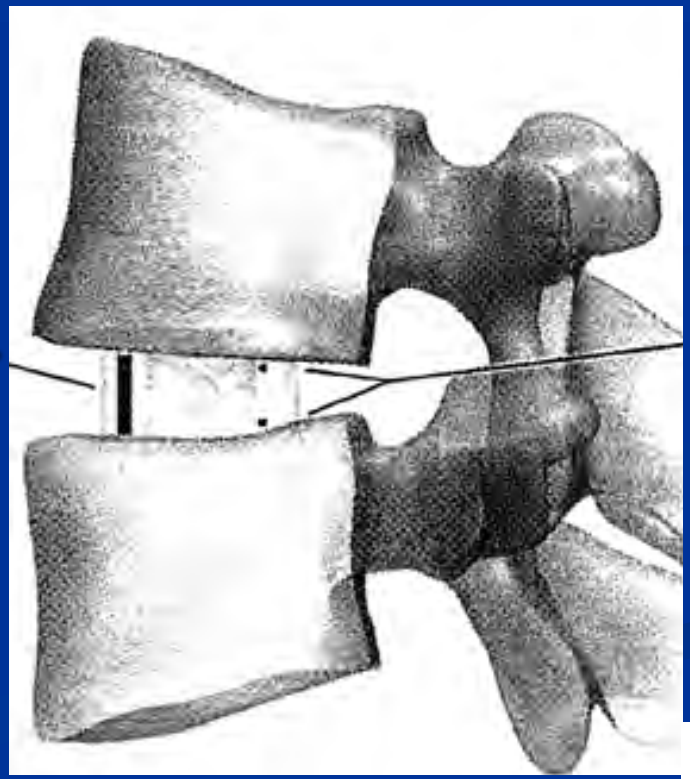
Complications of the Direct Lateral Approach

21 Feb 2020

Chambliss Harrod, M.D.

Deer Valley Meeting



THE SPINE CENTER at BONE & JOINT CLINIC OF BATON ROUGE

Acknowledgements

- Innovasis - Consultant.
- Integrity - Consultant
- K2M – Consultant, Research Aid
- Stryker – Consultant, Research Aid
- Depuy – Consultant, Research Aid

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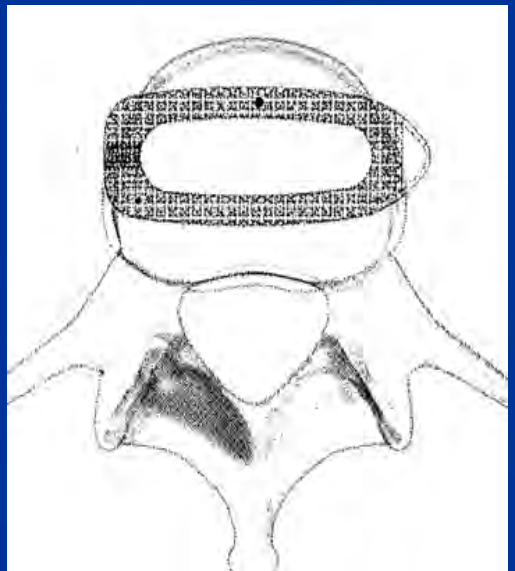
This *trans-psoas* procedure suffers many proprietary names

- DLIF (Direct Lateral Interbody Fusion – Medtronic)
- XLIF (eXtreme Lateral Interbody Fusion – NuVasive)
- LLIF (Lateral Lumbar Interbody Fusion - Globus)



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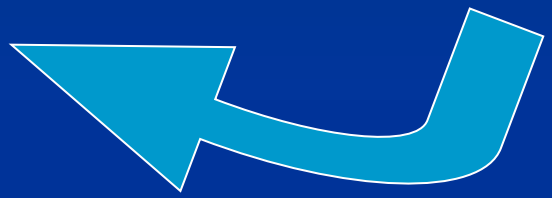
Rationale for the lateral approach

- Alternative anterior procedures
  - ALIF
  - Open lateral retroperitoneal

Lateral is less invasive?



- Alternative posterior procedures
  - TLIF
  - PLIF

Lateral is better reconstruction, better fusion?

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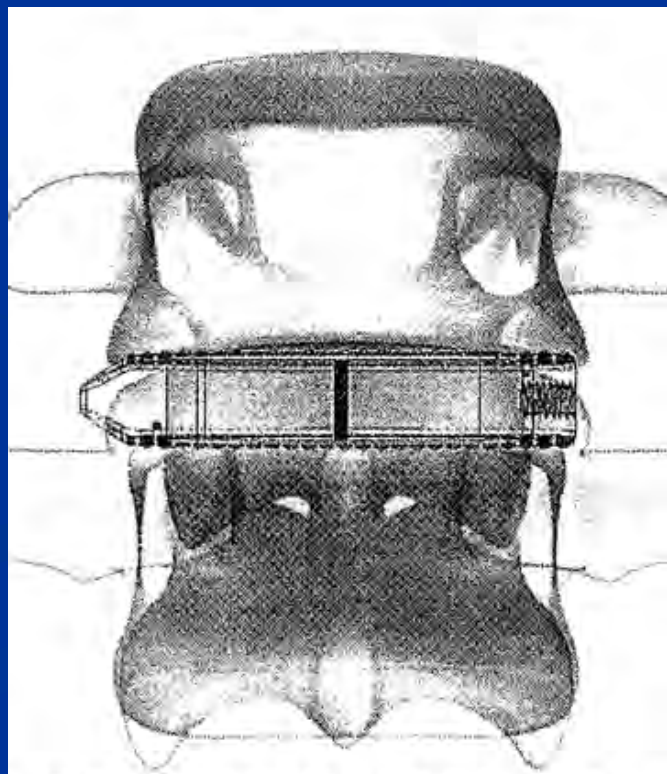
INTERBODY FUSION: INDICATIONS

- Spondylolisthesis
- Degenerative Disc Disease
- Scoliosis
- Pseudarthrosis
- Failed Laminectomies
- Junctional Degen/ASD
- Osteo/Diskitis
- Trauma



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INTERBODY AMAMENTARIUM

- ALIF
- PLIF
- TLIF
- Lateral

- OPEN
- MINI-OPEN
- LAPARASCOPIC
- MIS
- STAND-ALONE
- 270°
- 360°

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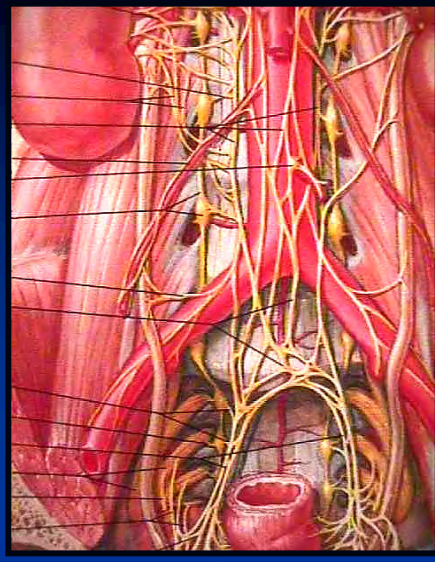
Interbody Approach

ALIF

- Vascular laceration
- Injury to ureter/kidney
- Ileus
- Retrograde ejaculation
- DVT

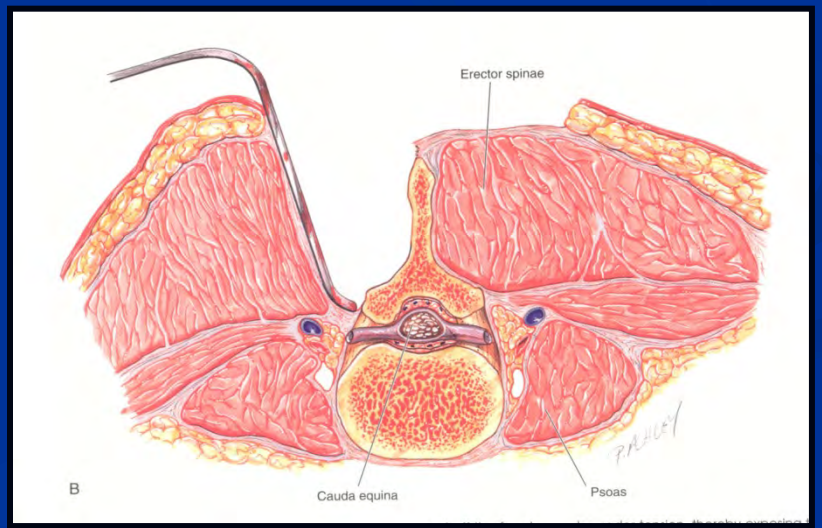
Lateral

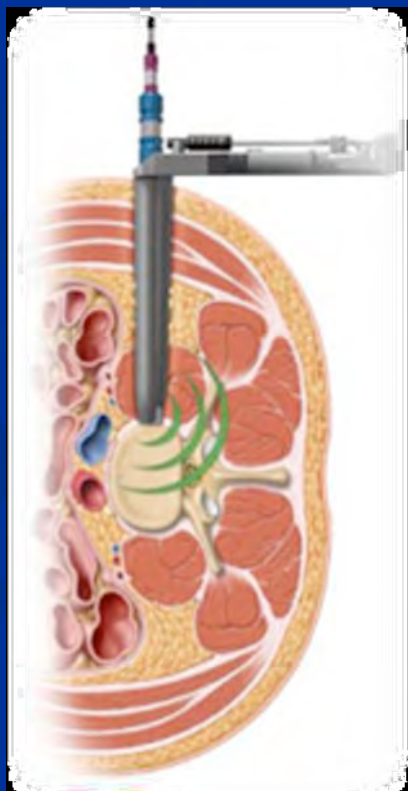
- Lumbar Plexus
- Setup
- Radiation



TLIF & PLIF

- Dural tear
- Injury to nerves
- Transition syndrome
- Infection (open)





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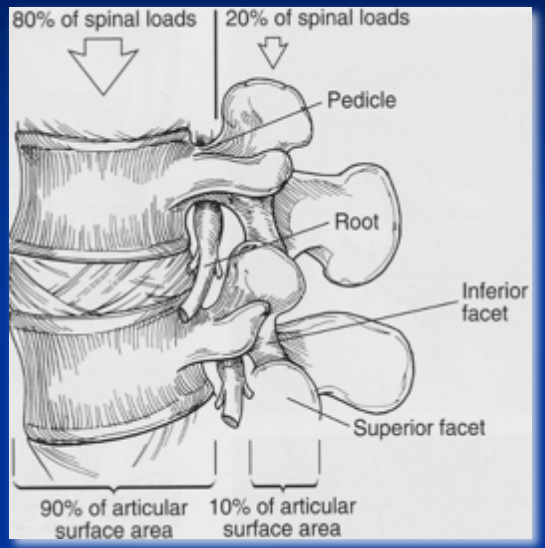
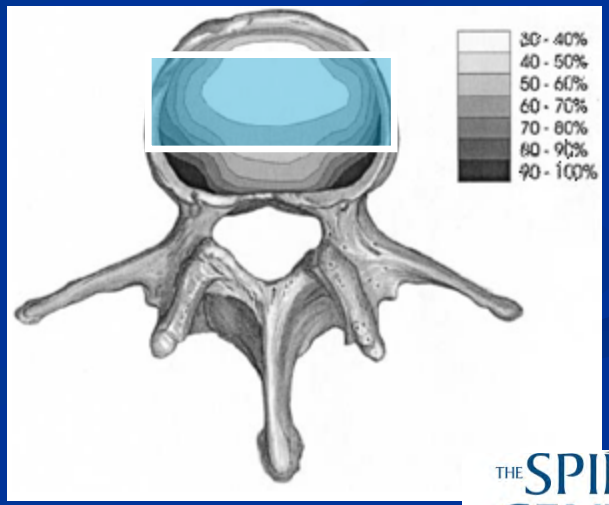
Lateral Interbody Indications

- Similar to those for any interbody fusion
  - **But it is NOT a panacea!**
- I have used it for:
  - Degenerative scoliosis
  - Isthmic spondylolisthesis
  - Non-union
  - Revisions, recurrent compression
  - Adjacent segment disease
  - Infection
  - Trauma
  - Tumor
  - **NOT back pain**
  - **Not DDD**
- Lateral interbody fusion benefits:
  - Excellent support of axial load
  - Broad fusion surface
  - Can perform bilateral releases





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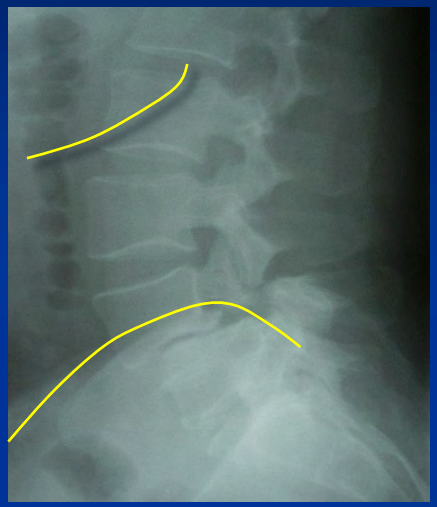
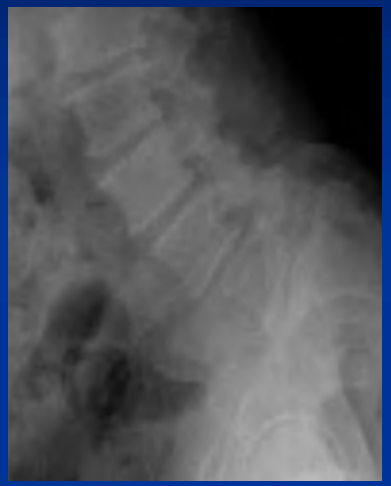
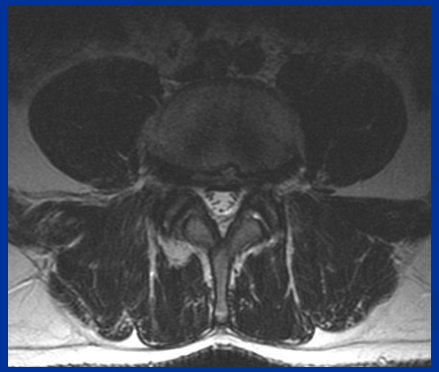
Pre-op Planning Pearls

- Standing X-rays:
  - Check for unfavorable anatomy
  - High iliac crest at L4-5
    - More problematic in males
  - Long 11th and 12th ribs
    - Go intercostal or remove part of ribs
- MRI:
  - Find the vessels
    - (esp in DEFORMITY)
  - Find the ureter
  - Psoas size, shape, position?
    - Beware Mickey Mouse Sign







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Left or right approach?

- Deformity correction good on either side
  - Go on side easiest to enter disk
  - Convex side for easier entry
  - Concave side for multilevel
  - L4/5 often has only one option
- Retroperitoneal anatomy – look at MRI
  - Psoas, lumbar plexus, ureter
- Prior retroperitoneal surgery
  - Use contralateral
- Tough lateral osteophyte
  - Use contralateral
- Patient leg pain
  - Use ipsilateral

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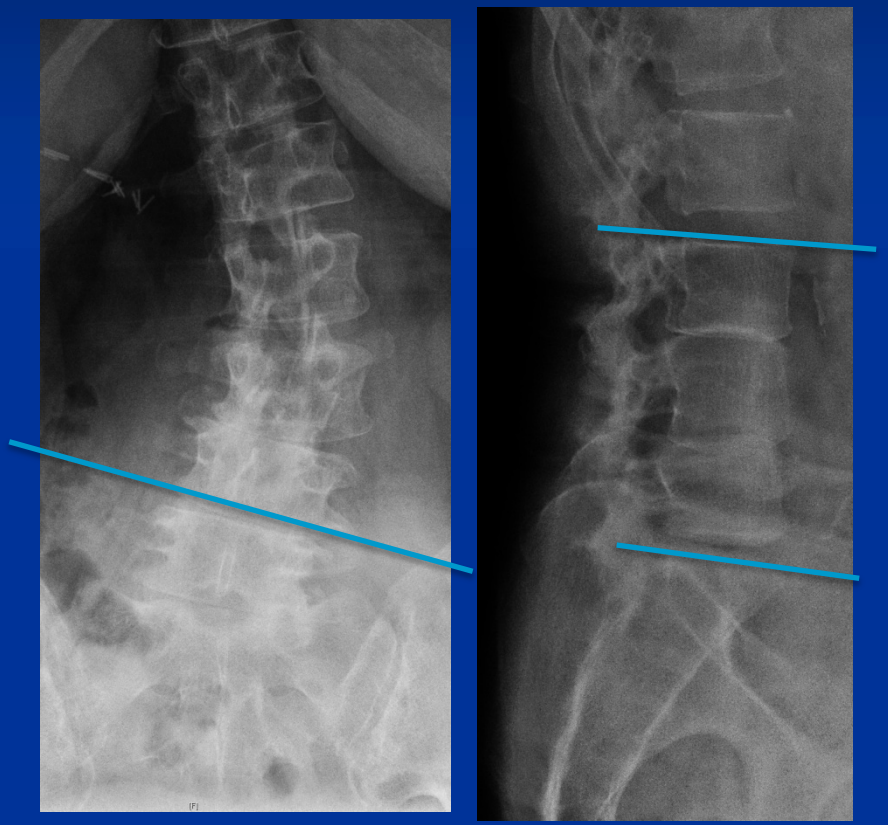
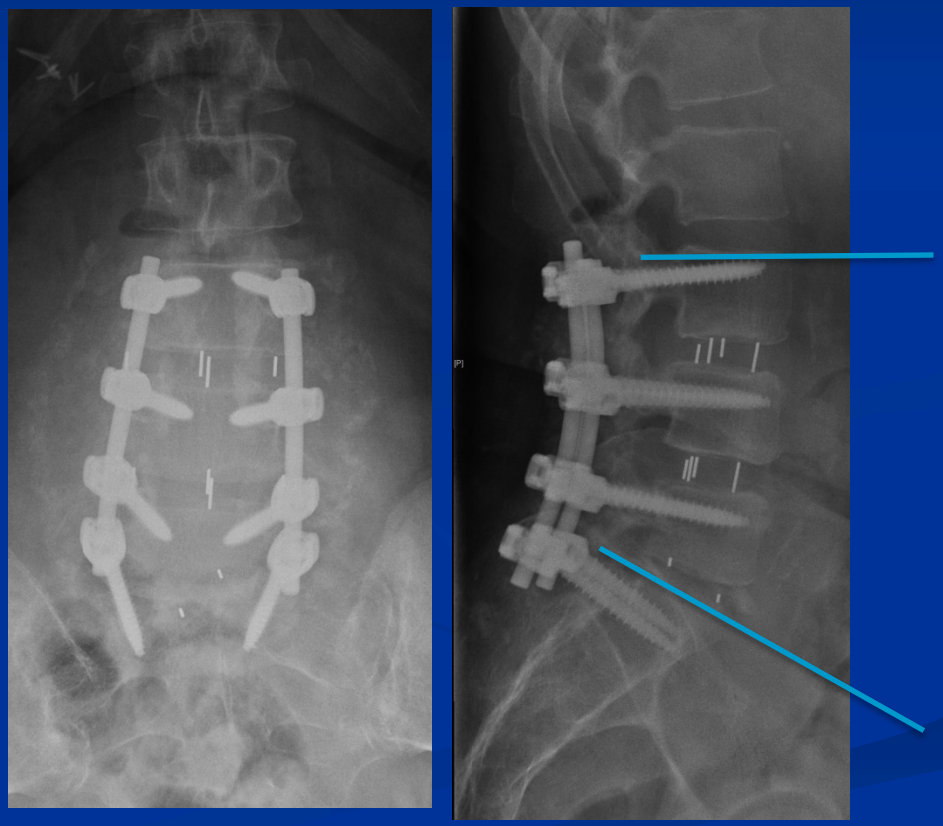
Example; Degenerative scoliosis, stenosis





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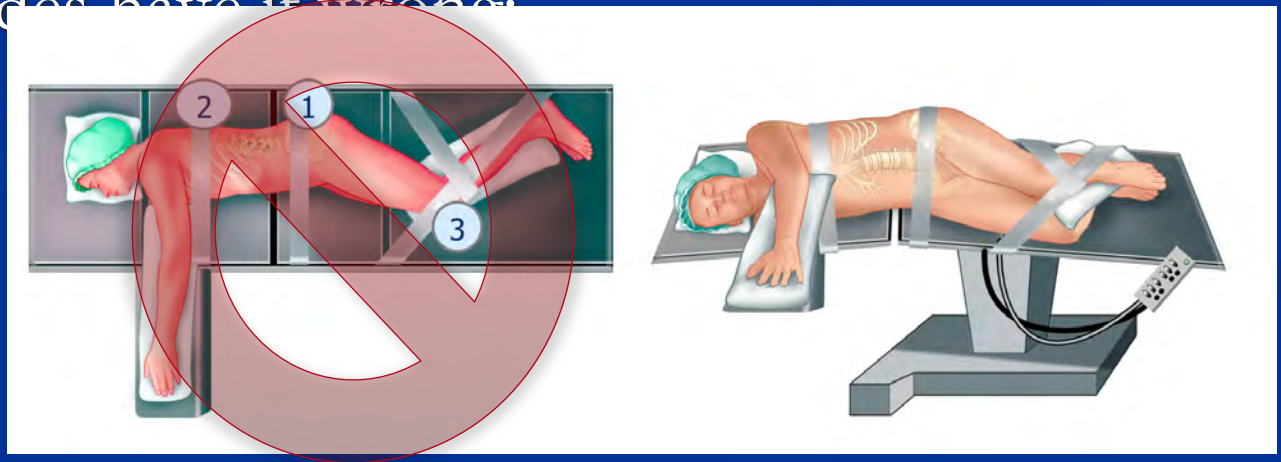
Positioning Pearls

- Secure pelvis and leg to lower half of table
  - Use 3 inch cloth tape directly on skin…
  - Beware fibular head

- Some technique guides have it wrong:



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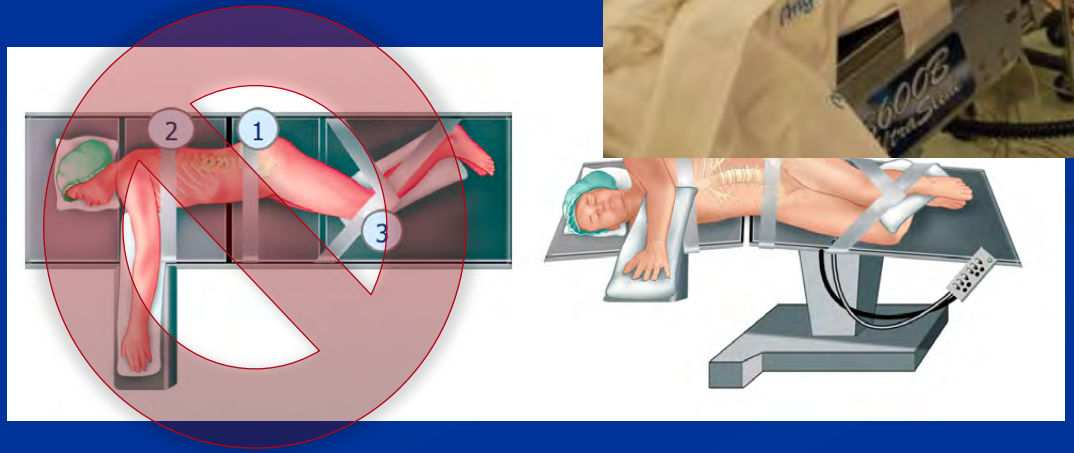
Pearl; flex table *before* securing chest

- If chest is taped before flexing table, can
  - Tear skin
  - Break ribs
  - Over-bend patient
- Watch effect of flexing table on patient position (and safety of position)



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Pearl; use lateral positioners when limited spine flexibility

- Patient may roll when table flexed if spine rigid
- Use lateral positioners to maintain position
- If patient rolls inter-operatively, can create dangerous situation where a previously "direct" lateral trajectory is now ventral or dorsal.

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Case example: limited flexibility…

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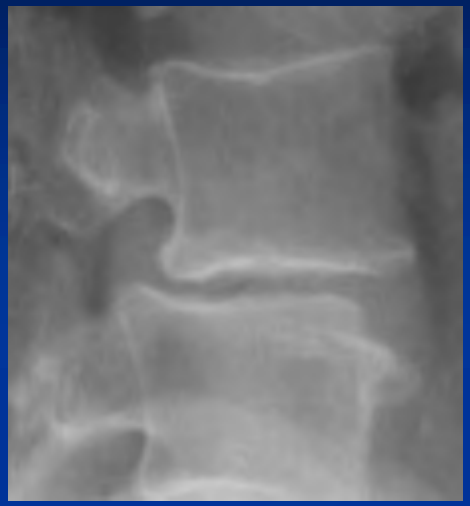
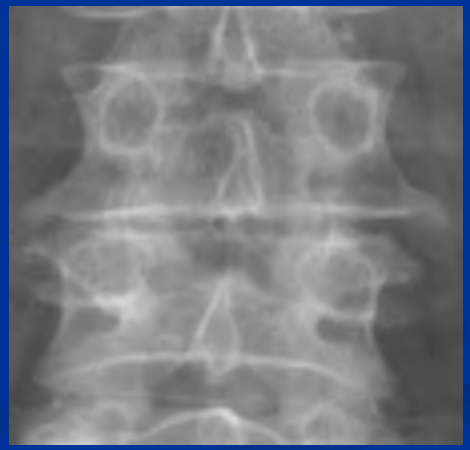
Positioning for orthogonal x-rays

- Make the endplate orthogonal to the wall!
- Move the bed NOT the fluoro
- Get true AP and lateral with fluoroscopy at 0 and 90 deg
  - Spinous processes at midline
  - Pedicles equal bilaterally
- Goal is to position so that you can operate in the trajectory perpendicular to floor
- In multi-level cases, readjust table for perfect image at each level





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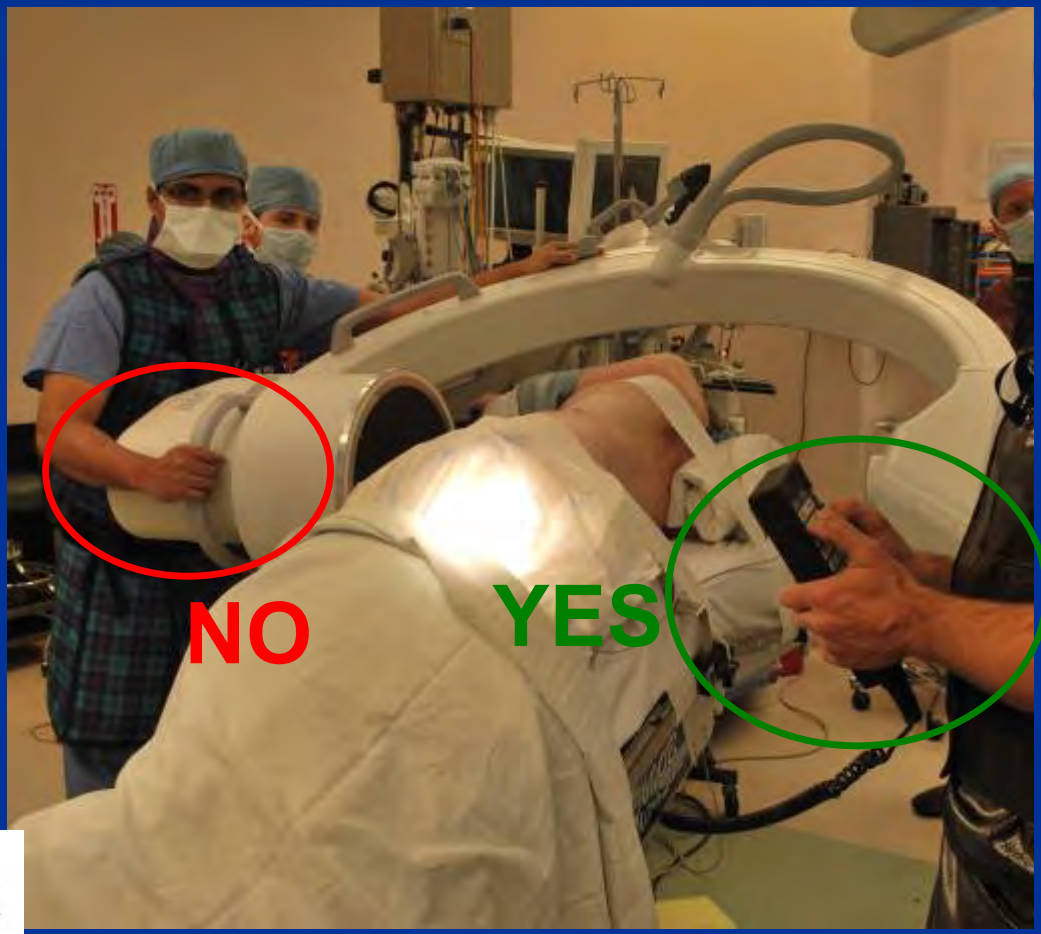
Pearl: Move table (not c-arm) for orthogonal x-rays. Keep beam parallel to floor.



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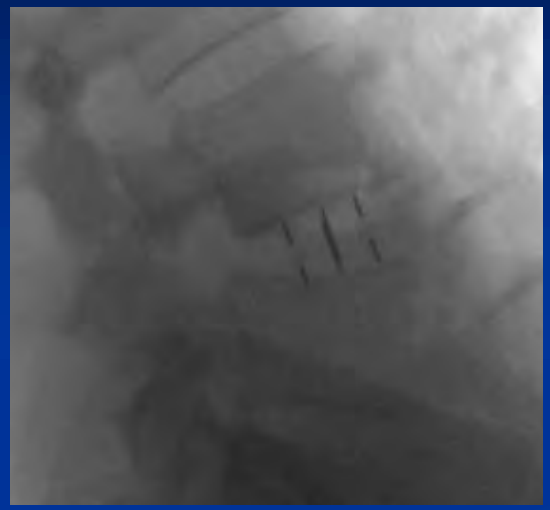

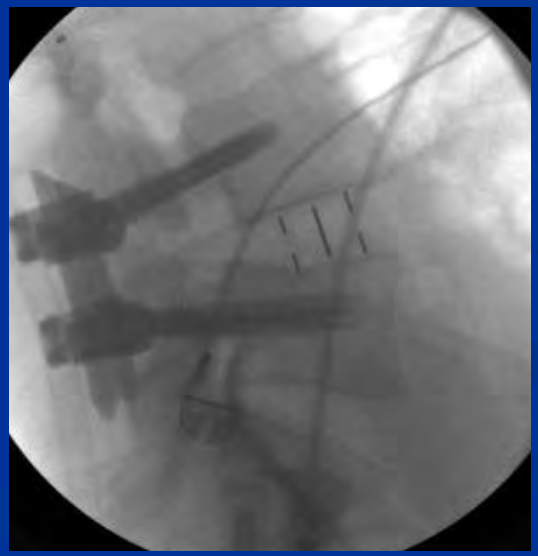

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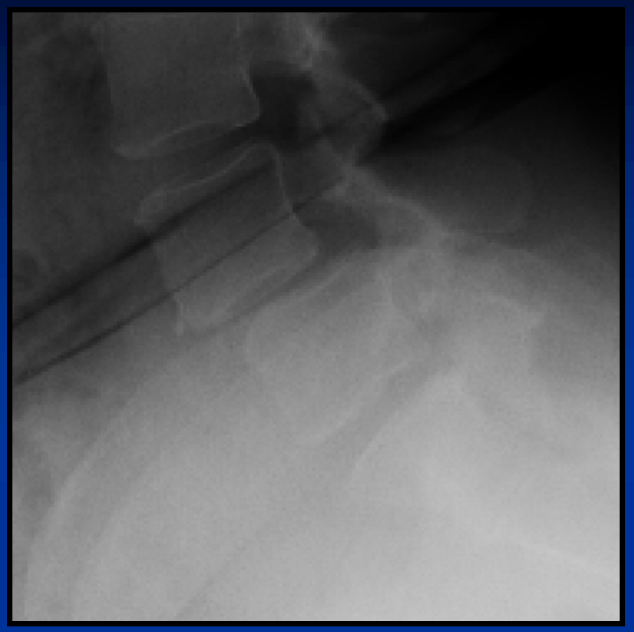

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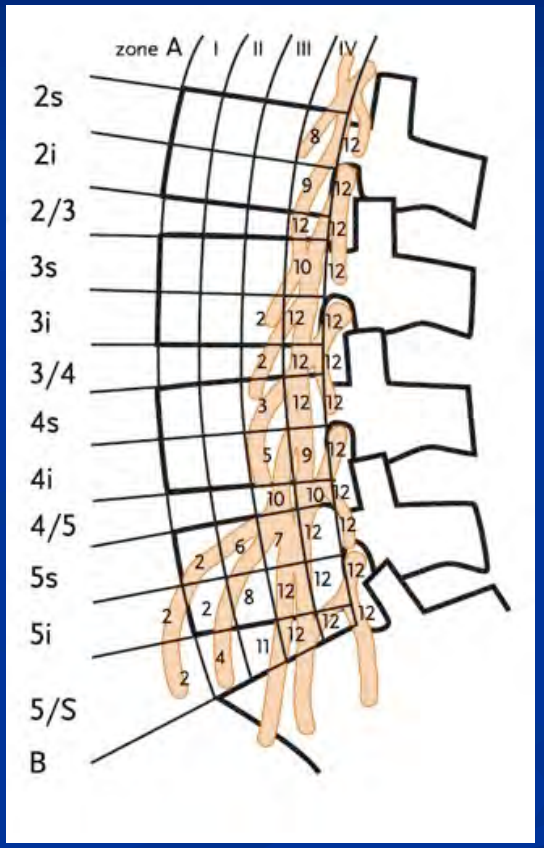
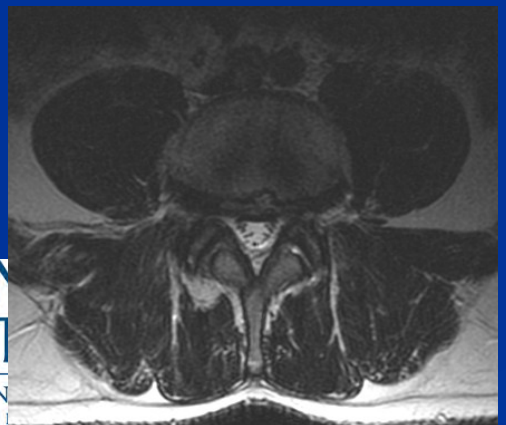
Nerve Injury Avoidance Pearls: Pre-op

- Consider risk of encountering nerve based on
  - Disk level
  - Anterior or Posterior passage through psoas
  - Psoas size, position, shape
    - Beware the Mickey Mouse Sign



Moro et al, Spine 28, 2003



Nerve Injury Avoidance Pearls: Intra-op

- Use REAL neuro-monitoring
  - Experienced and familiar technician
  - Cremaster leads
    - Two alerts so far…
  - Redundant femoral nerve monitoring
    - Two compelling examples so far…
- Pearls:
  - IONM stimulation inside and outside retractor
  - Get a true positive!
- Consider tcMEP
  - Hypothesis: *prolonged* retraction / compression of plexus nerve has an adverse effect.
  - I have three true positive MEP alerts so far (with no EMG changes)… all in longer cases…

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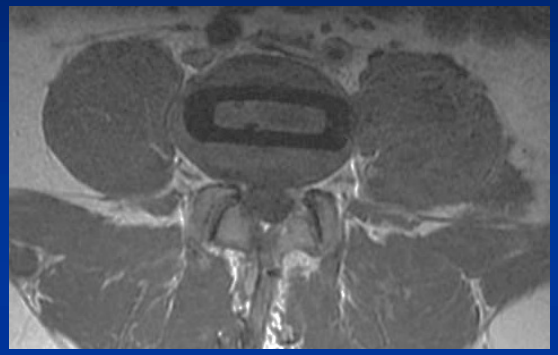
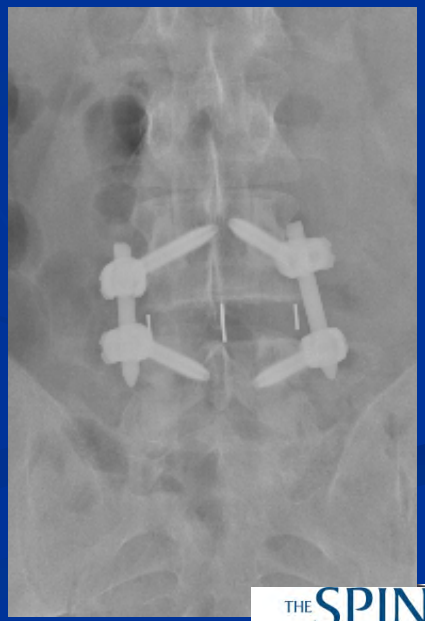
Neurological complication Case 1 (of 3)



- 40 yo male with 2 prior L45 decompressions
- Lost MEP during trans-psoas surgery
  - Quad 3/5 at extubation
  - MRI looked okay…
- Did posterior decompression, fusion subsequently.



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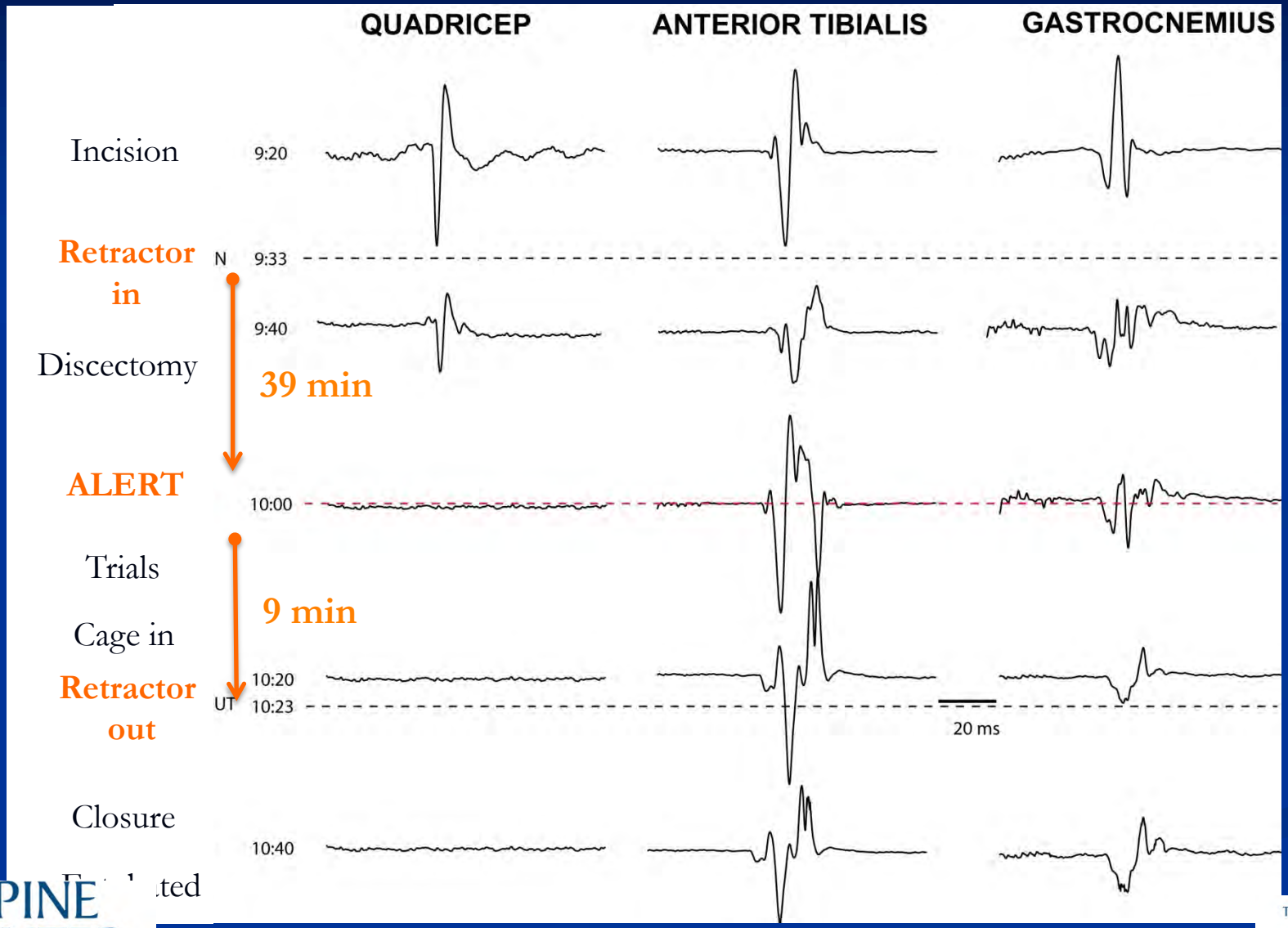
Case 1

TcMEP

EMG



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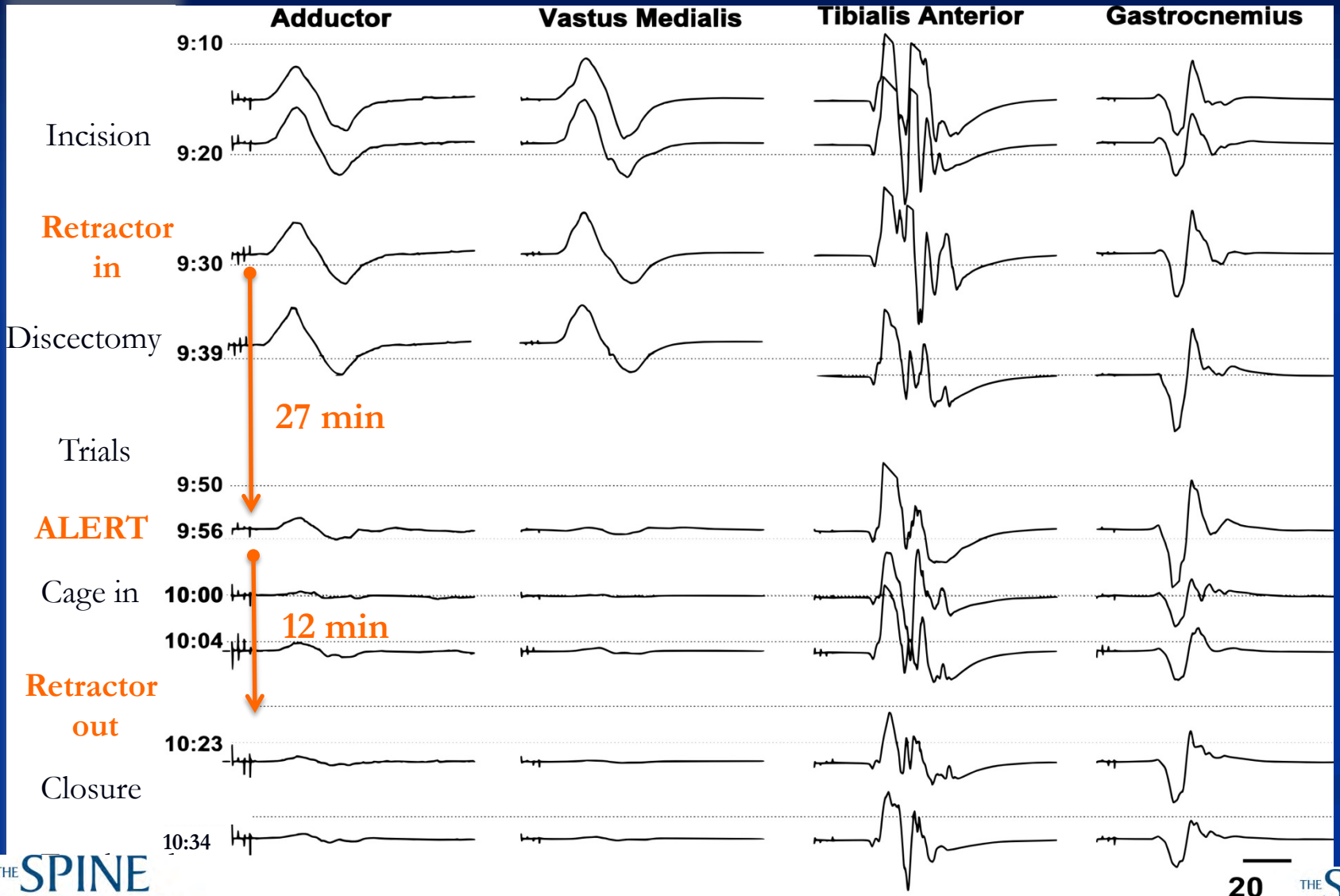
Case 2

TcMEP

EMG



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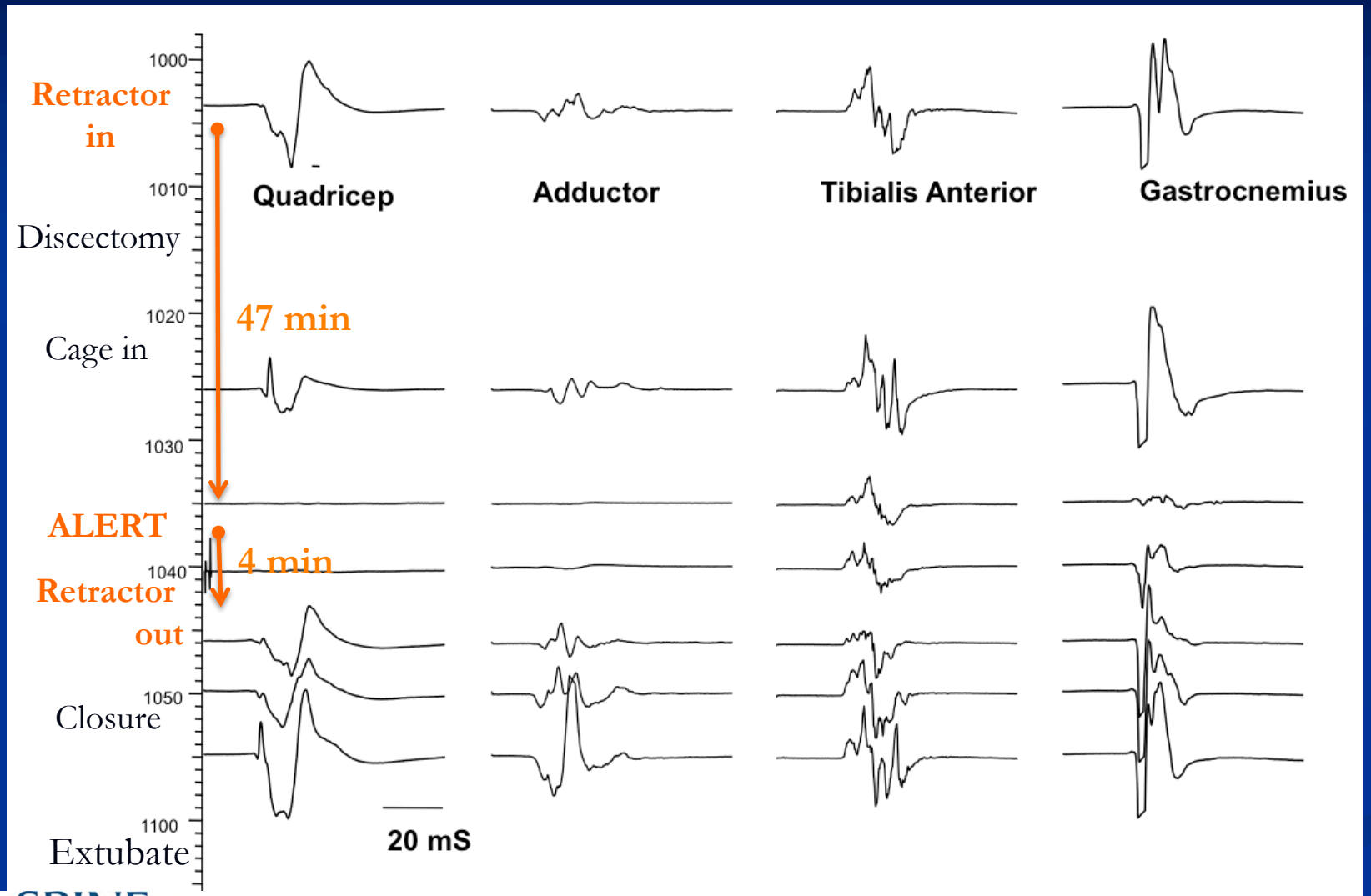
Case 3

TcMEP

EMG



quiet through-out the procedure

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Leg symptoms after MEP Alert

	Case 1	Case 2	Case 3
Loss of TcMEP after retractor placement	39 minutes	27 minutes	47 minutes
Removal of retractor after the initial TcMEP alert	9 minutes	12 minutes	4 minutes
Post-op Motor deficit	Psoas 4/5 Quads 3/5	Psoas 4/5 Quads 2/5	None
Sensory symptoms	Ant. thigh numbness	Ant. thigh numbness	Ant. thigh pain and numbness
Outcome of deficits	Psoas 5/5 (6w) **Quad 5/5 (7d)** Numbness + (6m)	Psoas 5/5 (3m) **Quad 5/5 (4d)** Numbness +(6m)	Numbness pain resolved (6w)

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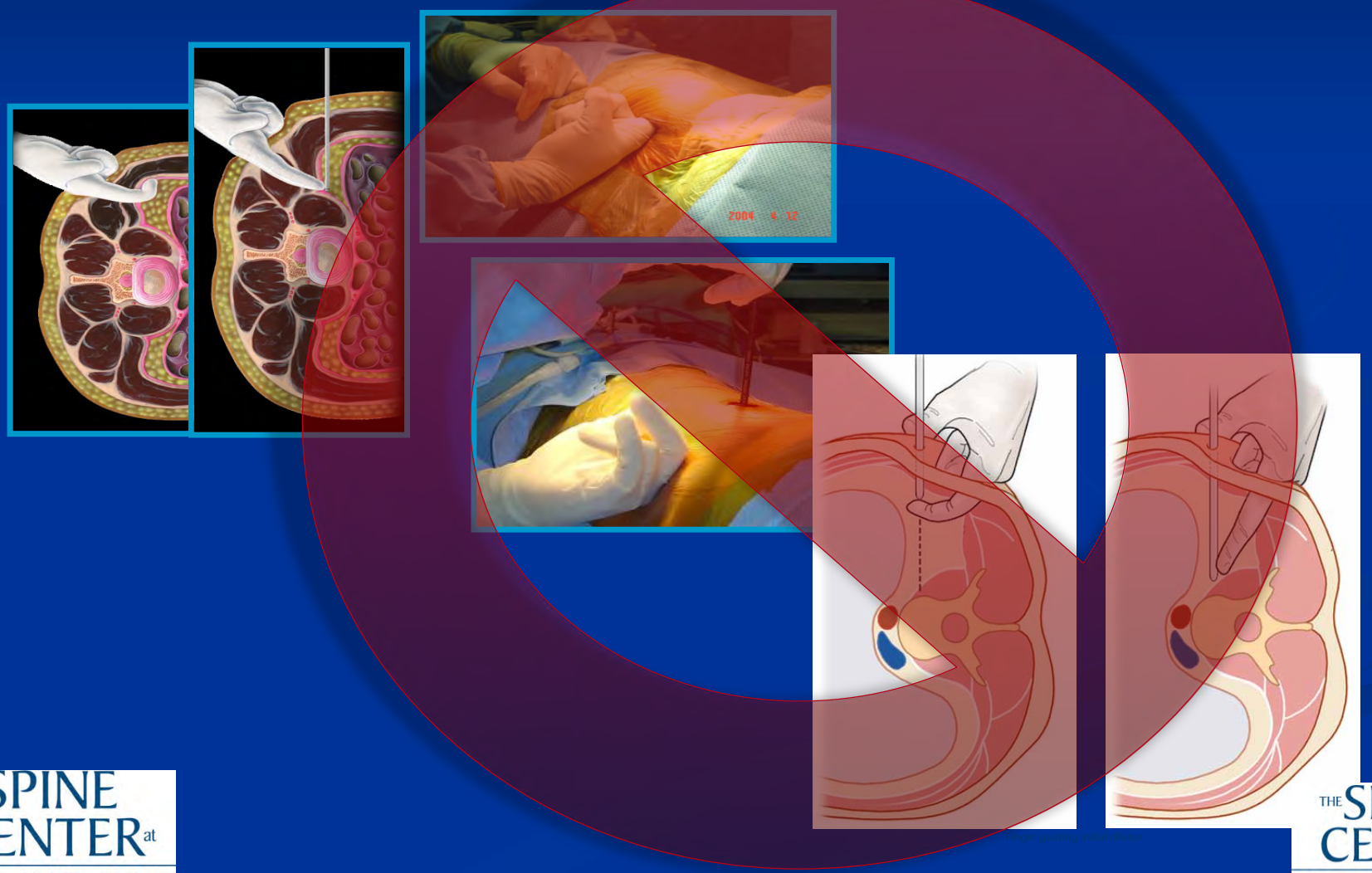
THE SPINE CENTER at BONE & JOINT CLINIC OF BATON ROUGE

Two Incision Method
Approach by feel and fluoroscopy



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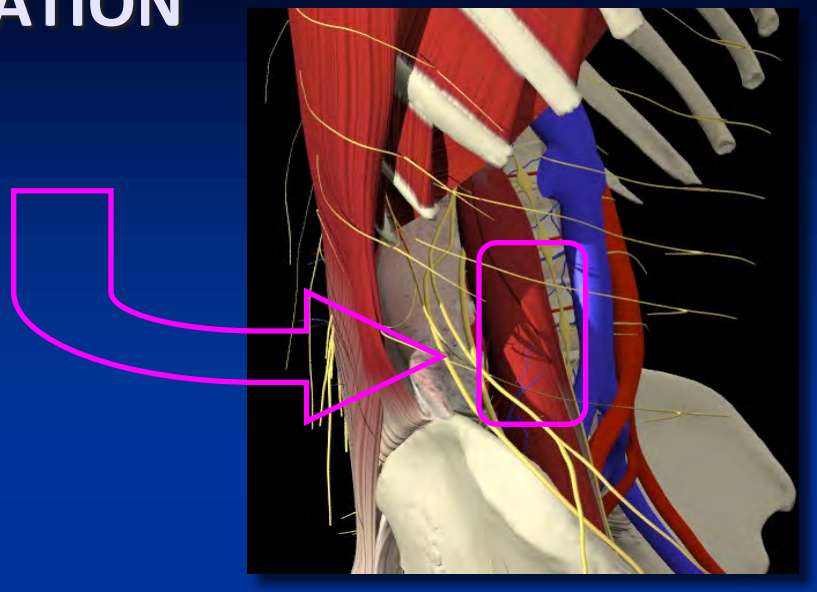
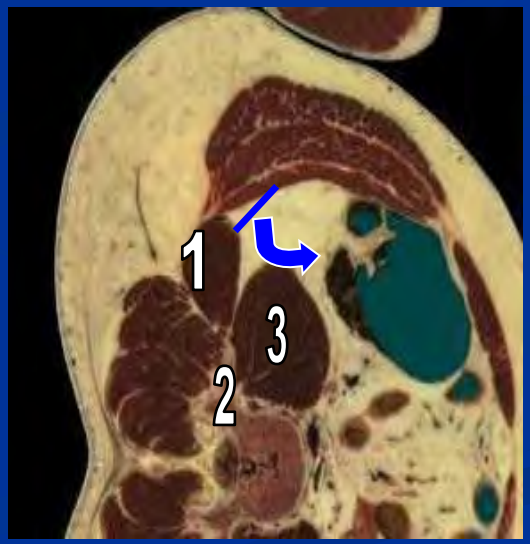
Pearl; use DIRECT VISUALIZATION

- Split muscle layers under direct visualization:
  - External Oblique
  - Internal Oblique
  - Transversalis
- See the retroperitoneal fat
- Sweep posterior to anterior:
  1. Quadratus Lumborum
  2. Transverse Process
  3. Psoas
- Look around - visualize:
  - Psoas shape and position
  - Vessels?
  - Ureter?
  - Genito-femoral nerve?





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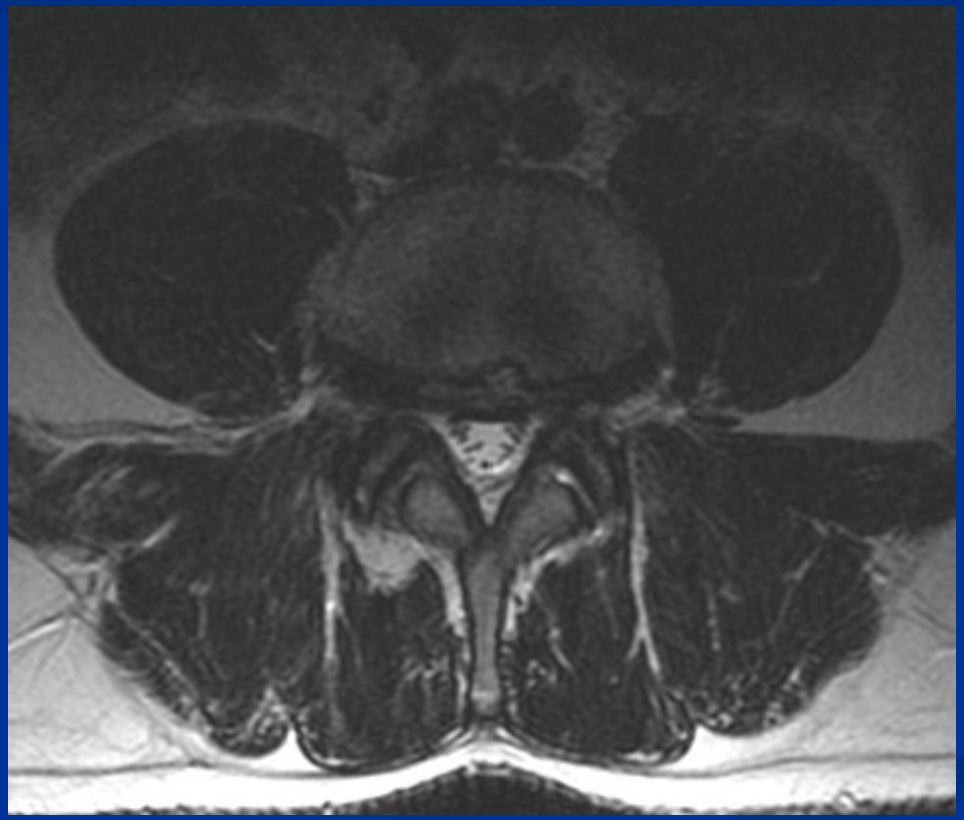
Pearl: direct visualization

- Use two large Wiley vein retractors to inspect retroperitoneal space
- Ensure that no peritoneum is overlying psoas
- Find ureter, GF nerve if possible
- Observe psoas surface, select the correct point to enter muscle
  - Recall the MRI



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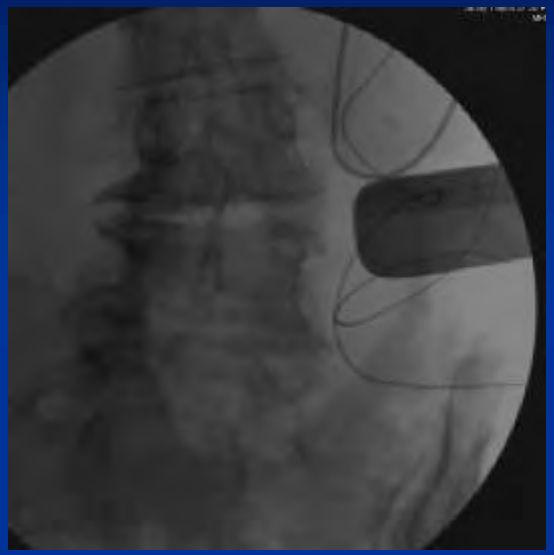
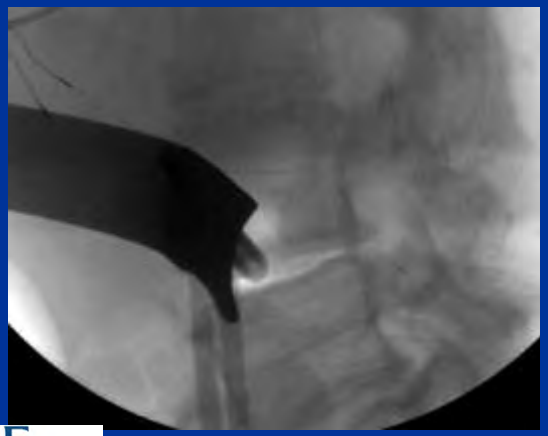
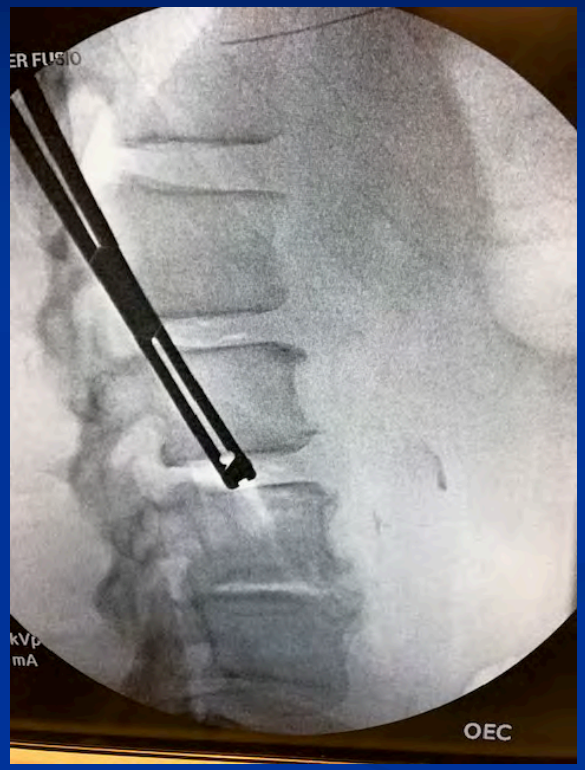
Traverse Psoas with direct visualization
Flouro to confirm







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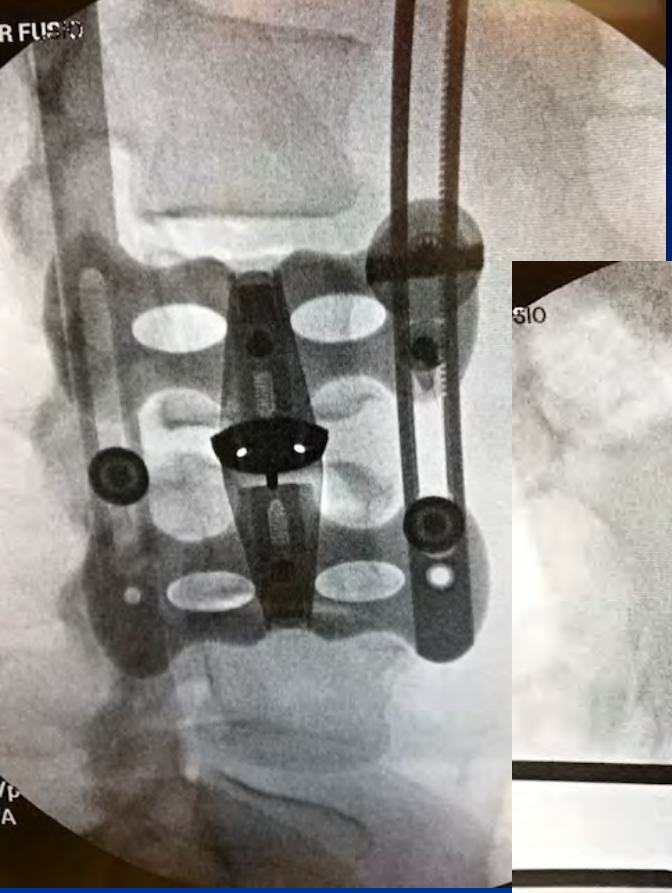

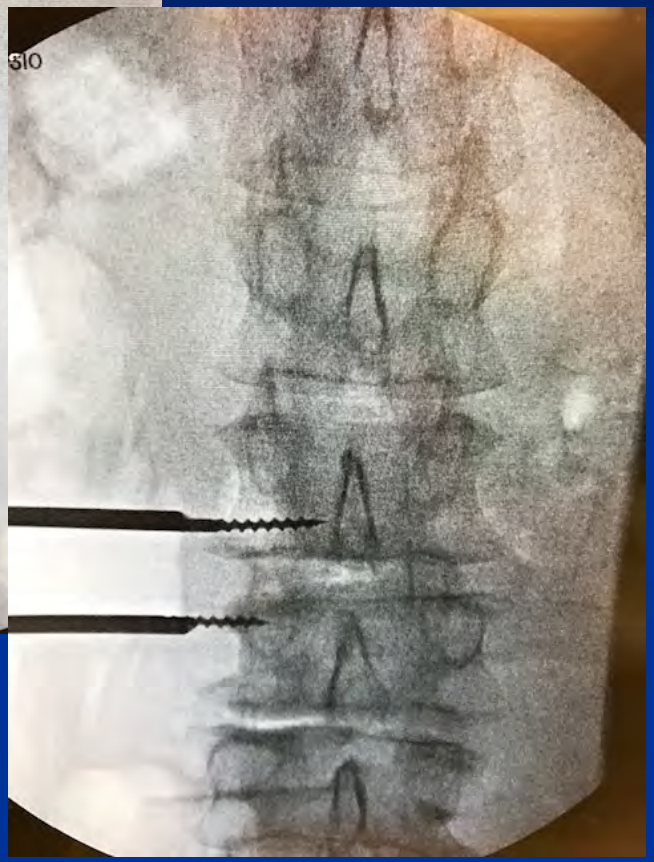

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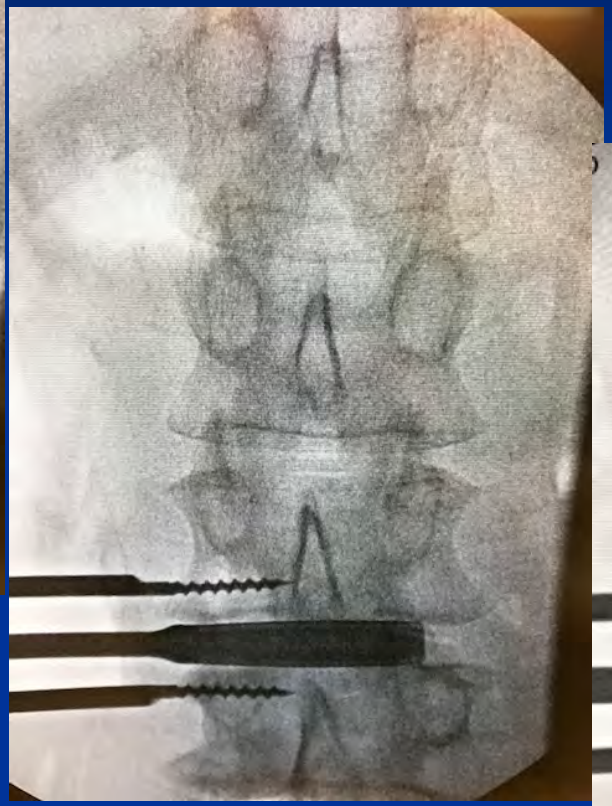

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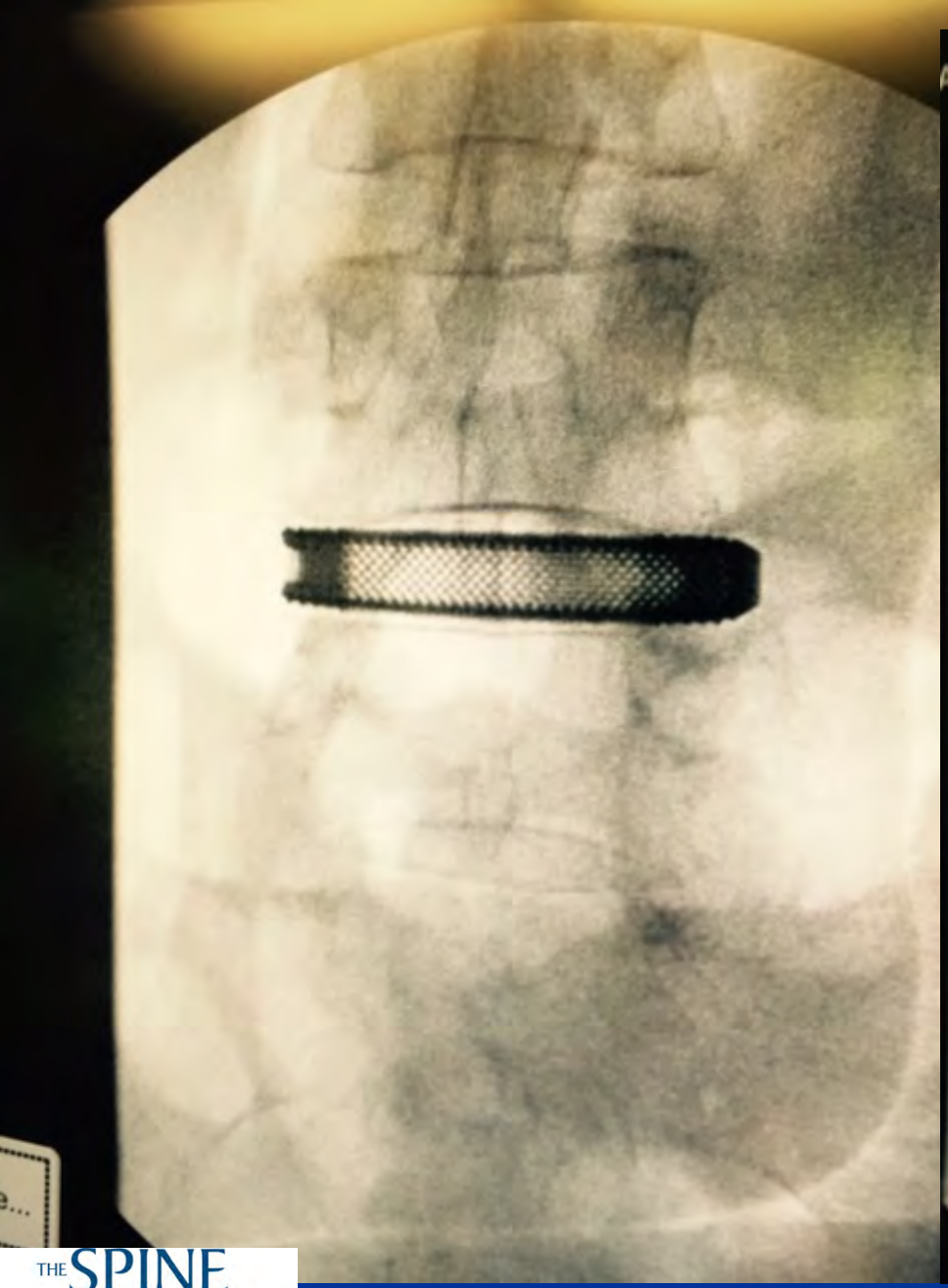

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OF BATON ROUGE

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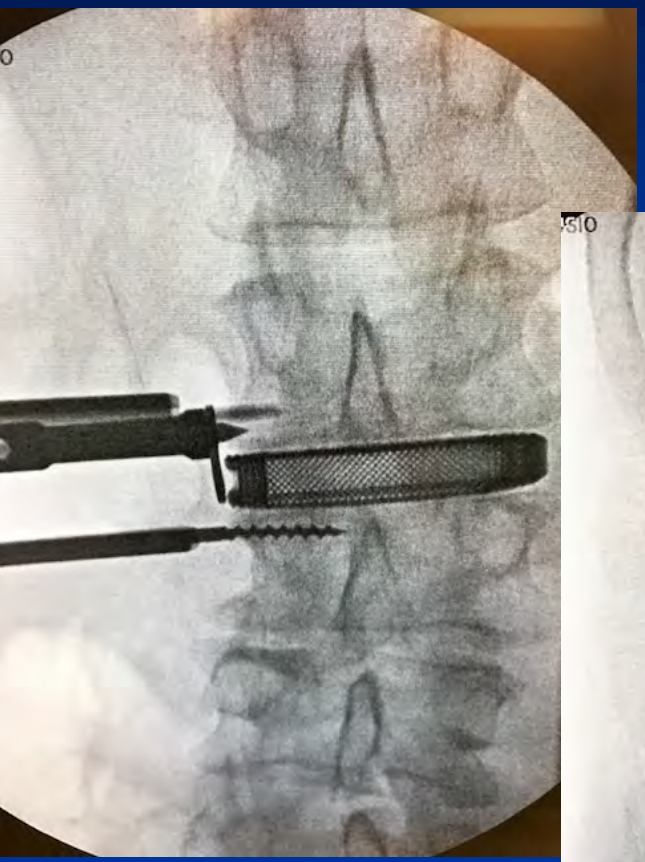

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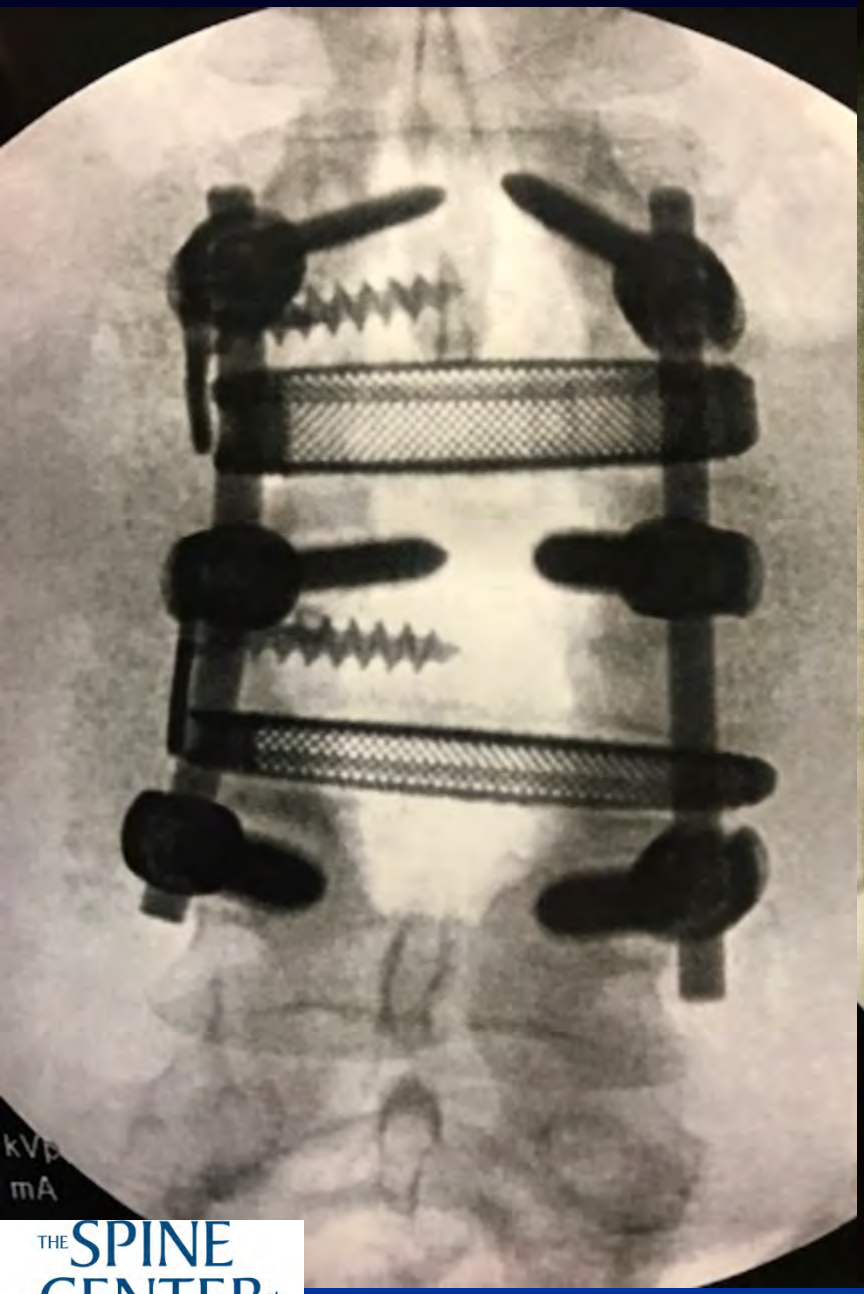

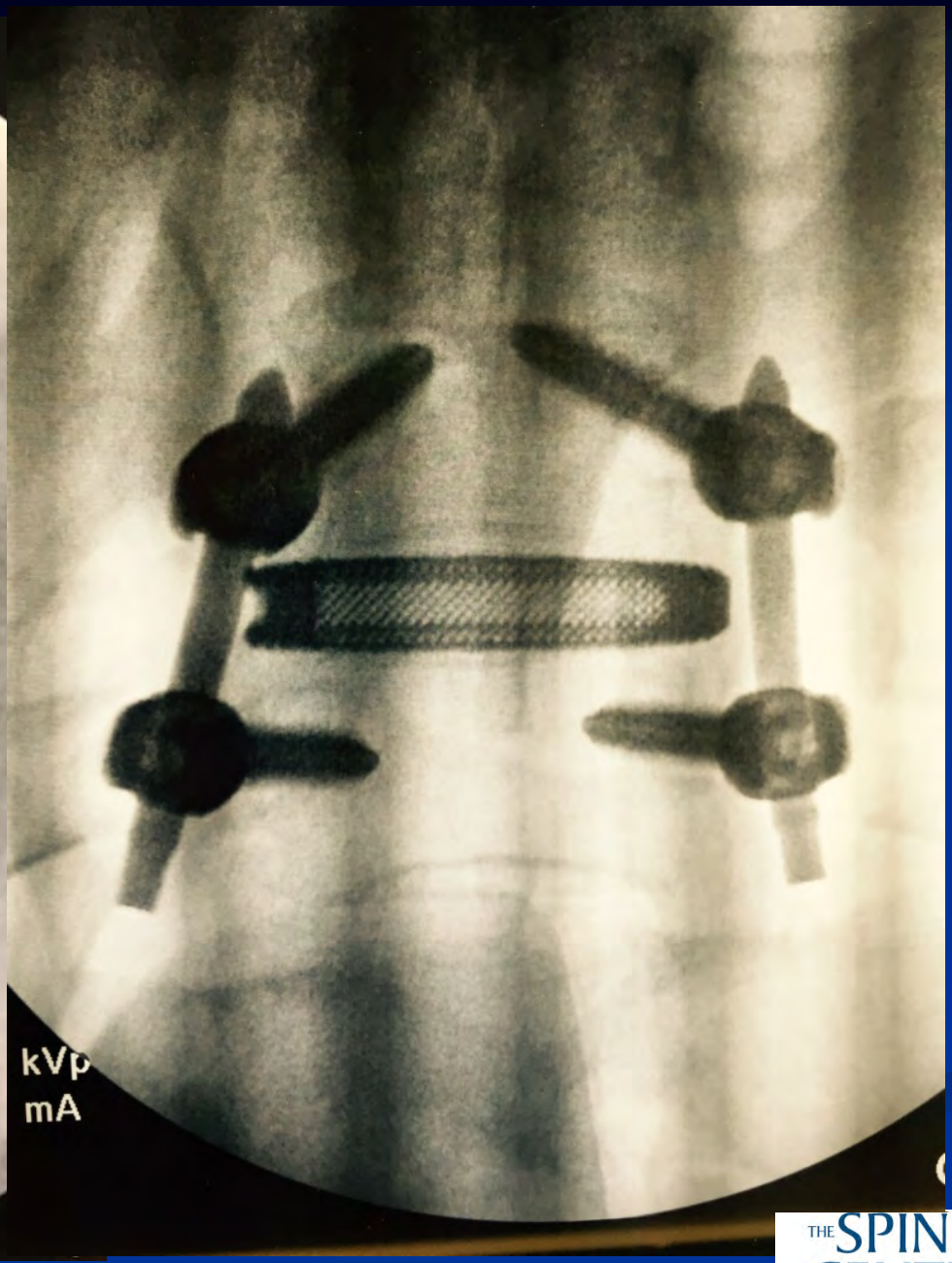

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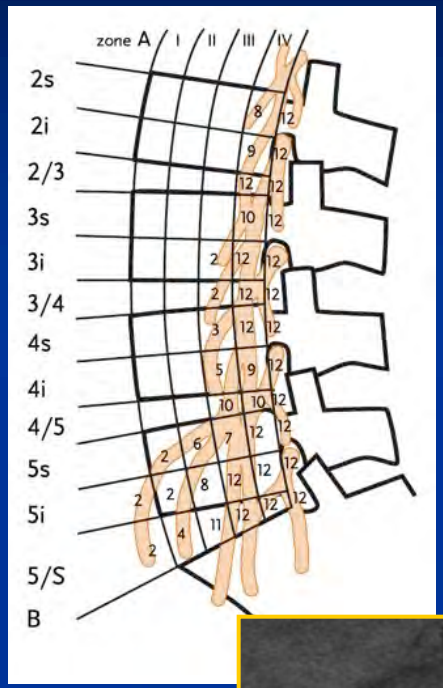
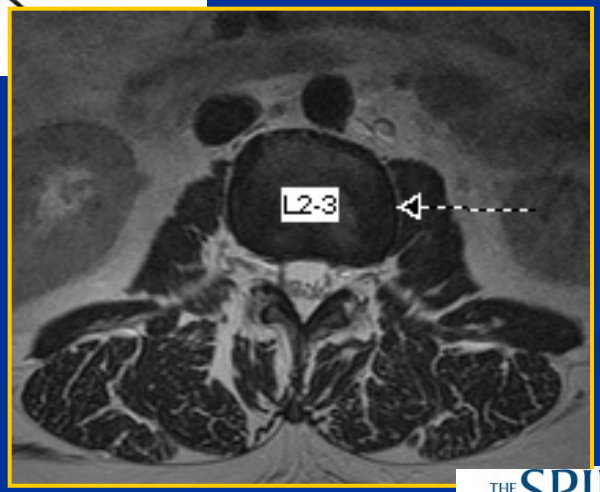
Pearl: Access disk anterior to mid-body

- More anterior portal / approach may be associated with
- Traversing less psoas (less muscle injury, hematoma)
- Better nerve avoidance
- Lower risk of iatrogenic compressive neuropathy from retractor
- Better lordosis (but worse foramen height restoration)

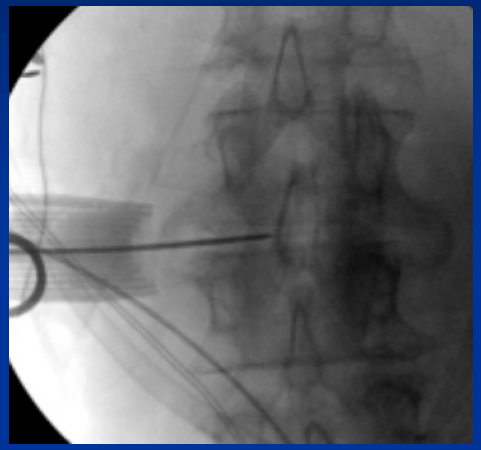


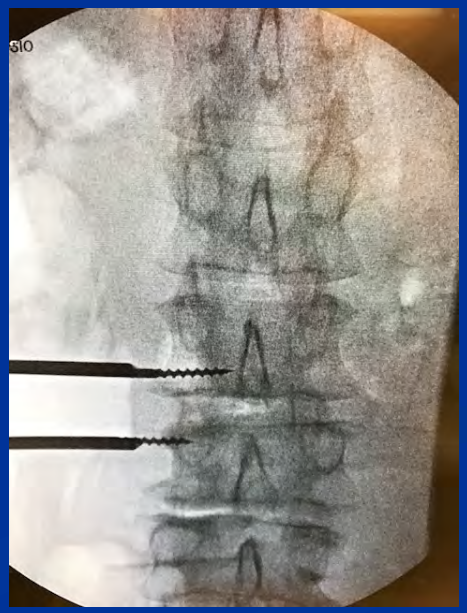


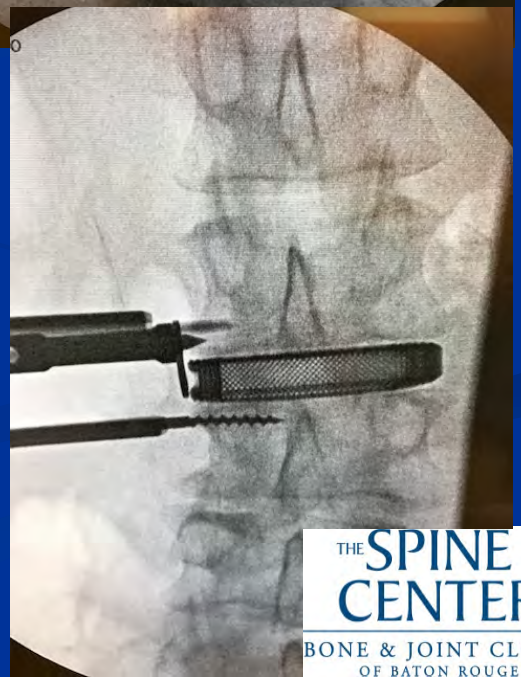
THE SPINE CENTER at BONE & JOINT CLINIC OF BATON ROUGE

Retractor pearls

- Patient Mounted
- Parallel Bladed
- Use osseous fixation with screw if possible
- "Least open"
- Remove one pin for buttress/plating





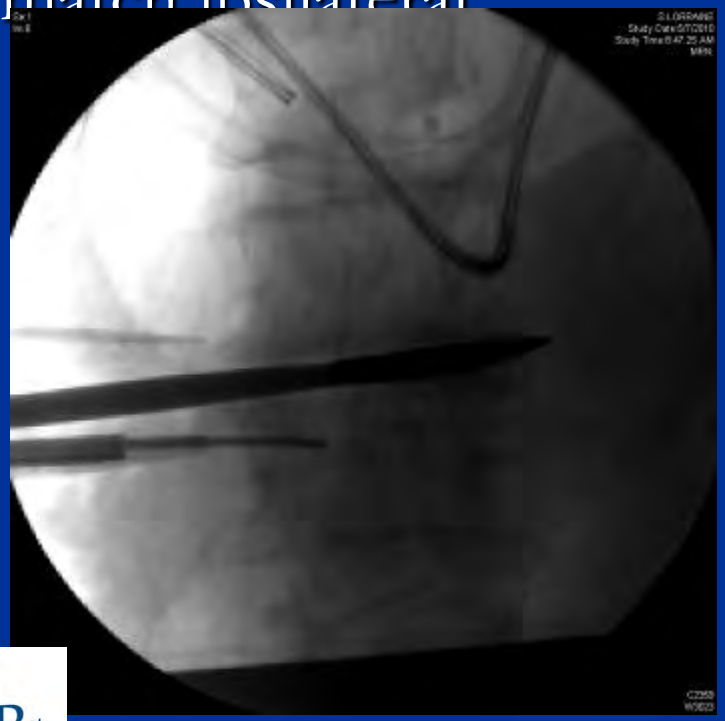


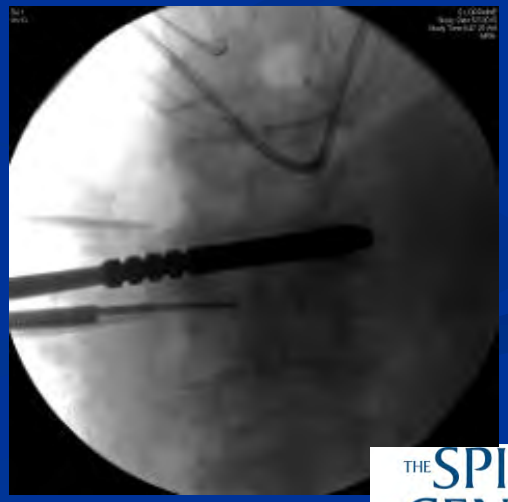
THE SPINE CENTER at BONE & JOINT CLINIC OF BATON ROUGE

THE SPINE CENTER at BONE & JOINT CLINIC OF BATON ROUGE

Pearl; perform balanced release

- Annulotomy contralateral to approach side should match ipsilateral





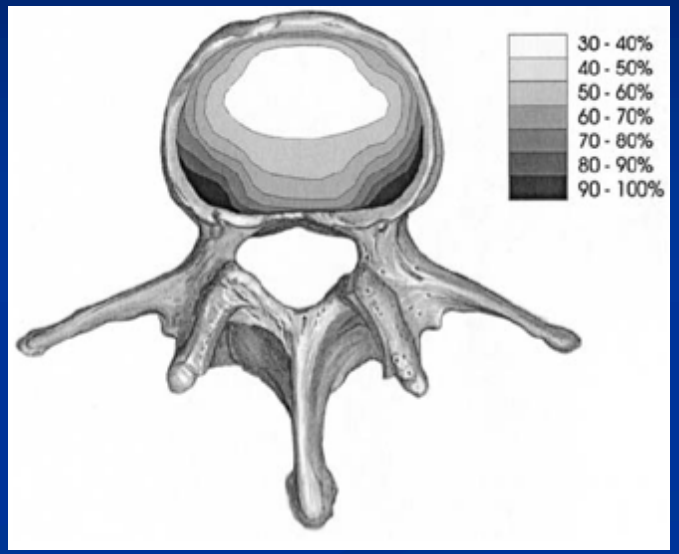
THE SPINE CENTER at BONE & JOINT CLINIC OF BATON ROUGE

Pearl: use wide implants when possible

- 18 mm is typical AP dimension
- 22 mm AP dimension may be associated with lower risk of subsidence (Pimenta, 2011)
- This is especially critical when relying on interbody restoration to provide indirect neurological decompression and or deformity correction
- Wide implant may not be applicable with significant listhesis (> grade 1)

THE SPINE CENTER at BONE & JOINT CLINIC OF BATON ROUGE

Implant size selection and location: where is the good bone?



- Structural bone is on ring apophasis and marginal cortex
- So where would you like your implant?
- And where does the TLIF c

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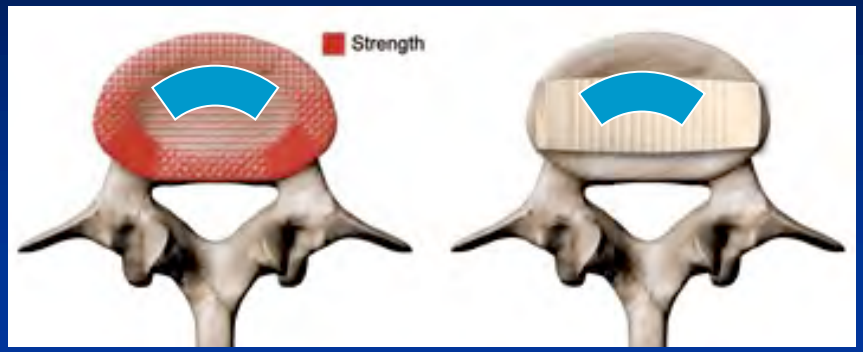
Interbody Device Shape and Size Are Important to Strengthen the Vertebra–Implant Interface

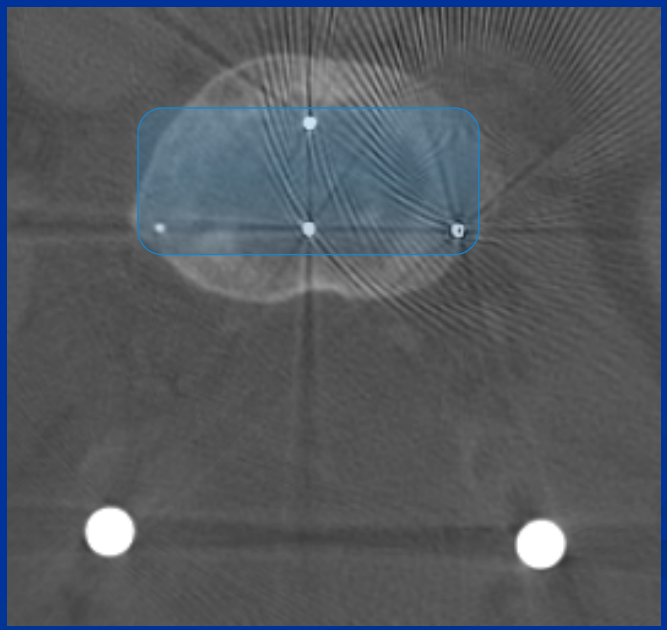
Juay-Seng Tan, MEng,* Christopher S. Bailey, MD, MSc(Surg), FRCSC,†
Marcel F. Dvorak, MD, FRCSC,† Charles G. Fisher, MD, MHSc, FRCSC,† and
Thomas R. Oxland, PhD*†

THE SPINE CENTER at BONE & JOINT CLINIC OF BATON ROUGE

Biomechanical Rationale



- Consider how:
  - Implant surface area
  - Implant bone interface
  - Implant internal volume



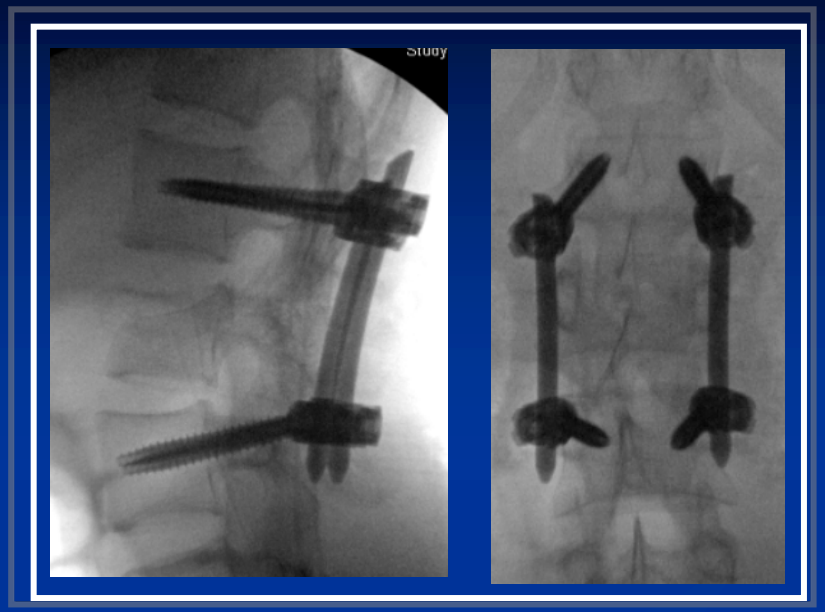
- Helps patients with:
  - Osteoporosis
  - Segmental deformities
  - Fusion risks

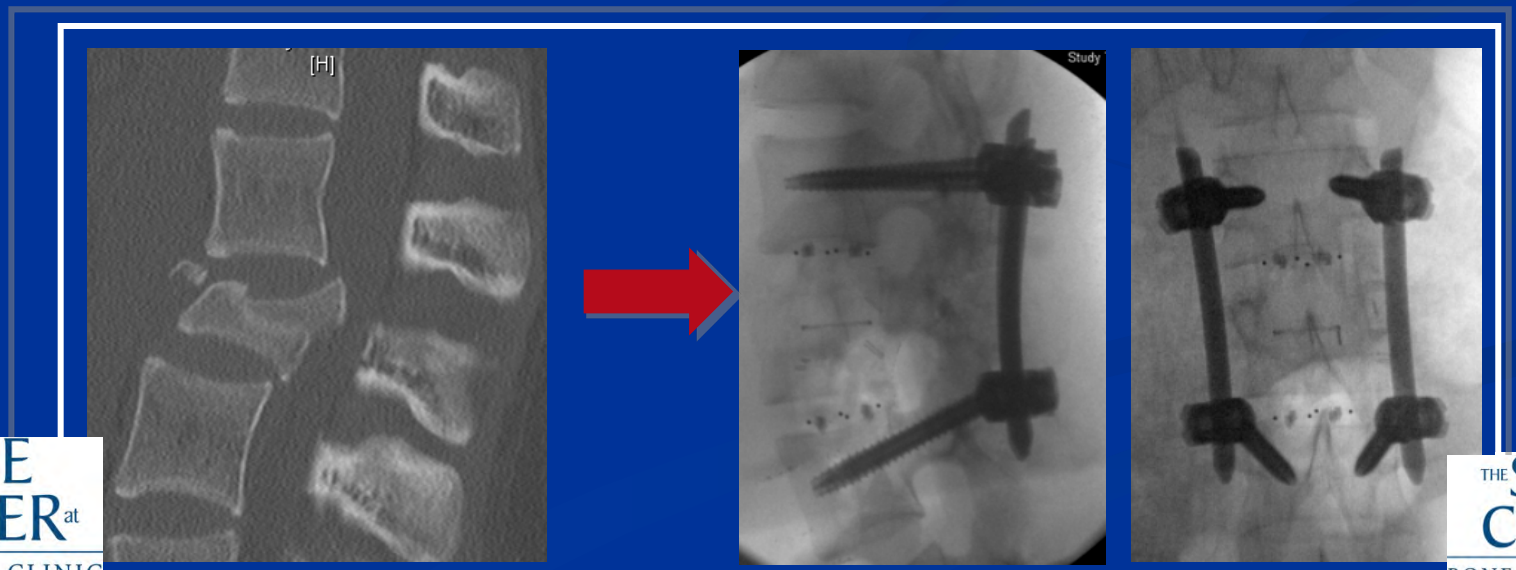
THE SPINE CENTER at BONE & JOINT CLINIC OF BATON ROUGE

Corpectomy Pearls

- Diskectomies first to limit prolonged psoas retraction
  - Then central corpectomy
  - Then posterior corpectomy, clear canal of delta fragment
- Care with ligating segmental vessels
- Consider posterior surgery first if alignment can be restored by posterior means…

THE SPINE CENTER at BONE & JOINT CLINIC OF BATON ROUGE





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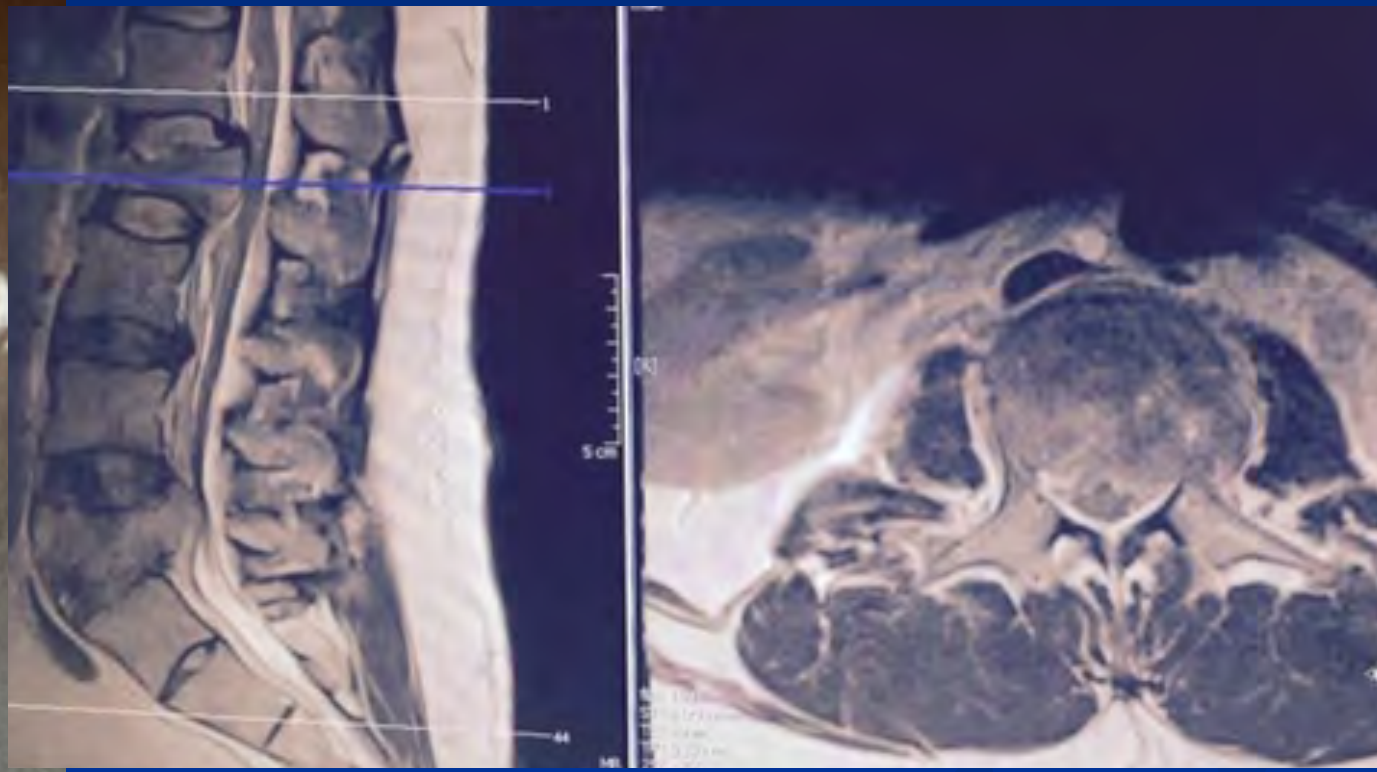
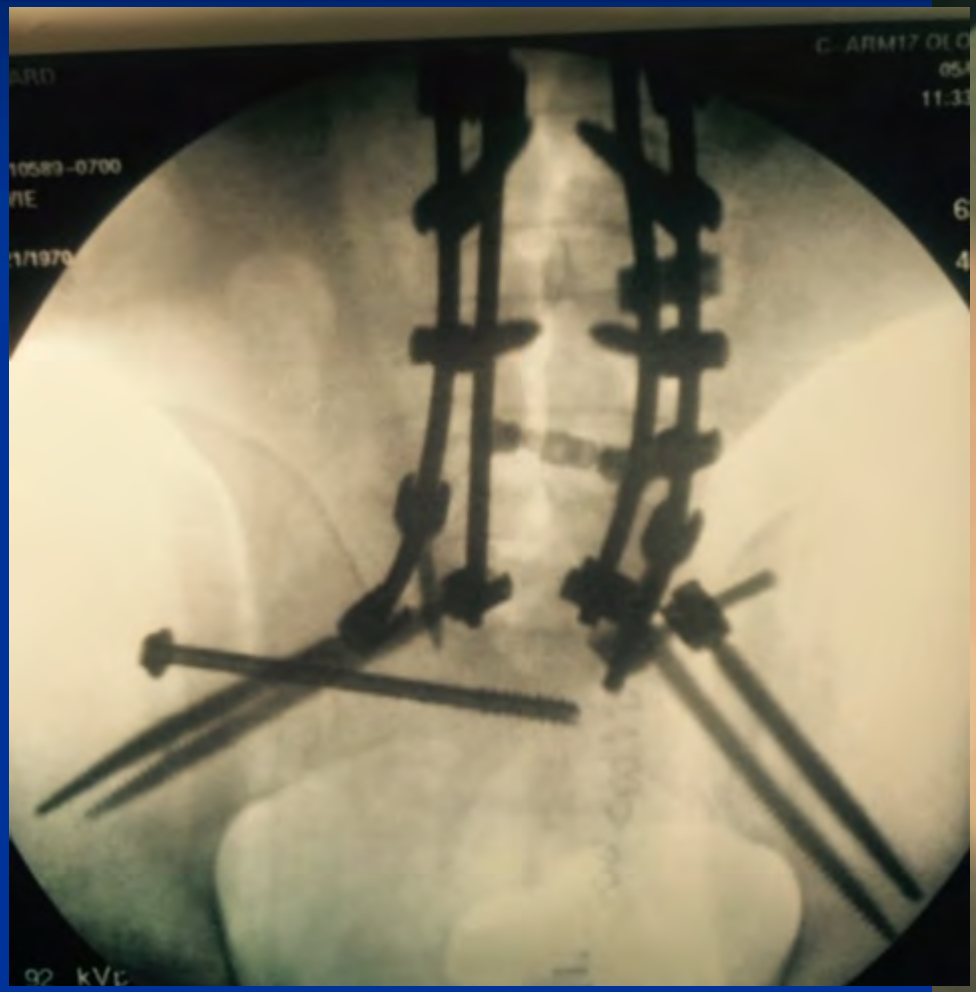
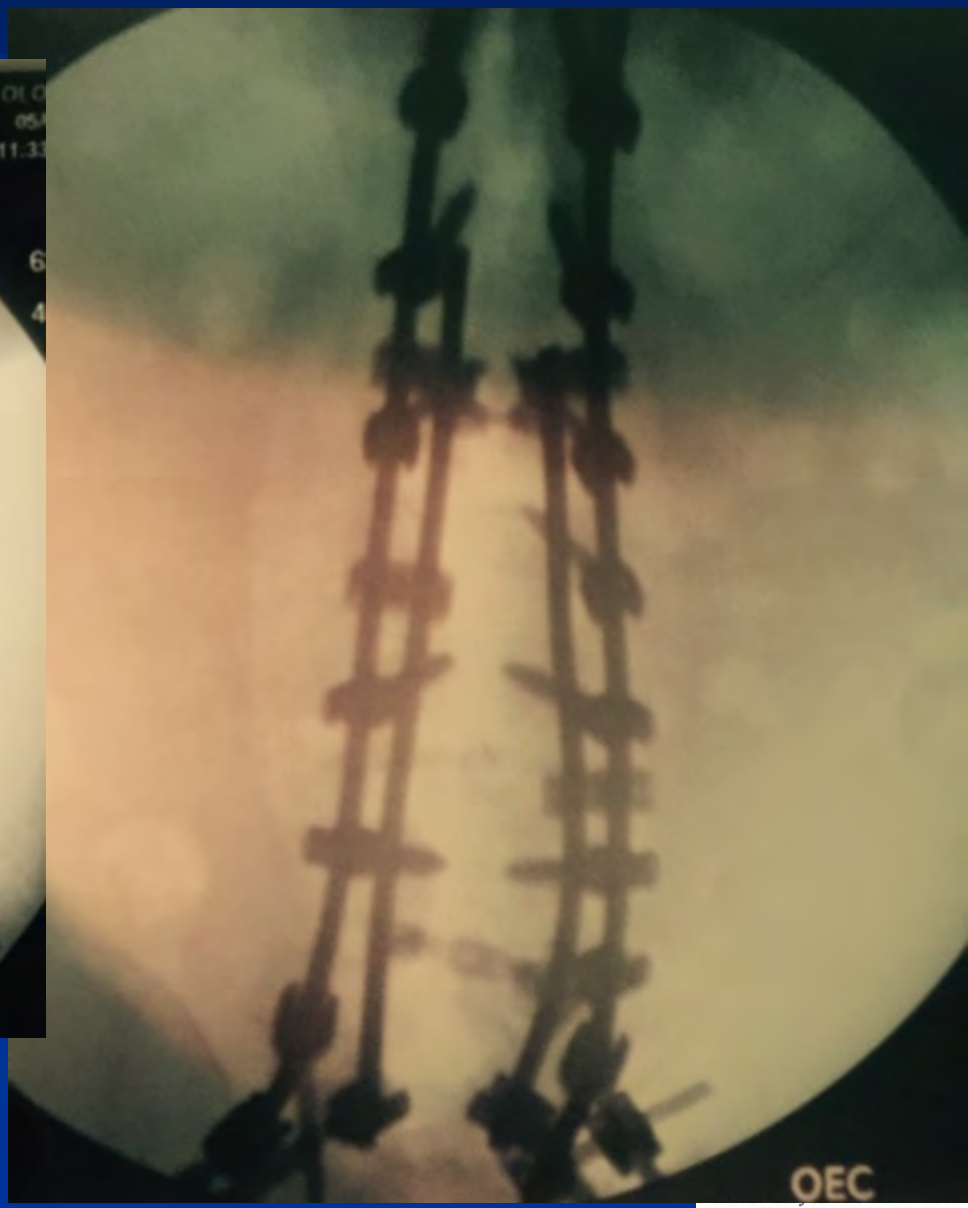


Stage 1 – Pelvic Ring
Stage 2 – Posterior Alignment





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Stage 3 – Anterior L5 Corpectomy

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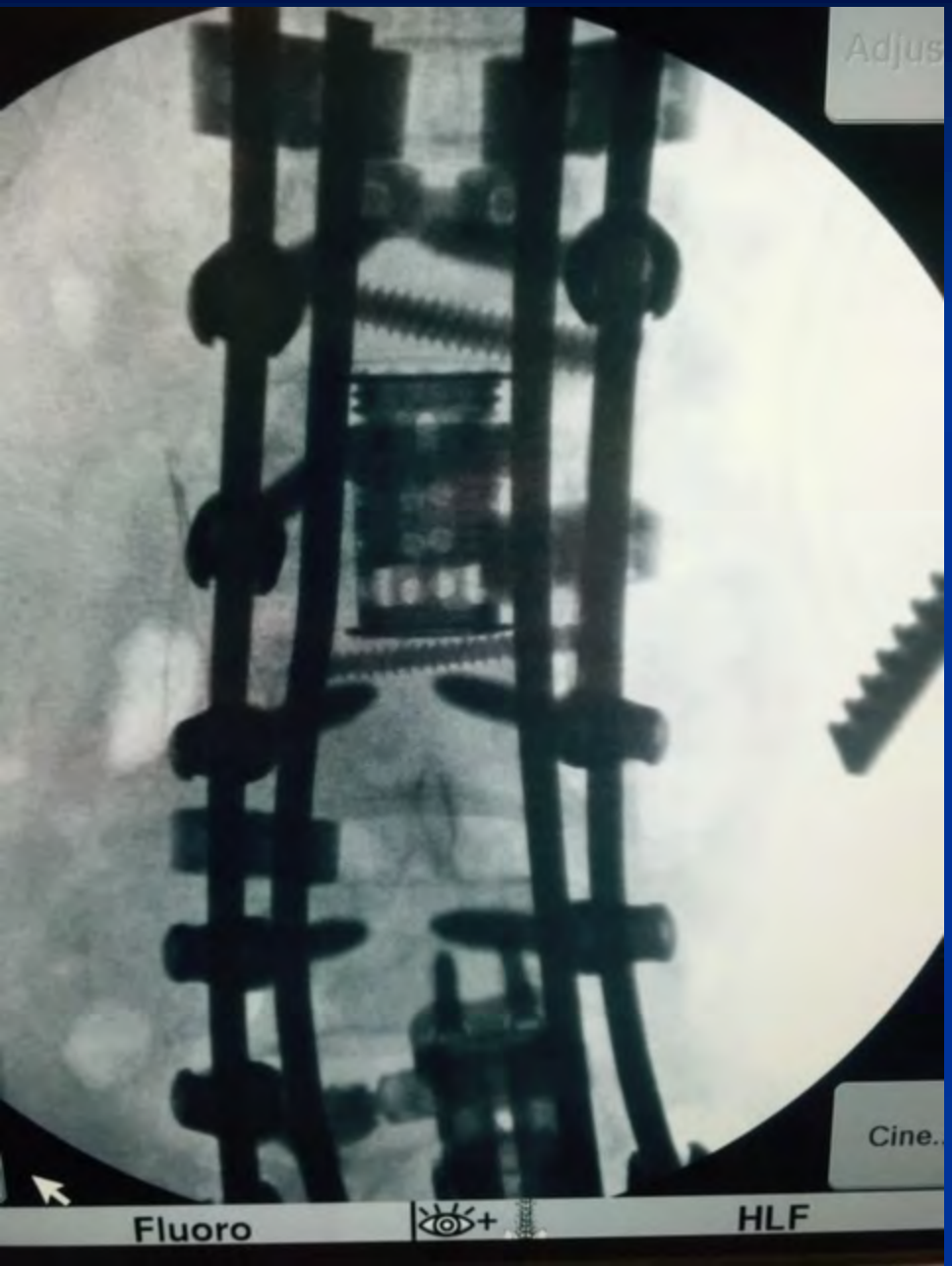
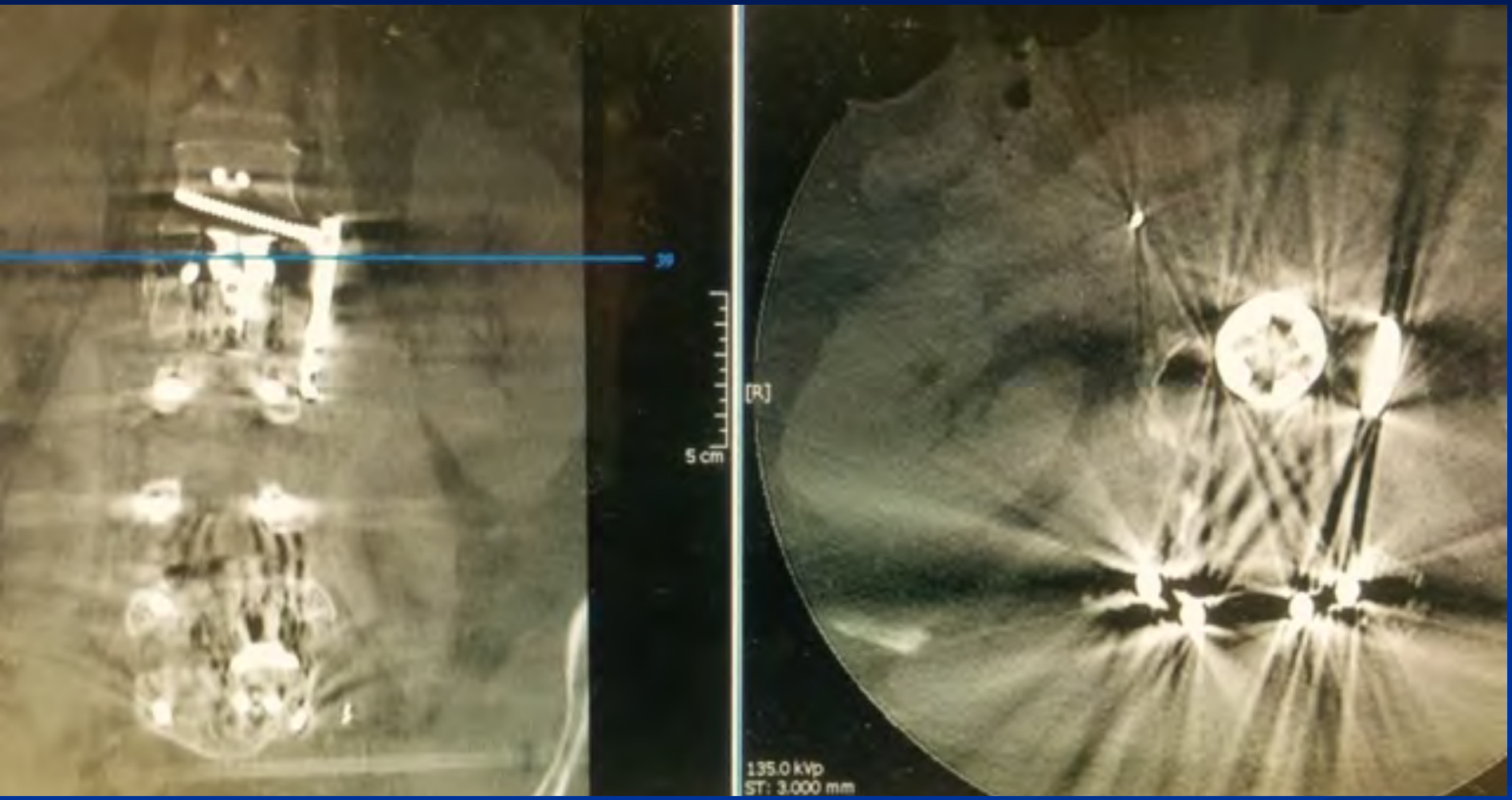
Stage 4– Lateral L2 Corpectomy



Stage 4– Lateral L2 Corpectomy



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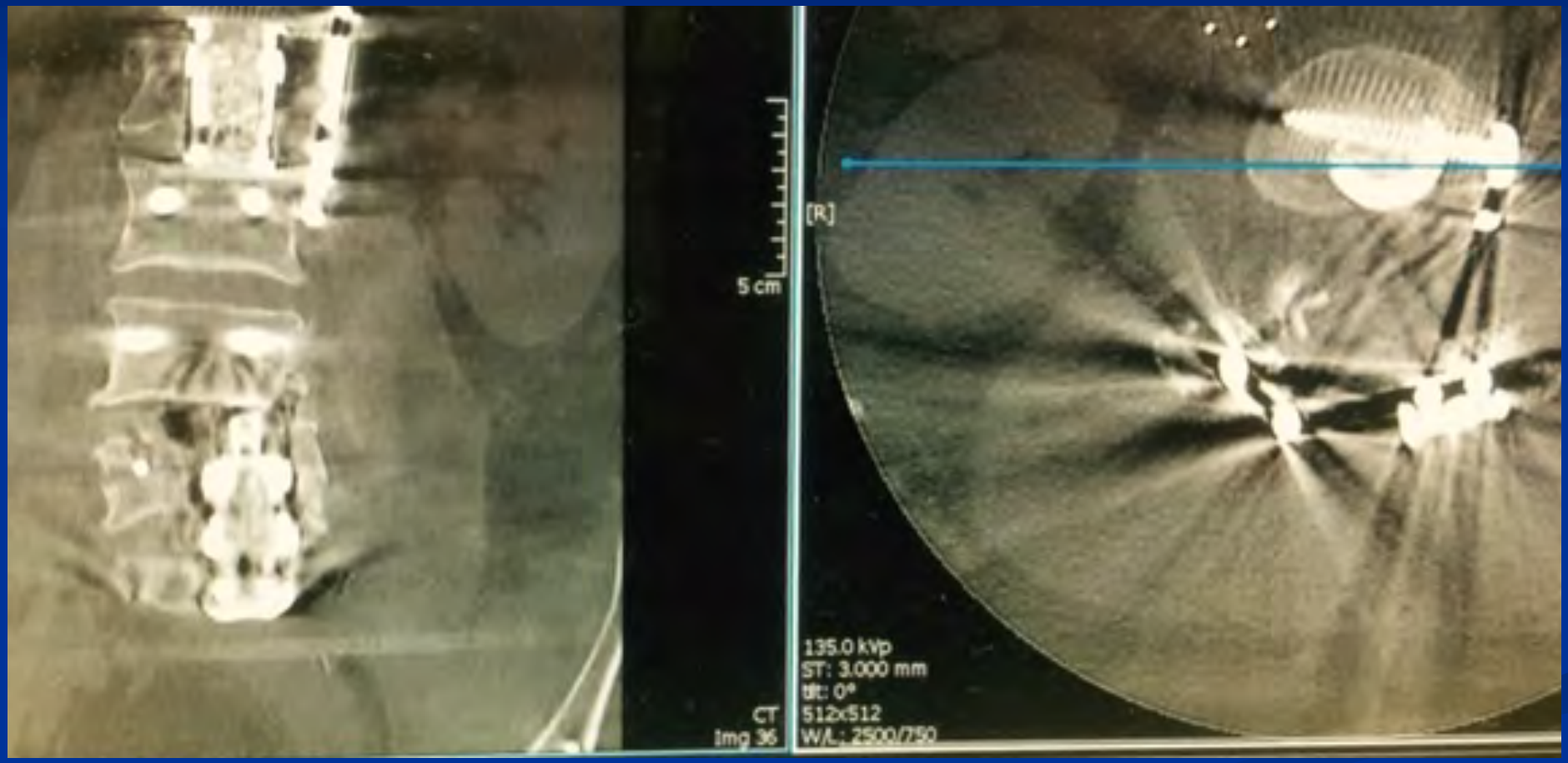
Stage 4– Lateral L2 Corpectomy



THE SPINE CENTER at BONE & JOINT CLINIC OF BATON ROUGE

Pearl: do not overstuff

- Apophyseal and marginal cortex bone provide great support for interbody reconstruction.
- Temptation is to oversize, trying to get more lordosis, or more restoration of foramen height
- Beware of the ability to oversize the height of the device.
- Overstuffing may be associated with
  - Subsidence
  - Iatrogenic trauma including fracture
  - Postoperative pain from over-distraction (I have seen this…)

THE SPINE CENTER at BONE & JOINT CLINIC OF BATON ROUGE

Pearl; limit psoas injury

- Limit retraction time
- Limit retraction force (don't open retractor)
- At end of case:
  - Meticulous hemostasis
  - Withdraw retractor and look for bleeders
  - Wax hole from fixation screw
  - Surgiflo in psoas; pull patty last
  - Dexamethasone in psoas muscle
- Consider post op MR
- Inform patient of expectations pre-op (analogous to ACDF dysphagia)

THE SPINE CENTER at BONE & JOINT CLINIC OF BATON ROUGE

Pearls / Pitfalls Review

- Pre-op imaging to determine side and reduce risk of injury
- Approach side dictated by coronal deformity, especially for L4/5
- Consider 2 c-arms if available
- Minimize Psoas retraction force and time
- Direct visualization is recommended
- Hemostasis within psoas
- Do not "overstuff"
- Position implant for lordosis versus foramen restoration
- Pre-op patient education
- Interbody device must cover apophyseal ring and marginal cortex
- Consider wide (22mm) implant if risk for subsidence
- Real neuro-monitoring with tcMEP
- Intra-muscular steroid
- Plan the order of levels in deformity correction
- Contralateral release for balanced correction
- Indications for indirect reduction are limited

UNDERSTAND ***YOUR*** LIMITS

THE SPINE CENTER at BONE & JOINT CLINIC OF BATON ROUGE

THANK YOU

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