Evidence Based Medicine in Spinal Surgery

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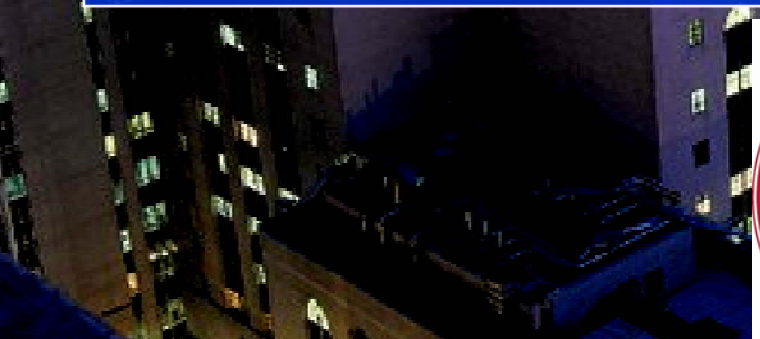


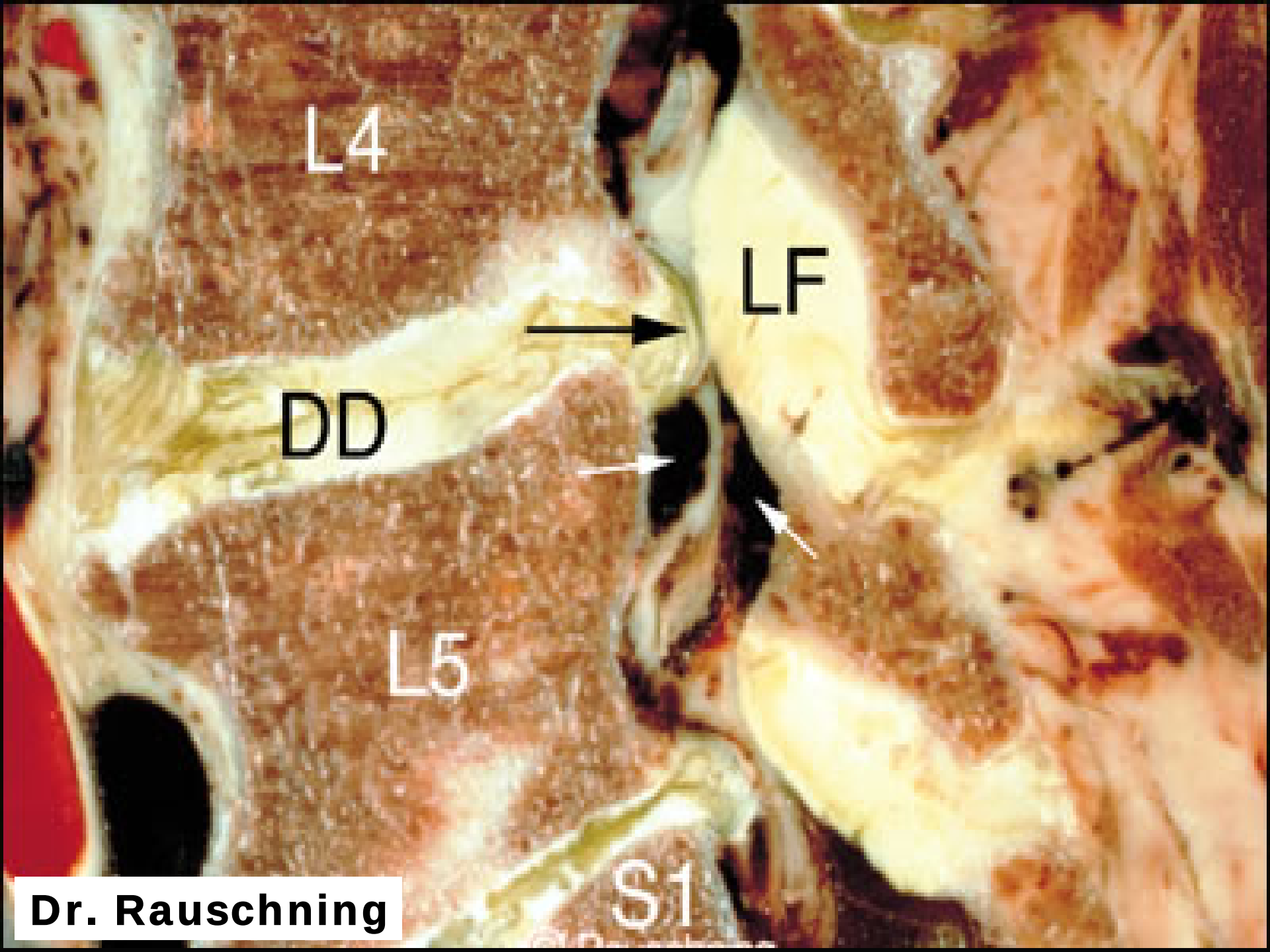
Weill Cornell
Brain and Spine Cente

Disclosure

- Synthes
  - Consultant
- Baxter
  - Fellowship funding / Consultant
- Spinewave
  - Consultant
- BrainLab
  - Consultant
- Lanx
  - Consultant
- AOSpine
  - AOSpine NA Board
  - Fellowship funding
  - Research funding

Back Pain

- Degenerative Disc disease
- Disc herniation
- Spinal stenosis
- Congenital anomalies
  - Spondylolisthesis = “Slippage”
- Trauma
  - Sprains and Strains
  - Fractures
- Facet-joint pain
- Sacro-iliac joint pain
- Neoplasm, infection, referred pain



Dr. Rauschning

Types of low back pain

- Radicular pain; Sciatica
  - Herniated disc
  - Foraminal stenosis
- Neurogenic claudication
  - spinal stenosis
- Chronic low back pain
  - DDD
  - “instability”
- Referred pain: hips, knees

SPINE Volume 34, Number 1, pp E27–E32

How Often Is Low Back Pain Not Coming From the Back?

Jonathan N. Sembrano, MD, and David W. Polly, Jr, MD

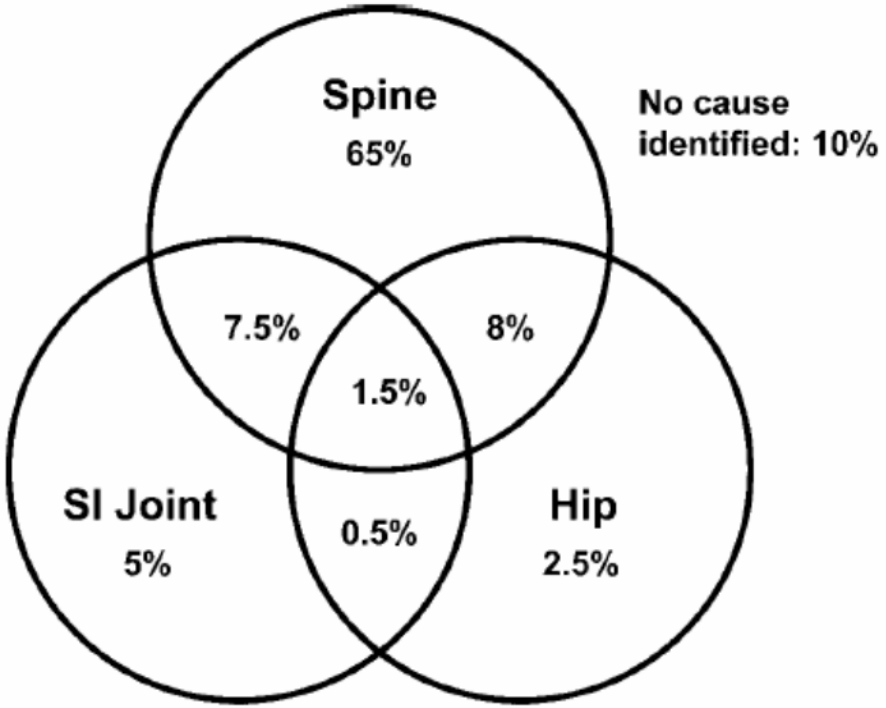


Figure 5. Venn diagram showing the distribution of pain generators (spine, hip joint, and SI joint) being responsible for symptoms in 200 patients complaining of low back pain, after diagnostic workup.

For 95% of patients:

Medicine

Psychology

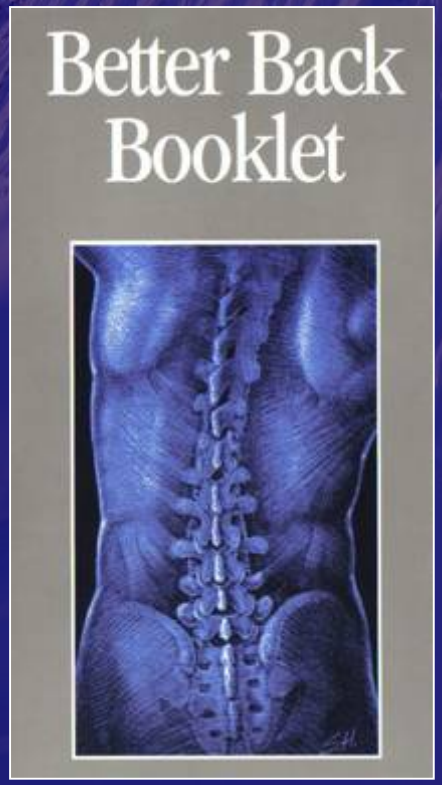
Radiology

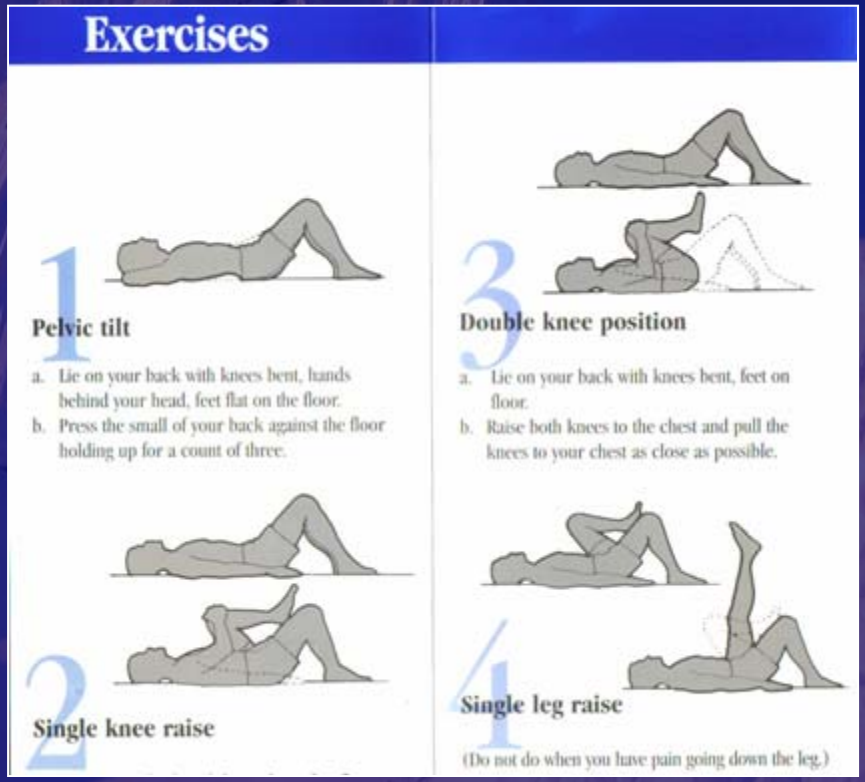
Neurology

Complementary Medicine

Non-operative management

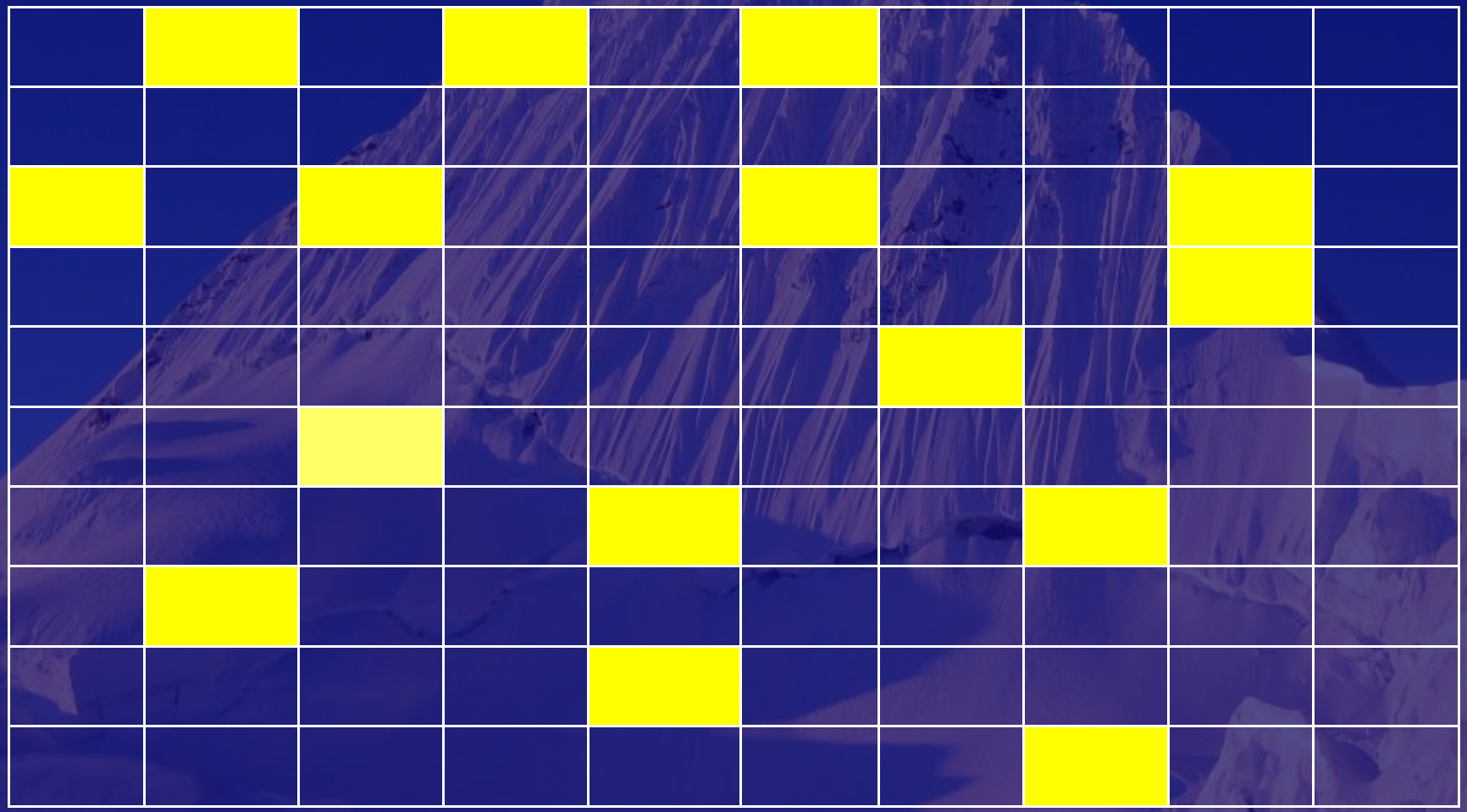
- At least 6 weeks
- Limited bedrest, early mobilization
- Exercises / PT
  - Aerobic, stretching, isometric



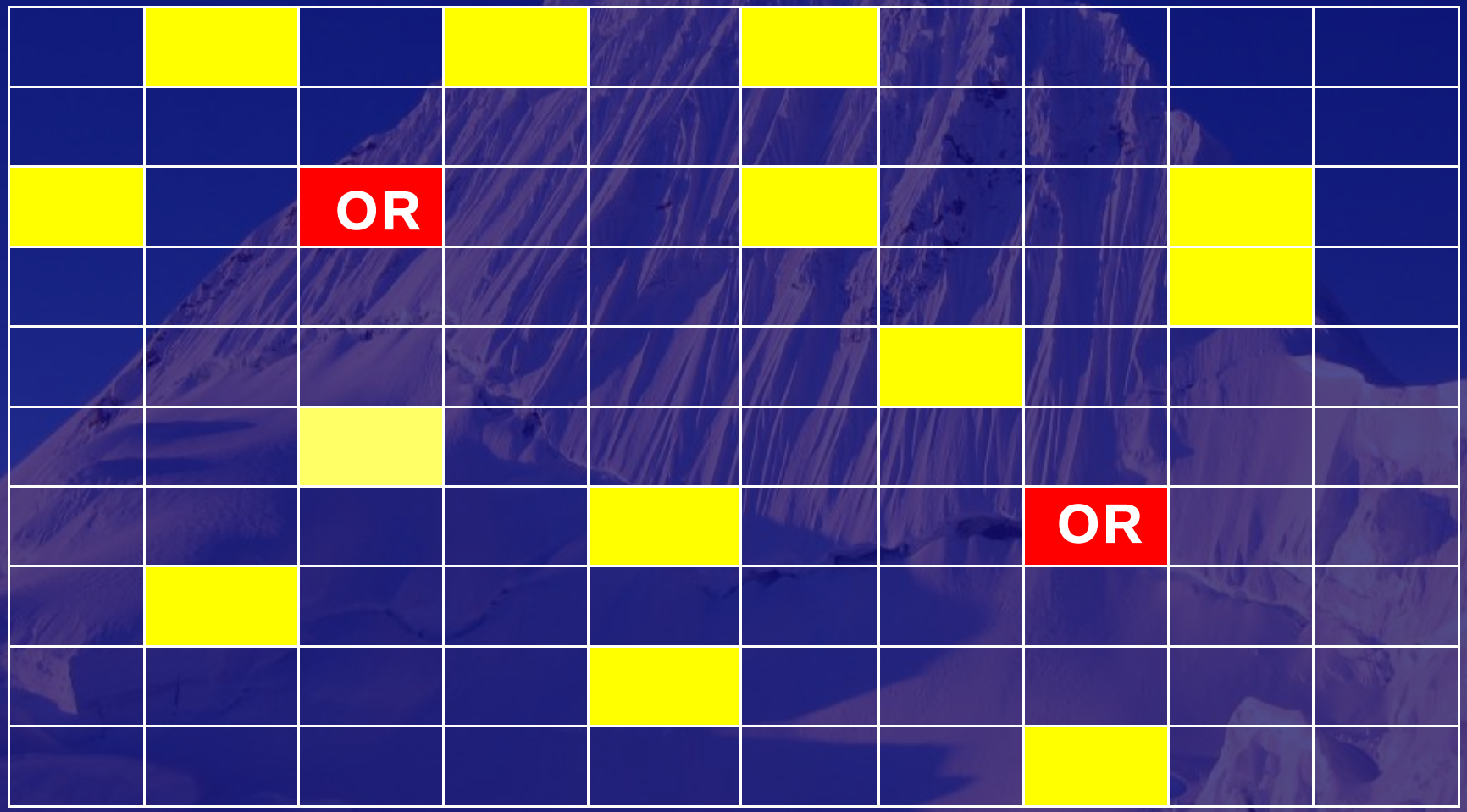


100 patients with low back pain

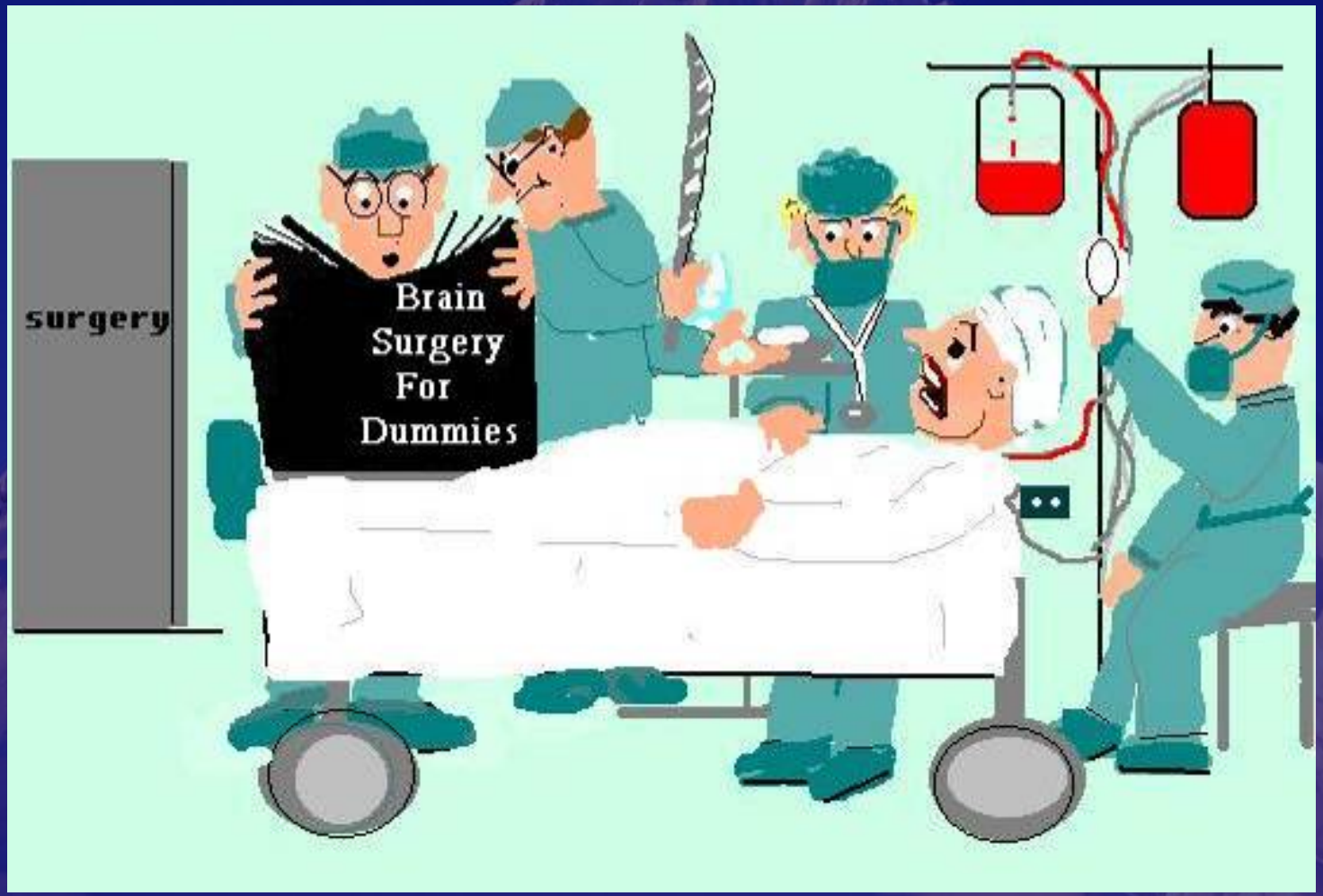
100 patients with low back pain



100 patients with low back pain



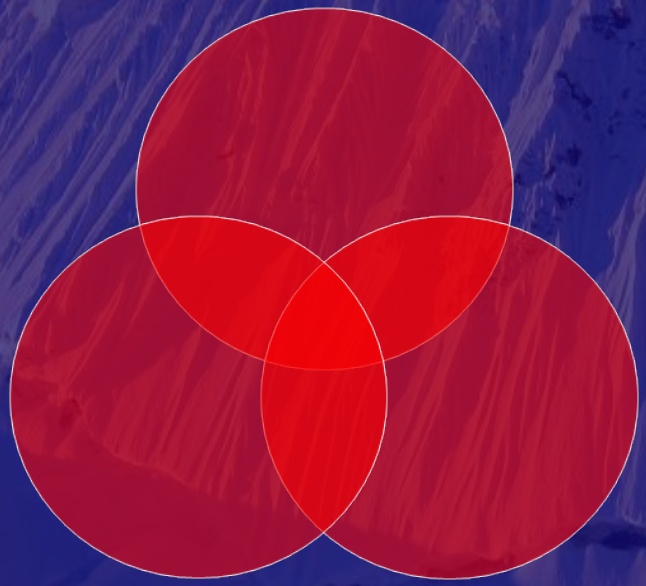
What happens if non-operative treatment fails?



The Role of Surgery

- Short answer -

Neck / back pain



Radiculopathy
= pain going down the leg

Myelopathy / Cauda equina
= Spinal cord or nerve injury

The Role of Surgery

- Short answer -

- **Factors that favor Surgery**
  - **Clinical findings and MRI findings fit**
  - **Failure of non-operative treatment**
  - **Severe Pain**
  - **Neurological deficit**
    - **Weakness**
    - **Bowel / bladder incontinence**
  - **Leg or arm pain or weakness**

What is Evidence Based Medicine?

The use of clinical methods and decision making that have been thoroughly tested by properly controlled peer-reviewed medical research.

Evidence Based Medicine

Class I

- Prospective, Randomized, Controlled Trials

Class II

- Non-Randomized, Prospective Controlled Trials
- Observational Studies

Class III

- Case Series
- Case Reports
- Expert Opinion

Evidence Based Medicine

- **Level 1 Recommendation**
  - –Class I Evidence
- **Level 2 Recommendation**
  - –Class II Evidence
- **Level 3 Recommendation**
  - –Class III Evidence

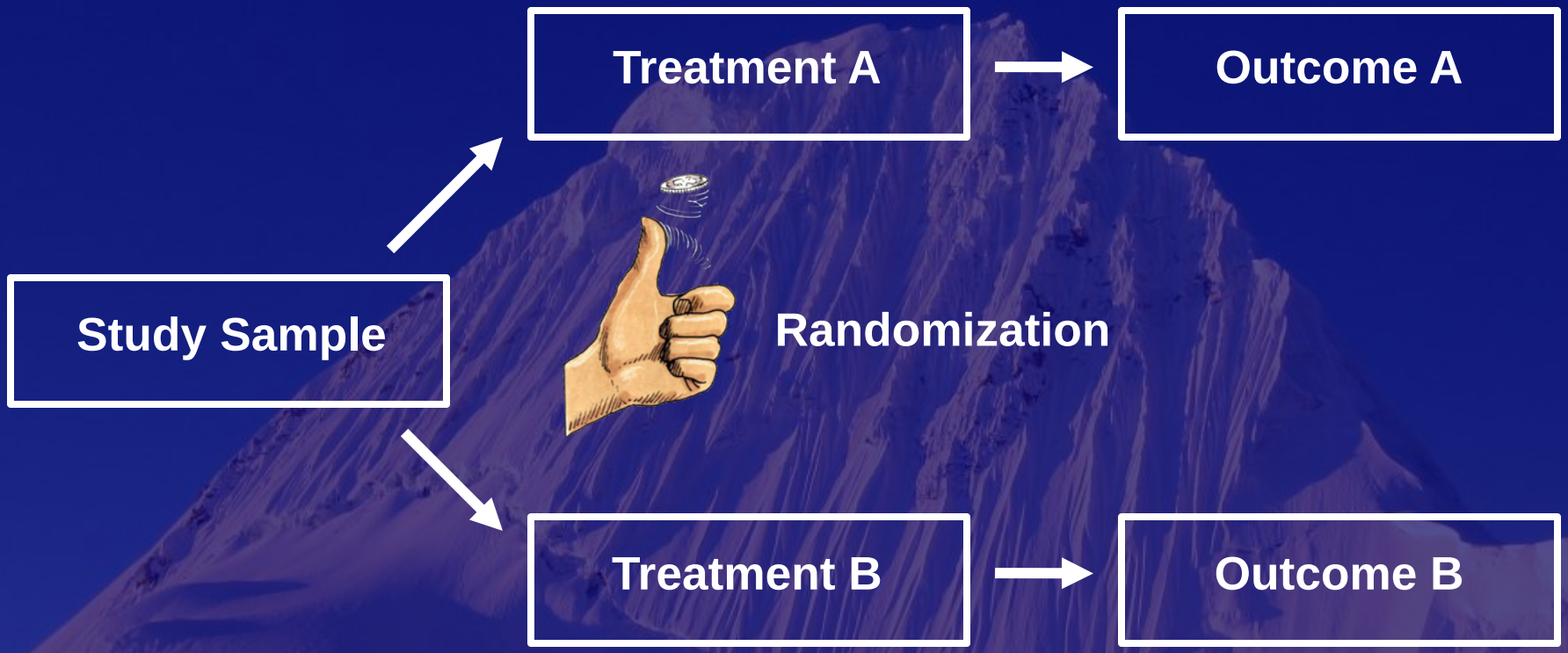


Diagram demonstrating the basic design of a RANDOMIZED CONTROLLED TRIAL. The study sample is randomized to different treatments, and the outcomes are prospectively determined.

The Importance of Study Design in the Spine Literature, Pearson A.,et.al.
Seminars in Spine Surgery, Vol 21 (4), Dec 2009

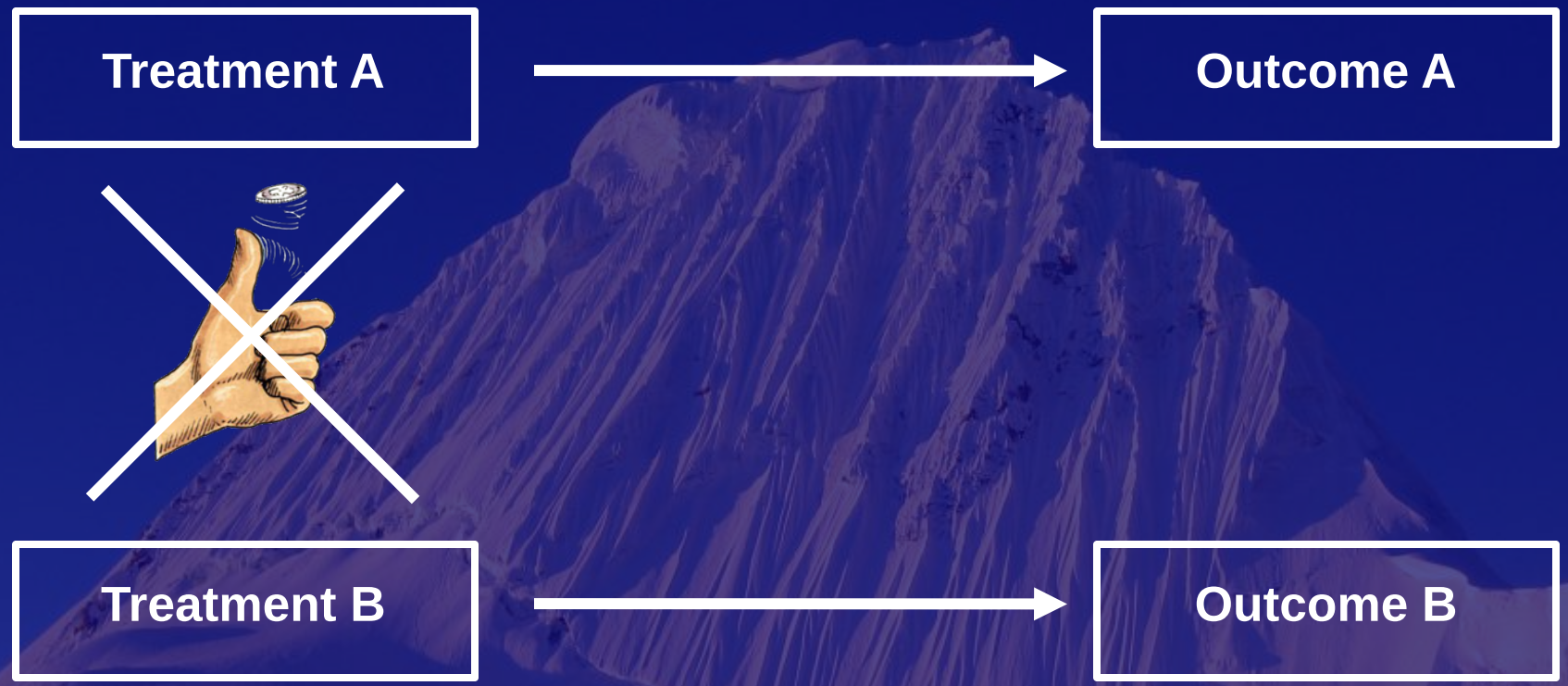


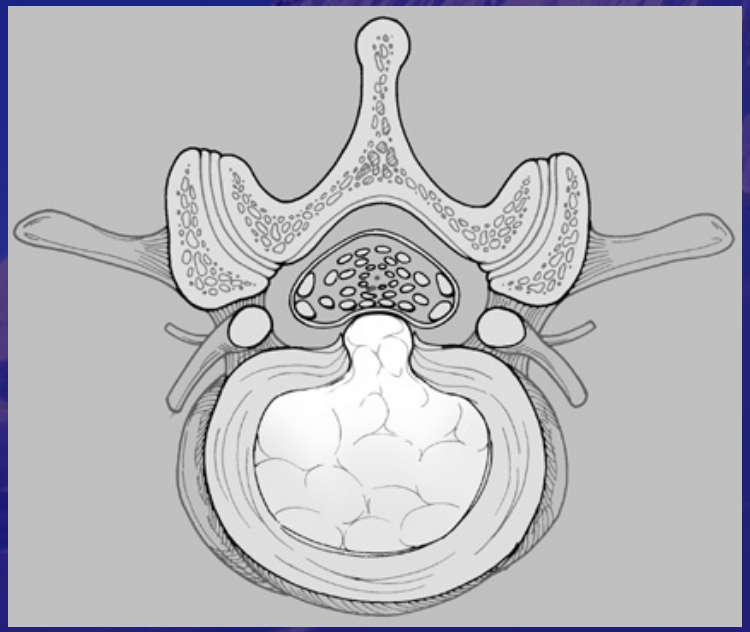
Diagram demonstrating the basic design of an OBSERVATIONAL COHORT STUDY. The treatment is chosen by the patient and physician rather than through randomization. The study groups are defined by treatment and outcomes are compared. Cohort studies can be prospective or retrospective.

The Importance of Study Design in the Spine Literature, Pearson A. et.al.
Seminars in Spine Surgery, Vol 21 (4), Dec 2009

Evidence Based Medicine: Spine

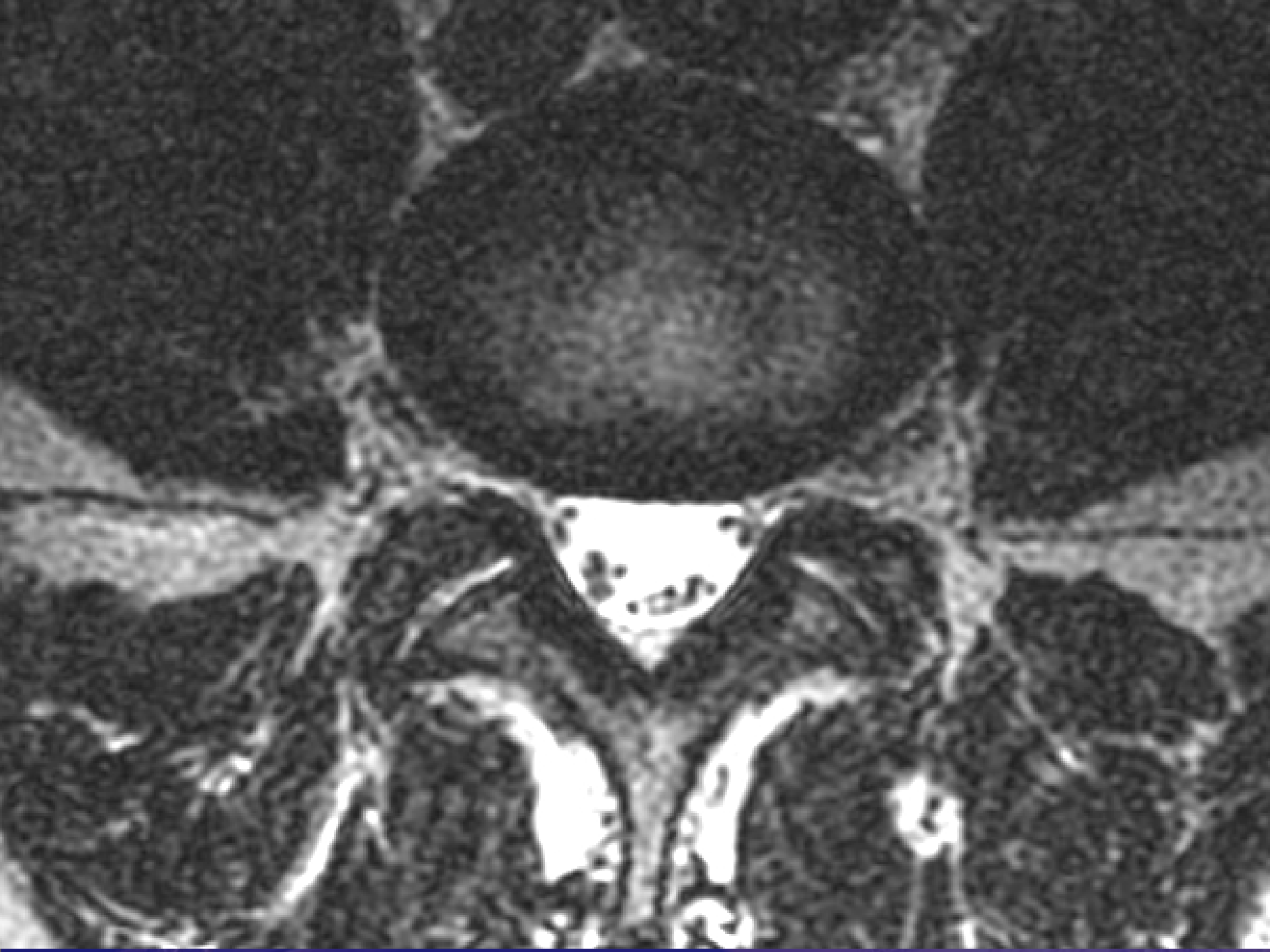
- Lumbar HNP (3)
- Lumbar stenosis (3)
- Degenerative spondylolisthesis (5)
- Axial LBP (4)
- Artificial disc (3)

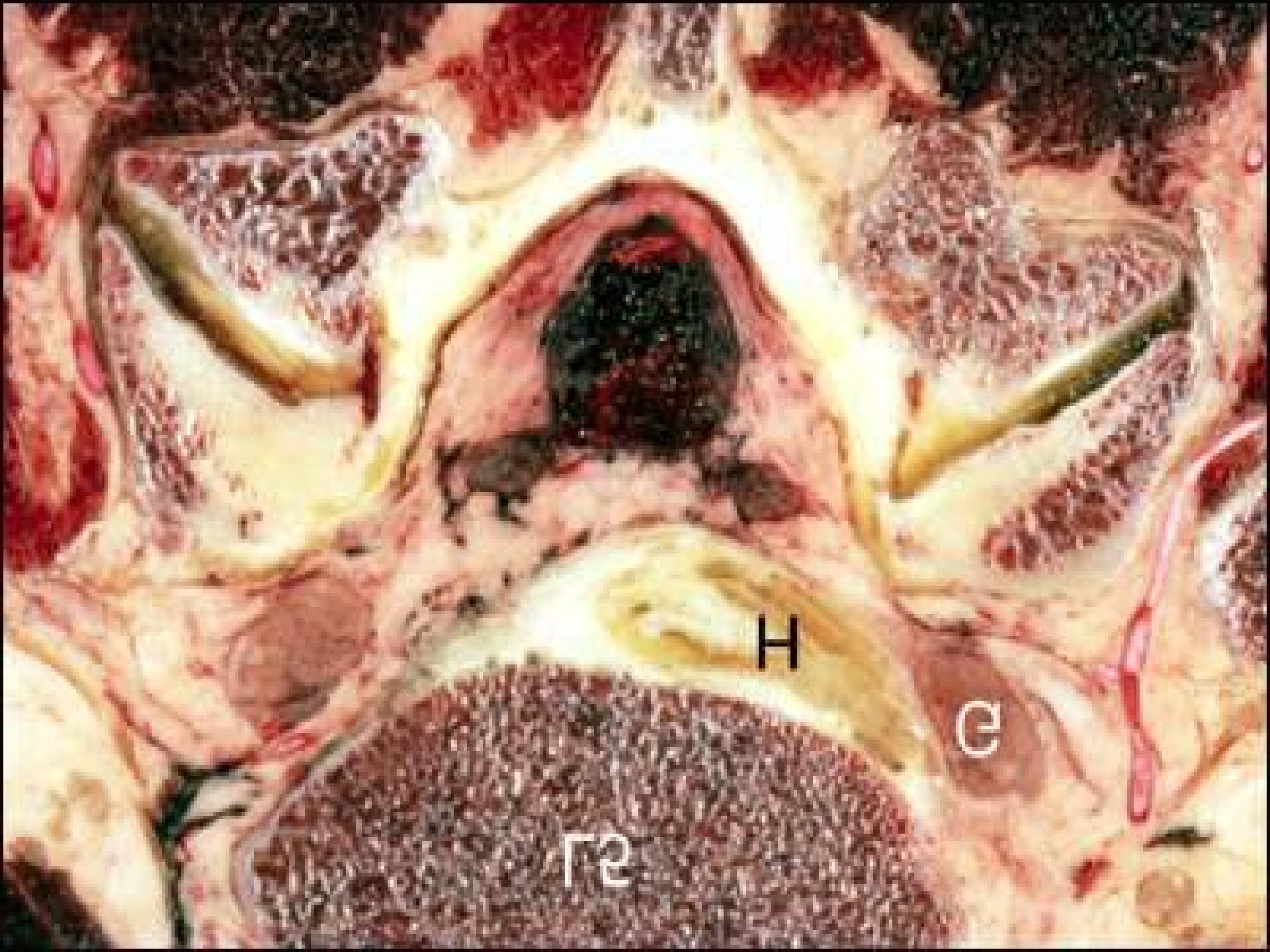
LUMBAR HERNIATED NUCLEUS PULPOSUS



Case example: Herniated Lumbar Disk

- 43 y/o male with 2 months of pain radiating into right foot
- No relieve by physical therapy and medication
- No back pain, weakness or urinary incontinence
- No “red flags”

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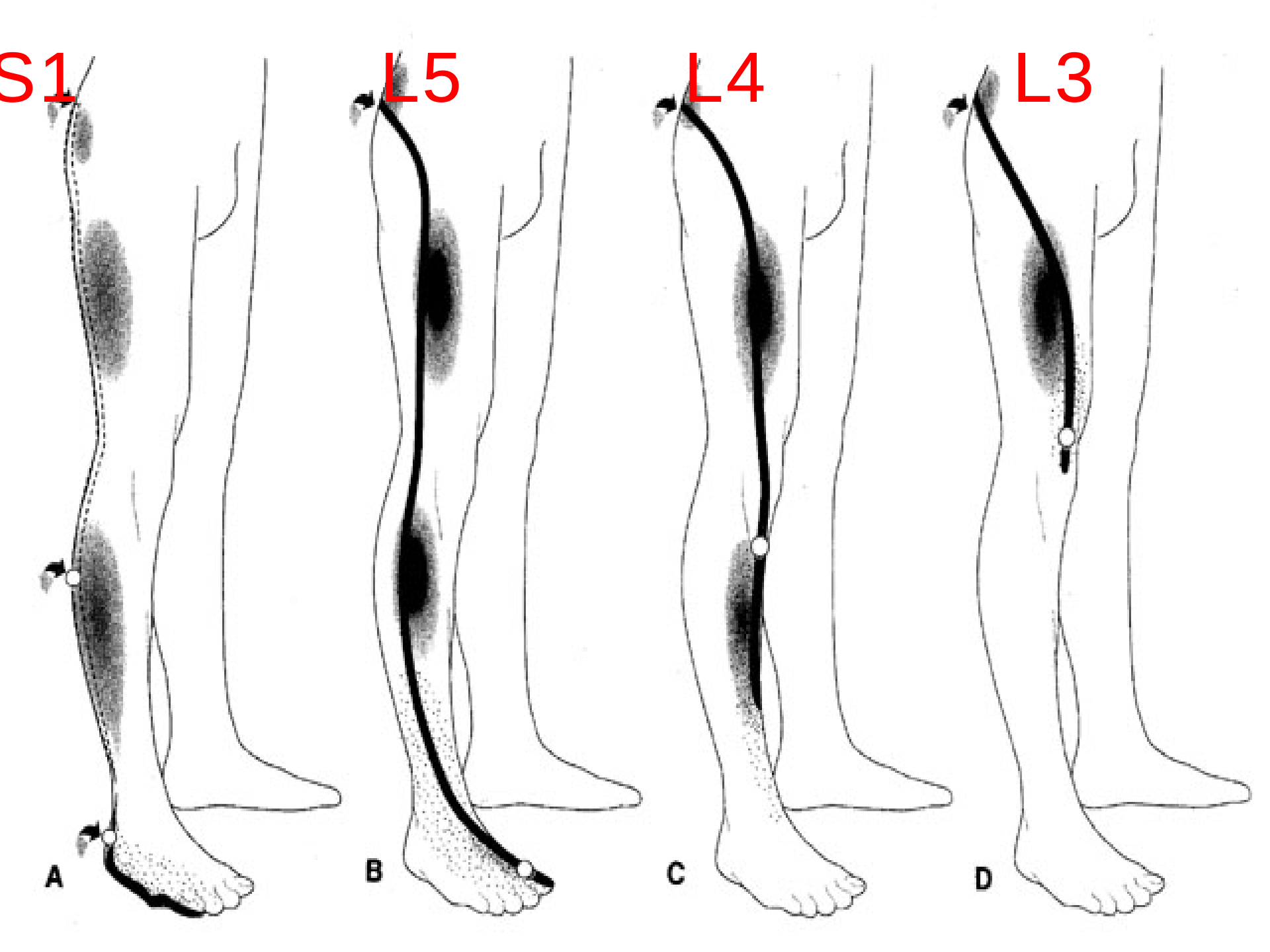
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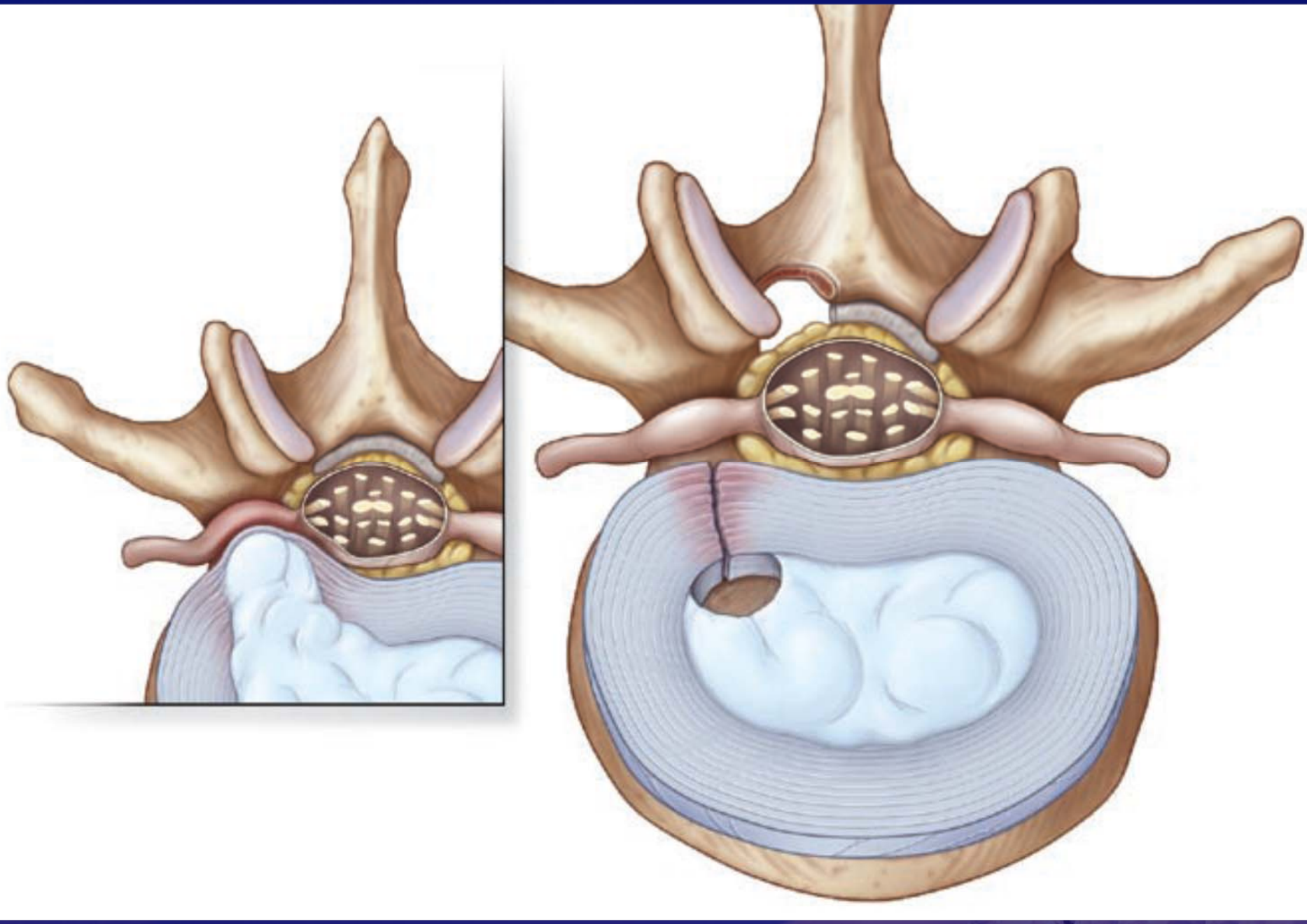


EBM-Spine: Lumbar HNP

Peul WC et al NEJM 2007

Design

Multicenter RCT with ITT Analysis

Patients

141 Patients- early surgery (median: 1.9 weeks)
142 Patients- non-operative management

Results

Early surgery resulted in faster recovery
No difference in outcomes in 1 year

Limitations

High cross-over rates
- 11% of surgery → conservative
- 39% of conservative → surgery

Blinding not possible
Follow-up only 1 year

EBM Spine: Lumbar HNP

Atllas SJ, et. al. Spine 2005 (Maine Lumbar Spine Study)

Design

Prospective Cohort Study (observational)

Patients

235 Surgery

272 Conservative

Results

Surgery: Improved in pain, function and satisfaction outcomes at 1, 5 and 10 years.

No difference in work status, surgery vs. conservative.

Benefit of surgery narrowed between the two groups over time but still statistically different at 10 years.

Limitations

Imaging not required

Mail in questionnaire rather than actual clinical exam.

EBM Spine: Lumbar HNP

Spine Patient Outcomes Trial (SPORT)

Weinstein JN , et.al. JAMA 2006, Spine 2008

Design

2 Combined Trials (Due to protocol non-adherence)

- RCT- 501 Patients
- Observational Cohort- 743

Patients

- 1244 total

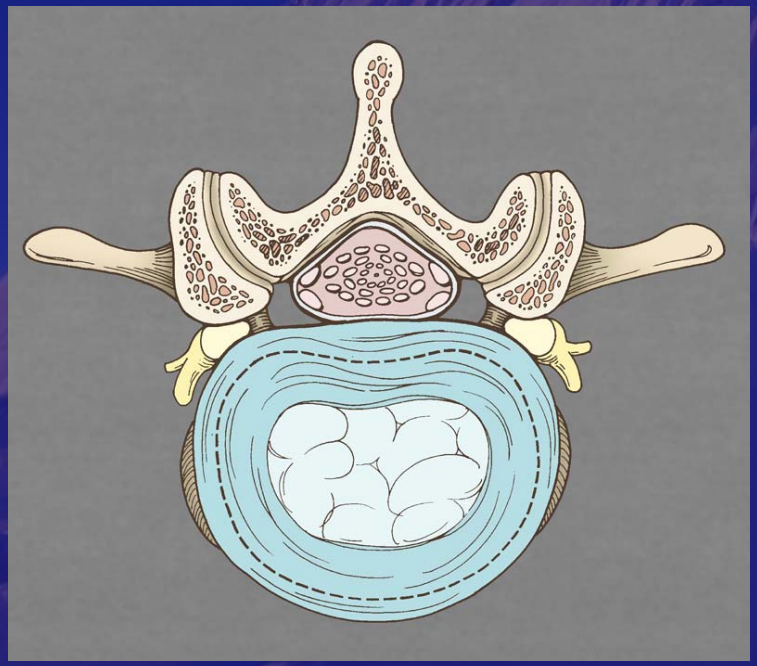
Results

- Surgery resulted in greater improvement compared with non-operative treatment at 4 years.

Limitations

- Cross over (40% of surgery group, 45% of non-operative). This precluded meaningful analysis of the data on an ITT basis because the 2 groups were very similar in treatment received at 2 years.

LUMBAR STENOSIS



EBM Spine: Stenosis

The Finnish Spinal Stenosis Study

Simotas A.C., Clin. Orthopedic Relat Res 2001

Design

RCT with ITT Analysis

Patients

94 Patients, (50 Surgical, 44 Non-surgical)

Results

Surgery better in ODI, leg and back pain. Greater difference at 1 year than at 2 years

Crossover rate 10% (low) in either direction.

Level I evidence favoring surgery but not in walking ability

Limitations

Small number of patients

20% of surgery group had instrumented fusion (variation in surgical management)

EBM Spinal: Stenosis

Maine Lumbar Study Atlas SJ et al, Spine 2005

Design

Prospective observational Cohort

10 year follow-up

Patients

148 Patients- (81 Surgical, 67 Nonsurgical)

Results

Level 2 evidence that decompression MAY provide better outcomes over nonsurgical treatment.

Limitations

Cross over to surgery 39%

Non-randomized: more severe patients to surgery.

Few patients with mild symptoms were treated with surgery

EBM Spine: Stenosis

Sport Trial for Lumbar Spinal Stenosis
Weinstein J, et. al., NEJM 2008, Spine 2010

Design

RCT with prospective observational Cohort

Patients

654 Patients (289 RCT, 365 Observational)

Results

Level 2 evidence to suggest that surgery results in better outcome at 2 years and maintained at 4 years.

Limitations

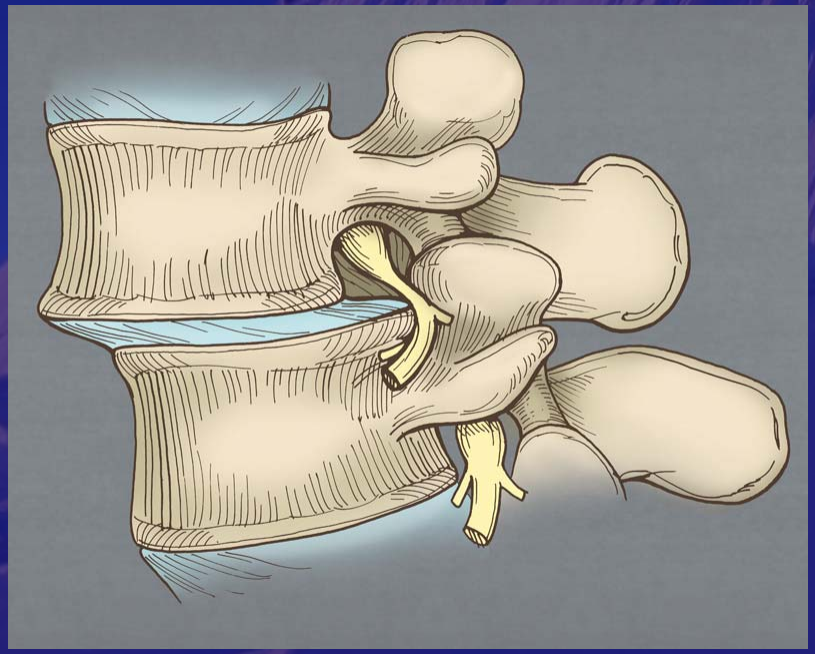
High cross over

- 33% of surgery group to non-surgery group
- 43% from non-surgery group had surgery

Surgical treatment variable (11% had a fusion)

Non-surgical treatment not specified

DEGENERATIVE SPONDYLOLISTHESIS



EBM:Degenerative Spondylolisthesis

Surgical vs. Nonsurgical Treatment for Lumbar Degenerative Spondylolisthesis
Weinstein J. et. al. NEJM 2007, JBJS 2009

Design

RCT with prospective observational cohort
(304 RCT, 303 Observational Cohort)

Patients

521 Patients Follow-up, (372 Surgery, 149 No-surgery)

Results

Surgery patients (laminectomy with 1 level fusion) had substantially greater pain relief and improvement in function at 4 years.

Limitations

High level of cross over, difficult to interpret ITT analysis
36% of surgery group, 49% of non-operative group

Non-operative treatment not standardized

Surgical treatment not standardized
(fusion posteriorly or circumferentially with or without instrumentation)

EBM:Degenerative Spondylolisthesis

The Surgical Management of Degenerative Lumbar Spondylolisthesis: A Systemic Review. Martin CR et.al. Spine 2007

Design

Literature Review: RCT and comparative observational studies in English, German and French (1966-2005)

Patients

13 Studies of 578 patients

Results

Fusion is more effective than laminectomy in achieving a satisfactory outcome

Instrumentation increased fusion rate

Decompression only had the least satisfactory outcome

Limitations

Some studies included non-consecutive patients

Some had undefined follow-up

No standardized outcome measure was used consistently

Strenghts

Comprehensive review on degenerative spondylolisthesis

EBM: Degenerative Spondylolisthesis

"Degenerative Lumbar Spondylolisthesis with Spinal Stenosis" Kornblum, et.al. Spine 2008

Design

A Prospective Long Term Study "Comparing Fusion and Pseudoarthrosis"

Patients

58 Patients with laminectomy and non-instrumented fusion

Results

Good or excellent outcome in
- 86% fusion
- 56% non-union

25/47 (53%) developed non-union

Strengths

Follow-up was long (5-14 years)

Limitations

Small number
Non-standardized outcome measure
19% (11 patients) lost to follow-up
Single center, secondary analysis

EBM:Degenerative Spondylolisthesis

Surgical Treatment of Spinal Stenosis with Spondylolisthesis: Cost Effectiveness after 2 years

Tosteson AN et al, Ann Internal Medicine 2008

Design

Prospective Cohort Study

Patients

601 Patients (randomized and observational cohort)

368 Surgery (fusion in 93% / 78% instrumentation)

233 Non-surgery

Results

A trend toward improved cost effectiveness with circumferential instrumented fusion

Surgery results in better improvement of health

Strengths

Multicenter study

Large number of patients

RCT and observational patients

Validated outcome measure used

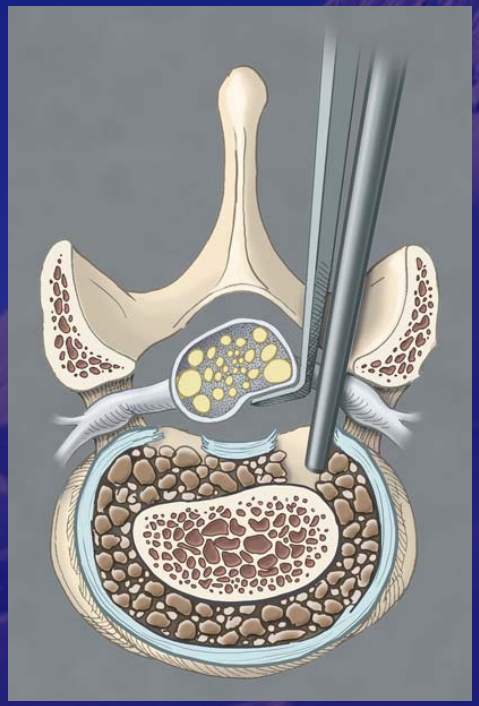
Limitations

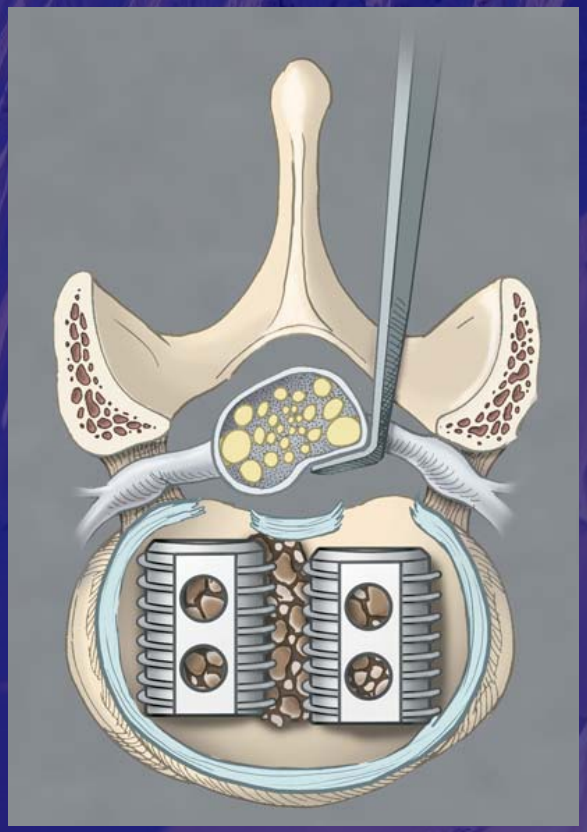
Non-operative care not specified

Costs relied upon self-reported utilization data

Follow-up limited to 2 years

AXIAL
LOW BACK PAIN





EBM: Axial Low Back Pain

Lumbar Fusion Versus Treatment of Chronic Low Back Pain: A Multicenter Randomized Controlled Trial From the Swedish Spine Study Group Fritzell P, et al Spine 2001

Design

Multicenter RCT with 2 year follow, ITT Analysis

Patients

292 (Fusion 222, Non-operative 72)

Results

Fusion may lead to better outcome

Strengths

Multicenter RCT small dropout (5 patients)

Limitations

No standardization in either group

Industry funding

Asymmetry of group sizes 75 (due to design as multiple fusion arms)

EBM: Axial Low Back Pain

Randomized Controlled Trial to Compare Surgical Stabilization of the Lumbar spine with Intensive Rehabilitation for Patients with Chronic Low Back Pain: The MRC Spine Stabilization Trial. Fairbank et al BMJ 2005

Design

Multi-centre RCT with 2 year follow-up

Patients

349 Patients (179 Surgery, 170 Rehab)

Results

Improvement above rehabilitation in ODI (4.1) with surgery (barely statistically significant)

Strengths

Multicenter RCT

Multiple outcome measures (ODI, walking test, SF36, work status)

Limitations

High crossover (28% non-operative to rehabilitation)

Included redo's and spondylolisthesis

Flexible stabilsations included as fusion

EBM: Axial Low Back Pain

Randomized Clinical Trial of Lumbar Instrumented Fusion and Cognitive Intervention in Patients with Chronic Low Back Pain and Disc Degeneration. Brox et al Spine 2003

Design

RCT with 1 year follow-up

Patients

64 patients

Results

Both groups improved significantly and equally

Strengths

Blinding of physical therapy evaluator

Standardized nonsurgical treatment

Limitations

Short follow-up

Small numbers

Lack of no treatment arm

Failure of treatment in assigned group (4/37 of the surgery group and 2/27 in non-surgical)

EBM Spine: Axial LBP

Lumbar Instrumented Fusion Compared with Cognitive Interventio and Exercises in Patients with Chronic Low Back Pain After Previou Surgery for Disc Herniation: A Prospective Randomized Controlle Study. Brox et al Pain 200

Design

Nationwide (Norway) RCT with 1 year follow-up and ITT Analysis

Patients

60 Patients

Results

No Difference

Strengths

RCT

Validated outcome measures

Blinding of PT evaluator

Limitations

Short follow-up (1year)

Small numbers

Lack of no treatment arm

7/29 Did not have surgery, 2/31 Did not have non-surgical

ARTIFICIAL DISC

EBM: Artifical Disc

Results of Prospective, Randomized, Multicenter Food & Drug Administration Investigational Device Exemption Study of Pro Disc-L Total Disc Replacement vs. Circumferential Fusion for the Treatment of 1 Level Degenerative Disc Disease Zigler et al Spine, 2007

Design

Multicenter randomized controlled non-inferiority trial with 2 year follow-up

Patients

161 pro-disc patients, 75 fusion patients

Results

Study suggests that short-term outcomes of artificial disc replacements are similar to or marginally better than fusion

Strengths

RCT

Limitations

Industry funding

About 10% lost to follow-up in each group

FDA revision of success criteria

EBM: Artifical Disc

A Prospective Randomized Food and Drug Administration Investigational Device Exemption Study: Lumbar Total Disc Replacement with the Charité Artificial Disc vs. Lumbar Fusion. Part I: Evaluation of Clinical Outcome. Bleumenthal S, et al Spine, 2005

Design

Multicenter RCT non-inferiority trial with 2 year follow-up

Patients

304 Patients. (205 Artificial Disc, 99 Anterior lumbar (BAK cage and autograft))

Results

Suggest that short term outcomes are similar or slightly better with artificial disc

Strengths

Multicenter RCT

Limitations

Large loss to follow-up (44 in disc group, 33 in fusion group)

Industry funding

72% of the disc replacement group and 86% of fusion group in the clinically "successful" results were still on narcotics at 2 years.

EBM:Cervical Artificial Disc

Combined Results of 3 US IDE Randomized Cervica Arthroplasty Trials with 2 years Follow-Up Upadhyaya et a Neurosurgery, 2010 (Abstract)

Design

Prospective randomized multicenter trials evaluating implants

2 year follow-up 605 study/561 control

Patients

Prestige- 276 study/265 control

Bryan- 242 study/221 control

ProDisc- 163 study/106 control

Results

Secondary surgery

3.1% study group vs. 8.2% control (fusion)

Strengths

Large multicenter RCT

Limitations

Industry supported

Short follow-up

Conclusions from these Studies

Lumbar HNP

- Early surgery, faster recovery
- Surgery, greater improvement

Lumbar Stenosis

- Surgery

Degenerative Spondylolisthesis

- Surgery – fusion with instrumentation

Conclusions from these Studies

Axial LBP

- Conservative vs Surgery: No difference

Artificial Disc

- Verdict not in

NONE are really Class I evidence

Studies in the Future

For Axial LBP

Studies to compare:

- fusion and structured post-op rehab
- to structured rehab only
- to a non-structured non-operative arm

For Axial LBP

studies examining the longevity and long term complication of artificial disc

Studies in the Future

For lumbar stenosis

- studies use validated oucomes (SSS / Zurich claudication questionnaire)

For degenerative spondylolisthesis

- There is no randomized controlled trial with long term follow-up comparing the various fusion techniques

Future studies will need to be:

- Not just effective but **cost effective**

Other questions remain....

Timing of the surgery?

Specific surgical technique?
(e.g. various fusion approaches)

The place for new technology
- disc arthroplasty?
- dynamic stabilization?
- BMP?

Alternatives to EBM based on Randomized Control Trial (RCT)

Observational cohort study

Best evidence & good judgment

Personalized medical treatments

EBM – Spine: Observational Studies for Providing the Best Answers to Some Questions

"RCT & Observational study design typically yield the same answer"

Benson K, Hartz AJ, NEJM 2000
Cancato et al NEJM 2000

OBSERVATIONAL STUDY

- Lower costs
- Easier patient recruitment

RCT

Extremely Expensive And Work Intensive

- 3 SPORT Studies - $12 million
- Difficult to obtain long term follow-up (SPORT IDH 35% lost to follow-up at 4 years).


BEST EVIDENCE
AND
GOOD JUDGMENT

EBM in Spine Practice

"Evidence-based medicine is the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual practice."

"EBM is not restricted to randomized trials and meta analysis."

Evidence Medicine: Which is it and which is not
Sackett, et al BMJ 1996

“It involves integrating individual clinical expertise with best available external clinical evidence from systemic research.”

Individual Clinical Expertise: Clinician experience and practice

External Clinical Evidence: Clinically relevant research