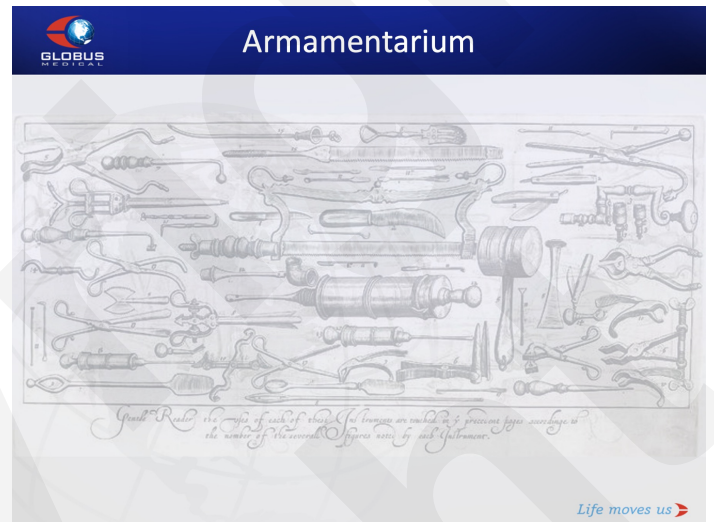




Indications for Surgery

- **What are you trying to achieve?**
- **MISS is a Tool in Surgical Armamentarium**
 - Use when appropriate to achieve your goals
 - Non-maleficence - "first, do no harm" (primum non nocere).

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Indications for Surgery - DRS

- **Decompression**
 - Spinal cord / nerve roots
- **Realignment**
 - Correct deformity
- **Stabilisation**
 - Prevent / Treat
 - Neurological deficit / deformity / pain
 - (Non fusion technology form of "stabilisation")

Annotations: All may require fusion, Require Instrumentation, Instrumentation increases fusion

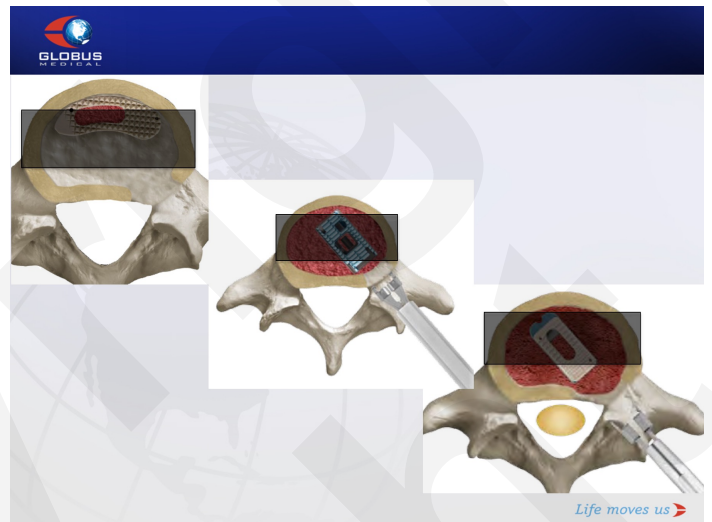
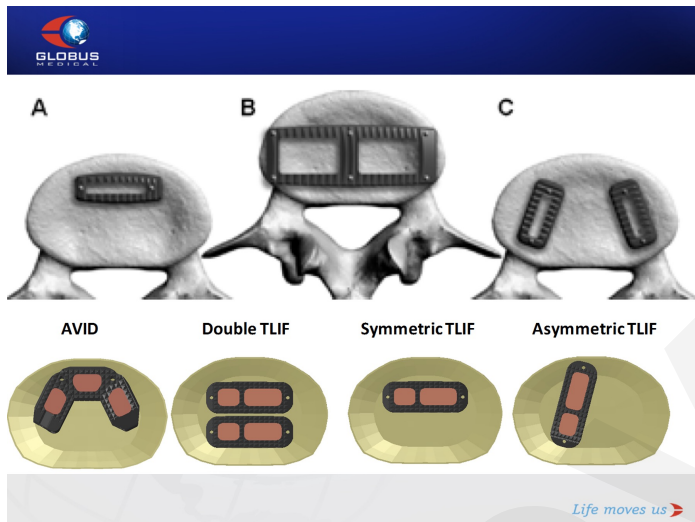
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Fusion

- **Fusion – think:**
 - $\propto$ contact surface area ($1/\alpha$ subsidence)
 - $\uparrow$ compression $\downarrow$ tension
 - autograft > allograft > synthetic
 - vascular > avascular
 - structural graft > non structural
 - BMP...
 - And unfortunately fusion may not be α clinical outcome

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Life moves us ➤



LLIF

- Tension intact ALL / PLL
- Indirect decompression
- Large surface area for fusion across strongest area of bone
- Good for laterolisthesis > rotated spine
- Multiple levels same incision

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LLIF Algorithm First Question

- Contraindications:
 - L5/S1
 - Low seated L4/5 (look at crests)
 - High grade slip
 - Retroperitoneal scarring / pathology
 - Medical comorbidities / contraindications to surgery
- Yes – then use other technique

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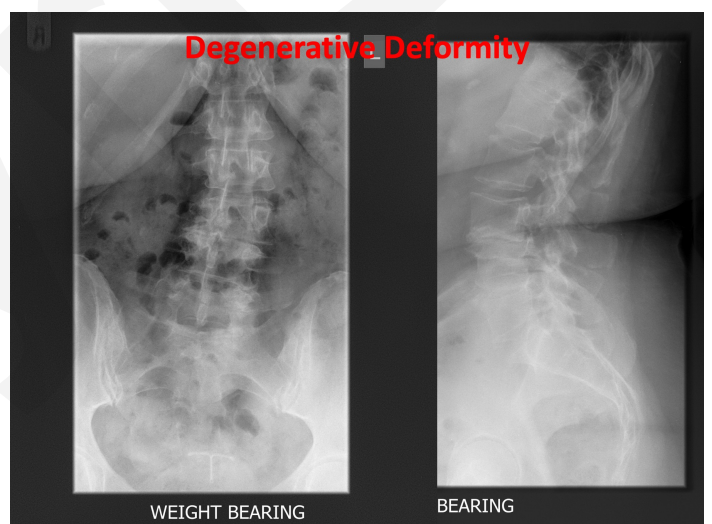
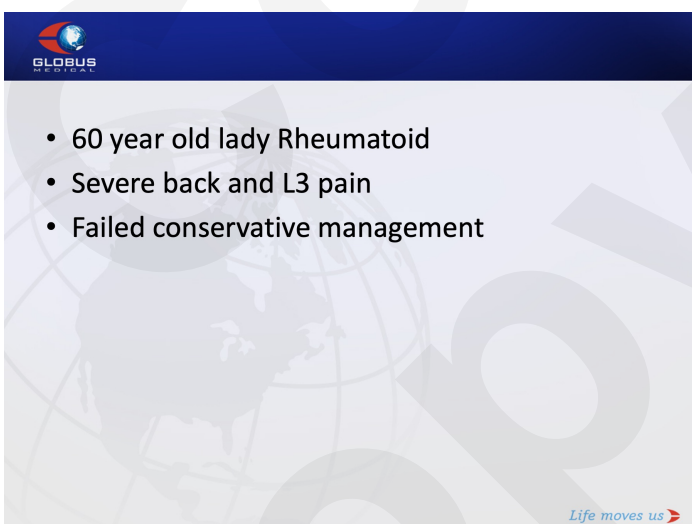
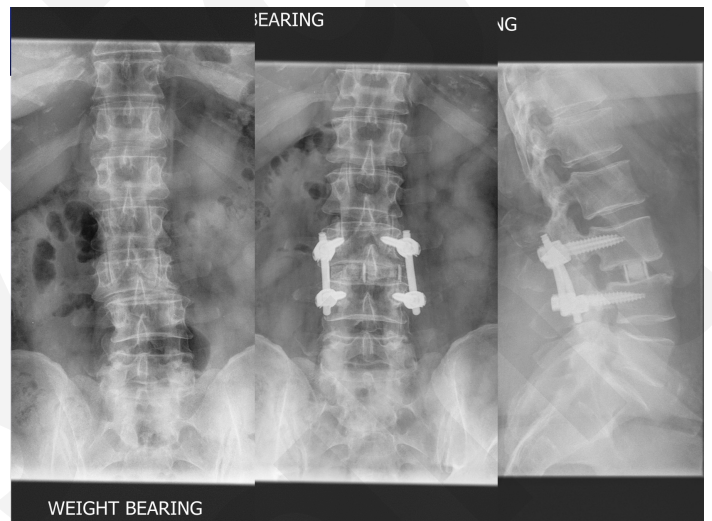
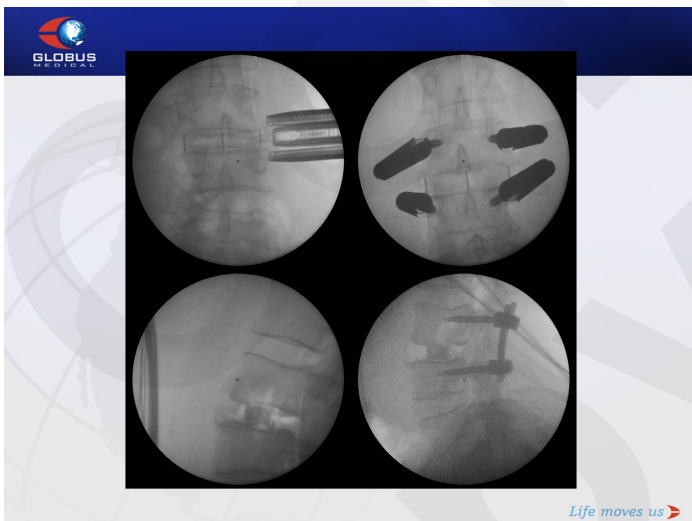
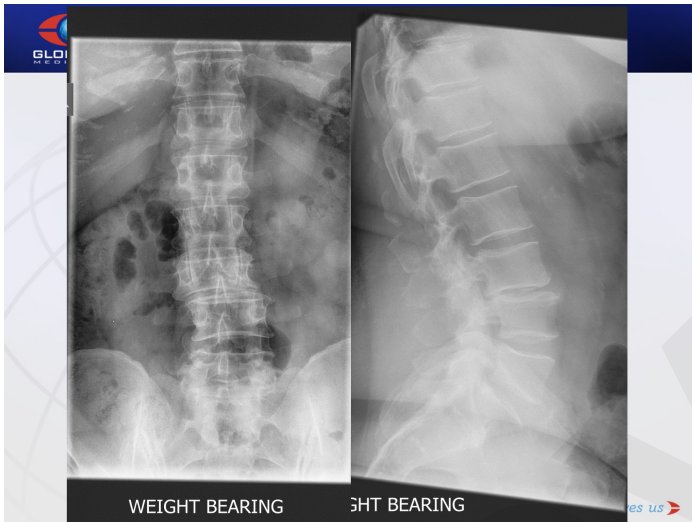
LLIF Algorithm Second Question

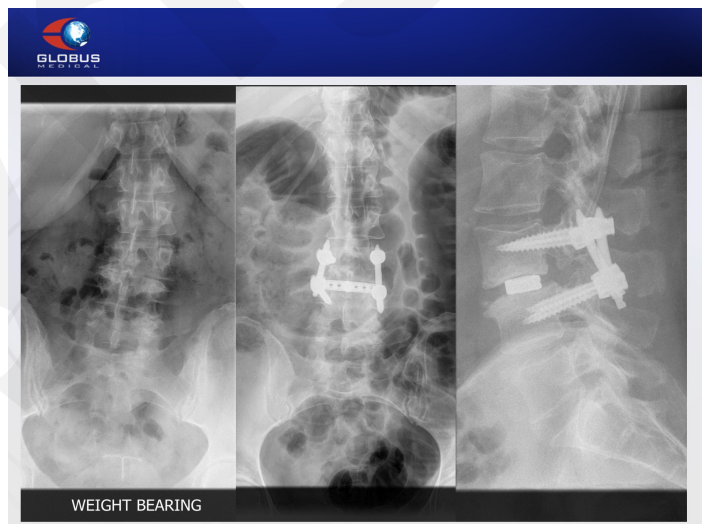
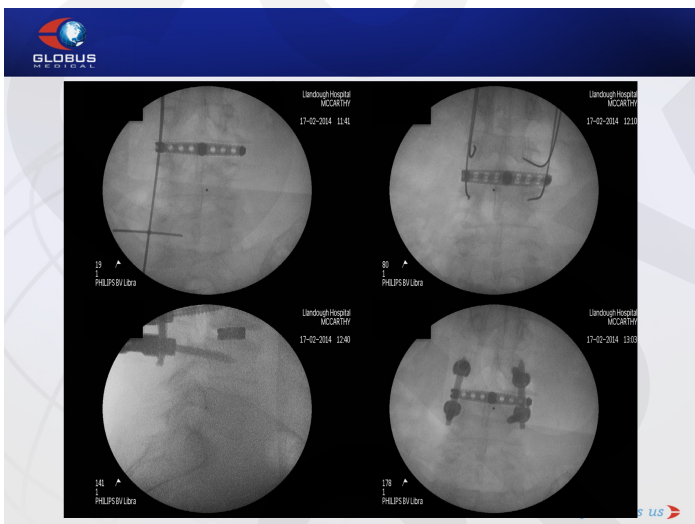
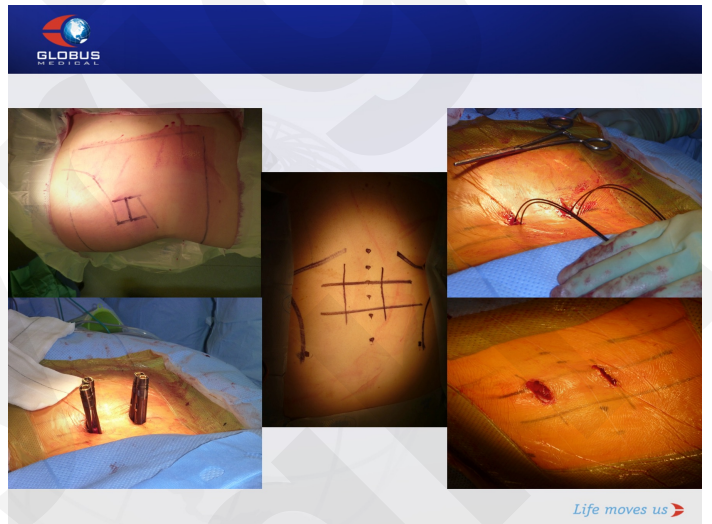
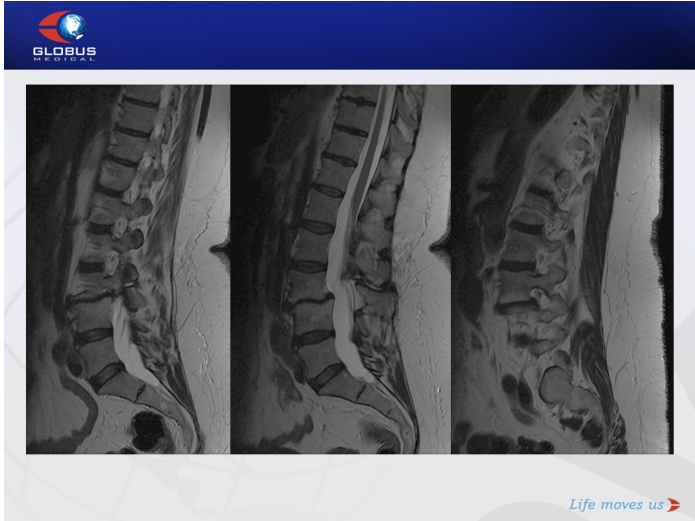
- Is direct decompression of spinal canal needed?
 - Yes
 - Consider single procedure / approach with TLIF / PLIF
 - Surgical philosophy / ability – 2 stages with LLIF may give better deformity correction / fusion

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- 60 year old man
- Progressive mid lumbar pain
- Some L3 pain
- Exhausted conservative measures

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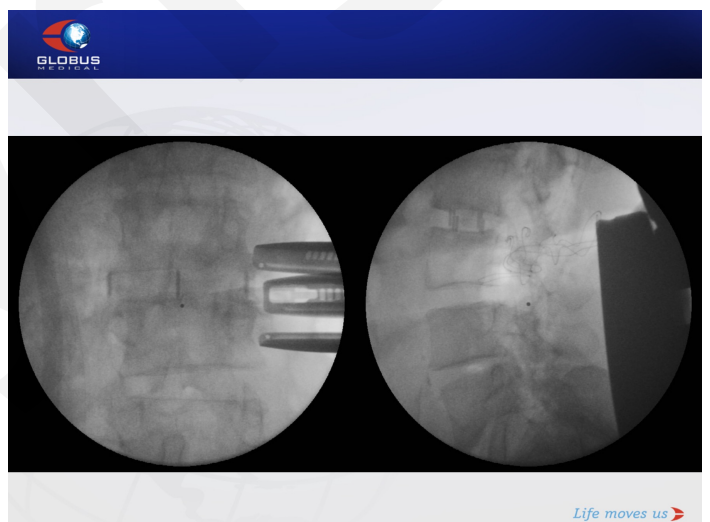
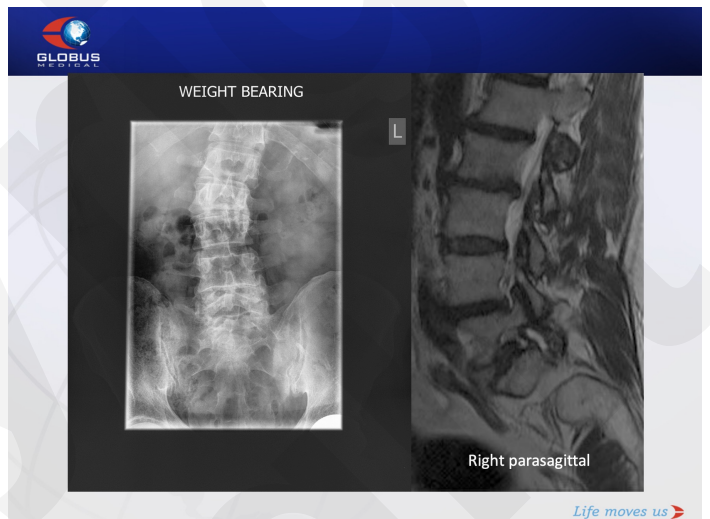
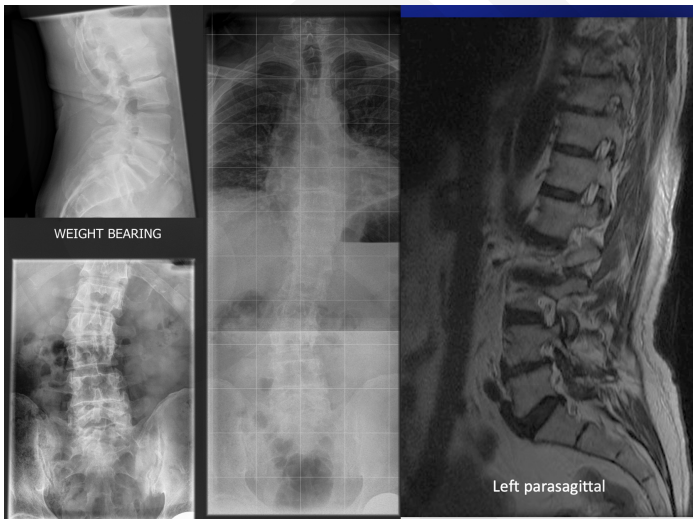


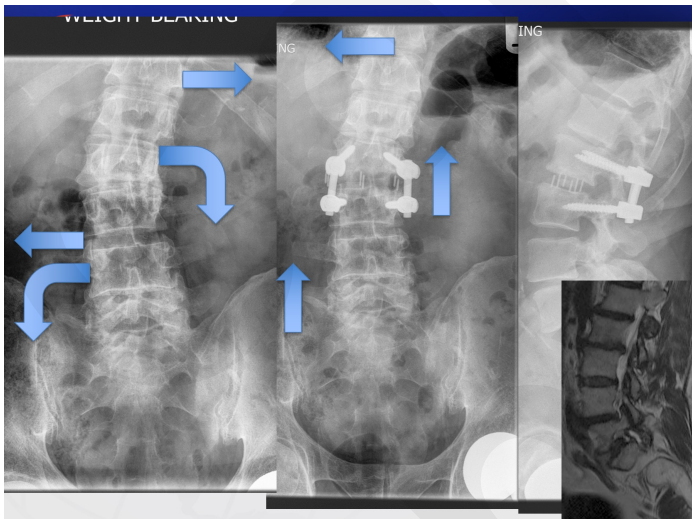
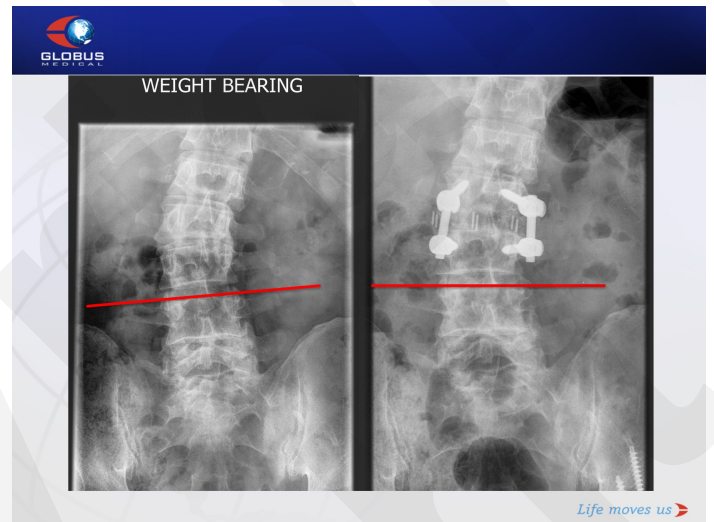
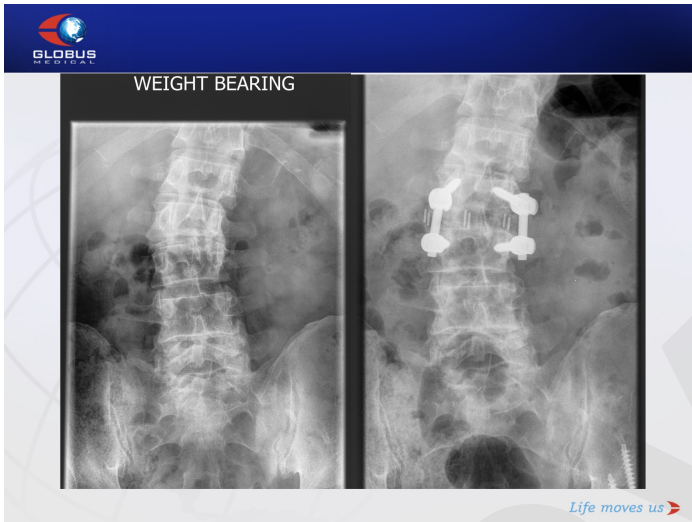


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- 55 year old man
- Agonising left L2 pain
- Mild right L5 pain
- Well built goes to gym regularly
- Failed conservative management

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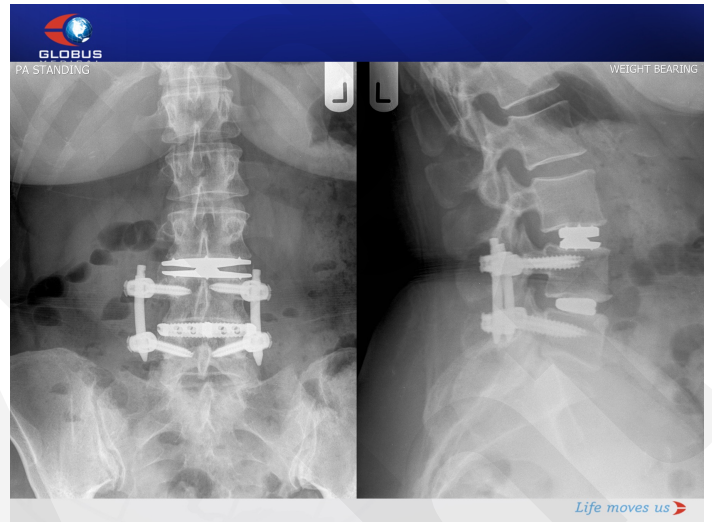


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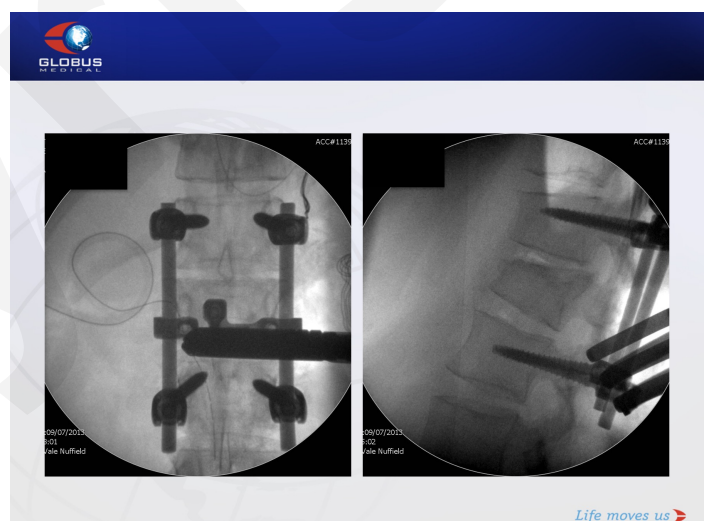
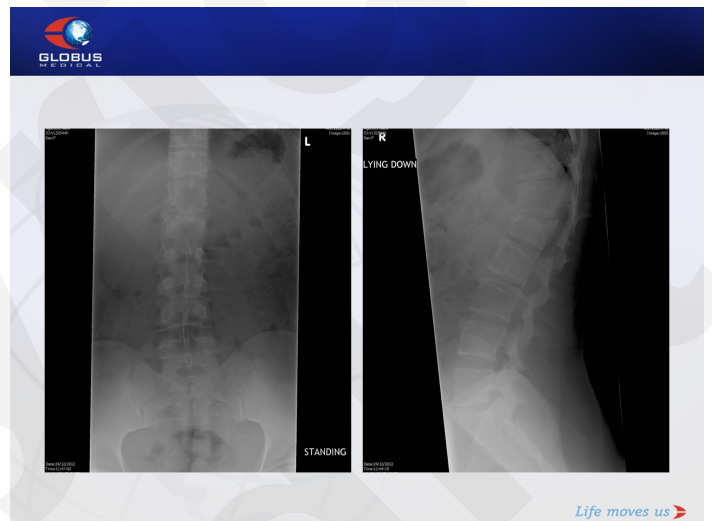
- 35 year old man
- Chronic low back pain
- Failed all conservative management

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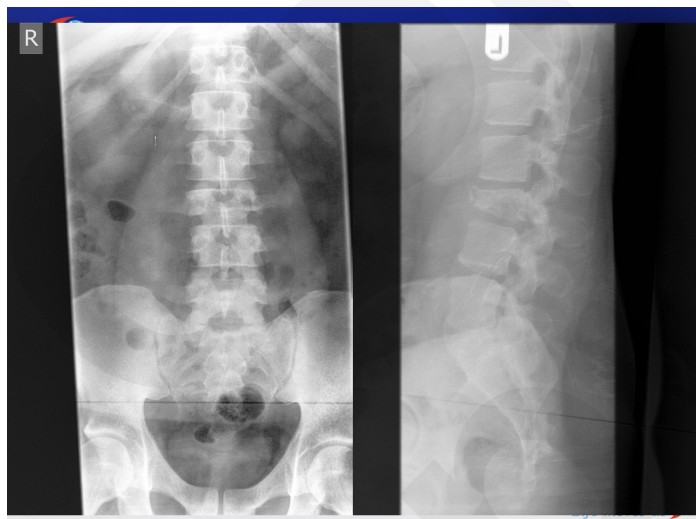
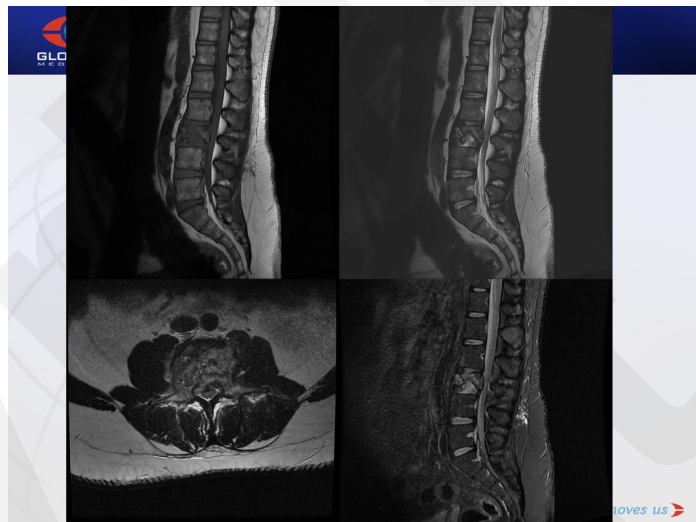
- 32 year old woman
- Fell off a horse 6 months ago
- On going upper low back pain
- No neurological symptoms
- Failed conservative management



GLOBUS MEDICAL

- Still getting worse
- 6 weeks later
- Biopsy x2 negative
- Rpt MRI

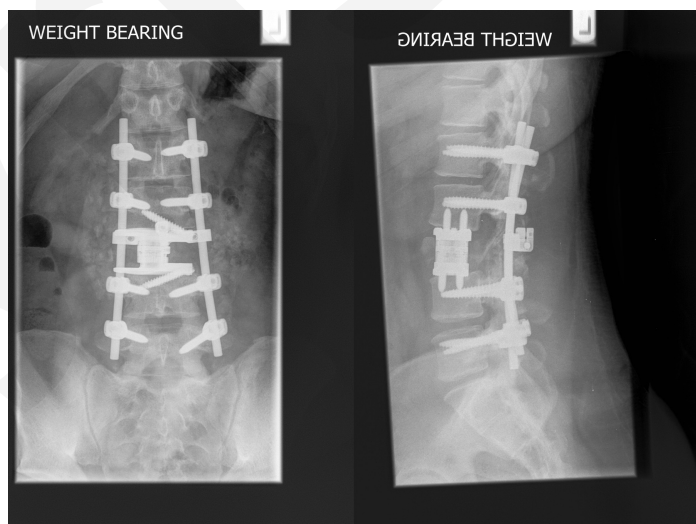
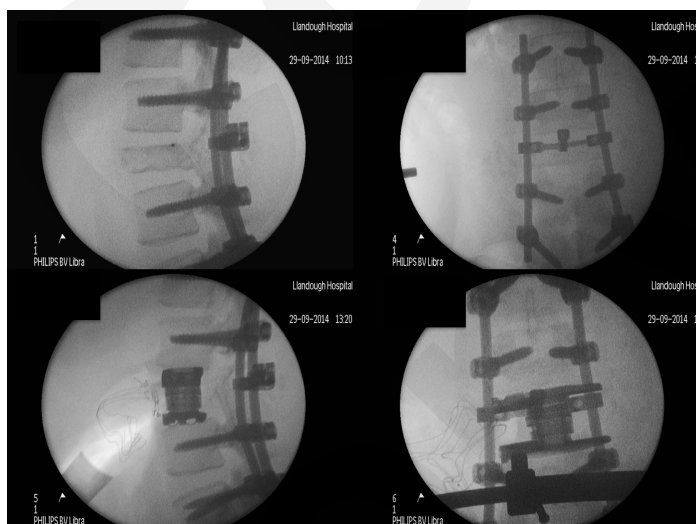
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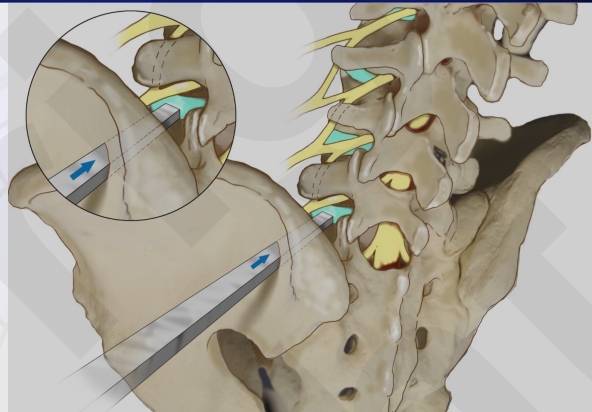
- Discussed at MDTM
- What now...
- Young man something nasty going on...

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- Just in case you thought it wasn't possible...

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• Courtesy of Dr M MacMillan

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Beware the...



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LLIF Doesn't Always Go Well...



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Spine

CLINICAL CASE SERIES

Intraoperative and Early Postoperative Complications in Extreme Lateral Interbody Fusion

An Analysis of 600 Cases

W. Blake Rodgers, MD, Edward J. Gerber, PA-C, and Jamie Patterson, BA

Study Design. Prospective analysis of 600 extreme lateral interbody fusion (XLIF) approach procedures for intraoperative and perioperative complications.

Objective. To delineate and describe complications in a large, prospective series of minimally invasive lateral lumbar fusion procedures (XLIF).

Summary of Background Data. While some small series of lateral lumbar fusion have discussed complications, no results from large studies have been reported.

Methods. A total of 600 patients were treated with a lateral approach to fusion (XLIF) for degenerative spinal conditions. Data were collected prospectively on all patients and analyzed for demographic, diagnostic, and hospitalization information to identify operative

(2.8%) in-hospital medical events, 6 (1.0%) out-of-hospital surgery-related events, and 5 (0.8%) out-of-hospital medical events. There were no wound infections, no vascular injuries, no intraoperative visceral injuries, and 4 (0.7%) transient postoperative neurologic deficits. Eleven events (1.8%) resulted in additional procedures/reoperation.

Conclusions. Compared with traditional open approaches, the MIS lateral approach to fusion by using the XLIF technique resulted in a lower incidence of infection, visceral and neurologic injury, and transfusion as well as markedly shorter hospitalization. Complications in MIS XLIF compare favorably with those from other MIS fusion procedures; duration of hospitalization is shorter than with any previously reported technique.

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Aortic Perforation During Lateral Lumbar Interbody Fusion

Alexander Aichmair, MD,* Gary A. Fantini, MD,† Sean Garvin, MD,‡
James Beckman, MD,‡ and Federico P. Girardi, MD*

Study Design: A case report.

Objective: To report a unique case of aortic perforation during lateral lumbar interbody fusion (LLIF).

Summary of Background Data: Among the reported advantages of this minimally invasive transposas procedure is the avoidance of an anterior intraperitoneal approach to the lumbar spine, thus avoiding visceral and vascular injuries typically associated with the latter.

Methods: We report a single case of aortic perforation during LLIF, which occurred in the setting of an incidental endplate and anterior vertebral cortex violation.

Results: During the implantation of an interbody prosthetic device at the L3–L4 level, the proximal aspect of the implant broke which caused cage misplacement. During the attempt to

Conclusions: The distal endplate and anterior vertebral cortex violation can result in the formation of an anterior bony spur in close proximity to the major abdominal vascular structures, and despite the avoidance of an anterior approach to the lumbar spine, surgery-related injury to major abdominal vessels can occur during LLIF. Aortic perforation is a rare, yet potentially lethal intraoperative complication of LLIF, which requires emergency laparotomy and vascular suture repair.

Key Words: lateral lumbar interbody fusion, complication, vascular injury, aortic perforation, endplate fracture
(J Spinal Disord Tech 2015;28:71–75)

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First report of major vascular injury due to lateral transposas approach leading to fatality

Case report

RACHID ASSINA, R.Ph., M.D., NEIL J. MAJUMDAR, B.S., YEHUDA HERSCHMAN, M.D.,
AND ROBERT F. HEARY, M.D.

Department of Neurological Surgery, Rutgers University–New Jersey Medical School, Newark, New Jersey

Extreme lateral interbody fusion (XLIF) has gained popularity among spine surgeons for treating multiple conditions of the lumbar spine. In contrast to the anterior lumbar interbody fusion (ALIF) approach, the minimally invasive XLIF approach affords wide access to the lumbar disc space without an access surgeon and causes minimal tissue disruption. The XLIF approach offers many advantages over other lumbar spine approaches, with a reportedly low complication profile. The authors describe the first fatality reported in the literature following an XLIF approach. They describe the case of a 50-year-old woman who suffered a fatal intraoperative injury to the great vessels during a lateral transposas approach to the L4–5 disc space.

As this approach gains more popularity and wider usage among experienced and nonexperienced spine surgeons, the real potential for injury to the great vessels must be recognized. This possibility is particularly worrisome if a tubular retractor system that has a detachable, nonfixed retractor blade anteriorly is used. A thorough understanding of the vascular anatomy in relation to the ALL is necessary, because a vascular injury is possible anytime the ALL is violated. This report also demonstrates the danger of performing an XLIF surgical procedure in an outpatient surgeon without immediate access to a vascular, endovascular, or general surgery back-up practitioner.

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Spine

SURGERY

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Contralateral Motor Deficits After Lateral Lumbar Interbody Fusion

Fadi Taher, MD,* Alexander P. Hughes, MD,† Darren R. Lebl, MD,† Andrew A. Sama, MD,†
Matthias Pumberger, MD,* Alexander Aichmair, MD,† Russel C. Huang, MD,† Frank P. Cammisia, MD,† and
Federico P. Girardi, MD†

Study Design. Retrospective case series.

Objective. To report on the rare finding of motor deficits contralateral to the transposas approach in patients who underwent lateral lumbar interbody fusion (LLIF).

Results. Of the patients reviewed, 2.9% (7/244) presented with a postoperative contralateral motor deficit, the most severe of which was a 1/5 weakness of the quadriceps muscle. An average of 3 levels (range: 2–4) was fused in 7 patients who developed a contralateral motor deficit, and in 3 of the 7 patients, an anterior lumbar interbody fusion (ALIF) was performed in addition to the LLIF. At 1 year follow-up, 3 patients presented with complete resolution of their muscle weakness, 1 patient still had mild weakness, 1 patient had decreased range of motion in the affected joint, and 1 patient had a 2/5 foot drop. One patient was lost to follow-up.

Conclusion. These data are among the largest reports of contralateral motor deficits after LLIF. Among possible underlying mechanisms are entrapment of the contralateral nerve root through translational correction of spondylolisthesis, front-to-back misalignment of the cage resulting in contralateral nerve root impingement, pressure on the contralateral peroneal nerve during positioning, and overdistraction neuropathia when using ALIF at L5–S1 concomitantly. Awareness of the possibility of this rare complication can play an important role in surgical consideration and preoperative patient counseling.

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Nerve injury during the transposas approach for lumbar fusion

TABLE 1: Studies in the English literature reporting motor deficits in patients who underwent either DLIF or XLIF procedures*

Authors & Year	No. of Patients	Approach	Clinical Motor Deficits
Anand et al., 2010	28	DLIF/XLIF	2 patients (7.1%) had quadriceps palsies from which they recovered within 6 mos
Isaacs et al., 2010	107	XLIF	36 patients (33.6%) had some evidence of weakness after surgery. 29 had hip weakness, 6 patients had lasting weakness at 6-month follow-up
Kepler et al., 2010	13	XLIF	3 patients (23.1%) developed transient postop hip flexion weakness at 1-yr postop follow-up
Knight et al., 2009	58	DLIF	2 patients (3.4%) with L4 nerve injury showed residual motor effects at 1-yr postop follow-up
Papanastassiou et al., 2011	32	XLIF	2 patients (6.25%) sustained contralateral psoas weakness; injury in 1 patient was caused by a displaced endplate fragment compressing the contralateral nerve root, the second patient had weakness from a far-lateral herniation after the XLIF procedure; both patients experienced resolution of their symptoms after reoperation 6 weeks after the initial surgery
Pimenta et al., 2011	36	XLIF	1 patient (2.8%) had weakness of the leg ipsilateral to the approach side, which lasted through the 3-month visit but was resolved by the 6-month visit; 1 patient (2.8%) had hypertrophy of the quadriceps contralateral to the approach side at the 12-month visit, which was resolved by the 2-yr visit
Rodgers et al., 2011	600	XLIF	4 patients (0.7%) exhibited transient postop neurological deficits
Tormenti et al., 2010	8	XLIF	2 patients (25%) suffered motor radiculopathy w/ 1 patient having persisting weakness at 3 mos following surgery
Youssef et al., 2010	87	XLIF	1 patient (1.1%) w/ leg weakness for 7 wks
Wang & Mummaneni, 2010	23	DLIF/XLIF/mini-open	7 patients (30.4%) w/ symptoms of thigh pain, numbness weakness, and dysesthesias, w/ 1 patient suffering prolonged symptoms requiring a gait-assist device

* Cadaveric or nonclinical papers were excluded.

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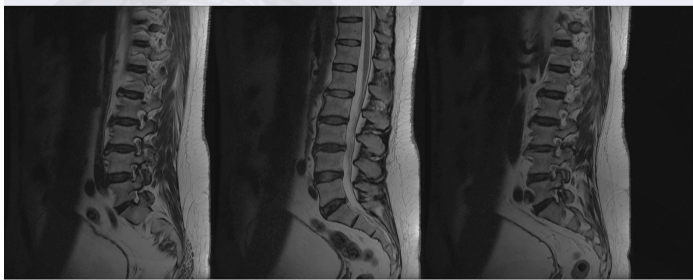
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Thank you

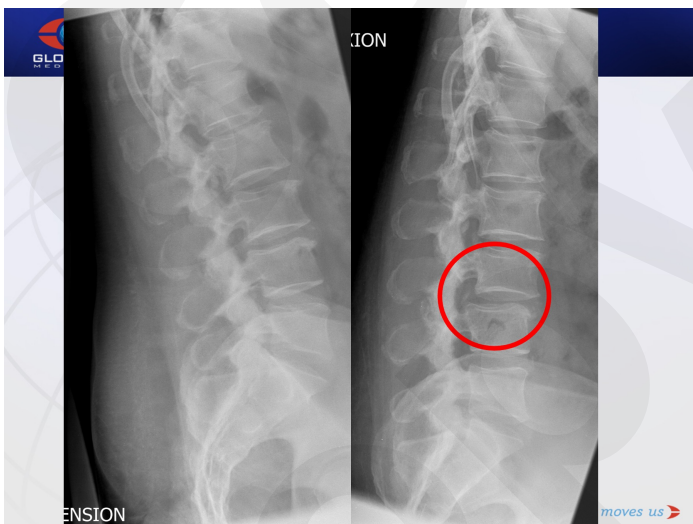
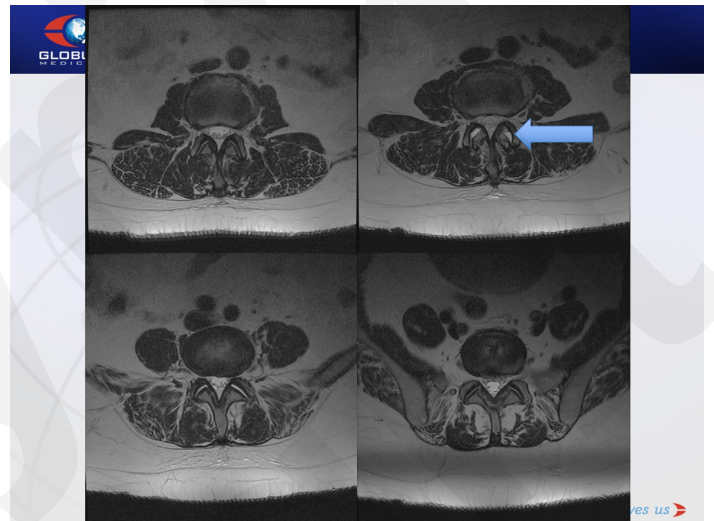


- 50 year old lady
- Some mid low back pain
- Barn door stenotic symptoms
- Normal pedal pulses

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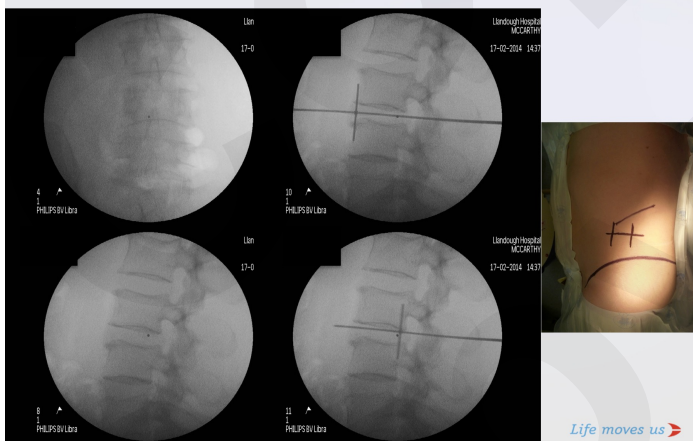
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- Dynamic compression / symptoms
- Large disc space
- Unstable L3/4 level
- Avoid the nerves

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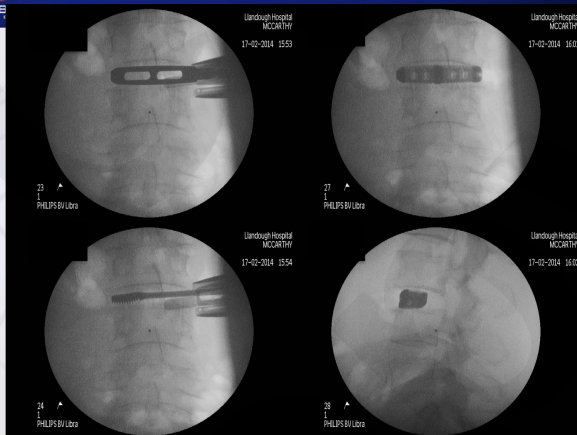
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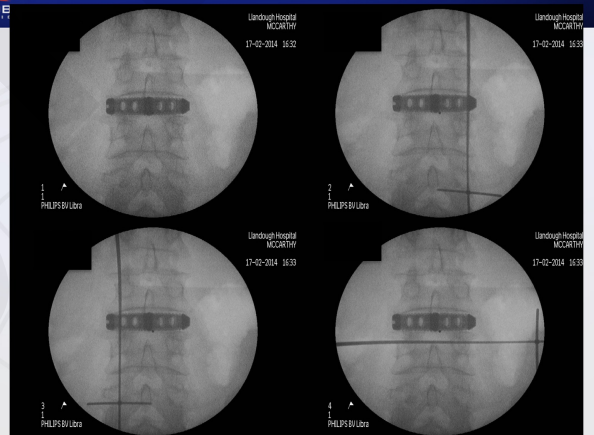
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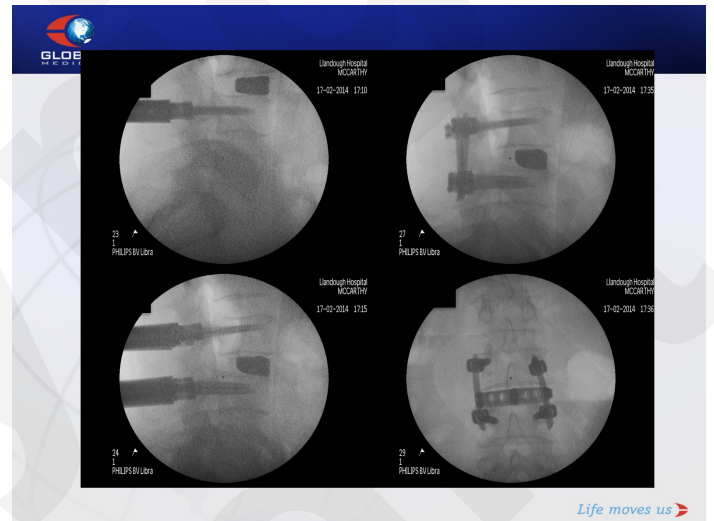
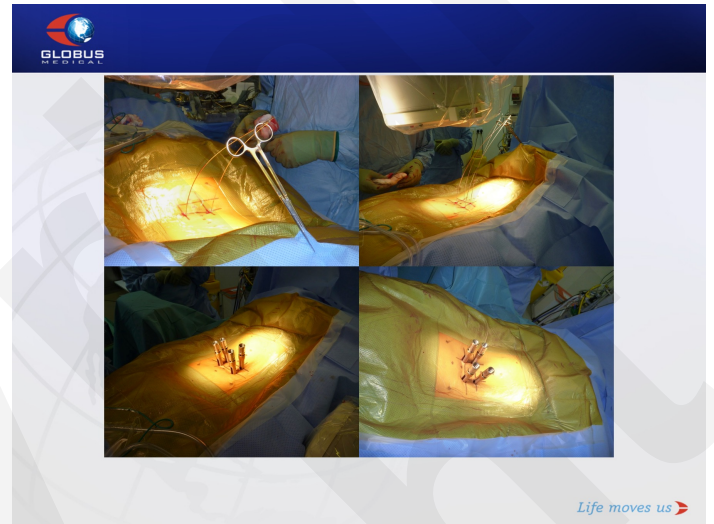
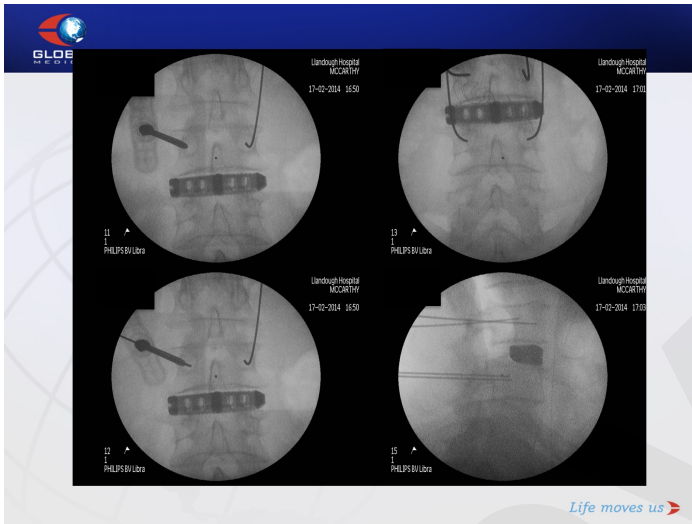
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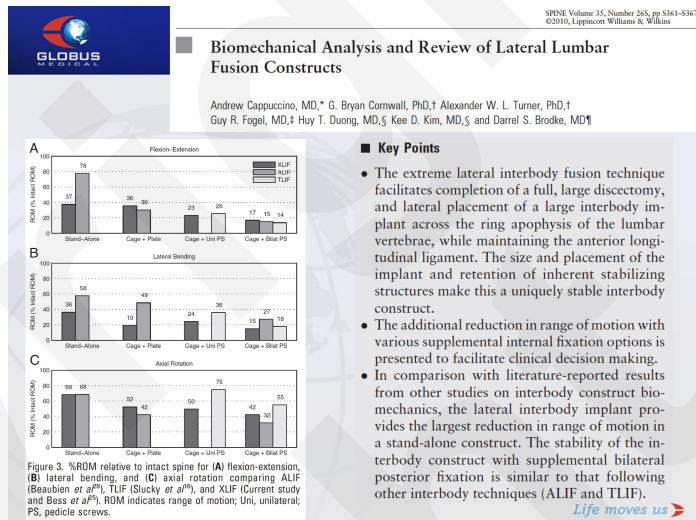


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Surgical Options

	Advantages	Disadvantages
PLIF	Bilateral access to canal, restores lordosis	Painful, infection, neural / dural injury scarring, limited higher up
Mini Open and MIS PLIF	Less painful, low infection, less blood loss, faster recovery	Fusion?, neural / dural injury scarring, limited higher up
Open TLIF	Access, fusion	Painful, infection, neural / dural injury scarring, endplate damage / subsidence
Mini Open TLIF	Less painful, low infection, fusion, less blood loss	Neural / dural injury scarring, disc preparation, endplate damage / subsidence
MIS TLIF	Even less pain, low infection, avoids paraspinal muscle damage, less blood loss, faster recovery	Fusion?, neural / dural injury scarring, disc preparation, endplate damage / subsidence
LLIF + Perc Post	Good fusion, less painful, low infection, T5-L5, avoids canal, less visceral vessel injury then ALIF, avoids paraspinal muscle damage, less blood loss, faster recovery	L4/5??, L5/S1 – No, endplate damage / subsidence, plexus injury, diaphragm injury, pneumothorax
ALIF + Perc Post	Best fusion, best restoration lordosis, less painful, low infection, avoids canal, avoids paraspinal muscle damage, mostly less blood loss than a TLIF	Access Surgeon, ilio lumbar vein, visceral vessel injury, ileus, not above L3

More Comparisons

MIS Technique	Direct Decompression	Interbody Fusion	Screw Stabilization	Spondy Reduction (Low Grade)	Postero-Lateral Fusion
MOTLIF	✓	✓	✓	✓	✓
pTLIF*	✓	✓	✓	✓	✓
PPS**	✓	✓	✓	✓	✓
pTLIF + PPS	✓	✓	✓	✓	✓
XLIF	✓	✓	✓	✓	✓
XLIF + PPS	✓	✓	✓	✓	✓
Mini-ALIF	✓	✓	✓	✓	✓
Mini-ALIF + PPS or Plate	✓	✓	✓	✓	✓

*pTLIF: percutaneous TLIF through non-expandable tubes; **PPS: percutaneous pedicle screws

A Radiological Comparison of Anterior Fusion Rates in Anterior Lumbar Interbody Fusion

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Global Spine J 2012;2:195–206.

Posterior instrumentation without posterior fusion increases anterior fusion rates (Fixable ALIF vs ALIF+post)

NASS 2013

123. Clinical Benefit after Lumbar Interbody Fusion: A Prospective, Multi-Institutional Comparative Effectiveness Study of Outcomes after TLIF Versus XLIF

Owoicho Adogwa, MD, MPH¹, Paul Thompson, BS², Kemp T. Knott, BS³, Kevin Huang, BA³, Ulysses Toche, BS³, Joseph S. Cheng, MD⁴, Robert E. Isaacs, MD², ¹Vanderbilt University, Nashville, TN, US; ²Durham, NC, US; ³Duke University Medical Center, Durham, NC, US; ⁴Vanderbilt University Medical Center Department of Neurosurgery, Nashville, TN, US

CONCLUSIONS: A significant clinical improvement from baseline was noted in multiple-validated outcome measurements following both XLIF and TLIF procedures. No significant difference was observed in the extent of functional improvement between both cohorts. However, patients undergoing TLIF procedures were more likely to experience a postoperative complication.