

# Lumbar Degenerative Disc Disease

Alya Alflouse NSX R2  
Dr. Hurlbert, J

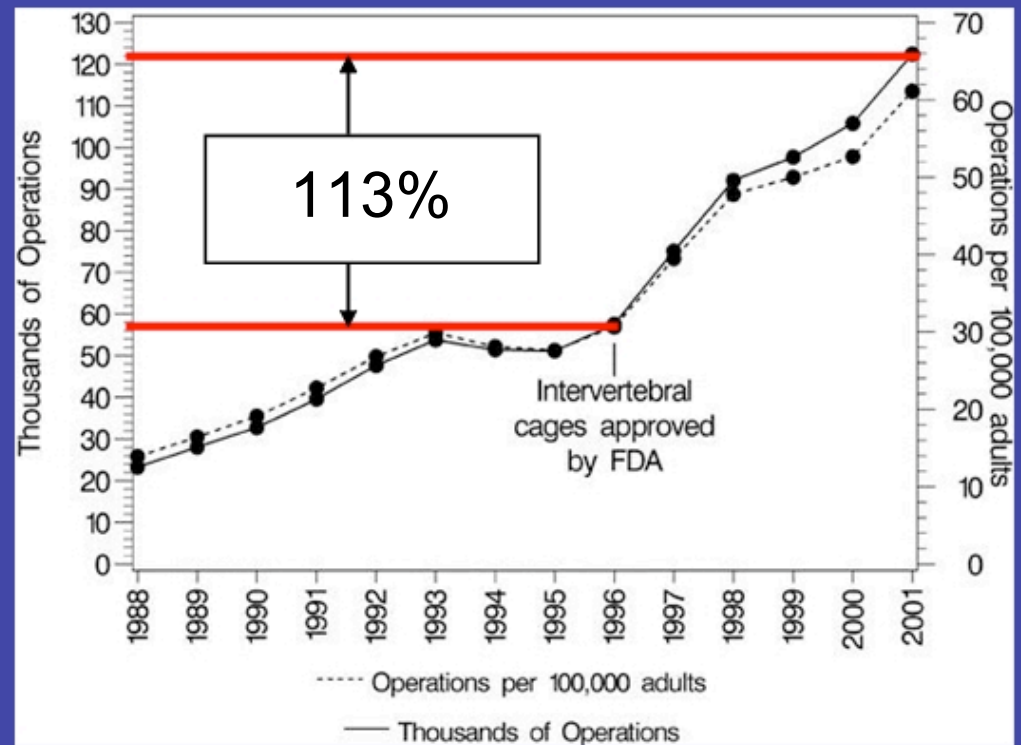
May, 17<sup>th</sup> ,07 Neurosurgery Rounds

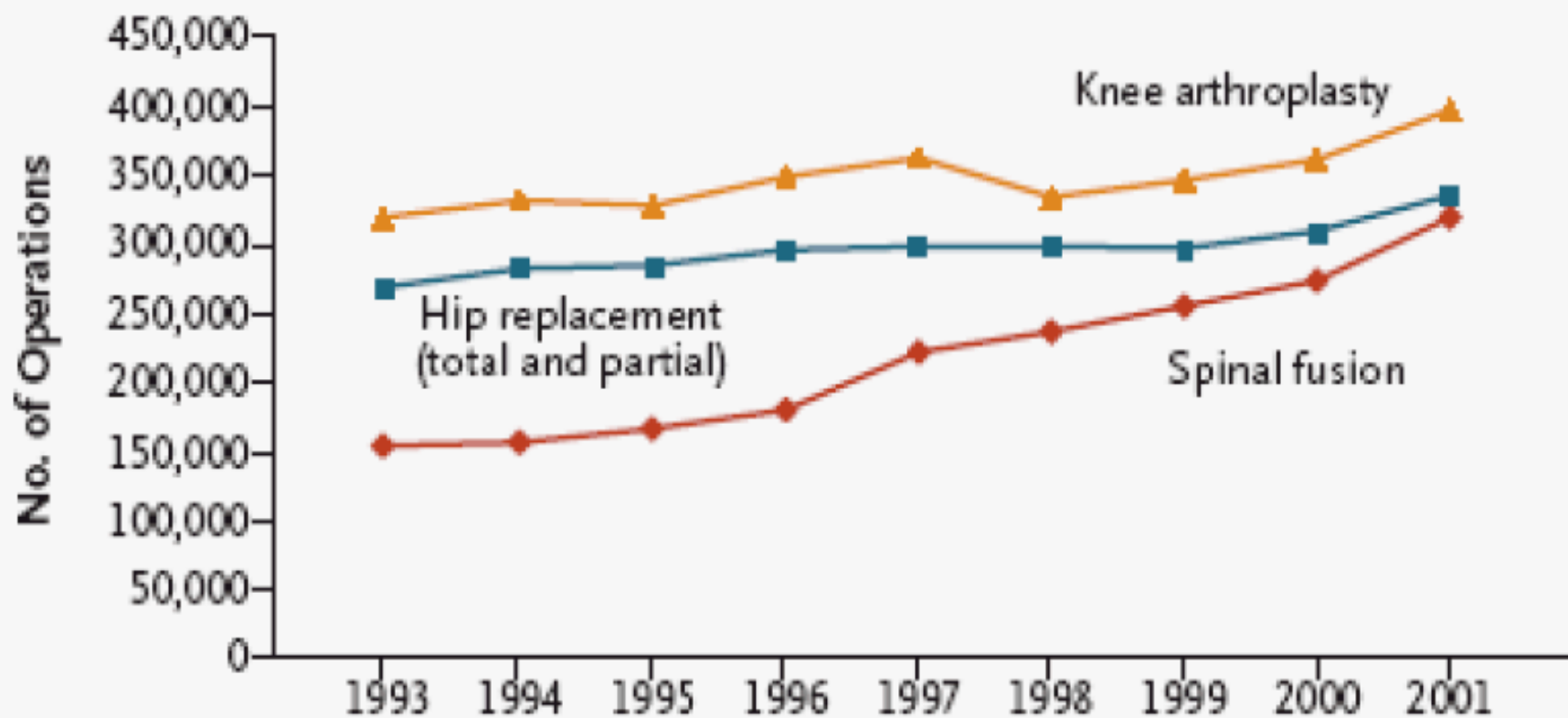
# Very Important Talk!! -- LBP

- A major public health problem
- The leading cause of disability for people < 45
- 2nd leading cause for physician visits
- 3rd most common cause for surgical procedures
- 5th 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.<sup>1</sup>

# 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

“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



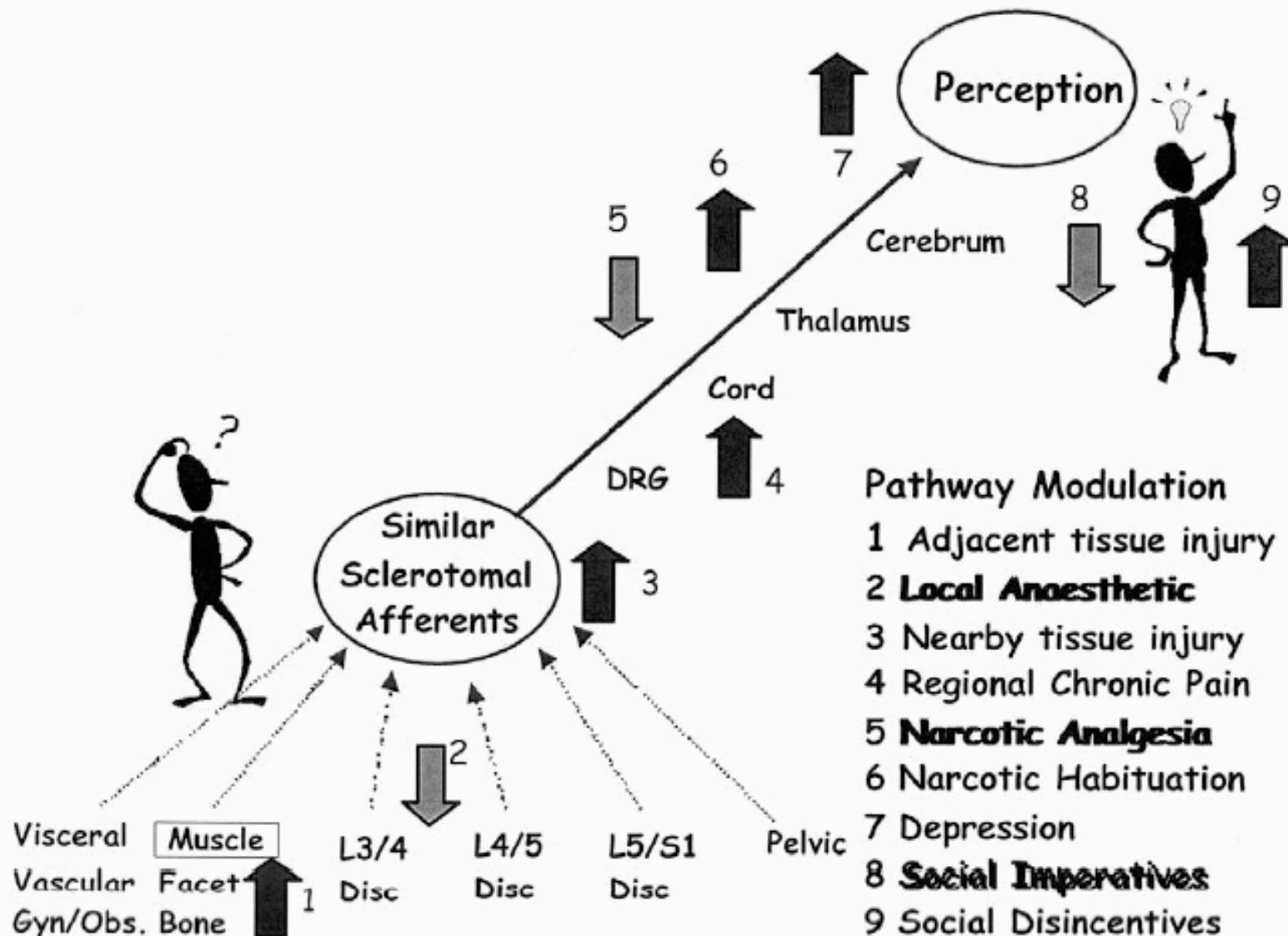
# Natural History

- 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 neurophysiological (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

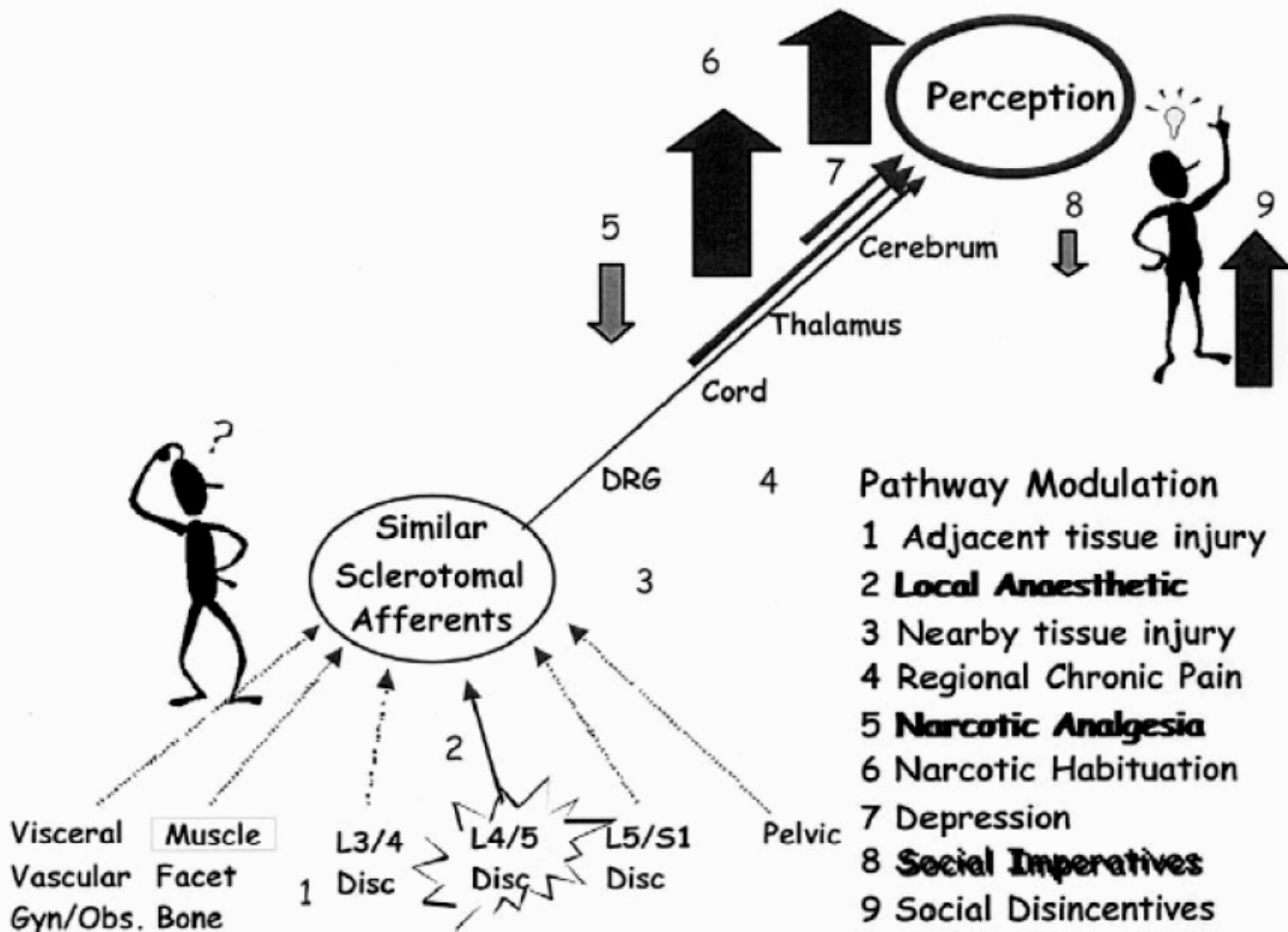


Fig. 2. Psychosocial failure to accommodate normal spinal nociception.

# Anatomical Considerations

1. Intervertebral Disks
2. Facet Joints
3. Musculo ligamentous 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
- Non mechanical 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)

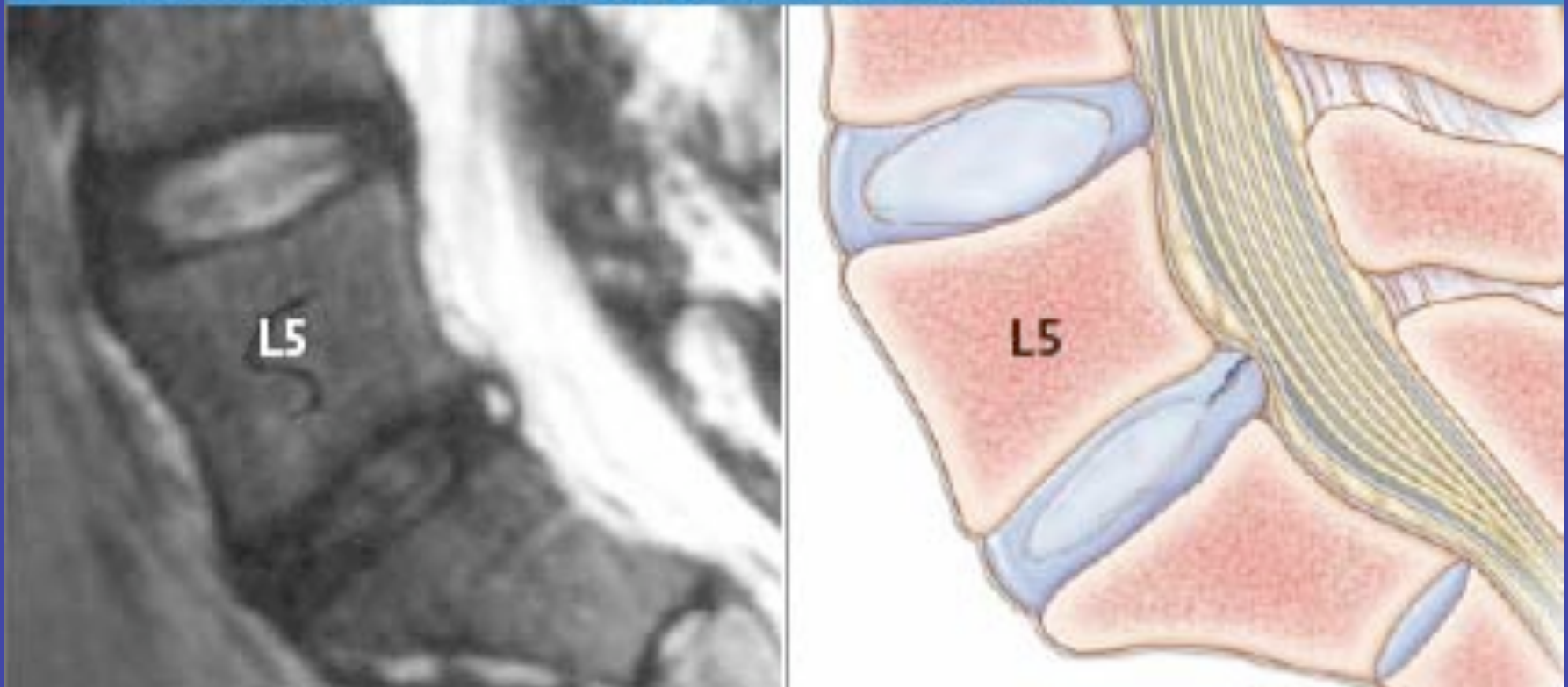
# MRI - High Intensity Zone “HIZ”

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

**D** Annular fissure with high-intensity signals



Carragee 2005, NEJM

## 2000 Volvo Award Winner in Clinical Studies

### Lumbar High-Intensity Zone and Discography in Subjects Without Low Back Problems

Eugene J. Carragee, MD, Steve J. Paragioudakis, MD, and Sanjay Khurana, MD

- (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

1<sup>st</sup> 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

# Cochrane Review - Surgery for Degenerative Lumbar Spondylosis

Gibson & Waddell, August 2005

1. Surgery for spinal stenosis or nerve compression: 8 RCTs, only 3 pooled
  - Postero-lateral fusion ( $\pm$  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

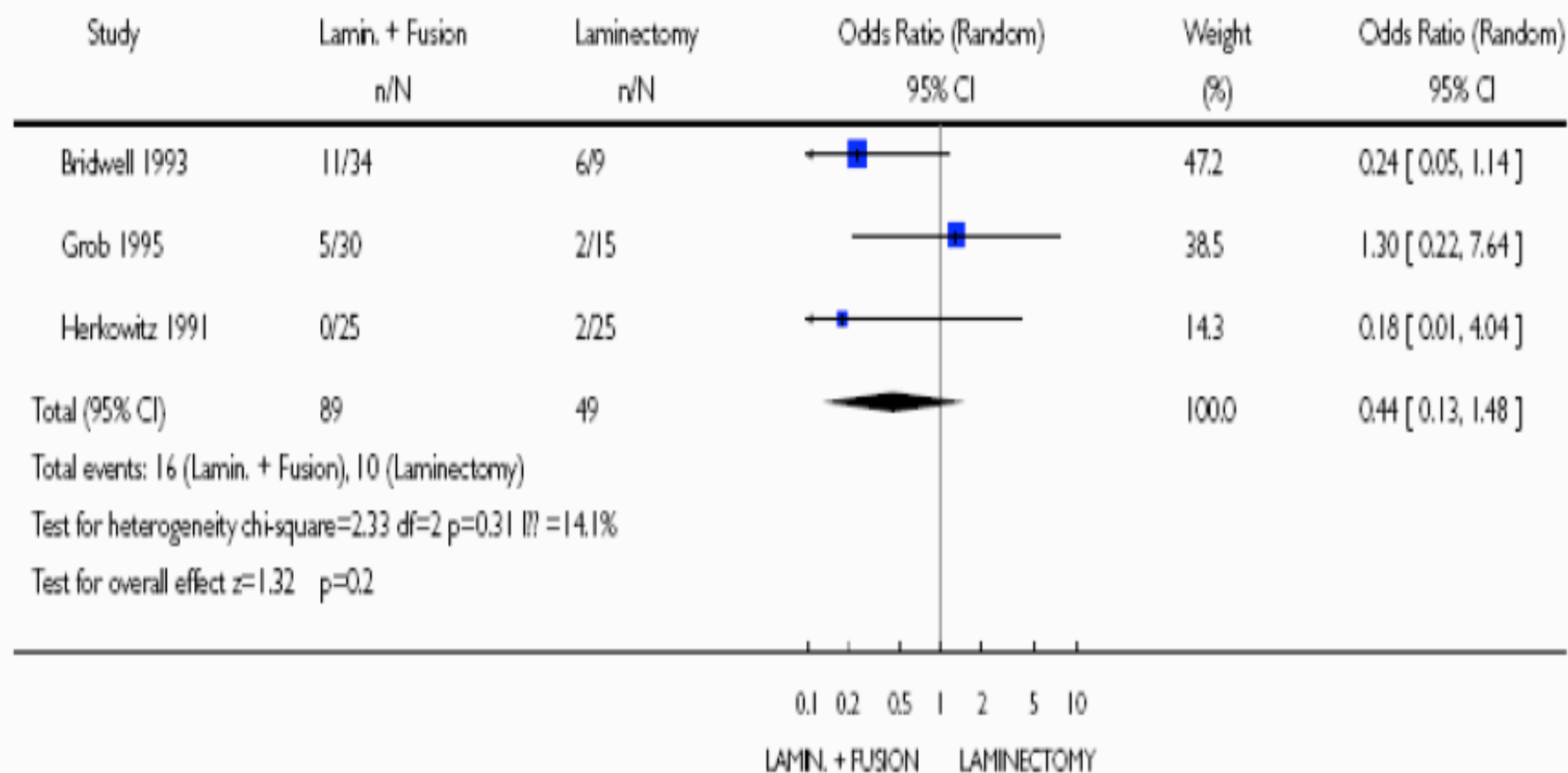
**Fig. 5. Comparison 03. LAMINECTOMY + FUSION ANY TYPE vs LAMINECTOMY**

**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



# Cochrane Review - Surgery for Degenerative Lumbar Spondylosis

Gibson & Waddell, August 2005

## 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



## 2001 Volvo Award Winner in Clinical Studies: Lumbar Fusion *Versus* Nonsurgical Treatment for Chronic Low Back Pain

A Multicenter Randomized Controlled Trial From the Swedish Lumbar Spine Study Group

Peter Fritzell, MD,\* Olle Hägg, MD,† Per Wessberg, MD,†  
Anders Nordwall, MD, PhD,† and the Swedish Lumbar Spine Study Group‡

- 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

# Fairbank et al. 2005, BMJ

## NOT in Cochrane

- 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

# Cochrane Review - Surgery for Degenerative Lumbar Spondylosis

Gibson & Waddell, August 2005

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)

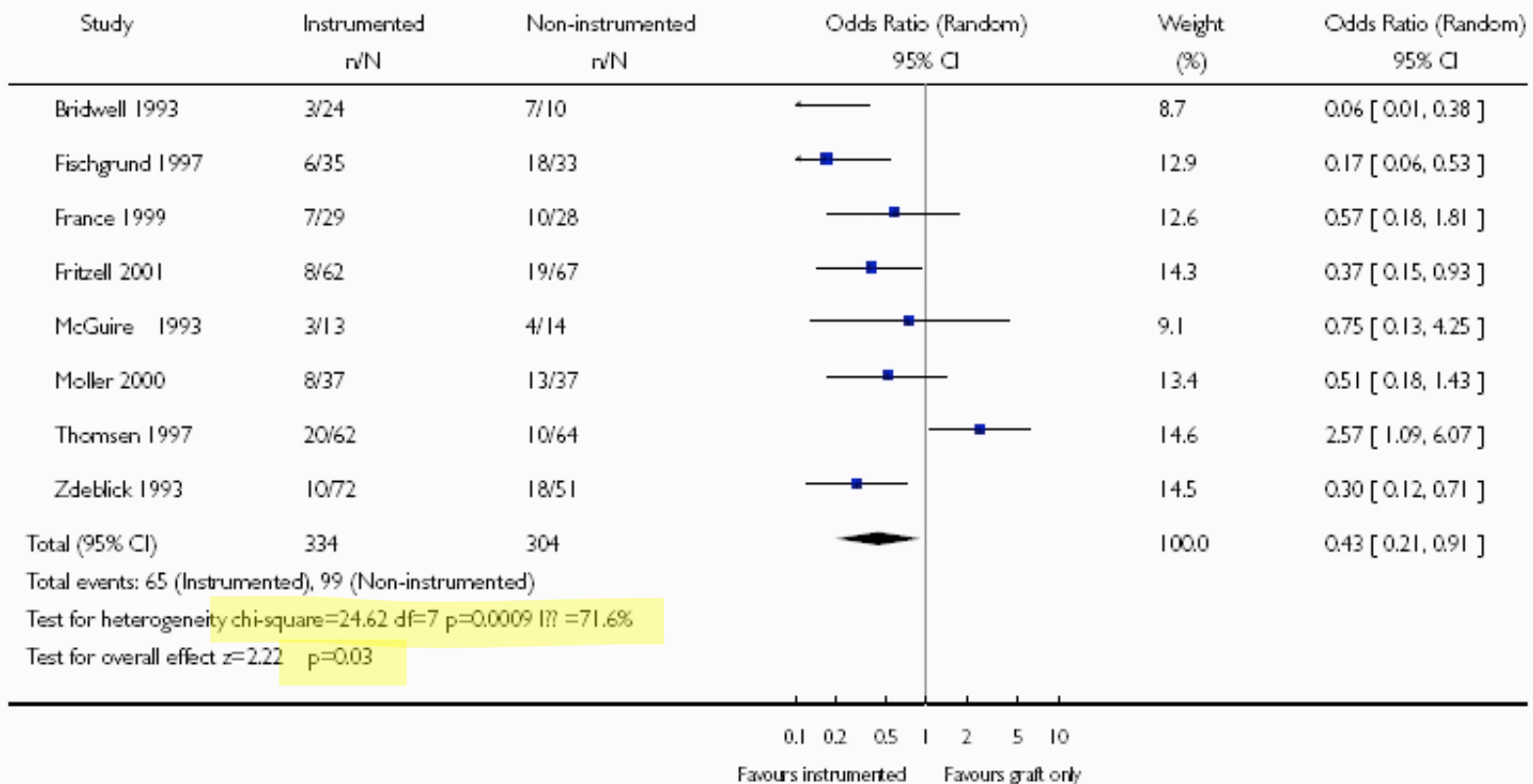
**Fig. 38. Comparison 12. INSTRUMENTED POSTEROLATERAL FUSION vs GRAFT ONLY (mixed disease)**

## 12.03 No fusion at 2 yrs

Review: Surgery for degenerative lumbar spondylosis

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

Outcome: 03 No fusion at 2 yrs



# Instrumentation

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

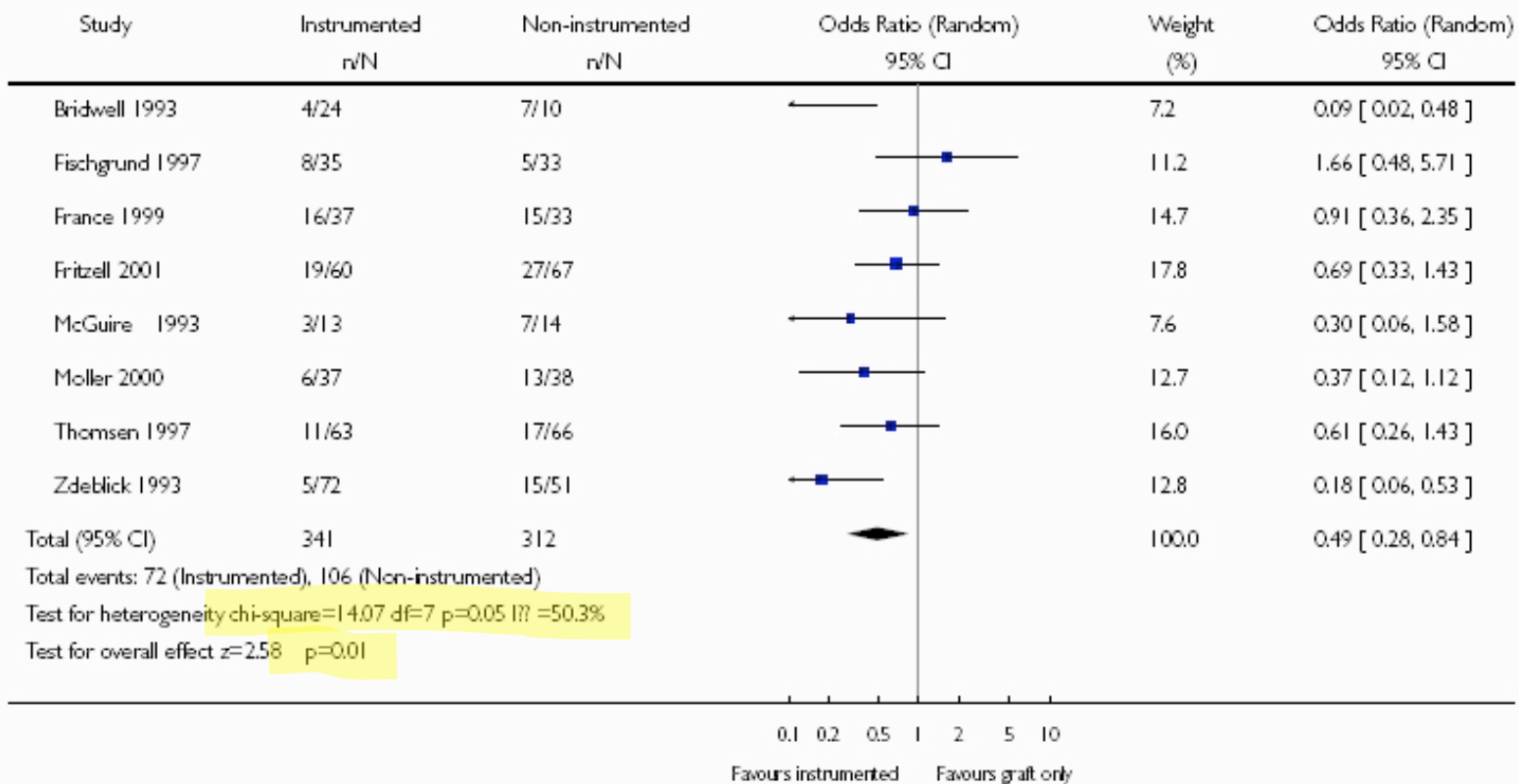
**Fig. 39. Comparison 12. INSTRUMENTED POSTEROLATERAL FUSION vs GRAFT ONLY (mixed disease)**

## 12.04 Poor clinical outcome

Review: Surgery for degenerative lumbar spondylosis

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

Outcome: 04 Poor clinical outcome



# Instrumentation

No difference in revision rate in 2 years

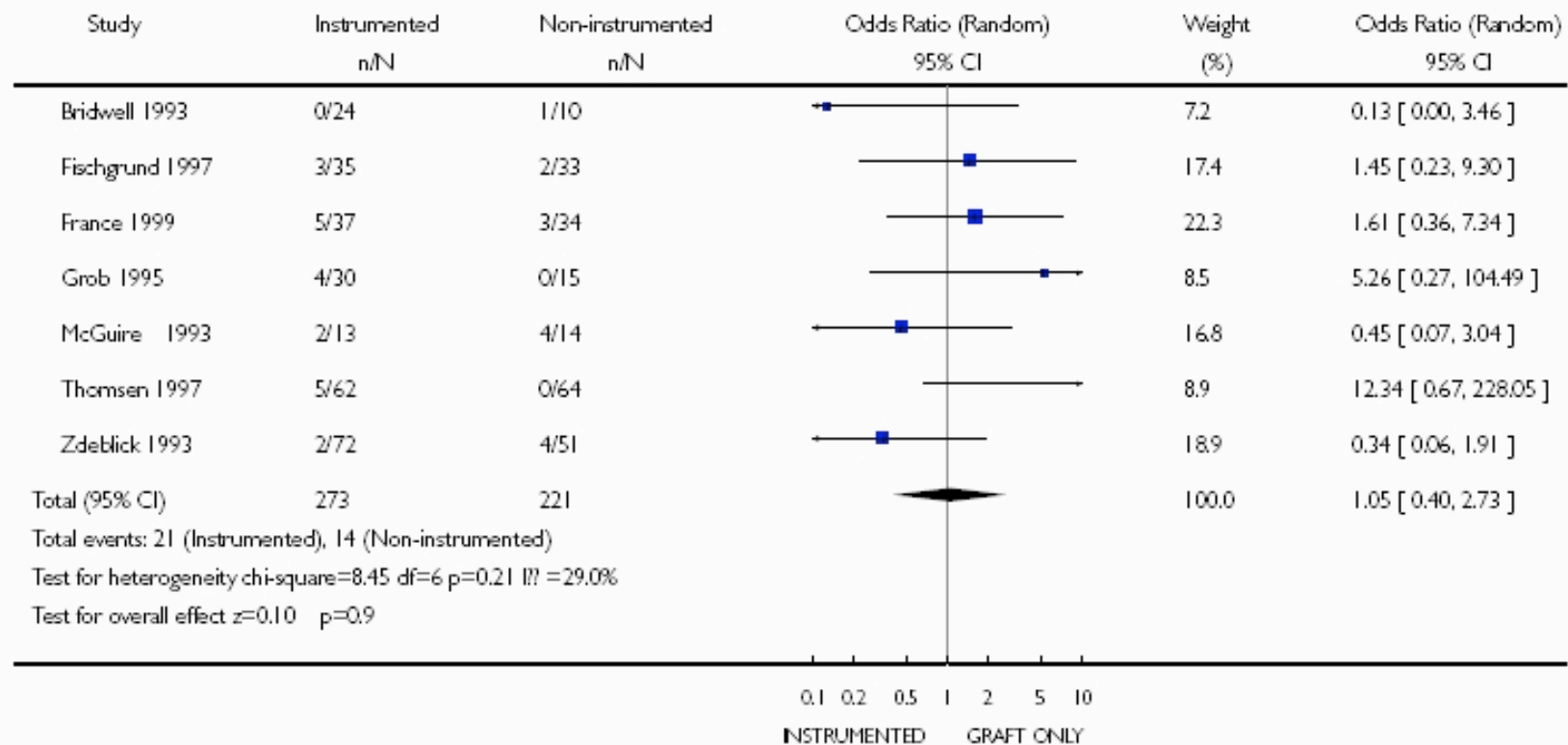
**Fig. 37. Comparison 12. INSTRUMENTED POSTEROLATERAL FUSION vs GRAFT ONLY (mixed disease)**

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





# Cochrane Review - Surgery for Degenerative Lumbar Spondylosis

Gibson & Waddell, August 2005

- 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

# BMPs and Lumbar Fusion

SPINE Volume 27, Number 23, pp 2662–2673  
©2002, Lippincott Williams & Wilkins, Inc.

## 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.

# Boden et al. 2002, Spine

- 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

# Arthroplasty

- Total Disc Arthroplasty:
  - Metal-Polyethylene-Metal: SB Charit III, ProDisc II
  - 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

# 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

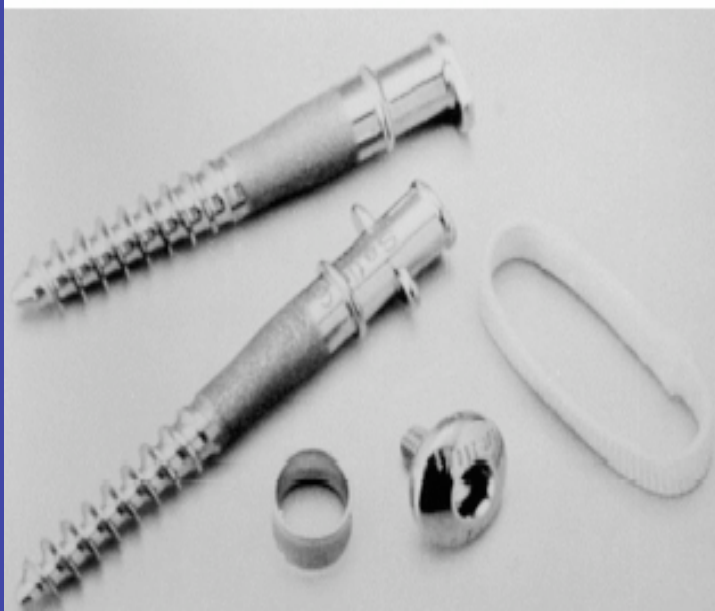
# Dynamic Stabilization

- Alters the mechanical loading of the motion segment by unloading the disc

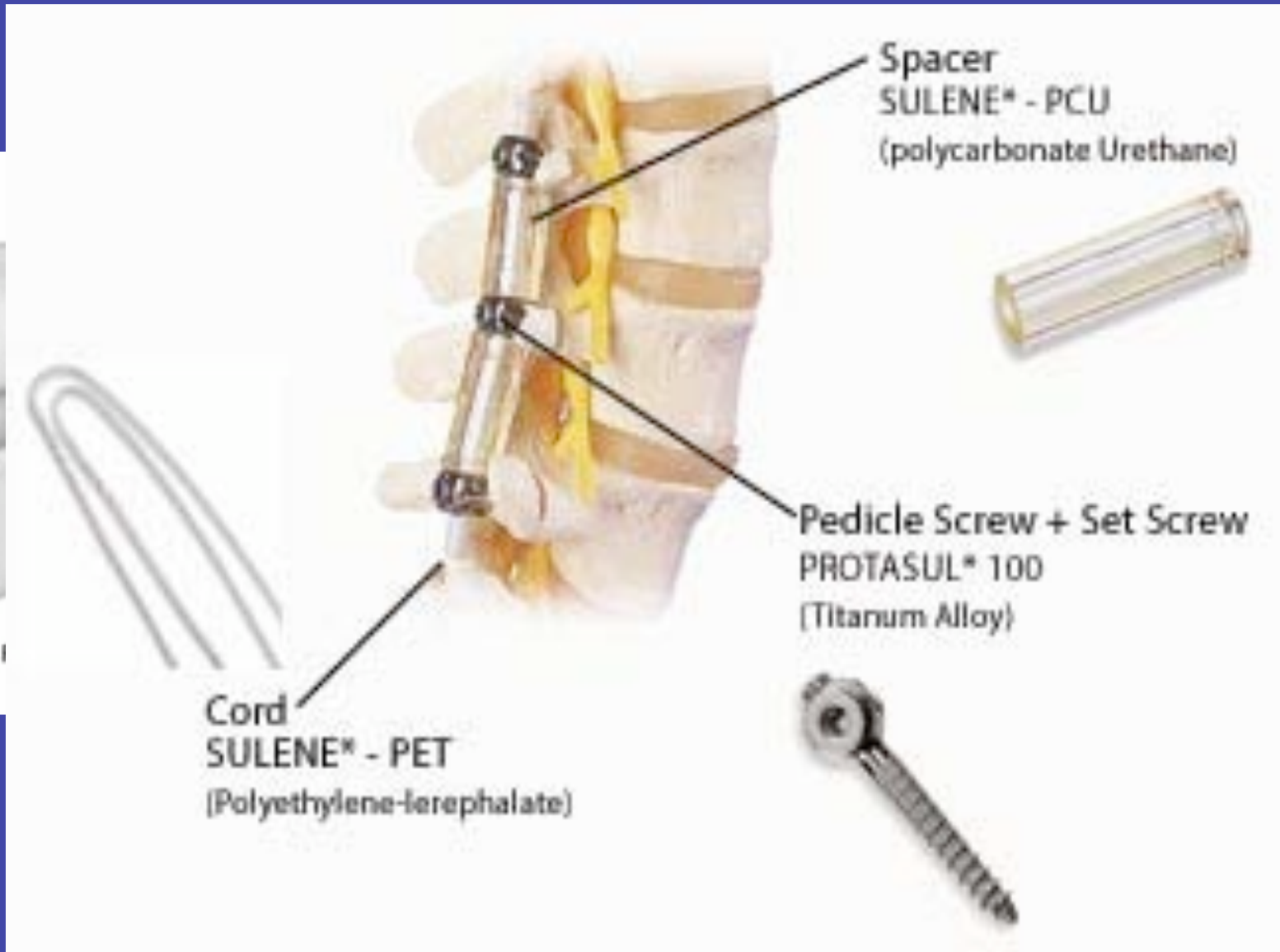
• Adjunct or alternative to fusion

- Especially helpful if the pathology of postural back pain is altered load transmission
-

# Graf



# Dynesys® System



# Results

- Ongoing RCT: Dynesys vs Posterior Lumbar Fusion with autograft and pedicle screw

# Dynamic Interspinous Process Technology

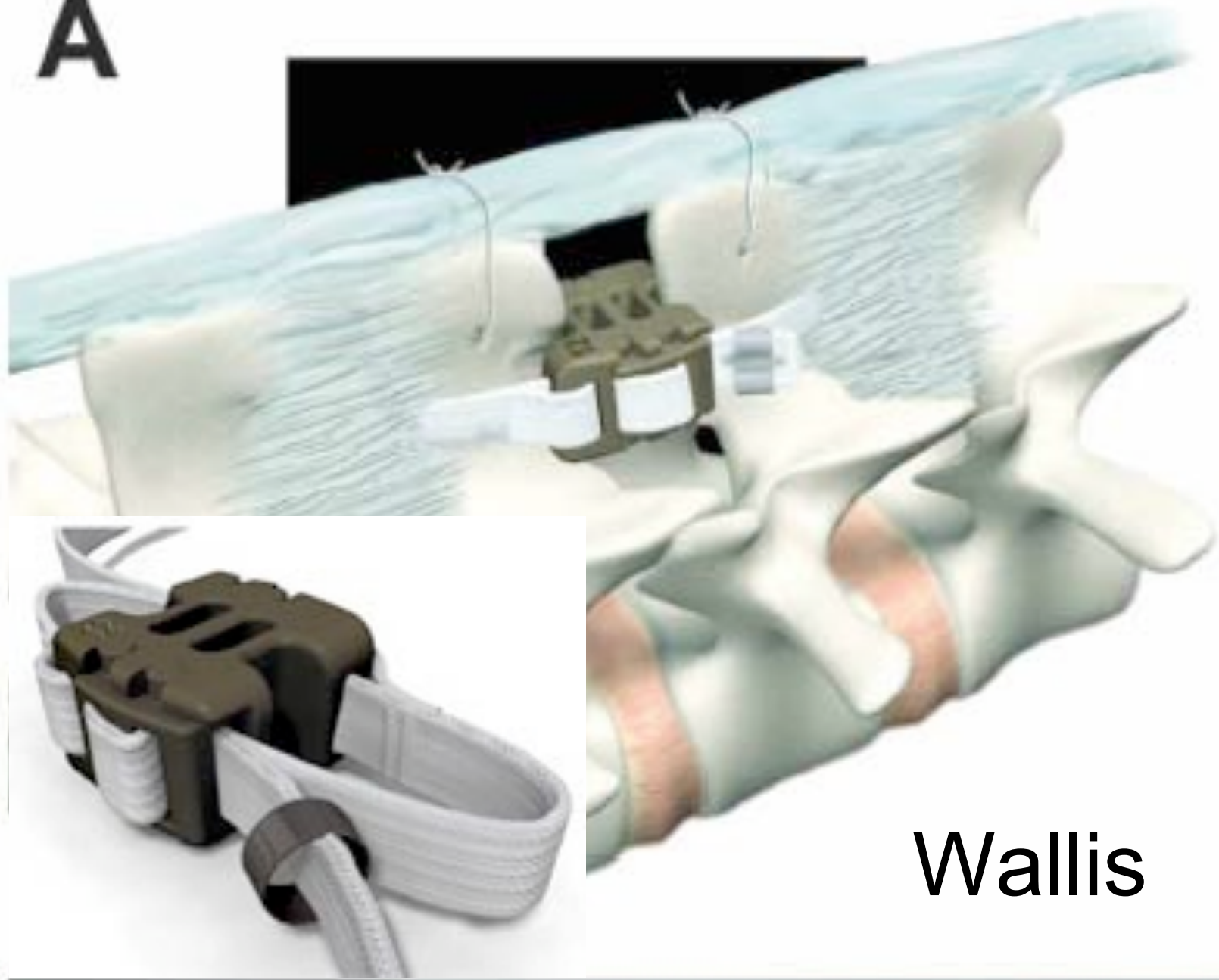




# Rationale

- 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

**A**



**Wallis**

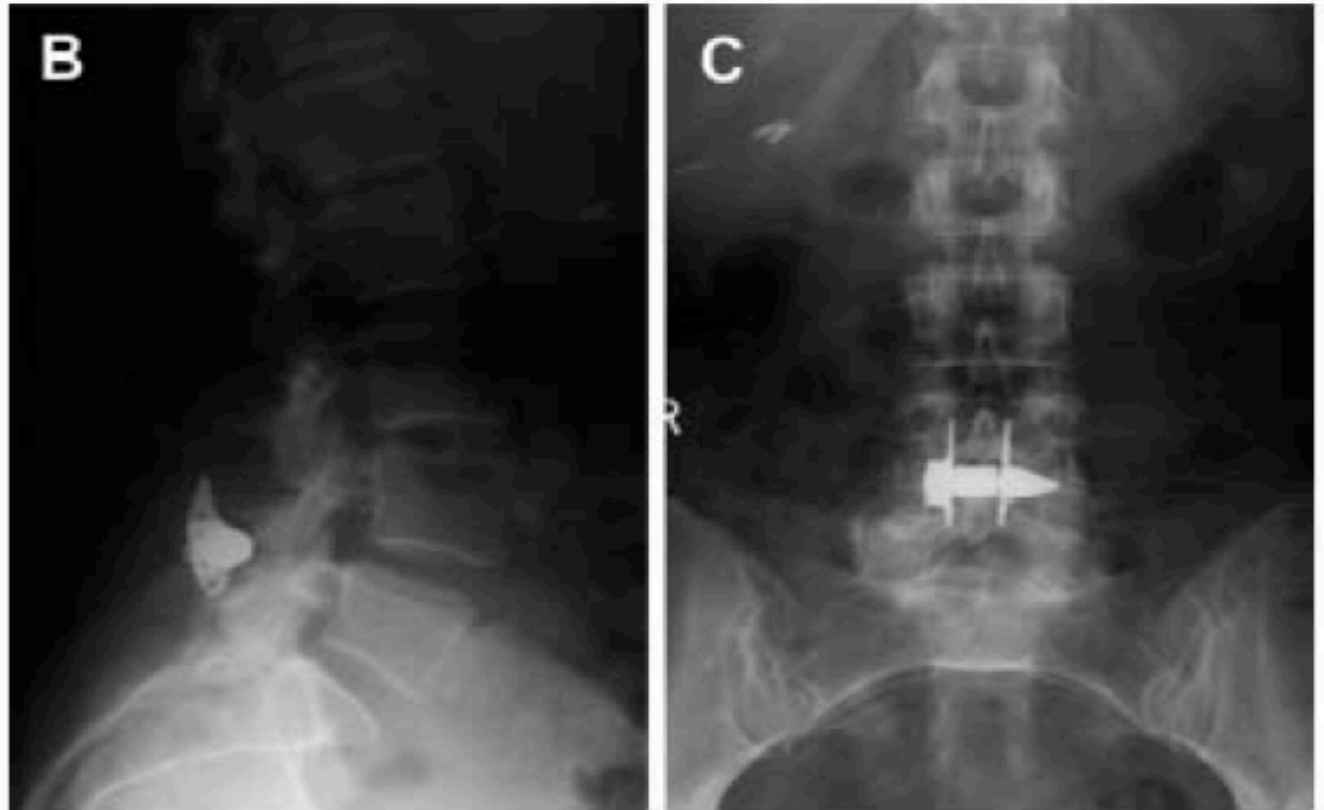


Figure 3. The X Stop. A, Illustration of the device. Lateral (B) and AP (C) postoperative views of implant. (Images are courtesy of St. Francis Medical Technologies.)

# Results

- Few case series and prospective cohort
- Ongoing RCT for Wallis, [www.spinalconcepts.com](http://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

“The decision is more important than the incision.”

Anonymous

**Eat the  
nut!!**

**Do not eat  
the nut!!**



**What do  
I do??**

