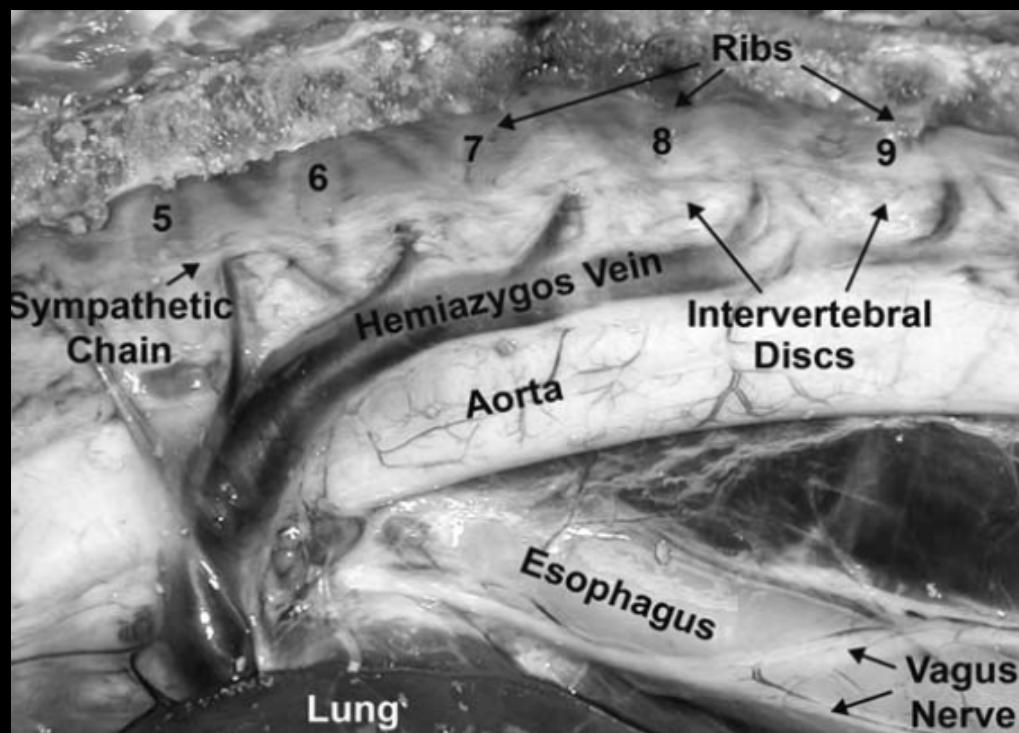
and Other Interventional Techniques

Comparative anatomy of the porcine and human thoracic spines with reference to thoracoscopic surgical techniques

H. Bozkus,¹ N. R. Crawford,² R. H. Chamberlain,² T. D. Valenzuela,² A. Espinoza,² Z. Yüksel,² C. A. Dickman²

¹ Department of Neurosurgery, VKV American Hospital, Güzelbahçe Sk. No. 20, 80200, Nisantasi, Istanbul, Turkey

² Spinal Biomechanics Research Laboratory, Barrow Neurological Institute, 350 West Thomas Road, Phoenix, AZ 85013, USA

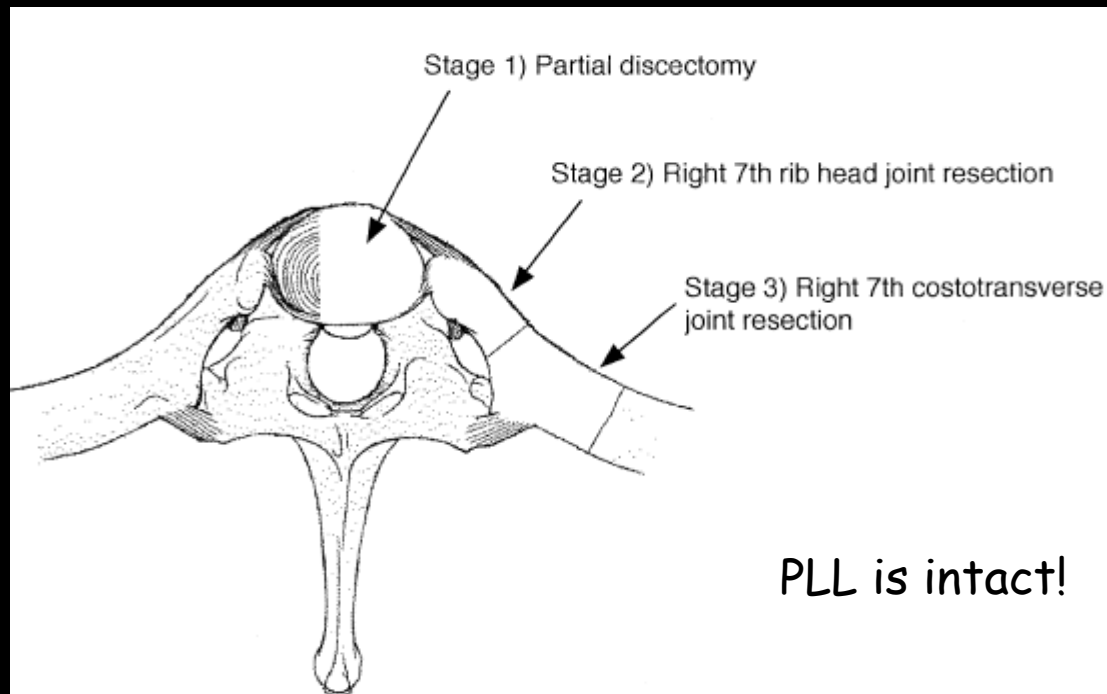


Biomechanical Role of the Intervertebral Disc and Costovertebral Joint in Stability of the Thoracic Spine

A Canine Model Study

Tatsuto Takeuchi, MD, Kuniyoshi Abumi, MD, Yasuhiro Shono, MD, Itaru Oda, MD,
and Kiyoshi Kaneda, MD

Canine model, ± 0.45 Nm moment



Conclusion

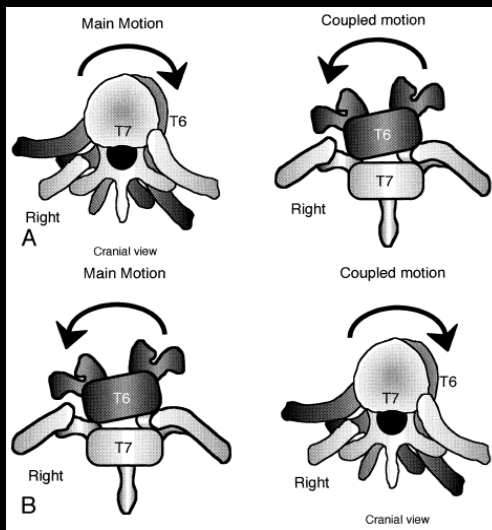
Table 2. Mean Neutral Zone (NZ) Value at Each Stage (N = 10)

	FE (°)	LB (°)	AR (°)
Intact	1.1 ± 0.3	5.9 ± 1.9	2.7 ± 0.7
Stage 1	2.4 ± 1.3*	11.7 ± 3.2*	4.7 ± 0.9*
Stage 2	2.1 ± 0.7	19.5 ± 5.9*	5.6 ± 1.5
Stage 3	2.1 ± 0.8	20.5 ± 5.2	5.4 ± 1.3

* $P < 0.01$.

Note: The mean NZ values at each stage are shown. Partial discectomy (Stage 1) significantly increased the NZ value under all loading conditions. After resection of the rib head joint (Stage 2), a significant increase in the NZ was observed only in LB. Resection of the right 7th costotransverse joint (Stage 3) did not affect the increase in the NZ.

- Ipsilateral costovertebrectomy and partial discectomy produces increased coupling motion in lateral bending and axial rotation.



Endoscopic Discectomy versus Transthoracic Discectomy

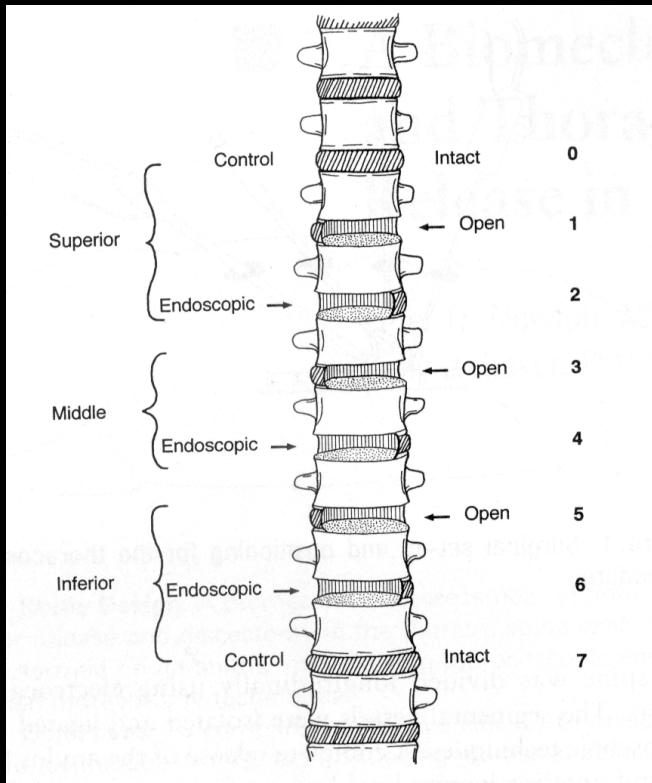
Porcine model

- Endoscopic thoracic discectomy provides similar spinal flexibility as discectomy with thoracotomy.

Wall EJ et al., Spine 1998

Endoscopic Discectomy versus Transthoracic Discectomy

Goat model, ± 1.8 Nm moment

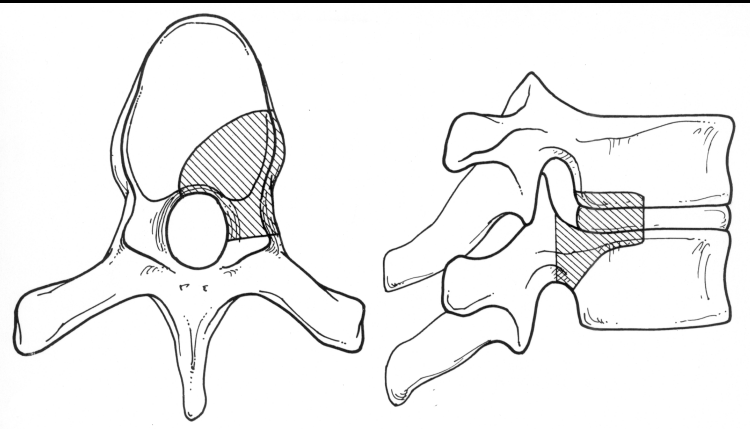


- Both surgical techniques significantly increased ROM in all motion modes especially axial rotation.

Newton PO et al., Spine 1998

Transthoracic Microdiscectomy

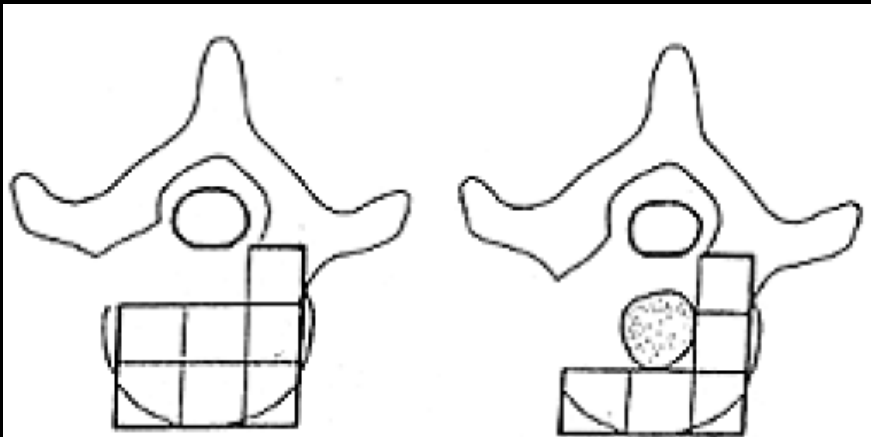
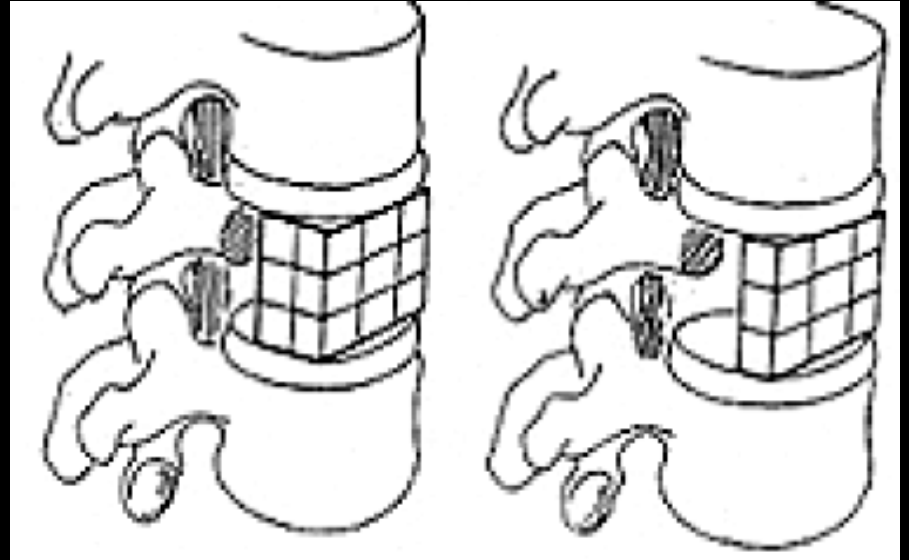
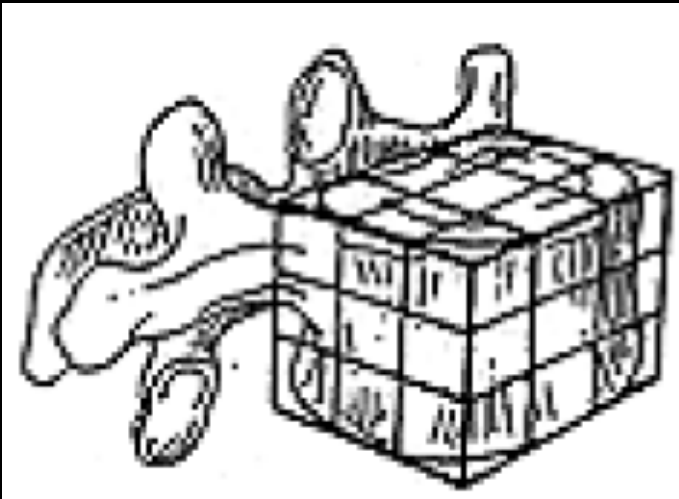
T4-12 cadaver model



- Increased ROM in all motion modes minimally but statistically significant (ave. 2.1°)
- IAR does not change
- Not overtly destabilize motion segments

Stabilization

27-cube model



谢谢

Thank you