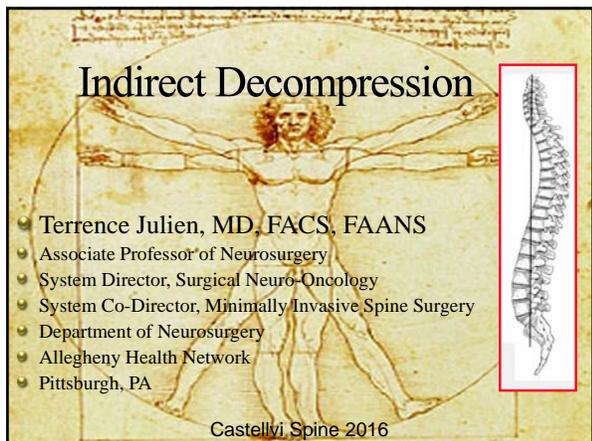


Indirect Decompression



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- Associate Professor of Neurosurgery
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Castelli Spine 2016

Disclosures

- Stryker Spine
- Exactech
- Camber Spine
- Amendia
- Corelink Surgical
- Alphatec Spine

STENOSIS

- Narrowing of the spinal canal or neuroforamina
- causing a symptomatic compression of the neural element.

PREVALENCE

- Most common indication for spinal surgery in patients over 60 y.o.
- 400,000 Americans are estimated to have spinal stenosis

SYMPTOMS

- Neurogenic claudication
- Radicular pain
- Weakness
- Sensory abnormalities
- Back pain

PHYSICAL FINDINGS

Physical Finding Literature Review

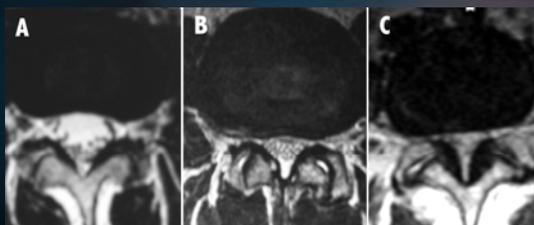
- Limited lumbar extension 66-100%
- Muscle weakness 18-52%
- Sensory deficit 32-58%

• Katz JN, et al: Diagnosis of lumbar spinal stenosis. Rheum. Dis. Clin. North Am. 20:471-483, 1994

NEUROGENIC CLAUDICATION

- Cardinal symptom of lumbar stenosis
- Progressive pain and/or paresthesia in the back, buttock, thigh and calves brought on by walking or standing, and relieved by sitting or lying down with hip flexion

SPINAL STENOSIS



SPINAL STENOSIS



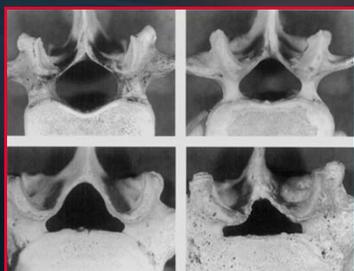
FORAMINAL STENOSIS



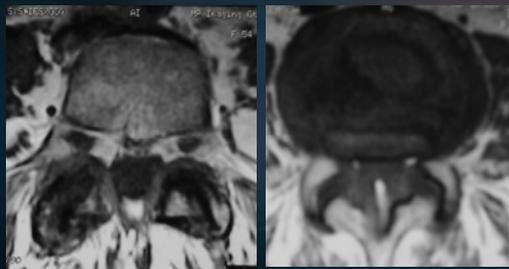
- Compresses the exiting nerve root

CANAL SHAPE

- Round
- Triangular
- Trefoiled (15%)
- Trefoiled & asymmetric



DEGENERATION & STENOSIS



POSTURE



AMBULATION



DIFFERENTIAL DIAGNOSIS

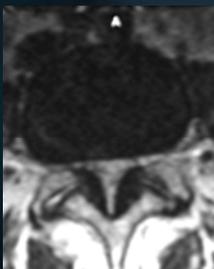
- Vascular claudication
- Osteoarthritis of hip or knee
- Lumbar disc protrusion
- Intraspinial tumor
- Unrecognized neurologic disease
- Peripheral neuropathy

FORAMINAL STENOSIS



- Root symptoms
- Unilateral
- No claudication
- Acute or chronic

LATERAL RECESS STENOSIS

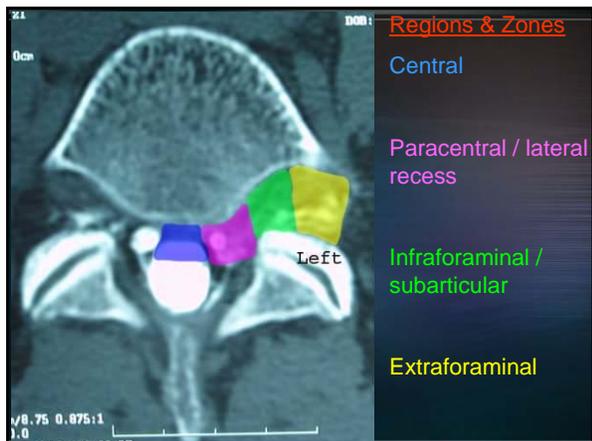


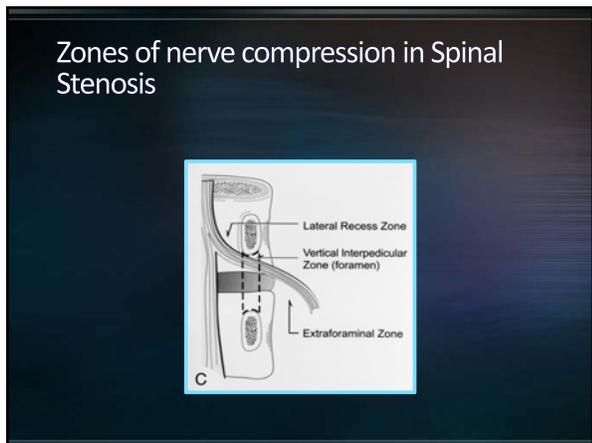
- Claudication
- Radicular pain
- Weakness is rare
- Acute or chronic

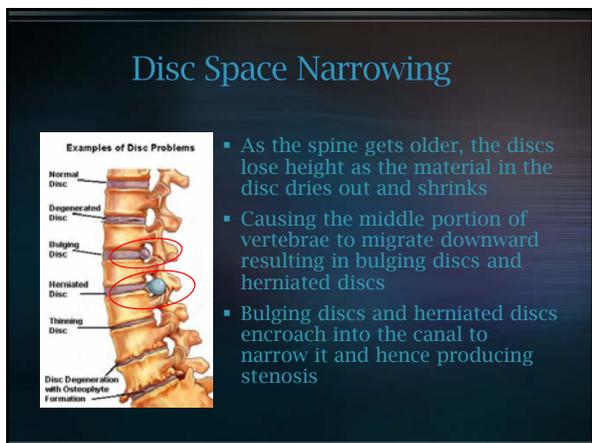
CENTRAL STENOSIS



- Varied presentation
- Classically with neurogenic claudication
- Some may only have back pain
- Rarely painless progressive weakness





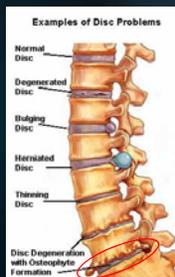


Posterior Apophyseal Arthropathy (abnormality of facet joint)

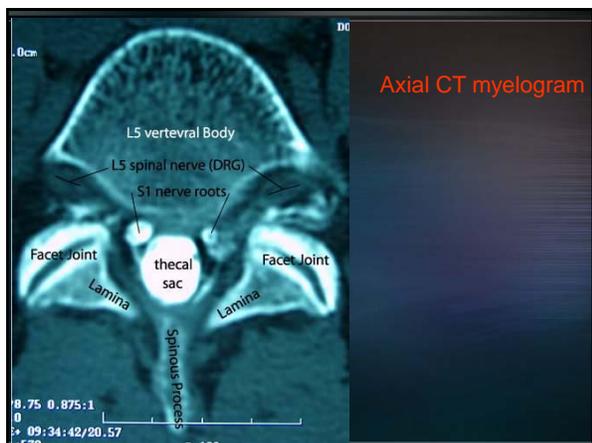


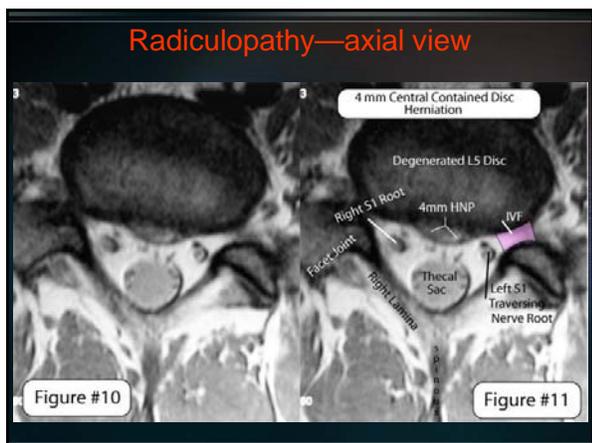
- Disc space narrowing can also cause instability between vertebrae
- The body attempts to reduce the instability by trying to fuse around the degenerated disc
- The facet joints enlarge and try to fuse together and hence producing stenosis

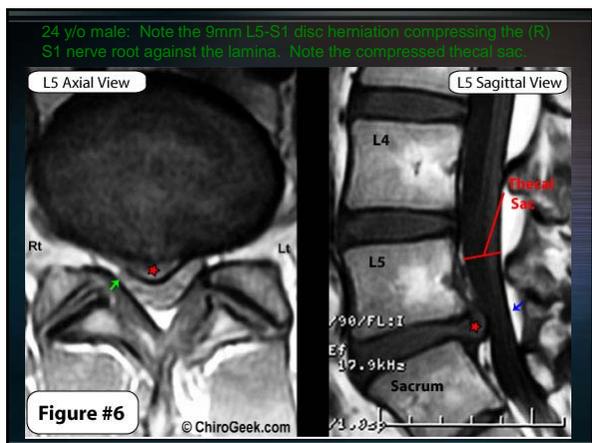
Osteophytes (abnormal bony outgrowth)

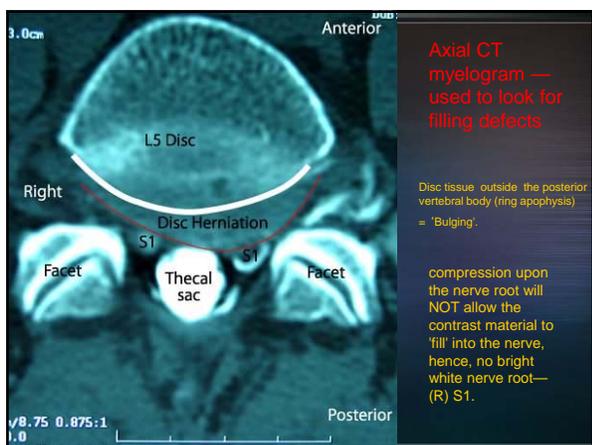


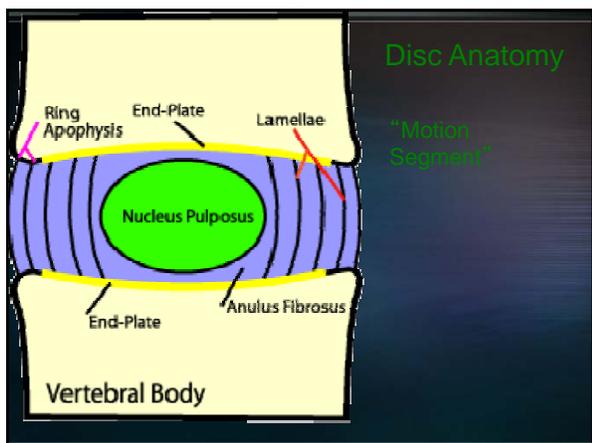
- **Osteophyte** - Small abnormal bony outgrowth (bone spurs)
- **Anterior Osteophyte** - Outgrowth at the front portion of a vertebrae
- **Posterior Osteophyte** - Outgrowth in the back of a vertebrae



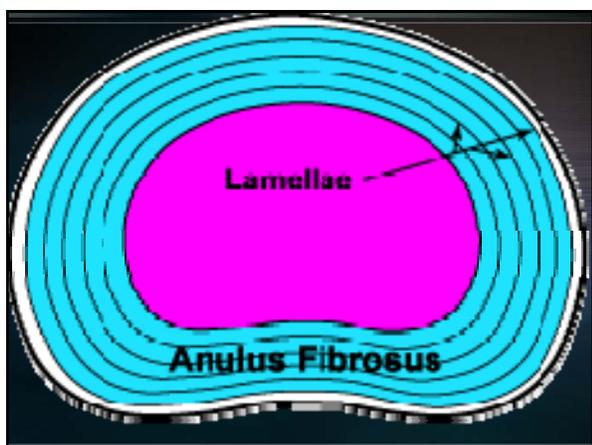












Mechanical Spine Pain—Disc

Produce, reduce, & turn it on and off rapidly during evaluation.



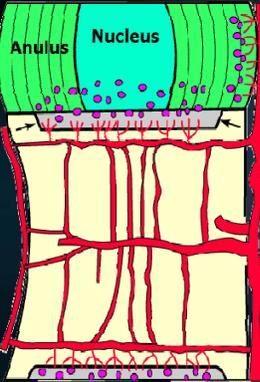
Normal Weight Distribution

Fig. #2

Pain 2" to stress on annulus

↓ ability to straighten up

Posterior nucleus migration



Anulus Nucleus

Disc Nutrition: As we start the day our discs, like squeezing out a sponge, compress and dehydrate due to the solid loads of gravity and physical activity. Healthy disc will shrink some 20%, which in turn decreases our height by 15 to 25mm.

Then as we sleep and decompress our spines, our discs swell with water plus nutrients and expand back to their fully hydrated state. This tide-like movement (diurnal changes of fluids in and out of the disc) helps with the movement of nutrients into the avascular center of the disc.

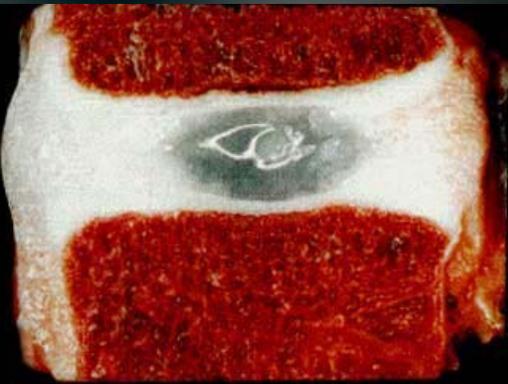
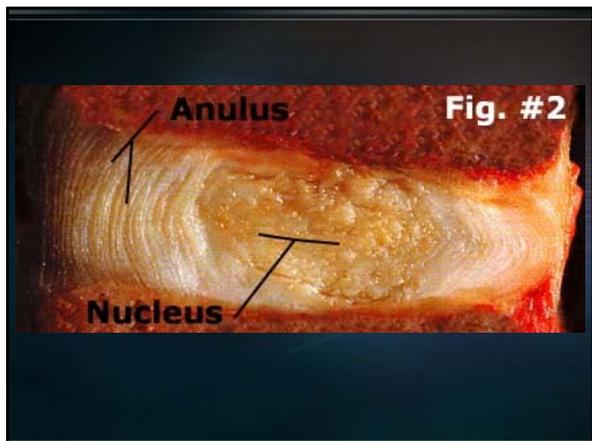
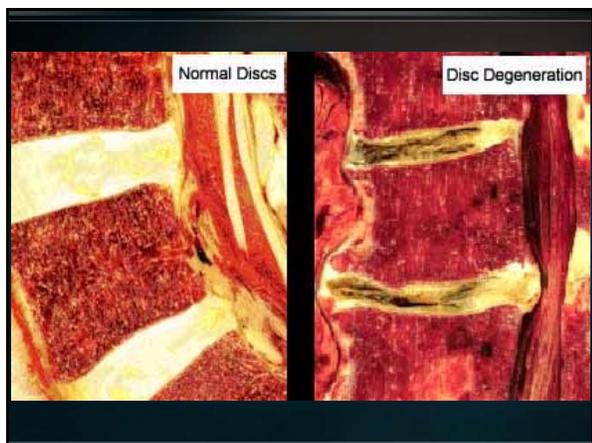


Fig. 3 Teen Disc



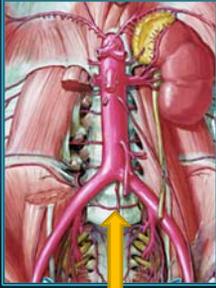




Treatment Techniques

Anterior Techniques

Anterior lumbar interbody fusion (ALIF): disc is approached from an anterior (abdominal) incision.
Advantage - avoidance of cutting muscles of the back.
Disadvantage is the risk of injury to structures in the abdomen.



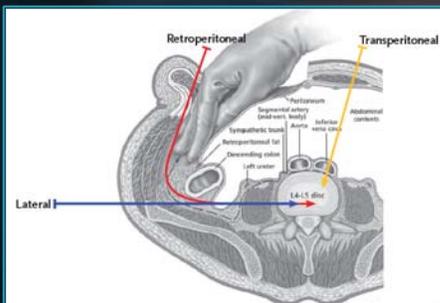
Indications -Anterior lumbar interbody fusion

- Degenerative disc disease with or without radiculopathy
- Spondylolisthesis
- Failed posterior fusion
- Scoliosis

Criteria -associated with a good outcome after ALIF

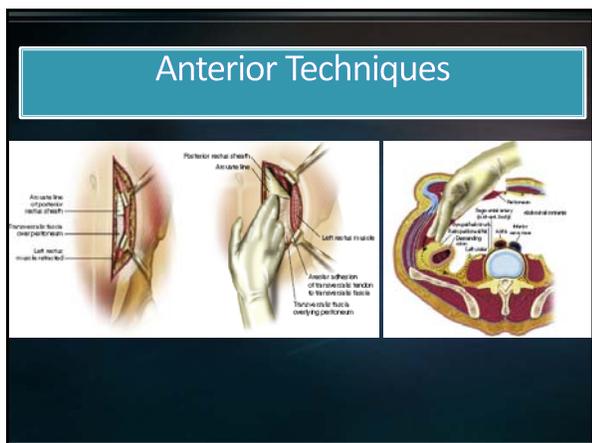
- (1) Axial back pain aggravated by spinal loading and fusion,
- (2) Radiographic studies consistent with disc degeneration,
- (3) Provocative discography that produces pain only at the affected levels, and
- (4) Dynamic studies demonstrating motion/sagittal deformity on sagittal views.

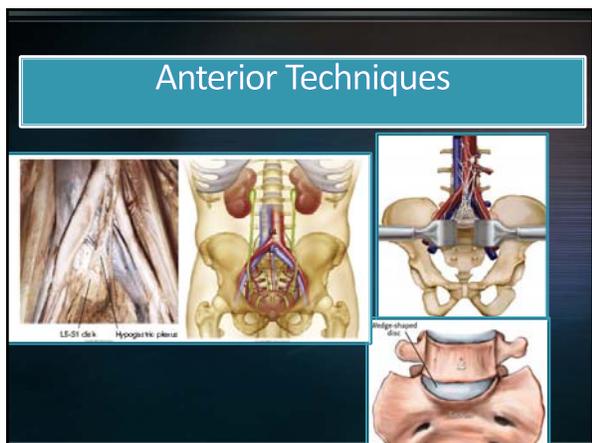
Anterior Techniques

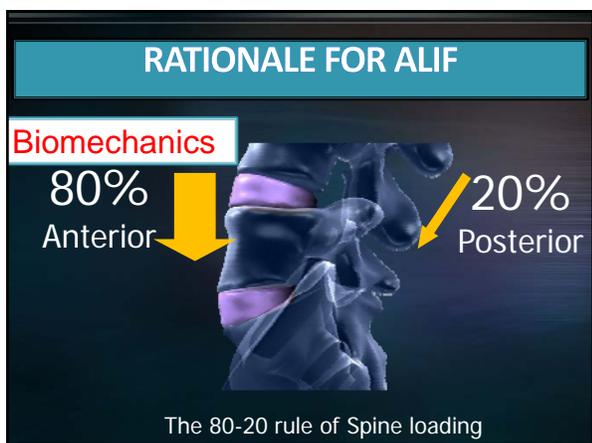


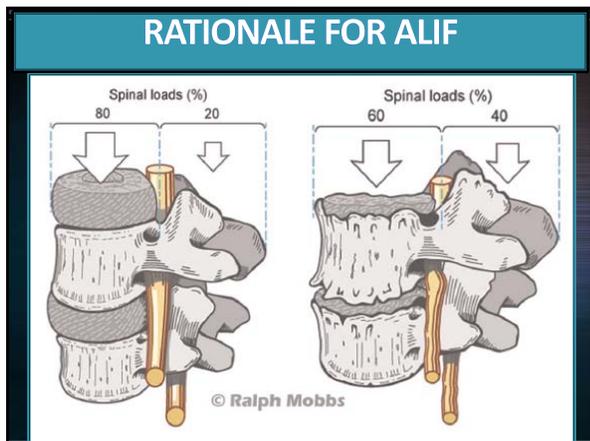
Anterior Techniques











RATIONALE FOR ALIF

- With ALIF, an interbody fusion device is used to redistribute the weight-bearing distribution to the original ratio.
- According to the Woolf law, the fusion potential increases if grafts are placed under the direct compression that supports the placement of the graft in the anterior column.

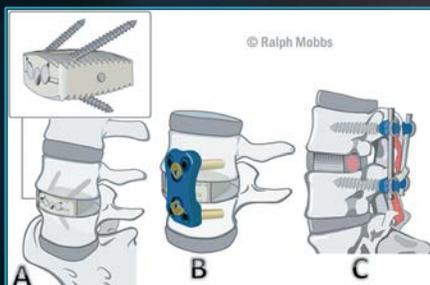
Mummaneni PV, Haid RW, Rodts GE. Lumbar interbody fusion: state-of the-art technical advances. J Neurosurg Spine. 2004;1(1):24-30.

RATIONALE FOR ALIF

- Radiological outcomes, including height restoration and focal and lumbar lordosis, were superior in anterior approach, whereas cost, blood loss, and operative time were greater in ALIF compared with transforaminal lumbar interbody fusion.

Jiang SD, Chen JW, Jiang LS. Which procedure is better for lumbar interbody fusion: anterior lumbar interbody fusion or transforaminal lumbar interbody fusion? Archives of Orthopaedic and Trauma Surgery. 2012;132(9):1259-1266.

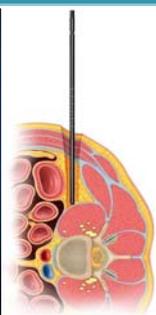
Anterior lumbar interbody fusion (ALIF)



(A) ALIF interbody device with integral fixation. (B) ALIF implant with anterior plate fixation. (C) ALIF implant with posterior instrumentation.

Lateral Lumbar Interbody Fusion (LLIF)

- Transpsoas lumbar interbody fusion (DLIF/direct or XLIF/eXtreme): the disc is approached through the psoas muscle, from an extreme lateral incision (retroperitoneal) on the patient's side.
- The **advantage** is the avoidance of back muscles and abdominal structures required in traditional fusion procedures.
- The **disadvantage** is that L5-S1 is not accessible with this procedure

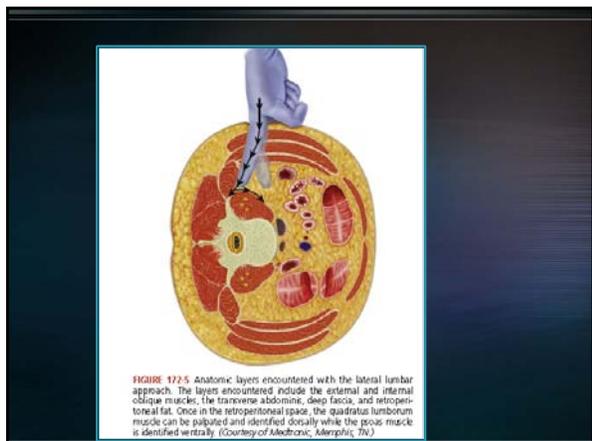


Indications and Contraindications – Lateral Lumbar Interbody Fusion (LLIF)

- LLIF is most suitable for interbody access from L2 to L4 for degenerative disc disease with or without instability
- Adjacent segmental disease
- Degenerative spondylolisthesis (grade I or II)
- Complex degenerative scoliotic deformity

Contraindications:

- LLIF at L5-S1 is generally contraindicated due to obstruction by the iliac wing.
- Other relative contraindications include grade III or greater degenerative spondylolisthesis, greater than 30-degree lumbar deformities
- Bilateral retroperitoneal scarring
- LLIF is generally not used alone when direct posterior decompression is necessary, such as with lumbar stenosis or disc rupture



Oblique lumbar interbody fusion (OLIF):

- Oblique lumbar interbody fusion (OLIF): the disc is approached from a lateral incision on the patient's side.
- The procedure is done "obliquely" (in front of the iliac crest) which gives access to L5-S1

Anterior Approaches - Contraindications

ALIF - Contraindications

- Calcified aorta
- Prior vascular reconstructive surgery
- Prior intra-abdominal or retroperitoneal surgery
- History of severe pelvic inflammatory disease
- Prior anterior spinal surgery

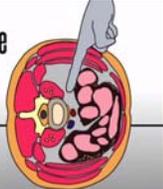
Transposas - Contraindications

- At L5/S1 and sometimes at L4/5 because of obstruction from iliac crest
- Prior retroperitoneal surgery or scarring

Advantages of OLIF than direct anterior approach

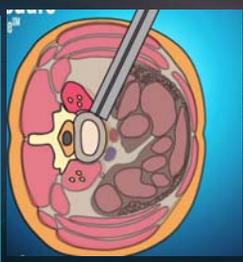
- Anterior to psoas muscle-avoids injury to psoas muscle and lumbar plexus there by less incidence of cruralgia
- Away from peritoneum and vasculature (beware of ileolumbar vein and transitional bifurcation of great vessels)
- Preserves sympathetic plexus- decreased incidence of retrograde ejaculation

Creating the oblique corridor.



Advantages of OLIF...

- Direct visualization and discectomy, easy to do end plate preparation
- Can be performed at L2-L3 to L5-S1
- Up to 3 level fusion can be done using 4 cm incision by "sliding window" technique



Rodgers WB, Gerber EJ, Patterson J. Intraoperative and early postoperative complications in extreme lateral interbody fusion: an analysis of 600 cases. Spine (Phila Pa 1976) 2011;36:26-32.

Advantages of OLIF

- Lesser incidence of hernias and ileus
- Decreased blood loss
- Increased surface area of the OLIF cage which is 3 times more than TLIF cage which gives better and stronger arthrodesis



Advantages of anterior approach

- nerve root retraction and entrance into the spinal canal are unnecessary, thereby eliminating epidural scarring and perineural fibrosis

Chung SK, Lee SH, Lim SR, et al. Comparative study of laparoscopic L5-S1 fusion versus open mini-ALIF, with a minimum 2-year follow-up. Eur Spine J. 2003;12 (6):613-617

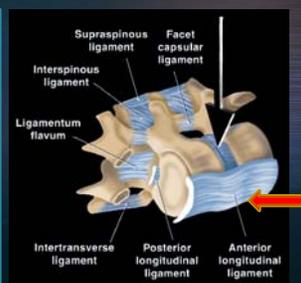
Advantages Anterior Approaches

- Larger graft placement without manipulation of nerve roots
- Deformity correction
- Indirect decompression
- Greater fusion surface area



Advantages Anterior Approaches

- Preservation of posterior stabilizing structures
 - Interspinous ligaments
 - Facet capsules
- No muscle disruption & Postop. muscle atrophy
 - ↓ed Chronic pain



ALIF - Complications

- Retrograde ejaculation
 - Most series < 1% to 7%
 - Much higher (10 times) with transperitoneal approaches and with laparoscopic approaches
- Blunt dissection versus electrocautery
- Large majority of patients recover within 6 – 12 months
- Bowel & Ureter injury

Extreme Lateral - Complications

- Reporting of complications has been inconsistent (3% - 60%)
- Genitofemoral, ilioinguinal or lateral femoral cutaneous nerve injuries - Thigh numbness, paresthesias
- Femoral nerve - Leg weakness
- Damage to lumbosacral plexus which progressively migrates anteriorly beginning at L1-2 level
- Psoas muscle injury and pain
- Traction injury to plexus -> post-op. dysesthesias

Conclusions

- DDD and disc space narrowing cause varying degrees of foraminal and spinal stenosis.
- Various anterior approaches can be used to address foraminal stenosis through indirect decompression.
- The larger grafts associated with ALIF and OLIF procedures as well as disc space preparation required, provide the best scenario for addressing indirect decompression in foraminal stenosis.

