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**Rationale and Basis of MIS :
ALIF vs LLIF vs TLIF**

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Fusion Portfolio Minimally Invasive Surgery Biomaterials Motion Preservation

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SAY HELLO, EVERYONE, TO BERT PHEEPS. HE'LL BE TAKING THE JOB OF SECURITY MANAGER FOR OUR ENTIRE POULTRY PRODUCTS DIVISION!

BRIBERY
HOW THINGS GET DONE

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Armamentarium

Great Rule: the more of each of these (of course in moderation) the better you will be at the work of the world. Signed and sealed by the author.

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Techniques

- ALIF
- TLIF
- LLIF
- Perc Screws

Front Back and Sides

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1829	Lumbar Laminectomy for Discectomy (Smith)	1969	Chymopapain Chemoneurolysis (Smith)	1999	MIS-Cervical-Odontoid Screw Placement (Korgan)
1893	Lumbar Laminectomy for Stenosis (Lane)	1975	Percutaneous Nucleotomy (Hijikata)	2000	Intradiscal Electrothermy-IDET (Saul)
1911	Lumbar Fusion (Albee, Hibbs)	1982	Percutaneous Pedicle Screws (Magerl)	2000	MIS-Cervical Laminoforaminotomy (Roh)
1925	Cervical Laminectomy for Discectomy (Ellenberg)	1984	Laser Percutaneous Discectomy-LPD (Ascher)	2000	Kyphoplasty (Wong)
1933	Anterior Lumbar Interbody Fusion - ALIF (Burns)	1985	Automated Percutaneous Lumbar Discectomy-aPLD (Maroon, Onik)	2001	Sextant Percutaneous Pedicle Screw System (Foley)
1939	Internal Spine Fixation (Hudra)	1987	Lumbar Arthroscopic Discectomy (Kambin)	2002	MIS-Lumbar Laminectomy for Stenosis (Gust, Khoo, Palmer)
1952	Posterior Lumbar Interbody Fusion - PLIF (Cloward)	1987	Vertebroplasty (Gallibert)	2002	MIS-PLIF (Khoo)
1955	ACDF (Robinson)	1991	Laparoscopic Anterior Lumbar Discectomy (Obenchain)	2003	Tubular Discectomy using Microscope-METRX (Foley)
1958	ACDF (Cloward)	1993	Percutaneous Facet Fusion (Wang)	2004	Transaxial Approach (Cragg)
1966	Lumbar Artificial Disc Replacement -ADR (Fermstrom)	1994	MIS-Thoracic Discectomy (Kozumizu)	2004	MIS-Cervical Laminoplasty (Peret-Cruet)
1967	Lumbar Microdiscectomy (Yeazell)	1995	MIS-ALIF (Mathews, Zucherman)	2006	Interspinous Device-XSTOP (Woodard)
1982	Transforaminal Interbody Fusion - TLIF (Harms)	1997	Microendoscopic Discectomy - MED (Foley)	2006	MIS-TLIF (Holly)
1983	Thoracic Discectomy (Benjamin)	1998	Lateral Transpos Approach-OLIF, XLIF (McAfee, Pimenta)	2008	MIS-ACDF (Wuetten)
				2008	MIS-Cervical Nucleoplasty (Li)

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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).
- **DO THE APPROPRIATE OPERATION FOR THE PATIENT AND THEIR PATHOLOGY AND YOUR SKILL / ABILITY**

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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")

All may require fusion

Require Instrumentation

Instrumentation increases fusion

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The 7 Ps

- Proper
- Planning and
- Preparation
- Prevents
- Piss
- Poor
- Performance

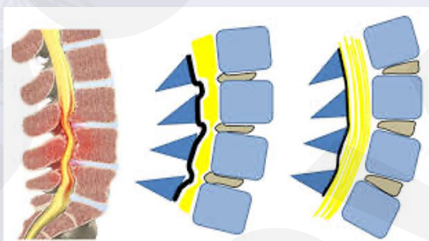


Attention to detail
Never let your guard down

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APPS

- Anatomy
- Pathology
- Planning
- Surgery



Recent Topic = Lordosis

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ORIGINAL ARTICLE ACTA ORTOP BRAS 14(4) - 2006

LUMBAR LORDOSIS: A STUDY OF ANGLE VALUES AND OF VERTEBRAL BODIES AND INTERVERTEBRAL DISCS ROLE

LUIZ HENRIQUE FORNBERG DAMASCENO¹, SILVIO RICARDO GUARIMTA CASTANH², ANTONIO DORIVAL CAMPOS³, HILTON LUIS ANNECIDO DORTCH⁴

	Damasceno et al., n=350	Stagnara et al., 1982 ⁽²⁾ n=100	Wambolt and Spencer, 1987 ⁽²³⁾ n=50	Guigui et al., 2003 ⁽¹³⁾ n=250	Vialle et al., 2005 ⁽²²⁾ n=300
L1	2.15° (14 to -9)	5° (12 to -3)	3°	4°	9.8°
L2	-0.36° (7 to -8)	3° (11 to -5)	1°	1.25°	1.2°
L3	-1.56° (8 to -10)	1° (10 to -7)	-2°	-0.52°	-0.6°
L4	-2.89° (4 to -14)	-1° (8 to -10)	-4°	-2.65°	-2.6°
L5	-9.23° (0 to -19)	-8° (5 to -27)	-10°	-8°	-8°
L1-L2	-4.99° (4 to -12)	-8° *	-6°	-5.6° *	4.55° *
L2-L3	-6.89° (0 to -15)	-10° *	-7°	-7.9° *	5.4° *
L3-L4	-9.25° (-2 to -20)	-10° *	-9°	-9.7° *	9.8° *
L4-L5	-12.29° (-2 to -26)	-14° *	-11°	-14° *	14° *
L5-S1	-15.58° (-4 to -35)	-13° *	-11°	-16° *	15.3° *

* measurement values for intervertebral discs assumed from measurements of vertebral segments, because they were not shown in the original study.

Table 7 - Vertebral bodies and intervertebral discs measurements found in this study and those described by other authors.

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	Mean Angle (°)	Standard Deviation	Range (°)	% participation in curvature L1S1 (range)
L1-L2	-4.99 *	2.9	4.0 to -12.0	8.16 (-8.57 to 24.00)
L2-L3	-6.89 *	2.73	0.0 to -15.0	11.35 (0.00 to 27.27)
L3-L4	-9.25 *	2.54	-2.0 to -20.0	15.38 (3.03 to 30.95)
L4-L5	-12.29 *	3.39	-2.0 to -26.0	20.43 (3.81 to 42.86)
L5-S1	-15.58 *	5.43	-4.0 to -35.0	26.07 (5.80 to 56.52)

(*)Averages different from each other with p<0.001

Tabela 2 - Intervertebral discs measurements

Lumbar curvature	Damasceno et al., n=350	Jackson and McManus, 1994 ⁽¹²⁾ n=100	Jackson et al., 1998 ⁽¹⁴⁾ n=50	Korovesis et al., 1998 ⁽¹⁵⁾ n=99	Cheng et al., 1998 ⁽⁶⁾ n=387	Tüzün et al., 1999 ⁽¹⁶⁾ n=150	Tsuji et al., 2001 ⁽¹⁷⁾ n=489	Guigui et al., 2003 ⁽¹³⁾ n=250
L1S1	-60.9° (-33 to -89)	-60.9° (-31 to -88)	-62.1° (-41 to -86)				-54.2°	-59°
L1L5	-45.1° (-15 to -78)			-45.7°	-41.95°	-45.85°		-43° (-13.6 to -69)

Table 6 - Lumbar lordosis measurement values found in this study and those described in literature by other authors.

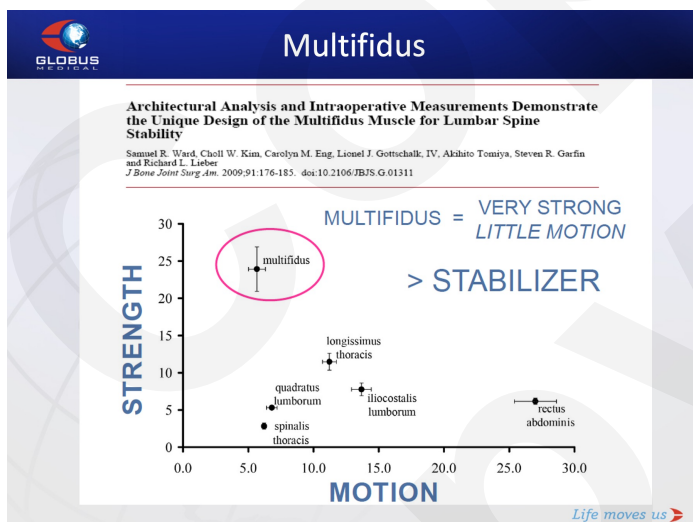
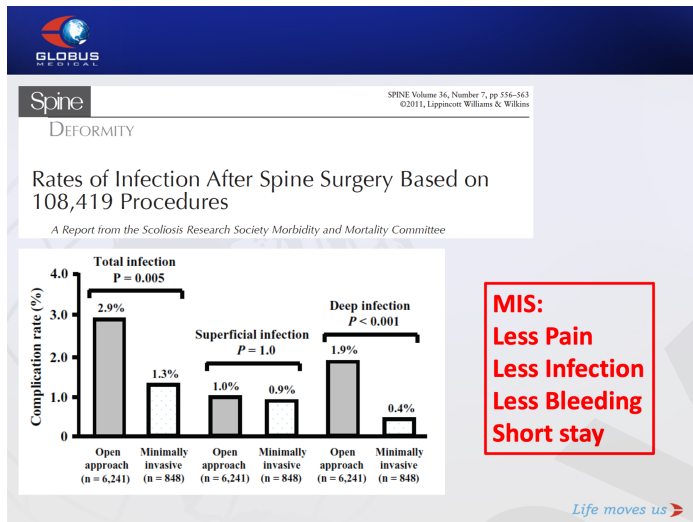
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>50% LL @ L4-S1
(21deg vs 28deg)

Why MIS?

1. Less blood loss
2. Less infections
3. Less post-op pain
4. Shorter hospital stay
5. Strong patient demand
6. Intense technology development
7. Cost effectiveness?
8. Long-term benefits?

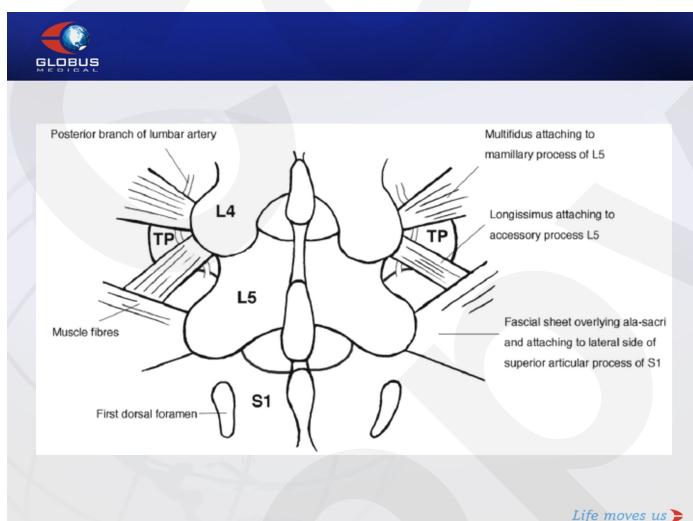
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Remember the Multifidus

- Multifidus originates from spinous process and inserts on mammillary process 2 levels below - detaching it affects > 1 spinal level
- MIS
 - Avoid tendon detachment
 - Avoid powerful retractors / crush injury (pain) - tubes

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Fusion

- **Fusion – think:**
 - α contact surface area (1/ α 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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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

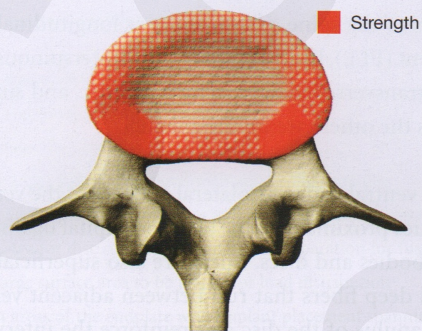
Rigid Internal Fixation / Instrumentation improves fusion

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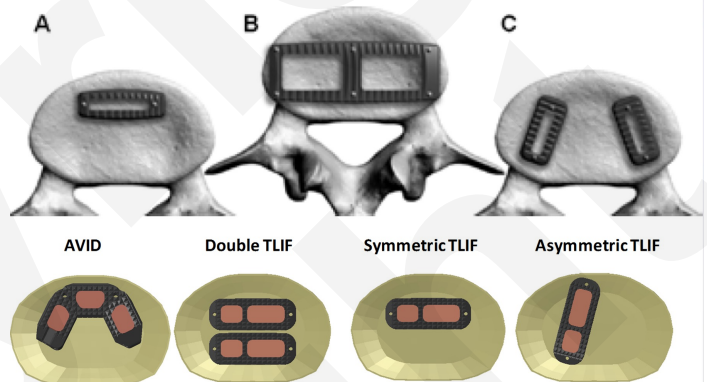
But...

- Joints are designed to move
- Fusion is abnormal
- Beware – nature against you!

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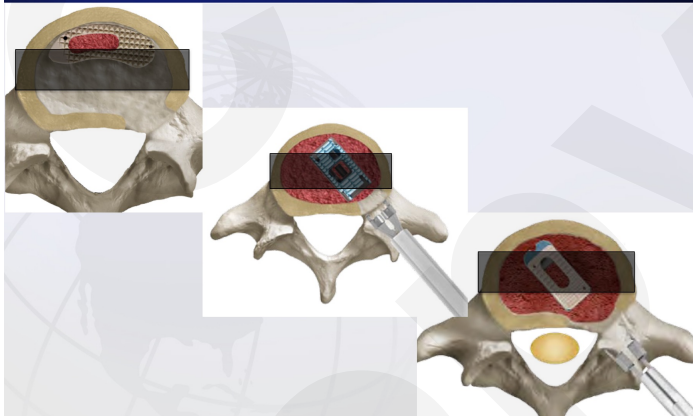


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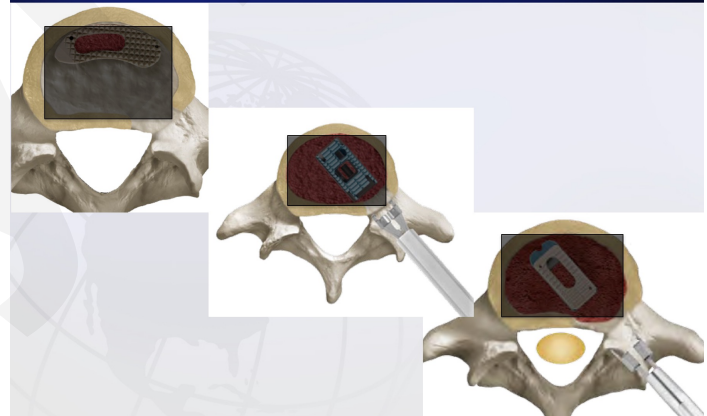
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LLIF vs TLIF



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ALIF vs TLIF



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	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

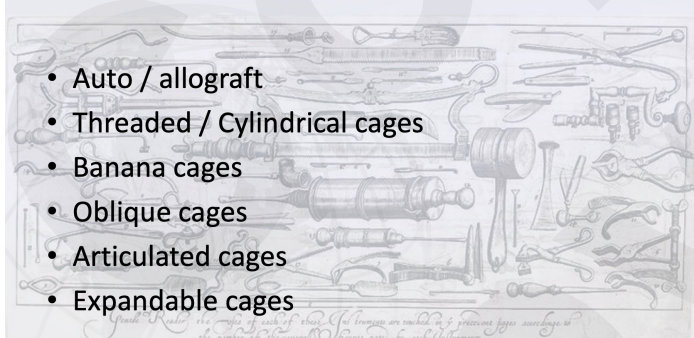
ALIF

- A great operation! But...
- **VESSELS / OBESITY / ELDERLY**



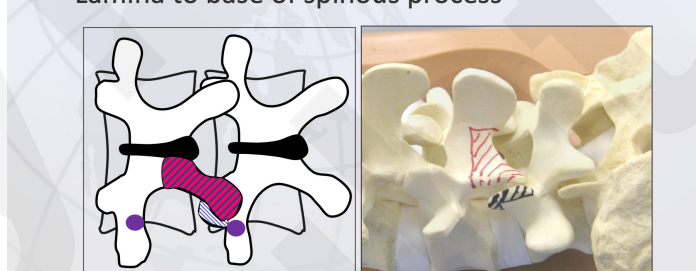
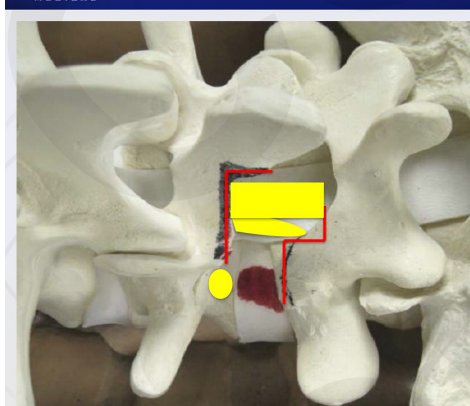
TLIF

- Auto / allograft
- Threaded / Cylindrical cages
- Banana cages
- Oblique cages
- Articulated cages
- Expandable cages



TLIF

- Inferior articular process IAP (red)
- SAP (blue)
- Lamina to base of spinous process

**Proficiency Point
MIS TLIF =
25 cases**

LLIF

- 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
 - (Obese people - fat can be swept away)

LLIF Algorithm First Question

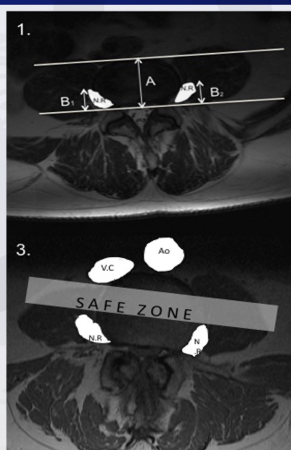
- Contraindications:
 - L5/S1
 - Low seated L4/5 (look at crests)
 - High grade slip
 - Retroperitoneal scarring / pathology
 - Medical comorbidities / contraindications to surgery
- Yes – then use other technique

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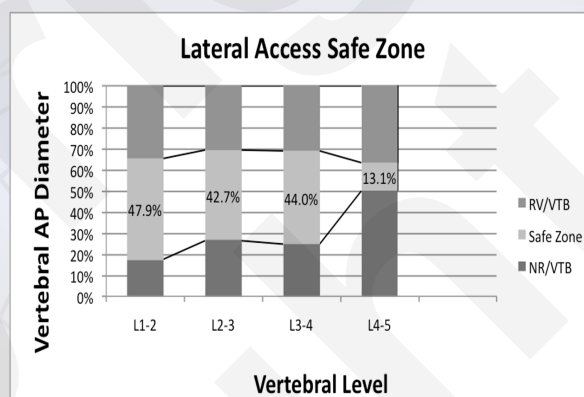
LLIF Algorithm Second Question

- 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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1. Have A Simple Strategy

- Is an interbody fusion required:
 - Restore foraminal height (up / down)
 - Improve fusion
 - Revision of failed posterolateral fusion
 - Restore lordosis / correct deformity
 - Biomechanics – shear / large disc height / entire facet removed / long construct involving L5/S1

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2. Have A Simple Strategy

- Is a direct posterior decompression required? (vs indirect ligamentotaxis)
- How many levels need to be fused?
- How long will it take?
- Is there a slip – how big / is it reducible?
- Etcetera...
- **DO THE APPROPRIATE OPERATION FOR THE PATIENT AND THEIR PATHOLOGY AND YOUR SKILLS / ABILITY**

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In Summary...

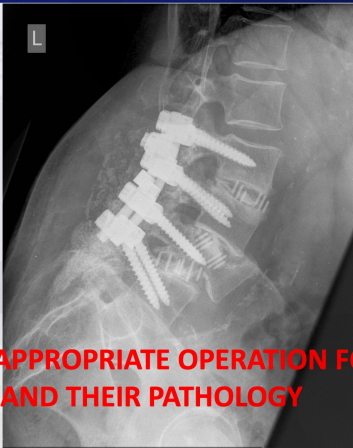


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Things can go seriously wrong



- **DO THE APPROPRIATE OPERATION FOR THE PATIENT AND THEIR PATHOLOGY**

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Should have gone to specsavers!

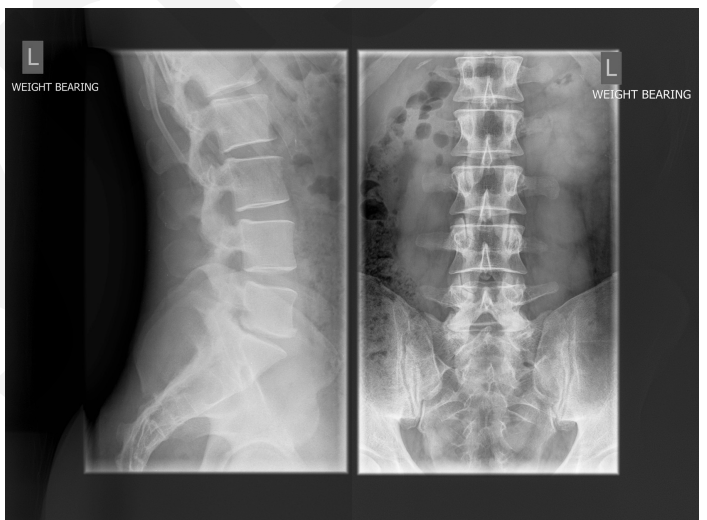


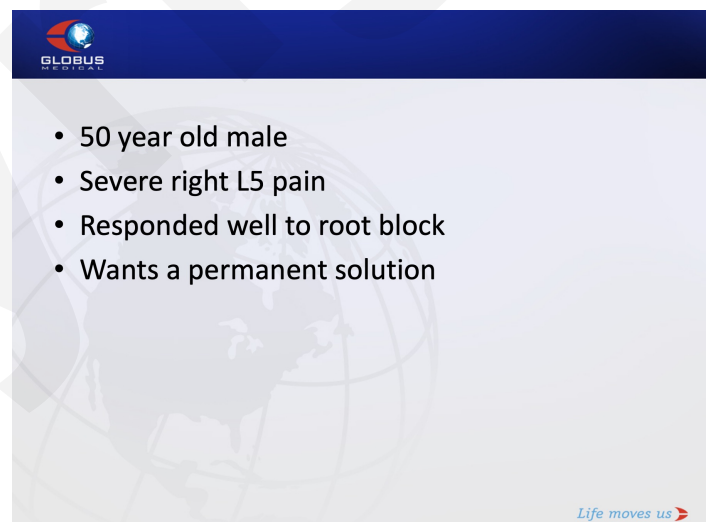
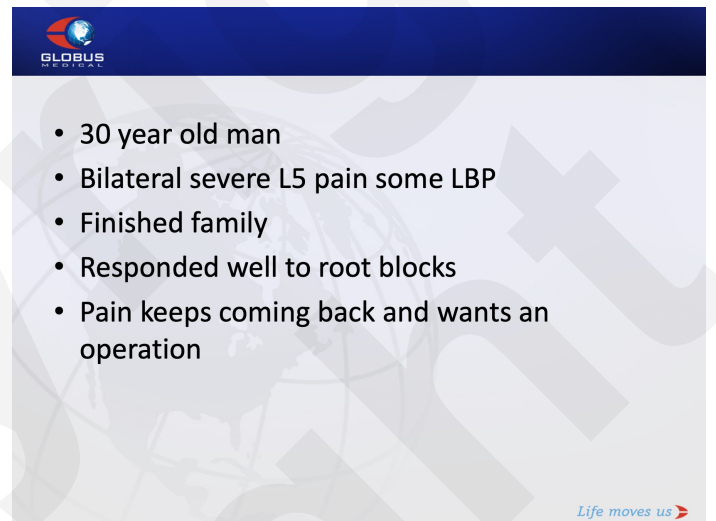
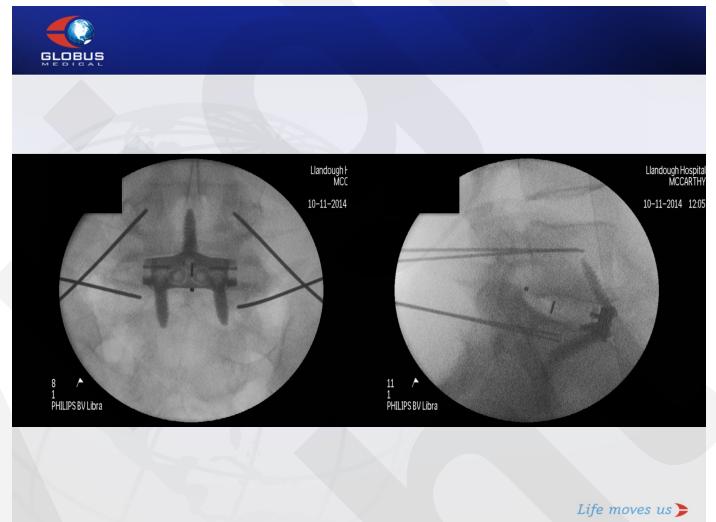
**Attention to detail
Never let your guard down**

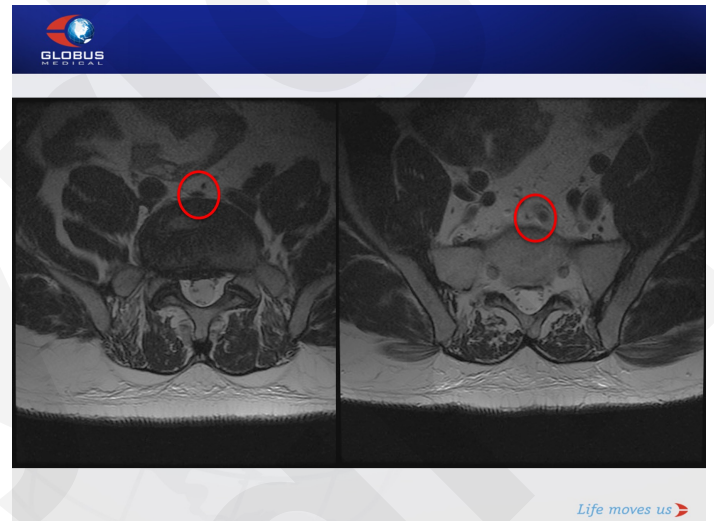
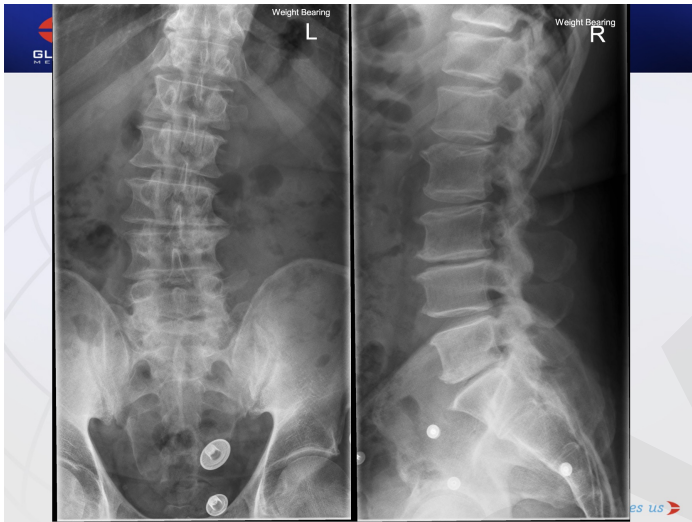
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- 35 year old man
- Worsening low back pain 5 years
- No leg symptoms
- Failed conservative management
- Facet injections temporary relief

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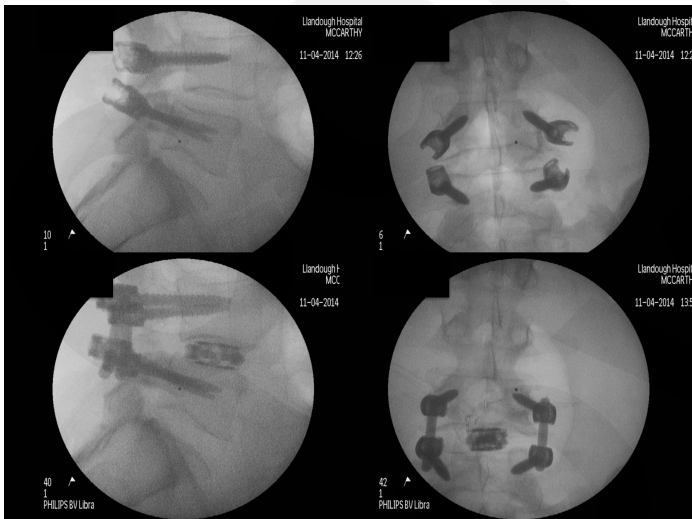






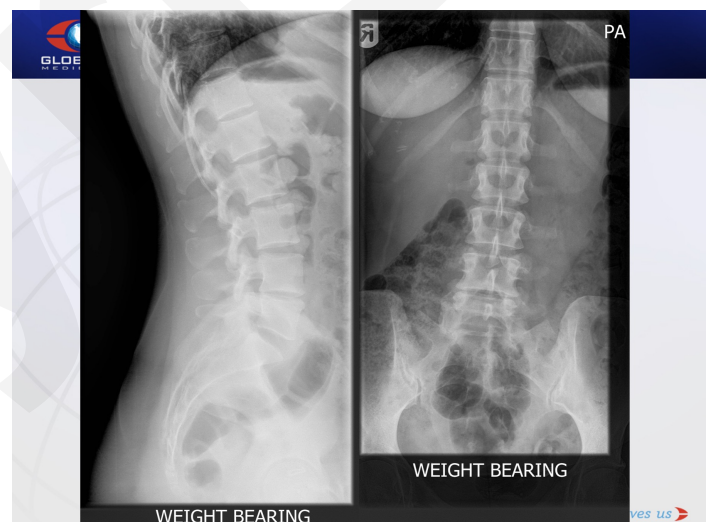
- 40 year old male
- Low back and bilateral leg pain
- Right L4 pain
- Failed conservative management

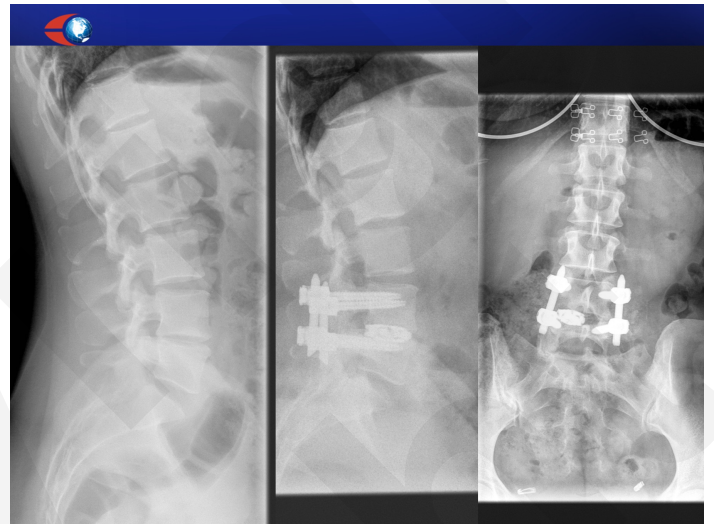
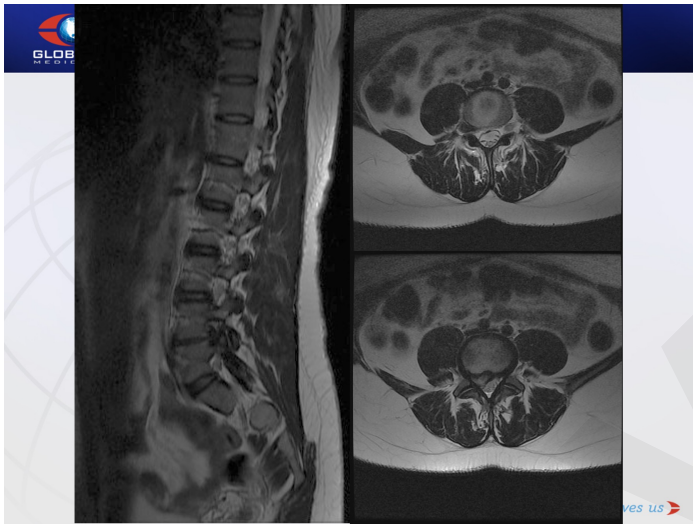




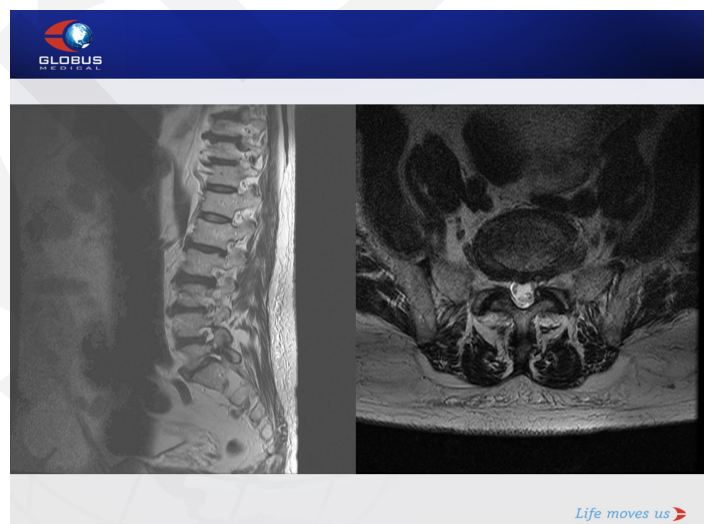
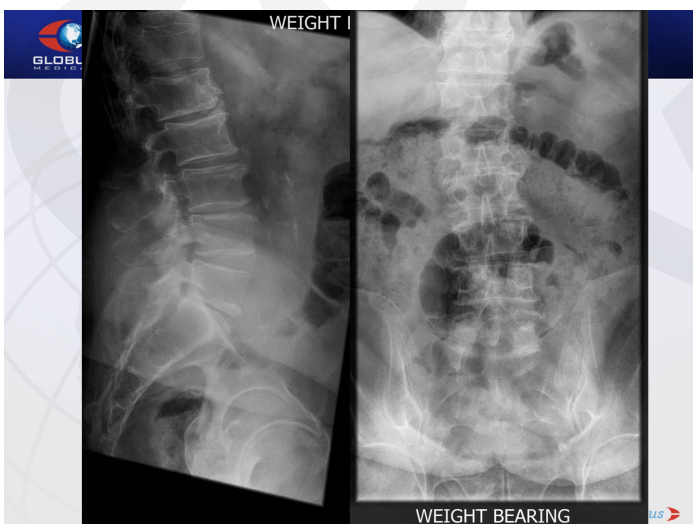
- 40 year old female
- Low back and sudden severe right L4 and 5 pain numbness weakness
- Failed conservative management
- Doesn't want an injection

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- 65 year old male
- Ex-miner, poor skin, overweight
- Severe right L5 pain
- Failed conservative management
- Responded well to root block





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

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