Lumbar Degenerative Disc Disease

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Very Important Talk!! -- LBP

• A major public health problem
• The leading cause of disability for people < 45
• 2\textsuperscript{nd} leading cause for physician visits
• 3\textsuperscript{rd} most common cause for surgical procedures
• 5\textsuperscript{th} most common reason for hospitalizations
• Lifetime prevalence: 49\%–80\%

Deyo et al. 2005, *Spine*

- USA: 113% increase in number of lumbar fusion compared with 13-15% increase in THA & TKA between 1996 and 2001
Figure 1. Annual Number of Knee-Arthroplasty, Hip-Replacement, and Spinal-Fusion Operations in the United States, on the Basis of the National Inpatient Sample.

Data are from the Agency for Healthcare Research and Quality.¹
Points Asked to Cover

1. Anatomical considerations: disc vs facet
2. Role of MRI: correlating findings
3. Role of discograms: technique & pitfalls
4. Fusion or arthroplasty
5. Minimally invasive surgery
6. Interbody fusions with BMP
Practice Guidelines


“Everything should be made as simple as possible, but not simpler.”

A. Einstein
Controversies in Lumbar DDD

• Etiology

• Diagnosis

• Treatment
Types of LBP

1. Non-specific “idiopathic”: 85%
2. Degenerative disc disease: discogenic pain, disk herniation, degenerative scoliosis
3. Developmental: spondylolisthesis, idiopathic scoliosis
4. Congenital: scoliosis
5. Traumatic
6. Infectious
7. Inflammatory
8. Neoplastic
9. Metabolic
10. Referred
Natural History

• Most non-specific LBP resolve within a week → no need for formal anatomic diagnosis
  – Unless red flags present

• If symptoms persisted >6-8 weeks, start diagnostic work-up:
  – A clear pathology found → treat
  – “degenerative changes” → identify a “pain generator”
“Pain Generator” in Lumbar DDD

• Not only capable of causing some discomfort, but should be the primary cause of symptoms

• Two Schools of Thought:
  – Multifactorial School: mechanical, psychological and neuropsychological (Burton 1995)

  – Single Disabling Pathology School: the psychological distress is secondary to crippling effect of pain → need to identify by discograms and blocks (Bogduk 1996)
Modulation of Pain Perception in LBP

Carragee et al. 2004, Orthop Clin N Am
Fig. 2. Psychosocial failure to accommodate normal spinal nociception.
Anatomical Considerations

1. Intervertebral Disks

2. Facet Joints

3. Musculoligamentous Structures: ALL, PLL and paraspinal muscles

4. Neural Structures
Controversy in Diagnosis

- **History & Physical**
  - Specific pathology (tumour, infection, #, cauda equina)
  - Radicular pain
  - Non-specific back pain
  - Flags: Red & Yellow

- **Imaging: Plain X-ray, MRI**

- **Special Imaging: Facet Injections, Discograms**
Red Flags of a Spinal Pathology

- Patient aged <20 or >55 years old
- Nonmechanical pain
- Thoracic pain
- History of cancer
- History of significant trauma
- Systemic symptoms: fever, chills, anorexia, malaise, weight loss
- Severe or progressive neurological deficits: saddle anesthesia, bowel or bladder symptoms, multiroot deficits
- History of immunosuppression: steroids, HIV
Yellow Flags (Prognostic Factors)

- Inappropriate attitudes and beliefs about back pain (e.g., back pain is harmful, or a high expectation from passive treatment)

- Inappropriate pain behaviour (e.g., fear-avoidance and reduced activity levels)

Kendall et al 1997
Yellow Flags (Prognostic Factors)

► Work related problems or compensation issues (e.g., poor work satisfaction)

► Emotional problems (such as depression, anxiety, stress, tendency to low mood and withdrawal from social interaction)

Kendall et al 1997
Special Tests

- **2 SR** (Deville et al 2000, Rebain et al 2002)

- **Lasegue (passive straight leg raise) test**
  - Diagnostic OR 3.74 (95% CI 1.2 – 11.4)
  - Sensitivity 0.91 (0.82-0.94)
  - Specificity 0.26 (0.16-0.38)

- **Crossed Straight Leg Raise Test:**
  - Diagnostic OR 4.39 (95% CI 0.74 – 25.9)
  - Sensitivity 0.29 (0.23-0.34)
  - Specificity 0.88 (0.86-0.90)
Role of MRI

• Most sensitive and specific to detect disc herniation, soft-tissue or neurologic lesions, neoplasms, or infections

• However, in LBP cases, MRI is too nonspecific to differentiate patients with chronic LBP from individuals with no LBP at all:
  – 30%–40% of asymptomatic subjects have degenerative changes (Boden 1990)
  – In symptomatic patients, MR findings were not correlated with severity of symptoms (Beattie 2000)
MRI – High Intensity Zone “HIZ”
Aprill and Bogduk 1992

• High T2 signal in the posterior or posterior-lateral annulus in discs that caused pain during a subsequent discogram

• Purported to be highly specific for discogenic LBP illness (PPV=90%)
HIZ

Annular fissure with high-intensity signals

Carragee 2005, NEJM
- MRI (looking for HIZ) then discography
- 109 discs in 42 symptomatic patients vs 143 discs in 54 asymptomatic group
- % of HIZ:
  - 59% in symptomatic, 25% in asymptomatic
- % of HIZ lesions positive in discography:
  - 73% in symptomatic vs 70% in asymptomatic
- Not pathognomonic as advertised
Discography

- Provocative test
- Injection of contrast directly into disc
- Localizes source of back pain
- Positive Test: A concordant pain pattern (reproduction of “usual” typical pain)
- Very controversial
Holt 1968, JBJS(A)

- Widely quoted study
- 72 levels lumbar discograms in asymptomatic volunteer prison inmates (?)
- 36% positive

However, methodological faults in technique of discograms, data interpretation and criteria for a positive test
Walsh et al. 1990, JBJS(A)

- Prospective study, responses videotaped and graded independently
- 7 chronic back pain patients: 35% positive
- 10 asymptomatic volunteers: all negative (100% specificity)

• However........
Carragee et al. 2000, *Spine*

- 26 volunteers, no history of LBP
- Some had chronic cervical pain or primary somatization disorder
- Positive lumbar discograms:
  - 10% in subjects without history of pain
  - 40% in subjects with history of cervical pain
  - 83% in subjects with somatization disorder
Discograms Summary Points

• High False-Positive Rate in:
  – patients with abnormal psychometric testing
  – those with somatization features
  – chronic pain patients
  – ongoing compensation litigation
1st Take Home Message
“It is much more important to know what sort of a patient has a disease than what sort of a disease a patient has.”

Sir William Osler
Treatment
Controversy in Treatment

- **Non-Surgical:** NSAIDs, Rehabilitation, Cognitive Therapy

- **Surgical:**
  - Fusion vs Arthroplasty vs Dynamic Stabilization
  - Fusion: ? approach, ? graft, ? instrumentation
    - Open vs MIS
    - Approach: ALIF, PLIF, Circumferential, TLIF
    - Graft: allograft, autograft
    - Instrumentation: need? type?
  - Arthroplasty: Total Disc vs Nucleus Pulposus
  - Dynamic Stabilization
Rationale of Fusion

• To eliminate pathologic segmental motion and its accompanying symptoms, especially low back pain
Cochrane Review - Surgery for Degenerative Lumbar Spondylosis
Gibson & Waddell, August 2005

• 31 RCTs

• 3 sections:
  1. Surgery for spinal stenosis and nerve root compression: 8 RCTs
  2. Surgery for back pain: 8 RCTs
  3. Comparison of fusion techniques: 15 RCTs
1. Surgery for spinal stenosis or nerve compression: 8 RCTs, only 3 pooled

- Postero-lateral fusion (± instrumentation) vs decompression alone (Herkowitz 1991, Bridwell 1993, Grob 1995):
  - 139 pt, pooled OR 0.44, 95% CI 0.13, 1.48
  - Surgeon rating as success of procedure
**Fig. 5. Comparison 03. LAMINECTOMY + FUSION ANY TYPE vs LAMINECTOMY**

**03.01 Poor result 18-24 months - Surgeon rating**

**Review:** Surgery for degenerative lumbar spondylosis  
**Comparison:** 03 LAMINECTOMY + FUSION ANY TYPE vs LAMINECTOMY  
**Outcome:** 01 Poor result 18-24 months - Surgeon rating

<table>
<thead>
<tr>
<th>Study</th>
<th>Lamin. + Fusion</th>
<th>Laminectomy</th>
<th>Odds Ratio (Random)</th>
<th>Weight (%)</th>
<th>Odds Ratio (Random)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridwell 1993</td>
<td>11/34</td>
<td>6/9</td>
<td></td>
<td>47.2</td>
<td>0.24 [0.05, 1.14]</td>
</tr>
<tr>
<td>Grob 1995</td>
<td>5/30</td>
<td>2/15</td>
<td></td>
<td>38.5</td>
<td>1.30 [0.22, 7.64]</td>
</tr>
<tr>
<td>Herkowitz 1991</td>
<td>0/25</td>
<td>2/25</td>
<td></td>
<td>14.3</td>
<td>0.18 [0.01, 4.04]</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>89</strong></td>
<td><strong>49</strong></td>
<td></td>
<td><strong>100.0</strong></td>
<td><strong>0.44 [0.13, 1.48]</strong></td>
</tr>
</tbody>
</table>

Total events: 16 (Lamin. + Fusion), 10 (Laminectomy)  
Test for heterogeneity chi-square=2.33 df=2 p=0.31 I²=14.1%  
Test for overall effect z=1.32 p=0.2
2. Surgery for back pain: 8 RCTs
   - 2: surgery vs no surgery
   - 3: intra-discal electrotherapy
   - 3 ongoing RCT: arthroplasty

• No pooled data because of heterogeneity of procedures
VOLVO and Spine Fusion
• 294 patients, 19 centers, over 6 yr

• Strict criteria: LBP > leg pain, > 2 yr, no nerve root compression, and failure of non-surgical treatment

• The patient must have been on sick leave (or have had “equivalent” major disability) for at least 1 yr

• Randomized into 4 groups: 72 conservative, 222 had one of 3 fusion sx (PLF, PLF+instrument, ALIF or PLIF)

• 98% follow-up at two years.
Fritzell et al. 2001, *Spine*

2 yr Results

- Excellent or Good: 46% of surgery vs 18% of conservative ($P = 0.0001$)
- More surgical patients rated their results as 'better' or 'much better' (63% versus 29%) ($P = 0.0001$)
- Significantly greater improvement in pain (VAS) and disability (Oswestry scale) in surgery groups
- The “net back to work rate" was significantly in favour of surgery (36% versus 13%) ($P = 0.002$)
- No significant differences in any of these outcomes between the three surgical groups.
Fritzell et al. 2004, *Spine J*

**NOT in Cochrane**

- Abstract, ISSLS 2004 Meeting
- 5-10 year follow-up of the RCT
- 18% surgical & 31% non-surgical dropouts
- 10 pt non-surgical group → OR
- No significant difference between the two groups in patient overall rating, ODI-score, VAS
Ivar Brox et al. 2003, *Spine*

- Norwegian trial

- Compared
  - posterolateral fusion with pedicle screws and post-operative physiotherapy, vs
  - 'rehabilitation' program: an educational intervention and a 3 week course of intensive exercise sessions, based on cognitive-behavioural principles

- 64 patients with LBP > 1 yr plus disc degeneration at L4/5, L5/S1 or both

- 97% follow-up at one year and ITT analysis
Ivar Brox et al. 2003, Spine

- No significant differences in any of the main outcomes of independent observer rating, patient rating, pain, disability or return to work

- Radiating leg pain improved significantly more after surgery

- At one-year follow-up, the conservative group had significantly:
  - Less fear-avoidance beliefs
  - Better forward flexion
  - Better muscle strength and endurance
Fairbank et al. 2005, *BMJ*

**NOT in Cochrane**

- UK, Multicenter (15), RCT
- Criteria: LBP > 1yr, surgical candidates but surgeon and patient uncertain which treatment strategies was best
- Fusion (surgeon choice) or an intensive rehabilitation
- 176 surgery, 173 rehab
- 81% follow-up at 2 yr
The mean Oswestry index changed:
- 46.5 to 34.0 in the surgery group
- 44.8 to 36.1 in the rehabilitation group.

Estimated mean difference between groups was −4.1 (95%CI -8.1, -0.1; P = 0.045) in favor of surgery.

No difference in other outcomes: walking distance & SF-36
3. Comparison of fusion techniques: 15 RCTs, very heterogeneous
- 8: instrumentations
- 4: approach
- 3: electrical stimulation to enhance fusion
### Instrumentation

**Improved fusion rate** (OR 0.43, 95% CI 0.21, 0.91)

**Fig. 38. Comparison 12. INSTRUMENTED POSTEROLATERAL FUSION vs GRAFT ONLY (mixed disease)**

12.03 No fusion at 2 yrs

- **Review:** Surgery for degenerative lumbar spondylolisthesis
- **Comparison:** 12 INSTRUMENTED POSTEROLATERAL FUSION vs GRAFT ONLY (mixed disease)
- **Outcome:** 03 No fusion at 2 yrs

<table>
<thead>
<tr>
<th>Study</th>
<th>Instrumented n/N</th>
<th>Non-instrumented n/N</th>
<th>Odds Ratio (Random) 95% CI</th>
<th>Weight (%)</th>
<th>Odds Ratio (Random) 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridwell 1993</td>
<td>3/24</td>
<td>7/10</td>
<td></td>
<td>8.7</td>
<td>0.06 [0.01, 0.38]</td>
</tr>
<tr>
<td>Fischgrund 1997</td>
<td>6/35</td>
<td>18/33</td>
<td></td>
<td>12.9</td>
<td>0.17 [0.06, 0.53]</td>
</tr>
<tr>
<td>France 1999</td>
<td>7/29</td>
<td>10/28</td>
<td></td>
<td>12.6</td>
<td>0.57 [0.18, 1.81]</td>
</tr>
<tr>
<td>Fritzell 2001</td>
<td>8/62</td>
<td>19/67</td>
<td></td>
<td>14.3</td>
<td>0.37 [0.15, 0.93]</td>
</tr>
<tr>
<td>McGuire 1993</td>
<td>3/13</td>
<td>4/14</td>
<td></td>
<td>9.1</td>
<td>0.75 [0.13, 4.25]</td>
</tr>
<tr>
<td>Moller 2000</td>
<td>8/37</td>
<td>13/37</td>
<td></td>
<td>13.4</td>
<td>0.51 [0.18, 1.43]</td>
</tr>
<tr>
<td>Thomsen 1997</td>
<td>20/62</td>
<td>10/64</td>
<td></td>
<td>14.6</td>
<td>2.57 [1.09, 6.07]</td>
</tr>
<tr>
<td>Zdeblick 1993</td>
<td>10/72</td>
<td>18/51</td>
<td></td>
<td>14.5</td>
<td>0.30 [0.12, 0.71]</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>334</td>
<td>304</td>
<td></td>
<td>100.0</td>
<td>0.43 [0.21, 0.91]</td>
</tr>
</tbody>
</table>

Total events: 65 (Instrumented), 99 (Non-instrumented)

- Test for heterogeneity: chi-square=24.62 df=7 p=0.0009 I² =71.6%
- Test for overall effect z=2.22 p=0.03
Instrumentation

Improved clinical outcome (OR 0.49, 95% CI 0.28, 0.84)

**Fig. 39. Comparison 12. INSTRUMENTED POSTEROLATERAL FUSION vs GRAFT ONLY (mixed disease)**

**12.04 Poor clinical outcome**

*Review: Surgery for degenerative lumbar spondylosis*

*Comparison: 12 INSTRUMENTED POSTEROLATERAL FUSION vs GRAFT ONLY (mixed disease)*

<table>
<thead>
<tr>
<th>Study</th>
<th>Instrumented n/N</th>
<th>Non-instrumented n/N</th>
<th>Odds Ratio (Random)</th>
<th>Weight (%)</th>
<th>Odds Ratio (Random) 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridwell 1993</td>
<td>4/24</td>
<td>7/10</td>
<td></td>
<td>7.2</td>
<td>0.09 [0.02, 0.48]</td>
</tr>
<tr>
<td>Fischgrund 1997</td>
<td>8/35</td>
<td>5/33</td>
<td></td>
<td>11.2</td>
<td>1.66 [0.48, 5.71]</td>
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<tr>
<td>France 1999</td>
<td>16/37</td>
<td>15/33</td>
<td></td>
<td>14.7</td>
<td>0.91 [0.36, 2.35]</td>
</tr>
<tr>
<td>Fritzell 2001</td>
<td>19/60</td>
<td>27/67</td>
<td></td>
<td>17.8</td>
<td>0.69 [0.33, 1.43]</td>
</tr>
<tr>
<td>McGuire 1993</td>
<td>3/13</td>
<td>7/14</td>
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<td>15/51</td>
<td></td>
<td>12.8</td>
<td>0.18 [0.06, 0.53]</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>241</td>
<td>312</td>
<td></td>
<td>100.0</td>
<td>0.49 [0.28, 0.84]</td>
</tr>
</tbody>
</table>

Total events: 72 (Instrumented), 106 (Non-instrumented)

Test for heterogeneity chi-square = 14.07 df=7 p=0.05 \( \chi^2 = 50.3\%

Test for overall effect z=2.58 p=0.01
**Instrumentation**

No difference in revision rate in 2 years

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**Fig. 37. Comparison 12. INSTRUMENTED POSTEROLATERAL FUSION vs GRAFT ONLY (mixed disease)**

12.02 2nd procedure by 2yrs

- **Review:** Surgery for degenerative lumbar spondylosis
- **Comparison:** 12 INSTRUMENTED POSTEROLATERAL FUSION vs GRAFT ONLY (mixed disease)
- **Outcome:** 02 2nd procedure by 2yrs

<table>
<thead>
<tr>
<th>Study</th>
<th>Instrumented n/N</th>
<th>Non-instrumented n/N</th>
<th>Odds Ratio (Random) 95% CI</th>
<th>Weight (%)</th>
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<td>Fischgrund 1997</td>
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<td>2/33</td>
<td></td>
<td>17.4</td>
<td>1.45 [0.23, 9.30]</td>
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<tr>
<td>France 1999</td>
<td>5/37</td>
<td>3/34</td>
<td></td>
<td>22.3</td>
<td>1.61 [0.36, 7.34]</td>
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<td>Grob 1995</td>
<td>4/30</td>
<td>0/15</td>
<td></td>
<td>8.5</td>
<td>5.26 [0.27, 104.49]</td>
</tr>
<tr>
<td>McGuire 1993</td>
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<td>0.45 [0.07, 3.04]</td>
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<td>8.9</td>
<td>12.34 [0.67, 228.05]</td>
</tr>
<tr>
<td>Zdeblick 1993</td>
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<td>4/51</td>
<td></td>
<td>18.9</td>
<td>0.34 [0.06, 1.91]</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>273</strong></td>
<td><strong>221</strong></td>
<td></td>
<td>100.0</td>
<td>1.05 [0.40, 2.73]</td>
</tr>
</tbody>
</table>

Total events: 21 (Instrumented), 14 (Non-instrumented)

Test for heterogeneity chi-square=8.45 df=6 p=0.21 I² = 29.0%

Test for overall effect z=0.10 p=0.9
Most of RCTs report short-term, technical, surgical outcomes rather than patient-centered outcomes

Although high fusion rate, but not necessarily long-term good pain control

Authors' conclusions: Limited evidence is now available to support some aspects of surgical practice
Use of Recombinant Human Bone Morphogenetic Protein-2 to Achieve Posterolateral Lumbar Spine Fusion in Humans

A Prospective, Randomized Clinical Pilot Trial
2002 Volvo Award in Clinical Studies

Scott D. Boden, MD, James Kang, MD, Harvinder Sandhu, MD, and John G. Heller, MD
Boden et al. 2002, *Spine*

- Pilot study

- 25 patients undergoing lumbar arthrodesis were randomized (1:2:2 ratio):
  - Autograft and TSRH instrumentation (n=5)
  - rhBMP-2/TSRH (n=11)
  - rhBMP-2 only without internal fixation (n=9)

- On each side, 20 mg of rhBMP-2 were delivered on a carrier

- The patients had single-level disc degeneration, Grade 1 or less spondylolisthesis, mechanical LBP ± leg pain, and at least 6 months failure of nonoperative treatment.
• All 25 patients were available for follow-up evaluation

• Radiographic fusion rate was:
  – 40% (2/5) in the autograft/TSRH group
  – 100% (20/20) with rhBMP-2 group with or without TSRH internal fixation ($P \ 0.004$).

• A statistically significant improvement in Oswestry score was seen:
  – at 6 weeks in the rhBMP-2 only group (-17.6; $P \ 0.009$),
  – at 3 months in the rhBMP-2/TSRH group (-17.0; $P \ 0.003$), but
  – not until 6 months in the autograft/TSRH group (-17.3; $P \ 0.041$).

• At the final follow-up assessment, Oswestry improvement was greatest in the rhBMP-2 only group (28.7, $P \ 0.001$).

• The SF-36 Pain Index and PCS subscales showed similar changes
DON'T OIL THE SQUEAKY WHEEL

And 19 Other Contrarian Ways to Improve Your Leadership Effectiveness

WOLF RINKE

Replace it with

GENUINE PARTS GUARANTEED TO FIT
Arthroplasty

• Total Disc Arthroplasty:
  – Metal-Polyethylene-Metal: SB Charité III, ProDisc II
  – Metal-on-Metal: Maverick, FlexiCore

• Nucleus Pulposus Arthroplasty:
  – Intradiscal implants
  – *In situ* curable polymers: silicone, polyurethane
Rationale of Total Disc Arthroplasty

To treat chronic LBP due to DDD while addressing the limitations of lumbar fusion:

1. Problems due to graft site harvest & pseudarthrosis
2. Posterior paraspinous soft tissue structures spared
3. By preserving motion at the operated segment, arthroplasty will reduce the incidence of adjacent segment disease
Results

• Multiple prospective cohort studies

• 4 ongoing multicenter RCTs: SB Charite, ProDisc, and Maverick

• No comments on ongoing trials
Nucleus Pulposus Replacement
Di Martino et al. 2005, Spine

Aim: to restore biomechanical functions of the annulus by placing annular fibers in tension
Nucleus Pulposus Replacement
Di Martino et al. 2005, *Spine*

Fig. 1. Prosthetic Disc Nucleus (PDN).

Fig. 3. The Aquavalve nucleus replacement device showing volume hydration rate.

Fig. 5. Nucleus Spiral implant uncoupled within the annulus.

Fig. 6. Nucleus pre- and post-hydration.
Clinical Results of PDN®

- >3,500 since 1996 (Raymedica.com)

- 423 implants in the literature (1996-2002):
  - Success rate: 60% to 85%
  - Removed in 10%: endplate failure, extrusion

- Ongoing Canadian study: Ottawa, Toronto & Halifax
More Fancy Stuff

Dynamic Stabilization Devices

Dynamic Interspinous Process Stabilization
Dynamic Stabilization

- Alters the mechanical loading of the motion segment by unloading the disc
- Adjunct or alternative to fusion
- Especially helpful if the pathology of postural back pain is altered load transmission

Nockels, Spine 2005
Dynesys® System

- Spacer
  - SULENE® - PCU
  - (polycarbonate Urethane)

- Cord
  - SULENE® - PET
  - (Polyethylene-terephthalate)

- Pedicle Screw + Set Screw
  - PROTASUL® 100
  - (Titanium Alloy)
Results

• Ongoing RCT: Dynesys vs Posterior Lumbar Fusion with autograft and pedicle screw
Dynamic Interspinous Process Technology

DIAM
Rationale

• Dynamic stabilization aims at restricting painful motion while enabling normal movement.

• Interspinous implants distract the spinous processes and restrict extension:
  – reducing the posterior annulus pressures
  – theoretically enlarging the neural foramen.
Figure 3. The X Stop. A, Illustration of the device. Lateral (B) and AP (C) postoperative views of implant. (Images are courtesy of St. Francis Medical Technologies.)
Results

- Few case series and prospective cohort

- Ongoing RCT for Wallis, www.spinalconcepts.com

- Ongoing RCT for X STOP (Zucherman et al. 2004, *Eur Spine J*)
Take Home Messages

- Know the natural history of the disease
- *Know* your patient
- Correlate clinical findings, MRI and discograms if needed
- Until definitive evidence available, choose the most cost-effective available treatment option: cognitive therapy, exercise, fusion, arthroplasty, dynamic stabilization
Spinal-Fusion Surgery — The Case for Restraint

Richard A. Deyo, M.D., M.P.H., Alf Nachemson, M.D., Ph.D., and Sohail K. Mirza, M.D.
Persistent Low Back Pain

Eugene J. Carragee, M.D.
“The decision is more important than the incision.”

Anonymous
Eat the nut!!
Do not eat the nut!!

What do I do??
COLORED PLAYERS  
F.I.M. CORPORATION  
presents  

The SCAR OF SHAME  

Story by  
DAVID STARKMAN
Acknowledgement

Dr. D. Bednar
Dr. W. Hussain
Thank You