Degenerative Lumbar Disc Disease

Surgery for Spinal Pain:

Disclosures

• Consultant
  Depuy - Synthes Spine

• Consultant, Product development, IDE site
  Stryker Spine

• Stockholder
  Medtronic Inc.

• Scientific Advisory Board, Chief Medical Officer
  InVivo Therapeutics

Many thanks to Dr. Gene Caragee for use of slide material

Degenerative Disc Disease

• Perspective
• DDD- overview
  – Clinical entities
  – Surgical management
  – Outcomes
• Future directions
• Controversies

Symptom Management
Natural History
Surgery
Scope of the Problem

- Enormous burden to society, healthcare systems, economy
- ~ 80% lifetime incidence
- > 50% annual prevalence
- $25 billion/y direct cost
- $50 billion/y indirect cost
- Frequent reason for MD office visits
  ✓ #1 cause of medical disability

Degenerative Disc Disease

Continuum...

Initial disc injury
  Altered biomechanics
    Hemiation, stenosis, instability
    Mechanical and chemical nociception
    LBP, radiculopathy, disability

Disc

- Stability
- Annulus
  - lamellar construction
  - Allows segmental flexibility
  - thins posterolaterally
- Nucleus
  - Proteoglycan gel
  - 70% water
Disc Biomechanics

- Axial loading
- Flow characteristics
- Effect of nuclear degeneration

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Intradiscal Pressure

% Relative Pressure

Nachemson 1983

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Pathology

- Vertebral vascular supply
  - Altered disc nutrition
  - Nucleus cell reduction
  - Proteoglycan degradation
  - Dehydration
- Annulus in compression
- Loss of height, Fissuring
- De-lamination
Macroscopic Grading

- Thompson DDD scale
- Reproducible macroscopic correlate for MRI evaluation, discography

Histologic Grading

- Semi-quantitative histologic analysis
- Cellularity, clefts, granulation, mucoid degeneration, cell death, fibrosis
- Correlates with aging

MRI Grading
Pfirrmann CWA et al. Spine 2001

- Grade I – V
- Dehydration on T2 sequences
- Endplate changes
- Reproducible
- Correlates with hypermobility
Modic Changes
Modic MT Radiology 1988; 166, 193-9

• Type I (4%) hypermobile/pain
• Type II (16%) stable/no pain
• Histology
  – Type I vascularized fibrous tissue (acute)
  – Type II yellow marrow (chronic/stable)

Clinical Syndromes

1. Disc herniation
2. Stenosis
3. Instability

Case- Lumbar HNP

• 48 YO WF
• Stooped forward, audible “pop”
• Immediate LBP, improved
• Posterior leg pain to the R lateral foot
• Calf, hamstring cramping
• Non- wt bearing
Lumbar Disc Herniation

• Presentation
  ➢ Radicular leg pain
  – LBP variable
  – Weakness 27%
  – Sensory loss 45%
  – DTR loss 51%
  – Frequency
    S1 45 – 50%
    L5 40 – 45%
    L4 5%


• Tumor
• Stenosis
• DM neuropathy
• Synovial cyst

Differential Diagnosis

• Tumor
• Stenosis
• DM neuropathy
• Synovial cyst

Natural History

• Generally benign
• Symptom management
• Short period of activity modification followed by resumption of activity as tolerated
  ➢ Exceptions:
    – Cauda equina syndrome
    – Progressive neurologic deficit
    – Intractable pain
Indications for Surgery

Controversial

- Variable
  - Region, specialty
- 15-fold variation in discectomy rates by geographic region within the United States
  - Weinstein JN 2000

Indications for Spinal Surgery

- Absolute
  1. Progressive neurologic deficit
  2. Cauda equina syndrome
- Relative
  3. Failure of adequate non-operative management
    - Correlating MRI/CT-myelogram

Discectomy Techniques

- Standard discectomy
- Microdiscectomy
- Percutaneous disc procedures
  - Chymopapain injection
  - Endoscopic discectomy
  - Nucleotomy
Complications

• Infection
  – Superficial  0.9 – 5%
  – Deep  < 1%
• Motor deficit  1 – 8%
• CSF leakage  0.3 – 13%
  – Higher for re-op
  Hodges HS et al. Spine 1999;24:2062
• Recurrent HNP  10%(10 y)
  Avis RA J Neurosurg 1994;80:415
Outcomes
Weber H Spine 8: 131, 1983

- Prospective randomized study of microdiscectomy v. non-operative tx
- ~ 60 pt /each group

- 1 year fu: significantly better outcomes for surgery
- 4 year fu: no significant difference
- 10 year fu: no significant difference
  ➢ ~ 25% of non-op group referred for surgery out of the study due to severe symptoms

Outcomes

- Prospective evaluation of 100 pts undergoing microdiscectomy
  - 1 year: 73% relief of leg pain
  - 1 year: 63% relief of LBP
  - 5 – 10 years: 62% relief of leg pain
  - 5 – 10 years: 62% relief of LBP
  - 86% “improved”


- Meta analysis
  - Only 1 study compared surgery to conservative treatment
  - Surgery > chymopapain > placebo
  ➢ No advantage of microdiscectomy over standard technique
  ➢ Surgery provides faster relief than non-operative treatment
  ➢ Long term effect unclear
Maine Lumbar Study Group  
Atlas SJ et al. Spine 2001

- Prospective cohort of 507 pts treated for HNP
  - 275 treated surgically; 232 non-operatively
- Surgery group had more severe symptoms
- Equal proportions of "moderate" sx

![Graph showing surgery vs non-op outcomes over 1, 5, and 10 years.]

- Surgery superior at 1, 5, and 10 years
- Advantages of surgery narrowed with time
- No differences in employment and compensation status

Maine Lumbar Study Group  
Atlas SJ et al. Spine 2001

Spine Patient Outcomes Research Trial (SPORT)


The Spine Patient Outcomes Research Trial (SPORT)

- Prospective, multi-center investigation
- NIH funded, registered clinical trial
- A priori construction, hypothesis driven
- 3 distinct studies, separate publications
  - Intervertebral disc herniation
    - Randomized/ Intention to treat analysis and cohort analysis
  - Spinal Stenosis
    - Randomized/ Intention to treat analysis and cohort analysis
  - Degenerative spondylolisthesis
    - Randomized/ Intention to treat analysis and cohort analysis

The Spine Patient Outcomes Research Trial (SPORT)

- 501 patients randomized
- 743 patients in the observational cohort analysis

Results – Primary Outcome Measures
Results – Secondary Outcome Measures

Transition to Cohort Analysis

- 40% of the patients in the randomized, intention-to-treat analysis crossed over
- Statistically, patients in both groups improved
  - Some data points showed a non-significant trend towards an advantage for surgery
- Essentially any methodologic separation between the two groups disappeared

Methods

- The methods, inclusion criteria, outcome measures, treatments, etc. were identical

- The difference is that this study represents the 743 patients who did not agree to have their treatment group assignment decided randomly
  - 521 patients initially chose surgery
  - 222 patients initially chose nonoperative care

Results
Summary of Observational Analysis

- Patients in both operated and non-operated groups have significant improvement following treatment for herniated lumbar discs

- Patients who elected to have surgery had statistically significantly greater and faster improvements than those patients who opted for non-operative care

Lumbar Stenosis

Congenital  Acquired  Combined

Arnold: CORR 1976
Patho- Anatomy

- Disc degeneration
- Facet hypertrophy
- Flaval buckling
- Instability

Pathophysiology

- Venous stasis
- Arterial ischemia
- Nutritional deficit
- Electrophysiologic
  - Sensory > motor
  - Demyelination
  - Wallerian deg

Clinical Presentation

- 5th-6th decade
- Symptom prevalence
  - LBP- 95%
  - Claudication- 91%
  - Leg pain- 71%
  - Weakness- 33%
  - Voiding- 12%
- Worse with extension/walking
  - "Grocery cart"
Exam

Subjective > objective
• Sensory 51%
• Reflex 47%
• SLR 24%
• Weakness 23%
• Perineal anesthesia 6%

Differential Dx

• Vascular
  - PVD
  - AAA
• Skeletal
  - OA hip/knee
• Other
  - CSM-10%
  - Neuropathy
    - DM
  - ALS
• Misc
  - Tumor
  - Renal disorder
  - Depression

Natural History

Related to Severity?

Porter Spine 1984
• 169 pts, 2 yr f/u
• Lateral recess stenosis
  ✓ 90% improvement

Johnson Spine 1991
• 19 pts, 31mos
• Partial-block
  • 26% -worse
  • 32% -same
  ▶ 42% -improved
Non-Operative Treatment

- **Noninvasive**
  - Medical
    - NSAID
    - GABA agonists
    - Calcitonin
  - Bracing
  - Therapy
  - Aqua
  - Chiropractic

- **Invasive**
  - ESI/SNRB
  - Controversial
  - Root isolation
  - Acute sx

Indications for Surgery

- **Absolute**
  - Progressive neurologic deficit
  - Cauda equina syndrome
- **Relative**
  - Failure of adequate non-operative management
  - Correlative MRI/CT-myelogram

Techniques

- Laminectomy
- Laminotomy
- Foraminotomy
- Unilateral laminectomy
Outcomes

• Pts with postural pain 96% relief
• Pts with activity pain only 50% relief
  Ganz JCJ Neurosurg 72;71, 1990
• Deterioration is common
• 27% recurrence in 5 years
  Caputy AJ J Neurosurg 77; 669, 1992
• Meta analysis
• Good/excellent outcomes in 24 – 100% (mean 64%)
  Turner JA spine 17;1, 1992
• Prospective study of long term outcomes
  • 78 – 88% “success” at 6 wk – 6 mo
  • Fell to ~70% at 1 year
  Javid MJ J Neurosurg 89;1, 1998

Maine Lumbar Study Group

• 81 surgery, 67 non-op
  – Surgery group more severe symptoms
  – 1 year f/u 5 year f/u
    55% surgery improved 70% surgery
    28% non-op improved 52% non-op
    (p=0.003) (p=0.05)
  Atlas SJ Spine 1996 21(15) 1787

Maine Lumbar Study Group

10 year f/u
• 54% initial surgery pts improved
  – 55% satisfied
• 42% initial non-op pts improved
  – 49% satisfied
  (p<0.05)
  ➢ Leg pain relief and back related functional status
  favored surgical treatment
  Atlas SJ et al. Spine 2005
Outcomes

- Cochrane Systematic Review 2005
  ✓ "No scientific evidence for spinal stenosis surgery"
    Van Tulder Eur Spine J 2006

- SPORT
  - 289 randomized to op v. non-op treatment
  - 365 observational cohort
  - 67% surgery pts operated upon
  - 43% non-op pts crossed over

➤ Both intent-to-treat analysis and cohort analysis showed a significant advantage of surgery v. non-op care at 3 months f/u that was maintained for 2 years
  Weinstein NEJM 2008

Summary

- Surgical decompression provides a greater chance for early improvement of symptoms than non-operative management for severe symptomatic spinal stenosis
- The benefits may attenuate with time
Spinal Instability

- When do we consider fusion for lumbar degenerative disorders?
  1. Gross instability
     - Good agreement
  2. Glacial instability
     - Relative agreement
  3. “Implied” instability
     - Controversial

Lumbar Fusion Procedures

- Postero lateral fusion
  - Onlay +/- instrumentation
  - “gold-standard?”
- Anterior lumbar interbody fusion - ALIF
- Posterior lumbar interbody fusion
  - PLIF, TLIF, variants
- “360”
- Minimally invasive

Shift Toward Interbody Fusion

- Instability
  - Trauma, Tumor, Infection, Deformity Degenerative disc disease, Failed prior surgery
  - Directly addresses the disc as a pain generator
Advantages of Interbody Fusion

- Restore normal anatomy
  - Widen the neural foramen
  - Re-establish sagittal balance
- Position bone/implant in compression
- Immobilize the segment

ALIF Technique

- Approach
  - Open
  - Laparoscopic
  - Mini lap open
- Spacers
  - Bone
  - Cages
  - Approach for disc arthroplasty

Complications

- Exposure
  - Overall 10 – 20%
  - Infection, hemia, lumbar plexus, sympathetic, ureter, viscera, great vessels
  - Retrograde ejaculation
    - Typically at L5-S1, hypogastric plexus, males
    - 0 – 19% - Rodts 1999
Grafts and Implants

- Bone
  - Bone dowels, femoral rings
- Cages
  - Threaded interbody fusion
- Alternative implants
  - Rectangular titanium, ALIF carbon fiber, HA, tantalum sponge

Femoral Ring Spacers

- Teeth/ridges increase push-out strength 3X
- Wedge shape restores lordosis
- Atraumatic insertion technique
  - No destruction of endplates
- Biological implant

Threaded Cages

- Bagby 1988
- Reduces morbidity of the approach
- Annular tensioning through distraction
- 98% 1 level fusion rate at 2 y
- Bridging bone, ≤ 5° on F/E, absence of lucencies
Anterior Stabilization - Motion
Oxland 2000

ALIF with Posterior fixation - Stiffness
Oxland 2000

Outcomes - Stand alone
Subach 2000

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<tr>
<th>Method</th>
<th>% Fusion</th>
<th>% RTW</th>
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<td>Blumenthal 1988</td>
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<td>Newman 1992</td>
<td>auto 89</td>
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<td>Vamjanij 1998</td>
<td>allo 60</td>
<td>31</td>
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<td>Kuslich 1998</td>
<td>BAK 98</td>
<td>91</td>
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<tr>
<td>Kim 1999</td>
<td>allo 90</td>
<td>85 sat</td>
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60 – 98 Fusion, 31 – 91 % working or satisfied
### Outcomes - 360
*Subach 2000*

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<tr>
<th>Method</th>
<th>% Fusion</th>
<th>% RTW</th>
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<td>allo/PLF</td>
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<td>95</td>
<td>82 sat</td>
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<td>allo/PLF</td>
<td>97</td>
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<tr>
<td>allo/PLF</td>
<td>100</td>
<td>89 sat</td>
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<tr>
<td>allo/auto</td>
<td>100</td>
<td>36</td>
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88 – 100% Fusion, 14 – 89% working or satisfied

### PLIF/TLIF

- McAfee 2005 Spine
  - 120, PLIF pedicle fixation
  - 98% fusion, 3.7 mm height restoration, 23% slip reduction
- Foley 2002 J Neurosurg
  - Percutaneous pedicle fixation
- Mummaneni 2004 J Neurosurg
  - Minimally invasive access for TLIF
Case
• 33 YO WM
• 2 y mechanical LBP, minimal leg pain
• Extensive non-surgical trx
• Discography +L5-S1, +/- concordant L4-5

Case
• Diagnosis: symptomatic L5-S1 DDD
• Failed conservative trx
• Out of work
"... wants something done..."

? Arthrodesis in DDD
• Primary procedure in degenerative disc disease
• "Salvage" procedures in hip and knee arthritis
• Hip arthrodesis long-term complications
  – Ipsilateral knee pain
  – Low back pain
Fusion Effects on Adjacent Levels

- With increasingly rigid fixation instrumentation, overstress in the adjacent segments may cause the return of pain in up to 50% of today’s patients
  
  Shono 1998

<table>
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<tr>
<th>Site</th>
<th>DISCECT.</th>
<th>VSP</th>
<th>ISOLA</th>
<th>CD/Hooks</th>
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<tr>
<td>Above</td>
<td>85%</td>
<td>115%</td>
<td>120%</td>
<td>55%</td>
</tr>
<tr>
<td>Below</td>
<td>95%</td>
<td>105%</td>
<td>105%</td>
<td>95%</td>
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</table>

Maximum Segmental Displacement Post-Instrumentation

Adjacent Segment Degeneration (ASD)

- Ghiselli, Wang et al. *JBJS* 2004
  
  - 16.5% at 5 years
  - 36.1% at 10 years

Future Directions

1. Total disc replacement
2. Nuclear replacement
3. Non-fusion stabilization
4. Disc regeneration
History of Disc Replacement

- Early clinical attempts of "disc replacement" were all nucleus replacements
- Based on the desire to prevent disc space collapse following discectomy

Fernstrom (Sweden, 1960s): first clinical series of disc replacements
- Stainless steel ball bearing put in disc space following discectomy
- President JFK had a Fernstrom Ball implanted by Dr. Harmon in the late 1950s

Reitz & Joubert (S. Africa, 1964)
- 12 patients received 19 steel ball prostheses
- 8 month follow-up concluded results superior to fusion
History of Disc Replacement

- Kostuik (mid-1980s)
  - Metal plates with springs and hinge
  - No clinical reports found
- Acroflex (Steffee, mid-1980’s)
  - Rubber core vulcanized to two titanium plates
  - Initially problems with materials, still difficulties with design, withdrawn from market

Modern Lumbar TDR Arthroplasty Devices

- Depuy Spine*
- Synthes Spine **
- Stryker Spine
- Medtronic
- Charité
- ProDisc
- FlexiCore
- Maverick

* FDA approved 6/04
** FDA approved 3/06

TDR Benefits/Complications

- Effective in relieving low back pain
- Effectively restores segment mobility
  - Earlier functional recovery over fusion
- Revision surgery is posterolateral fusion
  - Surgeons expect that maintenance of proper motion will improve adjacent disc disease
  - Complication rates similar to fusion (10%)
Complications

- Typically early event
- Technique
- Trauma
- Constraint possibly stresses implant-bone interface

FDA Randomized Trials

- Blumenthal et al. Spine 2005
- 304 pts, 14 centers
- Randomized 2:1
- Charite III or BAK ALIF
- ODI, VAS, SF-36
- Non-inferiority study

Blumenthal 2005
Subjective Evaluation
Blumenthal 2005

Nuclear Replacement

- Numerous prototypes
- Example: Prosthetic disc nucleus (PDN Raymedica)
  - Hyaluronic acid gel
  - Semipermiable membrane
  - Woven jacket
- Problems with extrusion

Dynamic Stabilization

- Dynesis™
- Pedicle screw/tension band system
- Designed to limit post laminectomy degeneration
- Early results show improvement over non-operative treatment
Motion Control Devices

• X-Stop™, Wallace, Diam™ Devices
  – Interspinous process spacers
  – Segmental flexion
  – Stenosis

Everyone Has LBP

• 33% point prevalence
• 70% one-year prevalence
• “Lifetime risk” - 50% have LBP episode in records
• “Lifetime risk” - 70% have LBP episode in 18 mo flu
• Most people with a LBP episode never see a doctor

• But … on any given day
  - 2-3% of working population are on permanent disability for LBP
  - 2% on temporary disability

• Always ask yourself, why is this person having so much more trouble with the same spine as most everyone else?
LBP Evaluation in Context

• Primary diagnostic evaluation (<10%)?
  – LBP short duration (days-weeks)
  – Hx, PE “rule out “red flags” of serious pathology
• Secondary Diagnostic Evaluation (<5%)
  – LBP not improving (weeks to 1-2 months)
  – Add ESR, CRP, rapid sequence MRI, motion study x-rays
  – Rule out “Yellow Flags”
    • psychosocial/neurophysiologic factors that inhibit recovery or coping

LBP Evaluation

• Tertiary Diagnostic Evaluation (<1%)  
  - Persistent pain, considering no specific Rx  
  (months to 1 year)  
  - Only common degenerative findings on imaging so far  
  - ? Consider discography, etc to identify disc as “pain generator”

Common MRI Findings

• Disc Degeneration
  - 40-80% of asymptomatic adults,
  - Increases with age
• Disc protrusion
  - 40-70% of asymptomatic adults
• Endplate sclerosis
  - 10-30% asymptomatic adults
• Annular disruption
  - 25-70% of asymptomatic adults
Do MRI findings predict LBP?

- Multiple prospective studies
  - MRI findings are poor predictors of future LBP

- Best predictors are:
  - other chronic pain problems
  - perception of “poor health”
  - previous WC or personal litigation for any reason
  - abnormal psychometric profiles (depression, anxiety)

- Equivocal Predictors
  - structural: severe loss of disc height, Modic changes, annular disruption (contradictory findings)

Boos et al; Jarvik et al; Carragee et al; Elfering et al; Borenstein et al

Does new severe LBP predict new MRI finding?

Carragee et al. Spine 2006

- 200 subjects w/o LBP
- Baseline MRI
- Follow Q 6 mo x 5 years
- MRI obtained with LBP > 6/10 and > 1 week
- 67 MRIs, mean 2.5 yrs after baseline

➤ 86% NO NEW FINDINGS
  - 2/67 had significant new findings, both had radiculopathy

IF PE, MRI, X-RAY, CT scan do not correlate with LBP, what does?

- Facet blocks
  - to identify facet pain
  - false positive rates unknown
  - utility unknown

- Discography
  - disc injections to see if pressure reproduces pain
  - primarily used to determine fusion/disc replacement
  - serious issue of false positive tests

- One controlled study: no improvement in surgery outcome if discography used compared to planning fusion w/o discography (Madan, 2002)
Hypothetical Response to Pressurization of a Degenerative Disc Depending on “Pain Sensitivity”

Do discography patients often have these false positive “Risk Factors”

- Abnormal Psych Testing
  - 85% discography pos (Stanford)
  - 79% discography pos (Derby)
  - 80% DDD fusions (Fritzell)
- Compensation Issue
  - 76% (Schwarzer)
  - 75% (Derby)
  - 68% (Carragee)
- Chronic Pain
  - 100% by definition CLBP
  - 70%--other chronic pain issues (IBS, TMJ, Migraine…)
- But don’t all chronic BP patients develop abnormal pain behavior, abnormal psych profiles, etc?

Chronic LBP Patients with Non-Specific Findings = “Discogenic Pain”

Cairns et al. 2003; Carragee et al 2001; Schwarzer 1995/96
Profiles in Other Spine Patients with Severe Chronic Pain
Which one is not like the others?

- Abnormal psych
- Narcotic dependency
- History of Drug/Alcohol
- Compensation litigation
- Other chronic pain syndrome

Compare Other Chronic Pain without Clear Local Pathology Coincidence?

- Abnormal psych
- Narcotic dependency
- History of Drug/Alcohol
- Compensation litigation
- Other chronic pain syndrome

When is Surgical Treatment Considered?

- “Failed” Conservative Treatment
- What does that mean?
  - waited > 6 months?
  - out of work x 6 months?
  - being referred to a surgeon?
  - hot packs and massage PT x 8 sessions?
  - Oxycontin dose exceeds body weight?
  - lawsuit coming to trial?

- In most cases “Failed Conservative Treatment” means nothing at all...
Best Evidence: “Effective” Combination Programs

- Medical care + P.T. or chiropractic
  - better than either alone
- Medical + P.T. + Cognitive Behavioral Therapy
  - i.e. strict functional goal, not pain guided
  - probably the best combination (strong evidence)
  - small effect sizes
  - expensive, intensive (>100 hr)
  - ? durability
  - poorly compensated
- Pain Management Schemes
  - little evidence of effect...expensive

Best Evidence: “Ineffective” Injections/RF Techniques

- Epidural/Root Blocks
  - only shown to be effective with primary radicular pain
- Prolotherapy
  - poor evidence of effect over placebo
- Facet Injections/MBB/Radiofrequency Rx
  - 75% RCT’s no lasting effect
  - possibly effective in very small subgroup
- IDET/Nucleoplasty
  - 3 RTC’s no effect over placebo (Freeman et al; Bogduk et al; Berendse et al)
  - 1 RTC small effect (1 in 5) in highly selected subjects
    (no psych, WC, modest baseline pain, etc)

Everything Works Great for LBP until tested: IDET
Surgery for Back Pain

- Historically known efficacy
  - root/cauda equina Compression
  - progressive deformity
  - polio
  - scoliosis
  - spondylolisthesis
  - Following Tumor Excision
  - Spinal TB or Pyogenic Infection
- Is spinal fusion effective for chronic BP with only degenerative changes in the spine?

Surgery for Non-Specific LBP

- Laminectomy
  - no evidence for use in LBP w/o root compression
- Fusion –
  - # RCT – Norway – 2002
    - fusion = P.T. + cognitive behavioral Rx
    - 22% returned to work
  - #2 RCT – Sweden – 2002
    - fusion slightly better than P.T.
    - 16% “excellent” objective outcomes
  - #3 RCT – England – 2004
    - fusion = P.T. + cognitive behavioral Rx
    - 6-10% excellent outcomes

“Discogenic Pain” Surgery: What Do Patients Expect?

- Minimal Acceptance Outcome in 94 patients having surgery for “degenerative disc” changes
  - Pain VAS---
    - median 4 point improvement
  - ODI (functional)
    - median 28 point improvement
  - Return to full time work---
    - 80%
  - Off all narcotics
    - 94%

Carragee et al, 2004
Lumbar Spinal Fusion > 290,000 In 2009
- Exceeded 300,000 in 2010

U.S. Spine Fusion Summary 2006-2012

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<th>Year</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
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<tr>
<td>Total</td>
<td>526,762</td>
<td>547,537</td>
<td>566,662</td>
<td>585,513</td>
<td>603,176</td>
<td>625,798</td>
<td>653,533</td>
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</table>

Table: PearlDiver 2009

Can Patient Selection Improve Outcomes?
- Patients with no structural or psychosocial risk factors:
  - single level disc degeneration
  - no WC, litigation
  - employed, normal psychometric scores
  - no other chronic pain problems
- 32 patients meet criteria in 5 years
- 27% complete relief at 2 years
- 42% met all minimum acceptable outcome goals at 2 years
- 50% return to usual work
- (compare 90% success in same surgery for isthmic spondylolisthesis)

Summary
- Serious LBP is associated with general pain intolerance, abnormal psych profiles, compensation disputes and no particular structural finding
- “Discogenic pain” has no validated diagnostic criteria
- False + risk factors in discography are the same as co-morbidity profile for chronic LBP
- Discography has not been shown to improve outcomes
- Fusion may confirm Dx in 50% of cases max
- Patient expectations are high but not usually met by fusion or arthroplasty surgery
Thank you