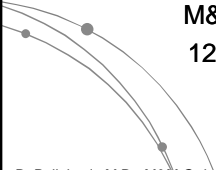



Less invasive Lumbar Spine Surgery

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Clinical Presentation of Intervertebral Disc Degeneration

- Many are asymptomatic or minimally symptomatic, episodic
- Axial LBP with or without referred pain to buttock or posterior thigh
- Mechanical LBP, worse with sitting
- Painful forward flexion
- Imaging: radiographs, MRI, discography

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Waddell's Signs Nonorganic Physical Signs

- Tenderness: pain at the tip of the tailbone; pain, numbness, or giving way of the whole leg; pain to light touch
- Simulation: pain with light axial loading of the head or shoulders; pain with pelvic rotation through the hips; reproduction of pain with rolling of the lumbar skin
- Distraction: no pain with a sitting straight-leg (SLR), pain with a supine SLR
- Regional: nonanatomic distributions of weakness or sensory changes (especially in stocking glove distribution)
- Overreaction: moaning, trembling, collapsing, sweating, and multiple emergency admissions

Waddell G, McCullough JA, Kummel E, et al. Nonorganic Physical Signs in Low Back Pain. Spine 1980;5:117.

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MRI – The Study of Choice

The diagram illustrates the relationship between MRI findings and segmental instability. It shows a curved line representing the spine with several points marked by dots. One point is labeled 'HIZ (Hyperintense zone)'. Below it, the text 'Degenerative bulging discs' is written. To the right, the text 'Segmental instability' is written. Several arrows point from the HIZ and degenerative discs towards the segmental instability, indicating a causal link.

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Discography

- MAY be the sole provocative test for pain generation from the intervertebral disc
- Fluid is injected under fluoro, increasing end-plate pressure, and creating a pain response that mimics typical sx
- Adjacent control levels should be pain free
- False positives low in normal patients (10%), but increases dramatically in chronic pain (40%) and abnormal psychometric subjects (83%)

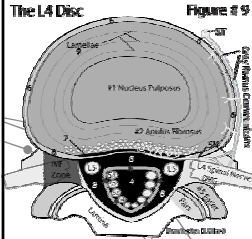
Patient's pain response at the involved level
Pain response at control levels
Disc morphology
Disc pressure and injectant volume

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The diagram shows a curved line representing the spine with several points marked by dots. One point is labeled 'Discography'. To the right, the text 'PAIN PROVACATION' is written. An arrow points from the discography point towards the pain provocation, indicating that discography is used to provoke pain.

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Painful Disc Principle



- Posterior portion of the annulus fibrosis is innervated by fibers of the sinuvertebral nerve, a branch of the dorsal root ganglion - responsible for axial back pain
- Rat model - pain fibers are not innervated segmentally; sensory information from the disc is conducted to other spinal levels thru the paravertebral sympathetic trunks
- Therefore, decompression of the nerve root at one level is unlikely to help w/ LBP symptoms
- Relieving axial symptoms - DLL (60%), DLLFI (65%)
- Disc material - direct source of chemically irritative substances: phospholipase A2, prostaglandin E, substance P, & lactic acid

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Conservative Therapy

- Vast majority of LBP is due to myofascial strains
- Incapacitating low back pain with disc degeneration
 - Consider surgery only after a lengthy trial of non-operative treatments
 - PT
 - NSAIDS
 - Narcotics
 - Aerobic exercises

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Current Treatment of Disabling LBP

- Natural History, Prevention Strategies
- Conservative treatment (medications, physical therapy, pain clinic, etc)
- Surgical Options
 - Spinal Fusion
 - IDET (intradiscal electrothermal therapy)
 - Artificial Disc
- Experimental
 - Dynamic stabilization
 - Biologic repair or regeneration of IVD

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Surgical Consideration

- Pain and disability for over one year
- Failure of aggressive, surgeon directed non-operative management over at least 4 months
- One or two level disc degeneration on MRI with concordant discogram
- Resolution of litigation and worker's compensation issues prior to surgery

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Types of Lumbar Interbody Fusion

- Anterior Lumbar Interbody Fusion (ALIF)
- Posterior Lumbar Interbody Fusion (PLIF)
- Transforaminal Lumbar Interbody Fusion (TLIF)
- Circumferential Two Incision (360° – combined ALIF and posterior spinal fusion)

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Posterolateral Spinal Fusion

- Traditional standard for lumbar stabilization
- Satisfactory outcomes range from 16 to 95%
 - Pseudarthrosis 14-70%
 - Reoperation rate 24%
 - Disability rate 25%

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Disadvantages of posterolateral approach

- Small surface area available for fusion
- Tensile forces across the fusion site
- Pedicle screws improve fusion rates, but significant differences in outcome have not been reported
- Wide dissection
- Even a solid fusion allows micromotion at the disc space
- Biomechanical disadvantage in preventing shear and cantilever forces from causing motion in the anterior column

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Theory Behind Interbody Fusion

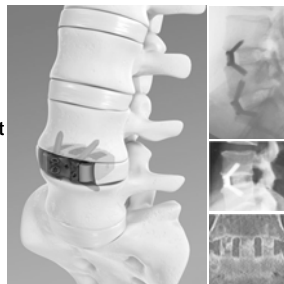
- Remove the presumptive pain generator – the disc
- Reduce the surgical morbidity associated with muscle stripping (ALIF)
- Wide cancellous beds are available for graft contact and subsequent fusion
- Grafts are placed under compression
- Only large graft that place the perivertebral ligaments under tension can restore torsional stiffness to the facetectomized spinal motion segment

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Stand-alone ALIF (L2-S1)

Benefits:

- Stand-alone ALIF
- Zero-profile
- Biomechanically equivalent to a spacer with pedicle screw fixation¹



1. C.M. Cain, P. Schleicher, R. Pflanzl, F. Scholz, M. F. Kandziora "A New Stand-Alone Anterior Lumbar Interbody Fusion Device: Biomechanical Comparison with Established Fixation Techniques." Spine. 2005 Dec 1; 30 (23): 2631-6.

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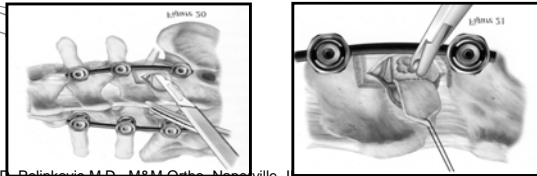
ALIF Results

- 125 pts ALIF w/ autogenous bone graft
- Spondylolisthesis, failed PLF, discitis, fx
- 98 of 125 – discogenic pain
- 78% - good relief of axial sx
 - Penta M, et al, Anterior lumbar interbody fusion: a min 10 yr f/u. Spine 1997; 22:2429-2434
- 83 pts, 81% w/ solid fusion in 5yrs,
- 74% - very much improved; 12% - little improvement; 14% - no improvement or worse after surgery
 - Tuusanen H, et al. ALIF in severe LBP. Clin Orthop 1996;324:153-163
 - Tuusanen H, et al. Functional and clinical results after ALIF. EurSpine J 1996;5:288-292

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Posterior Lumbar Interbody Fusion (PLIF/ TLIF) - ADVANTAGES

- Especially useful in LBP accompanied by symptomatic nerve root compression
 - Isthmic spondylolisthesis (grade I or II) with radiculopathy
 - Reducing percentage of slip
 - Increasing disc height
 - High fusion rates (96 to 100%)
- Single, posterior approach for interbody and transpedicular fixation
- Avoids hypogastric plexus, anterior vascular structures



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Outcomes PLIF

- Spondylolisthesis: 93% fusion rate, 95% excellent clinical results
 - Cloward RB. Spondylolisthesis: treatment by laminectomy and posterior interbody fusion. Clin Orthop 1981;154:74-82
- W/ adjunctive posterior instrumentation and fusion, 98.9% fusion rate and 86% clinical success
 - Brantigan, et al. Lumbar interbody fusion using the Brantigan I/F cage for PLIF and the variable pedicle screw placement system: two-year results from a FDA investigational device exemption clinical trial. Spine 2000;25:1437-1446
- LBP: 52.8% w/ improved sx

Outcomes TLIF

- No Long term outcomes
- 2 year F/U 90% fusion rates
- 85% had good to excellent results

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Conclusion

- Evolution of less invasive ways of achieving interbody fusion has expanded its application to various other spinal disorders
- Interbody fusion can be performed with minimal morbidity to the patients, allowing improved correction of deformity, improved fusion rates, clinical results equal or better than PLE alone
- Selection of patients remains the critical component in achieving a high rate of clinical success with these procedures!

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Minimal invasive surgery Goals

- Improved outcomes
- Less Blood Loss
- Less Tissue Damage and Pain
- More Accuracy
- Safety

Patient selection

- Obese
- Muscular
- Elderly

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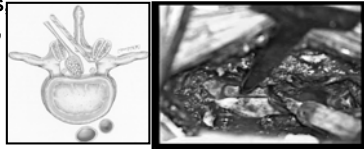
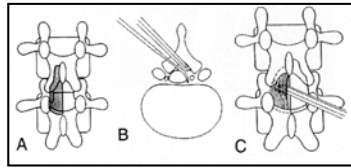
Surgical Treatment for Herniated Disc Causing Sciatica

- **Indications:** Persistent leg symptoms despite conservative treatment for at least 6 weeks (to improve the quality of life) and positive imaging study that correlates the clinical symptoms
- Microdiscectomy
 - Endoscopic discectomy,
 - Chemonucleolysis, etc.
 - Outcome, learning curve, cost, duration of surgery, complications
- SPORT (The Spine Patient Outcomes Research Trial)
 - Weinstein et al, JAMA, 2007: HNP patients did better with surgery in observational cohorts but similar to conservative treatment in randomized cohorts

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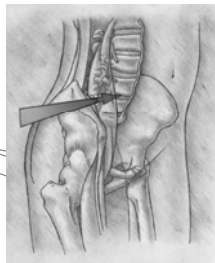
Minimally Invasive Techniques (Laminoplasty or Endoscopic)

- Hemilaminectomy
- Lateral recess decompression
- Contralateral decompression
- Best indicated for congenital stenosis, moderate stenosis, decompression for cases with concomitant instability



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 Hand and Wrist Clin. Spine, 1999

Lateral Approach



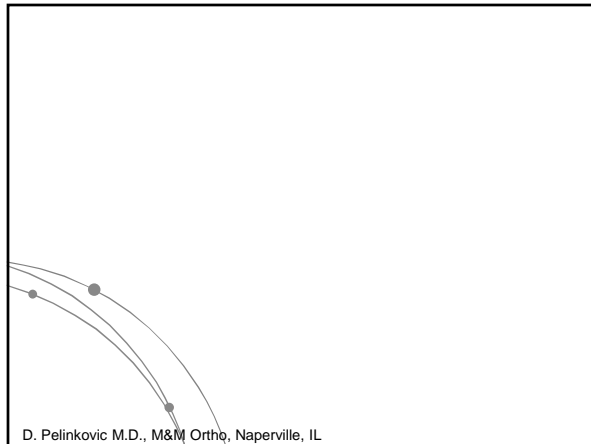
X - Lif

Oracle

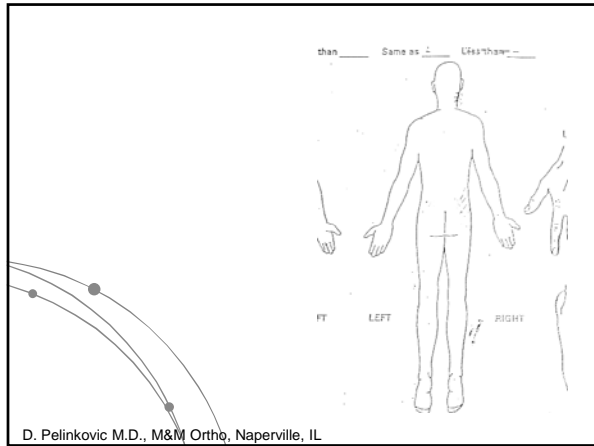
D - Lif

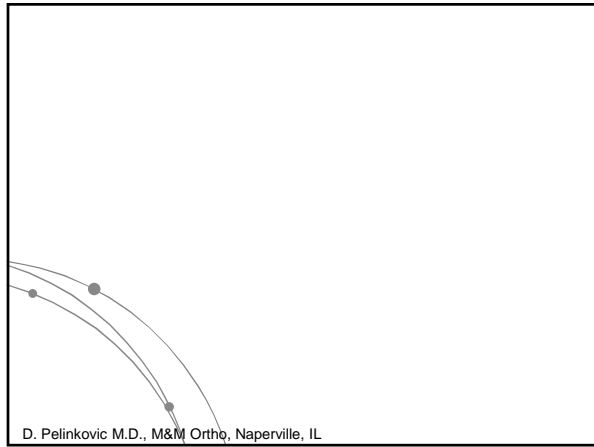


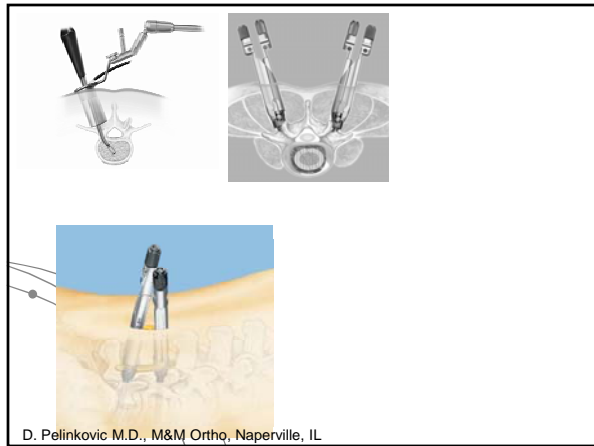
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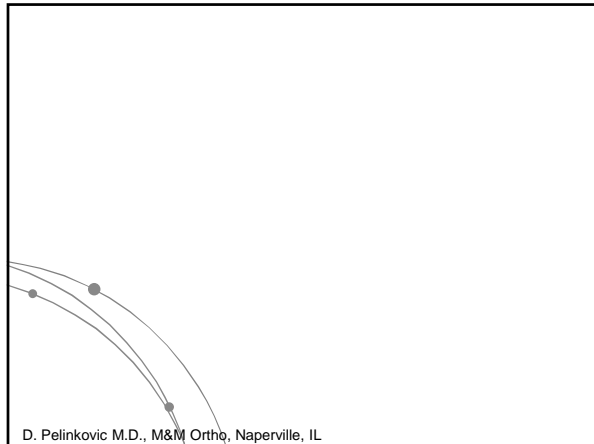


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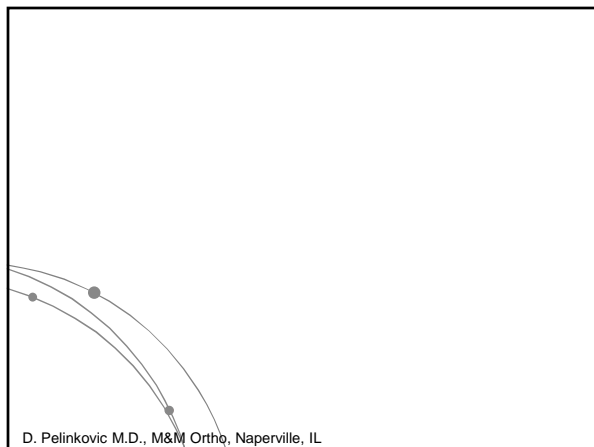
X-Stop

- 2 yr data
- 100 X-Stop
- 91 Controls
- X-Stop 73% satisfaction controls 36%
- 45% improvement in symptom severity score vs 7% controls



Zucherman JF, Hsu KY, Hartjen CA, et al.: A multicenter, prospective, randomized trial evaluating the X STOP® interspinous process decompression system for the treatment of neurogenic intermittent claudication: two-year follow-up results. *Spine* 2005;30:1351-1358

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Minimal Invasive - Advantages

- Hospital stay 1.9 days
- Less blood loss
- Less postoperative back pain
- Quicker recovery

- Park Spine 2007
- Schwender JSDT Feb 05
- Isaacs JNS Aug 08
- Scheufler NS Apr
- Kasis Spine 2009
- Ozgur The Spine Journal 2006

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Minimal Invasive - Disadvantages

- More Hardware complications
- Learning curve

- Same fusion rate

- Park Spine 2007
- Schwender JSDT Feb 05
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