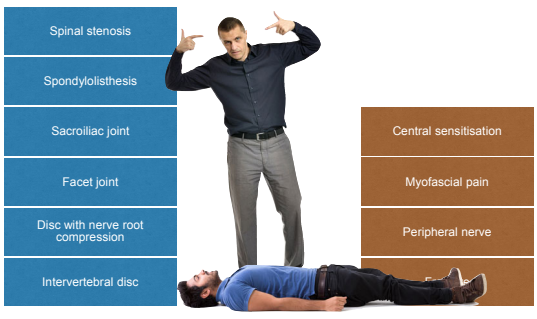
Indications for Lumbar Spine Surgery

Dr Anthony Nicholson DACNB FACO (aus)
CEO, Chiropractic Development International (CDI)
Adjunct Lecturer in Neuromusculoskeletal Diagnosis
Macquarie University
Chiropractor & Partner, Spine Partners Wahroonga
www.cdi.edu.au / www.spinepartners.com.au

OVERVIEW

Six major lower back pain diagnoses
Major goals for lumbar spine surgery
Most common reasons for lumbar spine surgery
Disc herniation
Degenerative instability
Spinal stenosis

WHAT DIAGNOSES ARE POSSIBLE?



MAJOR GOALS OF LUMBAR SURGERY

Surgery is decompressive in nature – most surgery is to prevent loss of function rather than to address pain *per se*

1. Progressive neurological insult
2. Instability

Unwise in patient exhibiting signs of CS, chronic pain or limbic overlay – "You can't cut out a patient's pain, only alter the anatomy and hope it doesn't hurt anymore"

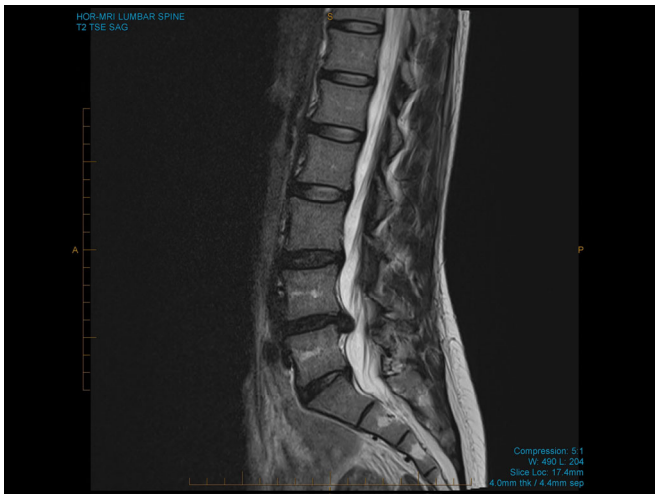
MAJOR REASONS FOR LUMBAR SURGERY

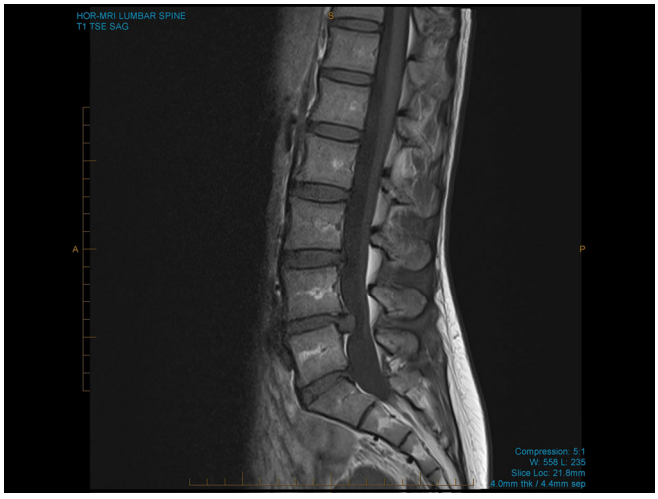
Disc herniation causing neural compression

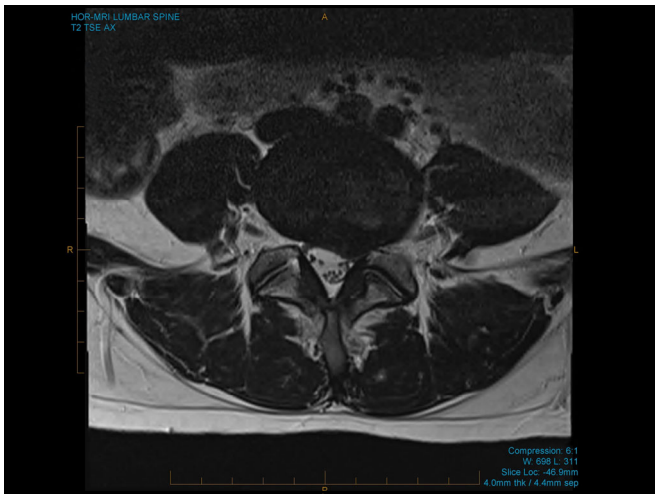
Spondylolisthesis and instability

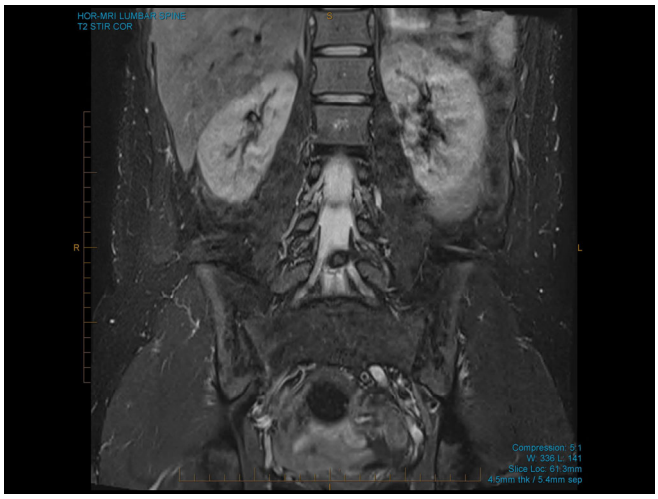
Lumbar spinal stenosis

John is a 35-year-old executive. He's been suffering from left-sided lower back pain, which radiates into the posterior thigh, calf and lateral foot. John has been troubled by recurrent back pain since his early twenties. However, he developed left-sided leg pain for the first time 4 weeks ago, which has progressively worsened to the point where he is now struggling to work. He has also had increasing difficulty in sleeping. John has been using anti-inflammatories on a daily basis to control his pain enough to continue working. Without analgesics his leg pain is 9/10 on a VAS. John has obvious difficultly arising from the reception chair and is antalgic to the right. Flexion of the lumbar spine sharply aggravates his leg pain, with a finger-to-floor distance of 30 cm. Lumbar extension is also reduced in range, but otherwise more tolerable. Motor power is intact, with the exception of mild weakness of left great toe extension. Reflexes are 2+ and symmetrical. Both slump and SLR aggravate John's left leg pain, while right SLR also provokes left leg pain. The left sacroiliac joint is tender and stiff on springing. There is no superficial tenderness over the spinous processes, although the L4-5 joint segment is painfully limited when challenged.









DISC HERNIATION

Some MRI essentials

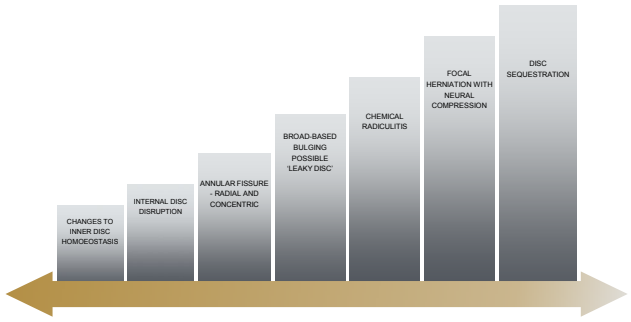
Contained versus un-contained

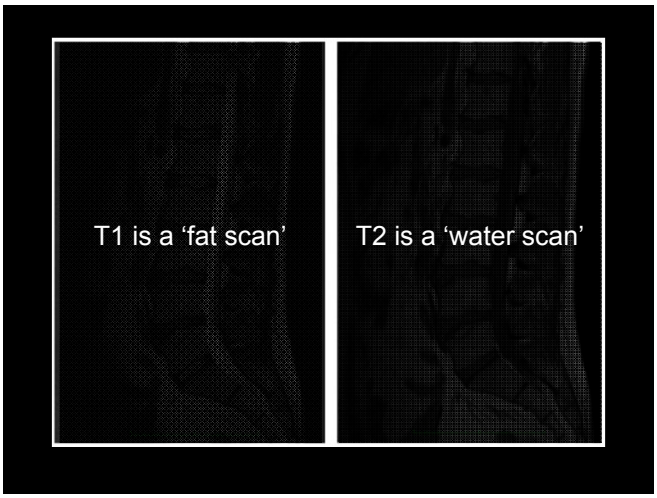
Grading neural compression

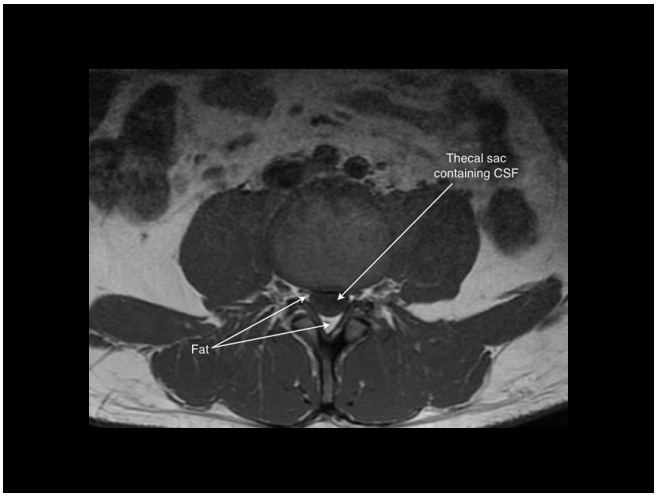
Prognosis - features predictive of resorption

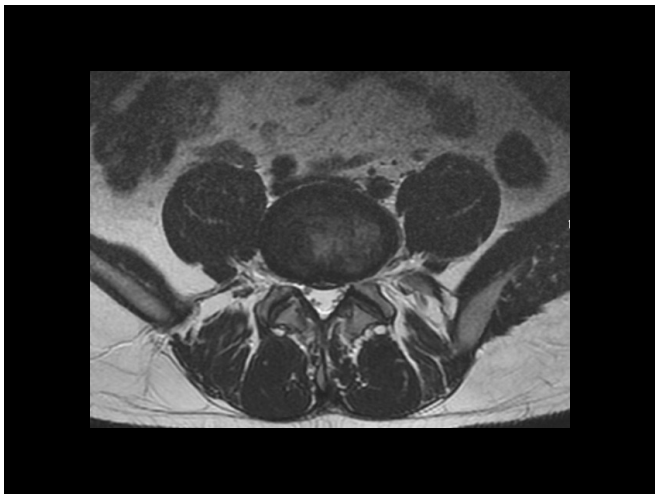
- Size
- Migration
- Composition
- Modic changes

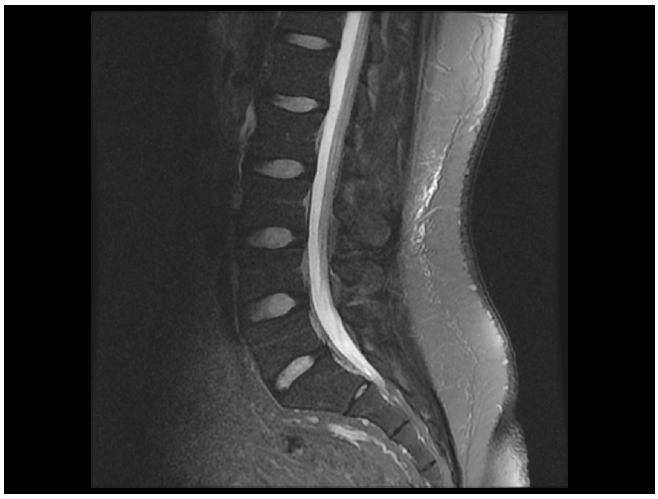
SPECTRUM OF DISC PATHOLOGY

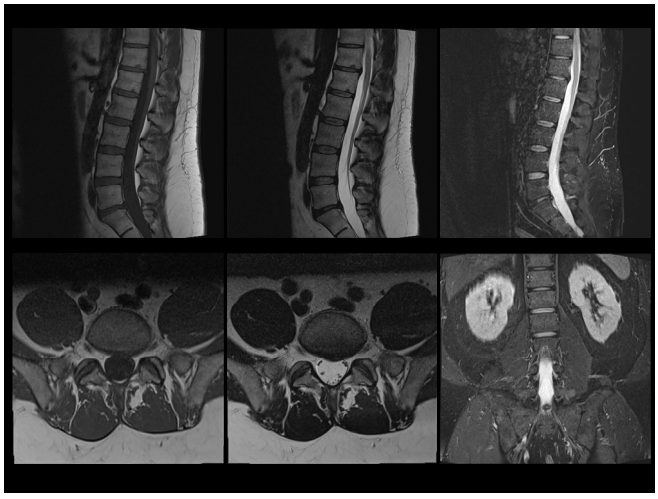










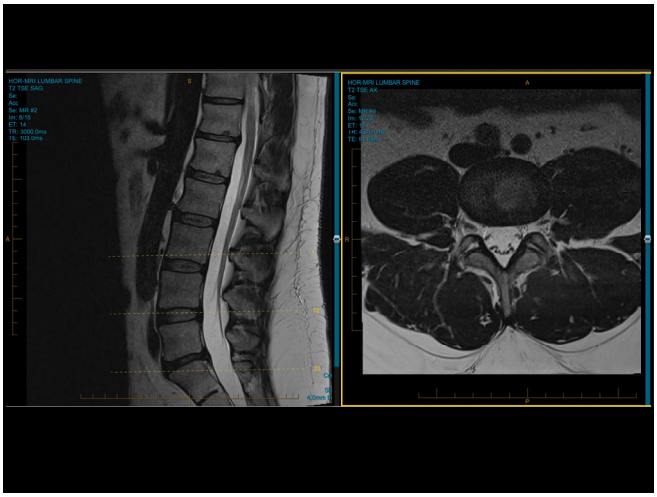


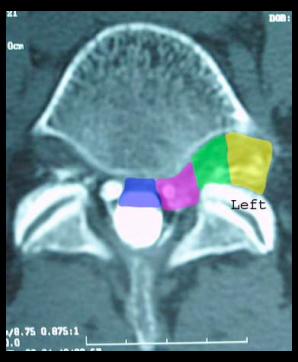
A - alignment

B - bones

C - canals and contents

S - soft tissue



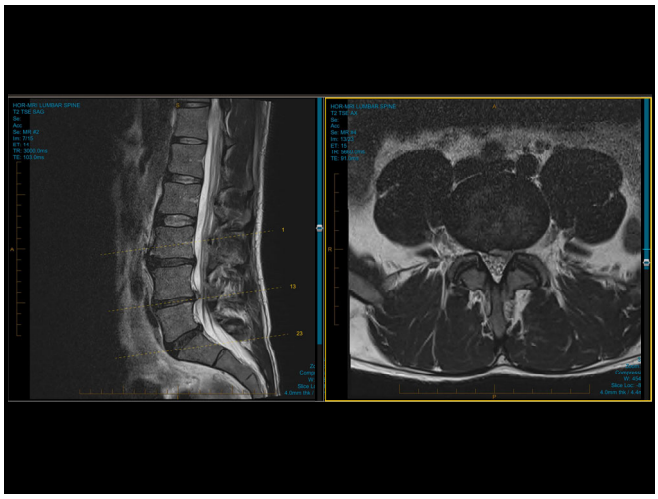


Blue = Central region

Pink = Paracentral region or lateral recess

Green = Intraforaminal zone

Yellow = Extraforaminal zone



RADIAL FISSURE

Small radial fissures are the most common defect. A nuclear cleft forms that extends outwards

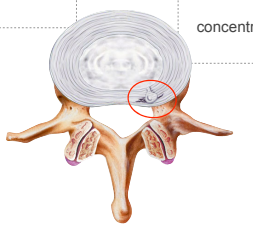
Most common at L5, then L4. Large radial fissures become symptomatic when they reach the outer 1/3

The defect heals with granulation tissue, but this remains a point of vulnerability

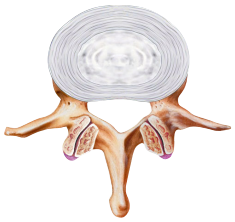
CONCENTRIC FISSURE

A concentric fissure involves separation of the annular layers. Delamination often occurs with twisting of the trunk

Found more often in young people than radial fissures. A radial lesion may join a concentric fissure to form a high intensity zone

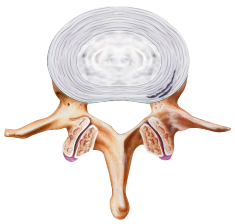


PROGRESSION OF DISC FAILURE



PROGRESSION OF DISC FAILURE

PROGRESSION OF DISC FAILURE



PROGRESSION OF DISC FAILURE

PROGRESSION OF DISC FAILURE

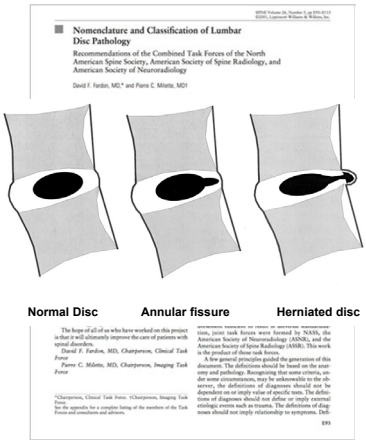
PROGRESSION OF DISC FAILURE

PROGRESSION OF DISC FAILURE

Uncontained

PROGRESSION OF DISC FAILURE

Uncontained

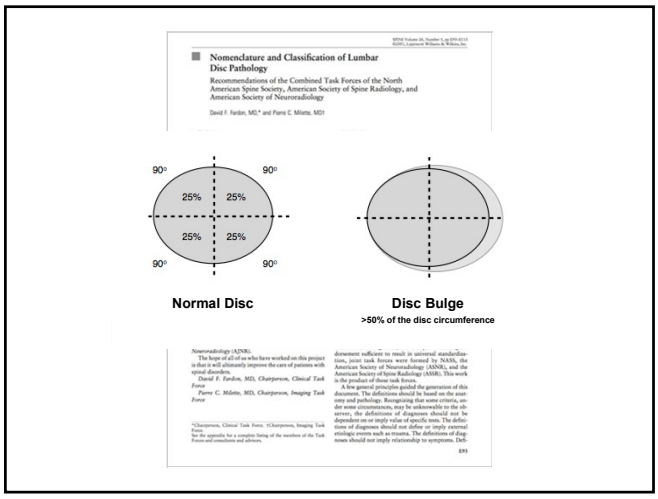


Nomenclature and Classification of Lumbar Disc Pathology

Recommendations of the Combined Task Forces of the North American Spine Society, American Society of Spine Radiology, and American Society of Neuroradiology

David F. Fardon, MD,* and Pierre C. Milette, MD†

Normal Disc Annular fissure Herniated disc



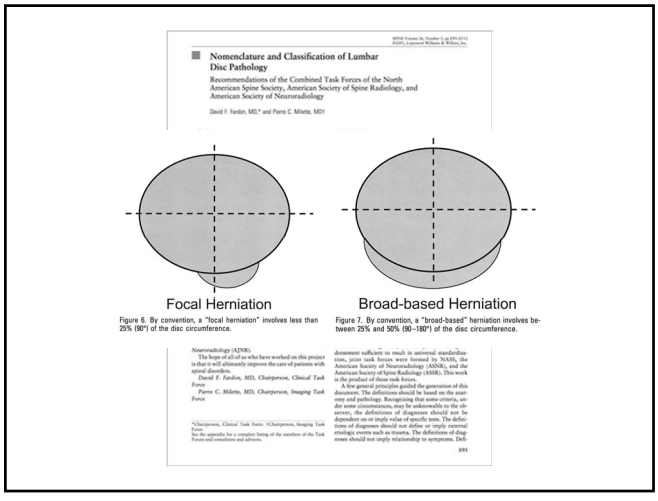


Figure 6. By convention, a "focal herniation" involves less than 25% (90°) of the disc circumference.

Figure 7. By convention, a "broad-based" herniation involves between 25% and 50% (90–180°) of the disc circumference.

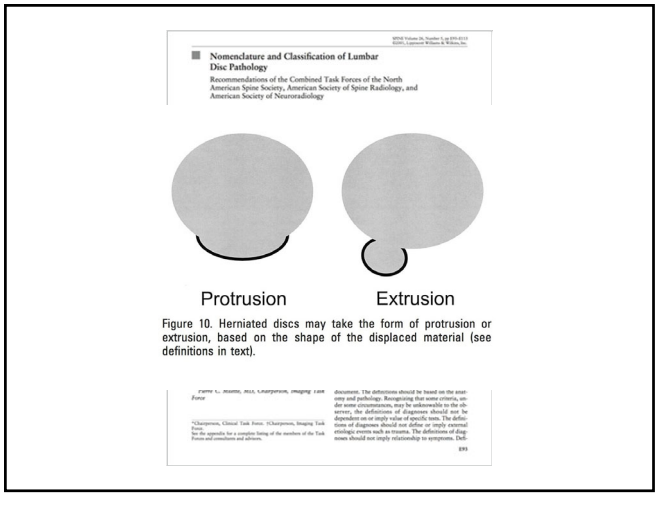


Figure 10. Herniated discs may take the form of protrusion or extrusion, based on the shape of the displaced material (see definitions in text).

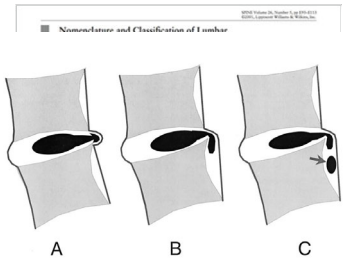
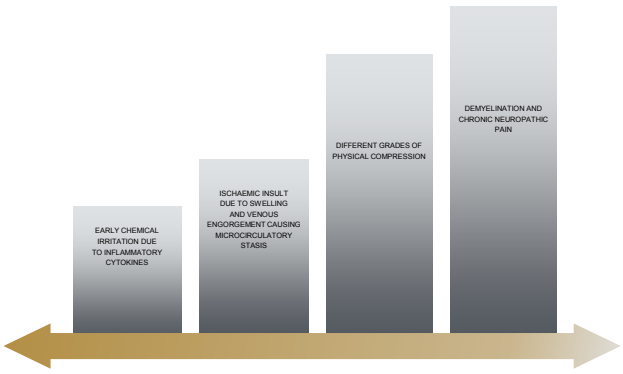


Figure 12. Schematic representation of various types of posterior central herniations. **A,** Small subligamentous herniation (or protrusion) without significant disc material migration. **B,** Subligamentous herniation with downward *migration* of disc material under the posterior longitudinal ligament (PLL). **C,** Subligamentous herniation with downward migration of disc material and *sequestered fragment* (arrow). (Reprinted with permission from Milette PC. Classification, diagnostic imaging and imaging characterization of a lumbar herniated disc. Radiol Clin North Am 2000; 38:1267–1292.)

THE 'LEAKY DISC'

MODIC CHANGES

SPECTRUM OF NERVE ROOT INSULT



THE VALUE OF THE HISTORY

THE VALUE OF THE EXAMINATION

Few physical signs result in alteration of a diagnosis made from the history

The straight-leg raise test does have value in screening out nerve root involvement

The SLR is not a predictor of root compression – rather it indicates root tension or irritation

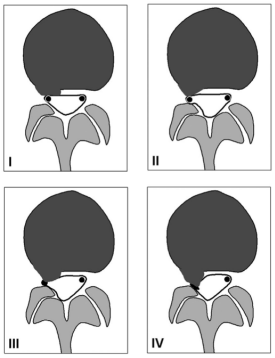
THE VALUE OF THE EXAMINATION

Finger-to-floor distance is a predictor of nerve root compression – reverses lordosis and may accentuate the mechanical effects of disc herniation upon nerve root

Centralisation is thought to be a positive prognostic indicator

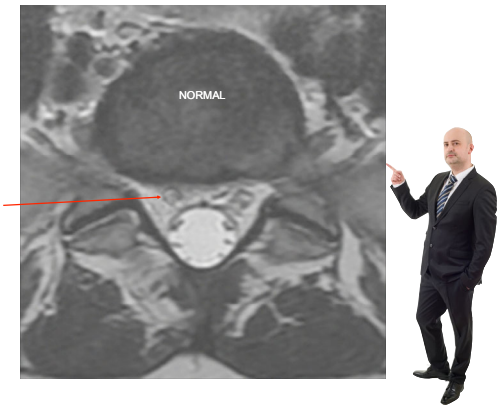
The presence of any motor weakness is clinically relevant

GRADING NERVE ROOT COMPRESSION

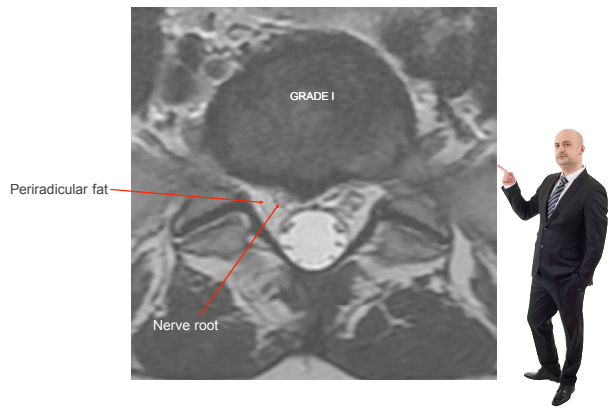


From Pfirrmann, C. W. A., Dora, C., Schmid, M. R., Zanetti, M., Hodler, J., & Boos, N. (2004)

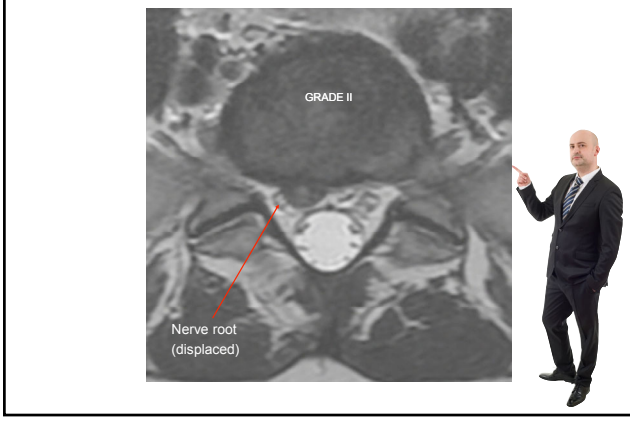
THE VALUE OF IMAGING



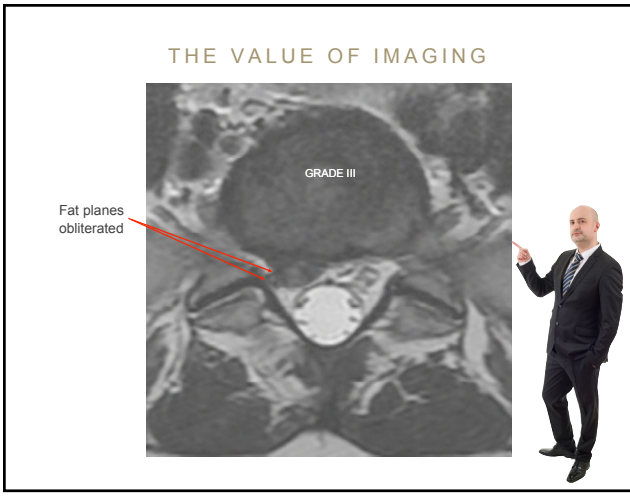
THE VALUE OF IMAGING



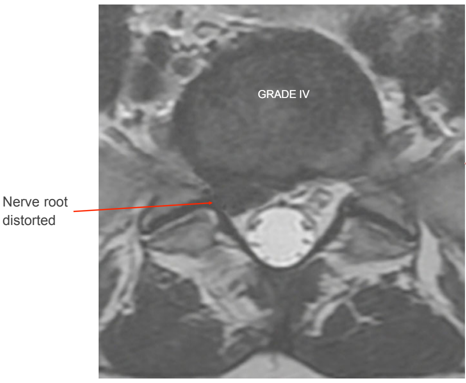
THE VALUE OF IMAGING



THE VALUE OF IMAGING

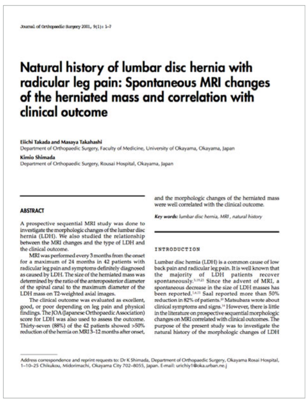


THE VALUE OF IMAGING



PROGNOSIS

A key feature linked to recovery is the tendency or ability of the nuclear mass to be resorbed



Journal of Orthopaedic Surgery 2001, 9(1): 1–7

Natural history of lumbar disc hernia with radicular leg pain: Spontaneous MRI changes of the herniated mass and correlation with clinical outcome

Eiichi Takada and Masaya Takahashi
Department of Orthopaedic Surgery, Faculty of Medicine, University of Okayama, Okayama, Japan
Kimio Shimada
Department of Orthopaedic Surgery, Rousai Hospital, Okayama, Japan

ABSTRACT

A prospective sequential MRI study was done to investigate the morphologic changes of the lumbar disc hernia (LDH). We also studied the relationship between the MRI changes and the type of LDH and the clinical outcome.

MRI was performed every 3 months from the onset for a maximum of 24 months in 42 patients with radicular leg pain and symptoms definitely diagnosed as caused by LDH. The size of the herniated mass was determined by the ratio of the anteroposterior diameter of the spinal canal to the maximum diameter of the LDH mass on T2-weighted axial images.

The clinical outcome was evaluated as excellent, good, or poor depending on leg pain and physical findings. The JOA (Japanese Orthopaedic Association) score for LDH was also used to assess the outcome. Thirty-seven (88%) of the 42 patients showed >50% reduction of the hernia on MRI 3–12 months after onset, and the morphologic changes of the herniated mass were well correlated with the clinical outcome.

Key words: lumbar disc hernia, MRI , natural history

INTRODUCTION

Lumbar disc hernia (LDH) is a common cause of low back pain and radicular leg pain. It is well known that the majority of LDH patients recover spontaneously.[3,19,21] Since the advent of MRI, a spontaneous decrease in the size of LDH masses has been reported.[1,6,11] Saal reported more than 50% reduction in 82% of patients.[20] Matsubara wrote about clinical symptoms and signs.[14] However, there is little in the literature on prospective sequential morphologic changes on MRI correlated with clinical outcomes. The purpose of the present study was to investigate the natural history of the morphologic changes of LDH

Address correspondence and reprint requests to: Dr K Shimada, Department of Orthopaedic Surgery, Okayama Rosai Hospital, 1–10–25 Chikukou, Midorimachi, Okayama City 702–8055, Japan. E-mail: urichiy1@oka.urban.ne.j

88% of the 42 patients showed >50% reduction of the hernia on MRI 3–12 months after onset, and the morphologic changes of the herniated mass were well correlated with the clinical outcome.

PROGNOSIS

- Presence of Modic changes
- Composition
- Vertical migration
- Size of herniation

SIZE OF HERNIATION

A key feature linked to recovery is the tendency or ability of the nuclear mass to be resorbed

Larger disc protrusions often have a high fluid component and do better because the swelling can reduce quite quickly

But successful surgery often requires early intervention - to avoid sustained chemical and physical insult on the nerve roots (causing demyelination and intraneural fibrosis)

Even small protrusions will produce chronic pain if they contain more fibrotic granulation tissue or calcified disc tissue

Observations on the natural history of massive lumbar disc herniation

G. I. Cribb, D. C. Jaffray, V. N. Cassar-Pullicino

From the Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry, England

We have treated 15 patients with massive lumbar disc herniations non-operatively. Repeat MR scanning after a mean 24 months (5 to 56) showed a dramatic resolution of the herniation in 14 patients. No patient developed a cauda equina syndrome. We suggest that this condition may be more benign than previously thought.

Most herniated lumbar discs resolve spontaneously.[1-4] Although smaller herniations may be safely treated non-operatively, massive extrusions and sequestrations are sometimes treated by operation for fear of cauda equina compression. We present the clinical and radiological outcome of 15 patients who were treated conservatively having presented with leg pain and a massive lumbar disc herniation.

Patients and Methods

We have reviewed 15 patients with a massive lumbar disc herniation and a painful radiculopathy who chose not to have surgery. They presented to a general spinal clinic over a period of five years. There were ten women and five men, with a mean age of 45 years (24 to 73). Ten herniations were at the L4-5 level and five at L5-S1. The decision to operate was chosen to be treated conservatively because either that their symptoms had started to improve spontaneously, that they feared surgical complications, or both. To qualify as a 'massive' herniation at least 50% of the spinal canal had to be occluded by disc material on axial MRI scans. The anteroposterior diameters of the spinal canal and of the disc were measured and the latter expressed as a percentage of the former. The patients were advised to return for emergency discectomy should they develop features of a cauda equina syndrome. Otherwise they were asked back for clinical review and a repeat MR scan. These scans were performed at a mean of 24 months (5 to 56) after the initial scan. All were performed without gadolinium enhancement.

The following criteria were used to distinguish protrusion from extrusion. The disc herniation was deemed to be a protrusion if the greatest distance, in any plane, between the edges of the disc material beyond the disc space was less than the distance between the edges of the base in the same plane. A disc extrusion was deemed to be present if any one distance between the edges of the disc material beyond the disc space was greater than the distance between the edges of the base measured in the same plane. An extrusion was designated a sequestration if the displaced disc material had completely lost continuity with the parent disc.[5]

Results

All 15 disc herniations were classified as extrusions, six of which were sequestrations. All were unconstrained as there was no surrounding annulus.

The mean percentage of the canal occupied by disc material on the initial MRI scans was 68% (40 to 80%). All but one herniation had resolved dramatically by the time of the second MR scan (Fig. 1). The reduction in size of the herniation on MRI was a mean of 80% (48% to 100%).

One patient needed a discectomy because of persistent pain, despite substantial resolution of the disc prolapse on MRI. In another patient whose disc had not resolved radiologically, the symptoms had diminished to such an extent that surgery was not required.

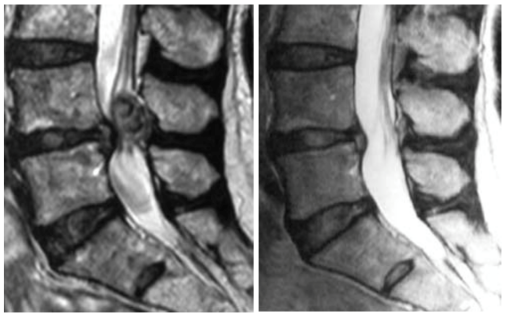
No patient developed a cauda equina syndrome.

Discussion

In 1983, Wiltse[1] showed that the natural history of radiculopathy because of lumbar disc herniation is to clinical resolution. Surgery carried out in the first year gave earlier relief of pain, but thereafter the results of surgery were the same as those of non-operative treatment.

Observations on the natural history of massive lumbar disc herniation

"Although massive herniations are rarely left alone for well-understood reasons, this small cohort of patients reveals a more benign side to this pathology which may not always deserve its fearsome reputation."

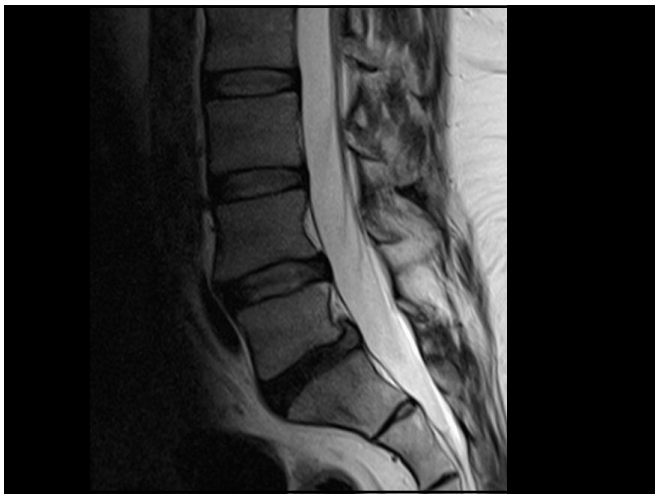


VERTICAL MIGRATION

Greater vertical migration of the herniated nucleus either above or below the adjacent vertebral body (Komori classification) is associated with a higher resorption rate

A patient age of between 41 - 50 years is also associated with a higher resorption rate

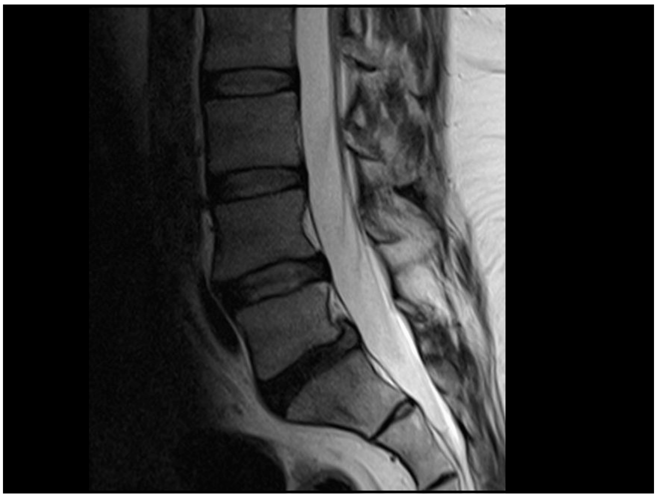
If the herniated material migrated at least 67% above or below the adjacent vertebra then it was more likely to resolve faster

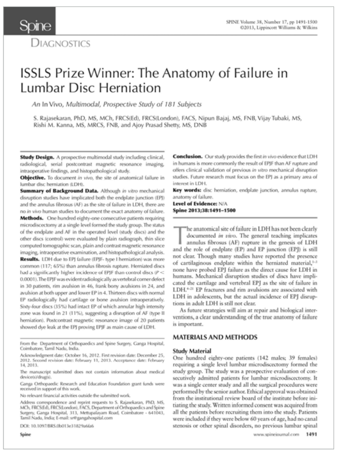


COMPOSITION

While most commentaries focus upon the migration of nuclear material (containing the hydrophilic *protoeglycan aggrecans*), hernia also contain other less pliable materials

A study by Rajasekaran and colleagues in the journal SPINE investigated two very different mechanisms of disc failure





Spine
SPINE Volume 38, Number 17, pp 1491-1500
©2013, Lippincott Williams & Wilkins

DIAGNOSTICS

ISSLS Prize Winner: The Anatomy of Failure in Lumbar Disc Herniation

An In Vivo*, Multimodal, Prospective Study of 181 Subjects*

S. Rajasekaran, PhD, MS, MCh, FRCS(Ed), FRCS(London), FACS, Nipun Bajaj, MS, FNB, Vijay Tubaki, MS, Rishi M. Kanna, MS, MRCS, FNB, and Ajoy Prasad Shetty, MS, DNB

Study Design. A prospective multimodal study including clinical, radiological, serial postcontrast magnetic resonance imaging, intraoperative findings, and histopathological study.

Objective. To document *in vivo*, the site of anatomical failure in lumbar disc herniation (LDH).

Summary of Background Data. Although *in vitro* mechanical disruption studies have implicated both the endplate junction (EPJ) and the annulus fibrosus (AF) as the site of failure in LDH, there are no *in vivo* human studies to document the exact anatomy of failure.

Methods. One hundred eighty-one consecutive patients requiring microdiscectomy at a single level formed the study group. The status of the endplate and AF in the operated level (study discs) and the other discs (control) were evaluated by plain radiograph, thin slice computed tomographic scan, plain and contrast magnetic resonance imaging, intraoperative examination, and histopathological analysis.

Results. LDH due to EPJ failure (EPJF- type I herniation) was more common (117; 65%) than annulus fibrosis rupture. Herniated discs had a significantly higher incidence of EPJF than control discs ($P <$ 0.0001). The EPJF was evident radiologically as vertebral corner defect in 30 patients, rim avulsion in 46, frank bony avulsions in 24, and avulsion at both upper and lower EP in 4. Thirteen discs with normal EP radiologically had cartilage or bone avulsion intraoperatively. Sixty-four discs (35%) had intact EP of which annular high intensity zone was found in 21 (11%), suggesting a disruption of AF (type II herniation). Postcontrast magnetic resonance image of 20 patients showed dye leak at the EPJ proving EPJF as main cause of LDH.

Conclusion. Our study provides the first *in vivo* evidence that LDH in humans is more commonly the result of EPJF than AF rupture and offers clinical validation of previous *in vitro* mechanical disruption studies. Future research must focus on the EPJ as a primary area of interest in LDH.

Key words: disc herniation, endplate junction, annulus rupture, anatomy of failure.
Level of Evidence: N/A
Spine 2013;38:1491–1500

From the Department of Orthopaedics and Spine Surgery, Ganga Hospital, Coimbatore, Tamil Nadu, India.

Acknowledgment date: October 16, 2012. First revision date: December 25, 2012. Second revision date: February 11, 2013. Acceptance date: February 14, 2013.

The manuscript submitted does not contain information about medical device(s)/drug(s).

Ganga Orthopaedic Research and Education Foundation grant funds were received in support of this work.

No relevant financial activities outside the submitted work.

Address correspondence and reprint requests to S. Rajasekaran, PhD, MS, MCh, FRCS(Ed), FRCS(London), FACS, Department of Orthopaedics and Spine Surgery, Ganga Hospital, 313, Mettupalayam Road, Coimbatore - 641043, Tamil Nadu, India; E-mail: sr@gangahospital.com

DOI: 10.1097/BRS.0b013e31829a6fa6

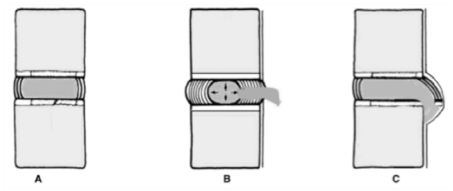
The anatomical site of failure in LDH has not been clearly documented *in vivo*. The general teaching implicates annulus fibrosus (AF) rupture in the genesis of LDH and the role of endplate (EP) and EP junction (EPJ) is still not clear. Though many studies have reported the presence of cartilaginous endplate within the herniated material,[1-3] none have probed EPJ failure as the direct cause for LDH in humans. Mechanical disruption studies of discs have implicated the cartilage and vertebral EPJ as the site of failure in LDH.[4-21] EP fractures and rim avulsions are associated with LDH in adolescents, but the actual incidence of EPJ disruptions in adult LDH is still not clear.

As future strategies will aim at repair and biological interventions, a clear understanding of the true anatomy of failure is important.

MATERIALS AND METHODS

Study Material

One hundred eighty-one patients (142 males; 39 females) requiring a single level lumbar microdiscectomy formed the study group. The study was a prospective evaluation of consecutively admitted patients for lumbar microdiscectomy. It was a single center study and all the surgical procedures were performed by the senior author. Ethical approval was obtained from the institutional review board of the institute before initiating the study. Written informed consent was acquired from all the patients before recruiting them into the study. Patients were included if they were below 60 years of age, had no canal stenosis or other spinal disorders, no previous lumbar spinal



The line diagram depicts the three situations of normality **(A)**, failure through the annulus fibrosus **(B)**, and failure through avulsion of the endplate junction **(C)**.

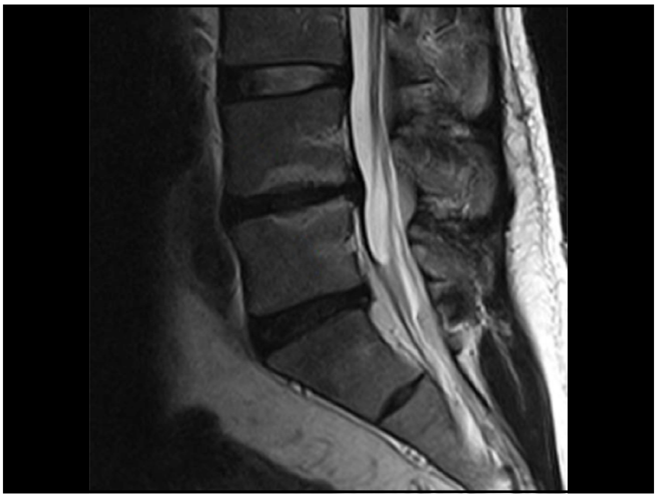
From Rajasekaran *et al*

Type I herniation occurred due to failure of the endplate junction - typically contains both cartilage and bone from the endplate - far less likely to spontaneously resorb than the water-rich nucleus

Type I herniation occurred due to failure of the endplate junction - typically contains both cartilage and bone from the endplate - far less likely to spontaneously resorb than the water-rich nucleus

Type II herniation described the more classically understood failure of the annulus fibrosus – more likely water rich nucleus with greater resorptive capacity

PRESENCE OF MODIC CHANGES



SPINE Volume 39, Number 9, pp 736-744
©2014, Lippincott Williams & Wilkins

Spine

CLINICAL CASE SERIES

Spontaneous Resorption of Lumbar Disc Herniation Is Less Likely When Modic Changes Are Present

Zhi Shan, MD,* Shunwu Fan, MD,* Qingbo Xie, MD,*† Letu Suyou, MD,* Junhui Liu, MD,* Chongyan Wang, MD,* and Fengdong Zhao, MD*

Study Design. A retrospective survey on 85 consecutive patients with primary single-level lumbar disc herniation (LDH).

Objective. To investigate associations between Modic changes (MCs) and the likelihood of resorption of herniated lumbar intervertebral discs.

Summary of Background Data. Spontaneous resorption of LDH has been demonstrated, whereas the mechanisms are unclear. MCs are closely associated with disc degeneration, but research focusing on their association with spontaneous resorption of LDH has not been specifically investigated.

Methods. Eighty-five consecutive patients with LDH (52 males, 33 females, aged 20-66 yr) were included. Patients' diagnosis was based on clinical presentation, magnetic resonance imaging, and computed tomography. Patients were divided into surgical and conservative groups and further divided into MC and non-MC subgroups. Spontaneous resorption and clinical success in the conservative group were assessed by reduction in the herniated volume and Oswestry Disability Index. Disc tissues collected from the surgical group were examined histologically, and immunohistochemistry was used to identify endothelial cells and macrophages.

Results. In total, 35 of 85 patients showed MC, mostly type II. Herniated tissue in MC group contained relatively more hyaline cartilage endplate than that in non-MC group (on average, 50% vs. 8%, $P < 0.05$) but less nucleus pulposus (18% vs. 55%, $P < 0.05$). Conservative treatment reduced Oswestry Disability Index scores in non-MC group from 29.4 to 23.5 on average ($P < 0.05$), but reductions in MC group (30.1–29.0) were nonsignificant. Herniated volumes reduced after conservative treatment in non-MC group (0.44–0.21 cm^3, $P < 0.05$) but not in MC group (0.52–0.45 cm^3, $P > 0.05$). More neovascularization and macrophage infiltration was observed in herniated tissue from non-MC group than from MC group ($P < 0.001$).

Conclusion. MCs in patients with LDH are associated with cartilaginous herniations that resorb poorly, so that patients respond less well to conservative treatments. Loss of cartilaginous endplate may explain the origins of MCs and their association with disc infection.

Key words: lumber disc herniation, Modic changes, disc resorption, histology, magnetic resonance image.

Level of Evidence: 3

Spine 2014;39:736–744

Modic changes (MCs), or signal changes in the vertebral endplate and subchondral bone, are seen on T1- and T2-weighted magnetic resonance (MR) images.[1] MCs are classified into 3 types: type I presents decreased signal intensity on T1-weighted images and increased signal intensity on T2-weighted images, the prevalence is 2% to 15% (Figure 1A–D); type II manifests increased signal intensity on T1-weighted images and slightly increased or isointense intensity on T2-weighted images, the prevalence is 7% to 30% (Figure 1E, F); and type III displays decreased signal intensity on both T1- and T2-weighted MR images, with a prevalence of around 1%.[2,3]

MCs are associated with lumbar disc herniation (LDH),[4,5] which is one of the most common causes of back and leg pain in the general population. Albert and Manniche[4] suggested that LDH is a strong risk factor for developing MCs, particularly type I. MCs are particularly associated with a disc herniation that contains hyaline cartilage from the vertebral endplate,[5] and MCs in the presence of LHD increase the risk of bacterial infection of the disc.[6] Surgery is effective in treating patients with LDH, but conservative therapy can also be successful, presumably because some herniated discs can spontaneously "resorb."[7,8] Mechanisms of resorption are

From the *Department of Orthopaedics, Sir Run Run Shaw Hospital, School of Medicine, Zhejiang University, Hangzhou, P. R. China; and †The first people's Hospital of Linhai, Linhai city, Zhejiang province, P.R.China.

Acknowledgment date: August 7, 2013. Revision date: December 20, 2013. Acceptance date: January 21, 2014.

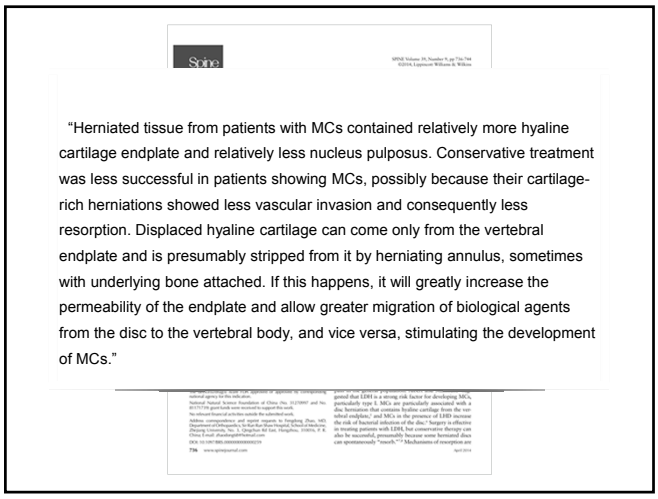
The device(s)/drug(s) is/are FDA approved or approved by corresponding national agency for this indication.

National Natural Science Foundation of China (No. 31270997 and No. 81171739) grant funds were received to support this work.

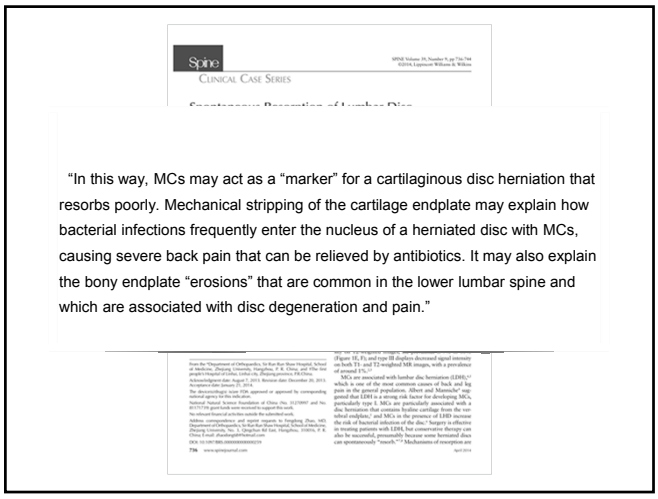
No relevant financial activities outside the submitted work.

Address correspondence and reprint requests to Fengdong Zhao, MD, Department of Orthopaedics, Sir Run Run Shaw Hospital, School of Medicine, Zhejiang University, No. 3, Qingchun Rd East, Hangzhou, 310016, P. R. China; E-mail: zhaodong68@hotmail.com

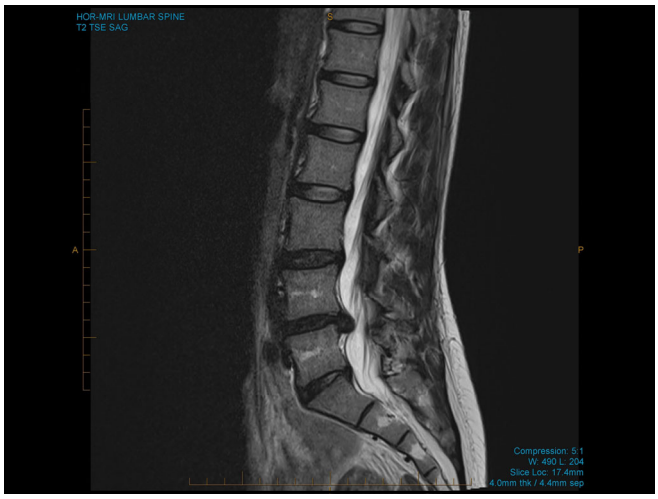
DOI: 10.1097/BRS.0000000000000259



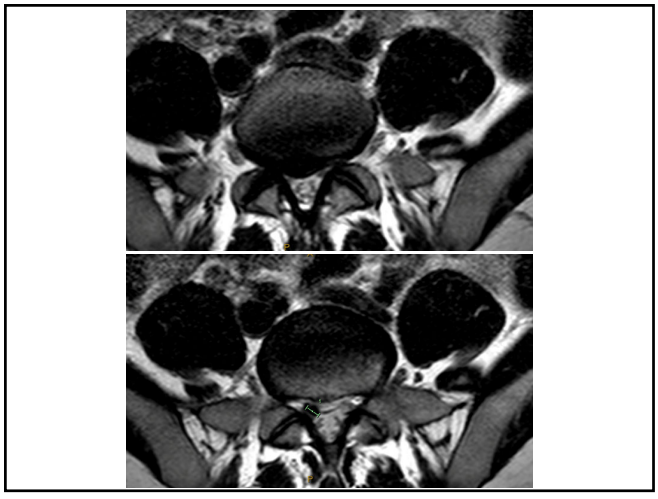
"Herniated tissue from patients with MCs contained relatively more hyaline cartilage endplate and relatively less nucleus pulposus. Conservative treatment was less successful in patients showing MCs, possibly because their cartilage-rich herniations showed less vascular invasion and consequently less resorption. Displaced hyaline cartilage can come only from the vertebral endplate and is presumably stripped from it by herniating annulus, sometimes with underlying bone attached. If this happens, it will greatly increase the permeability of the endplate and allow greater migration of biological agents from the disc to the vertebral body, and vice versa, stimulating the development of MCs."



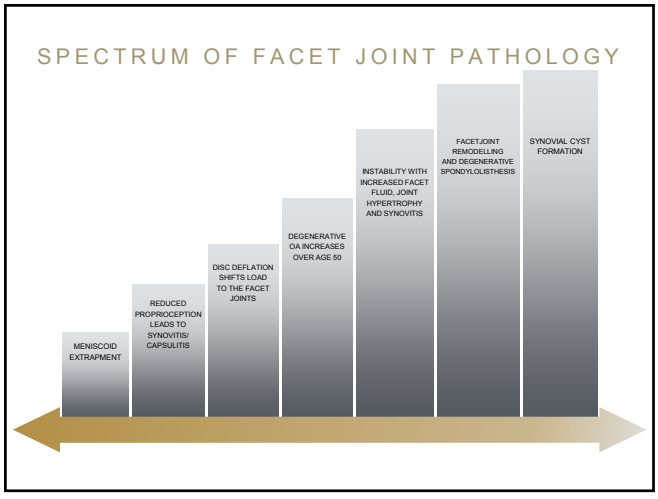
"In this way, MCs may act as a "marker" for a cartilaginous disc herniation that resorbs poorly. Mechanical stripping of the cartilage endplate may explain how bacterial infections frequently enter the nucleus of a herniated disc with MCs, causing severe back pain that can be relieved by antibiotics. It may also explain the bony endplate "erosions" that are common in the lower lumbar spine and which are associated with disc degeneration and pain."


HOR-MRI LUMBAR SPINE
T2 TSE SAG
S
A
P
Compression: 5:1
W: 400 L: 204
Slice Loc: 17.4mm
4.0mm thk / 4.4mm sep

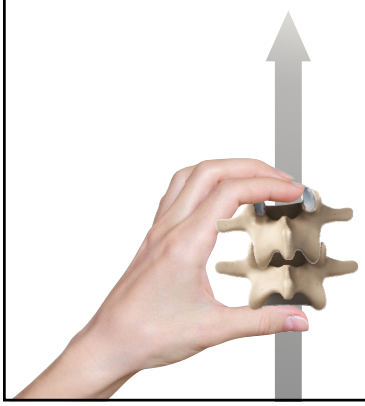

H



Susanne is 62 years old and presents for assessment of recurrent lower back pain that extends into the right buttock and posterior thigh. Her symptoms began three years ago. She was getting her golf buggy out of the car when she suffered a sudden onset of severe lower back pain and weakness of the right foot. Susanne was adamant that she wanted to avoid surgery and her pain did gradually come under control with intensive conservative treatment. Her dorsiflexion weakness resolved and she managed quite well up until one year ago. Around that time she began to suffer lower back pain again and she described a sense of "electrical pain" spreading across her lower back and into her right posterior thigh. She found relief through procedures such as bringing the knees to the chest. Standing and walking aggravate her symptoms.



DEVELOPMENT OF SEGMENTAL INSTABILITY



- Heading towards potential spinal stenosis
- Synovial cyst formation
- Ligamentum flavum hypertrophy
- Multifidus atrophy
- Anterolisthesis (degenerative spondylo)
- Facet joint OA and remodelling
- Disc degenerative change - bulging

CAN FACET JOINTS CAUSE RADICULAR SIGNS?

- Synovitis
- Foraminal stenosis - dynamic lateral entrapment due to instability
- Synovial cyst

SEGMENTAL INSTABILITY

Transient neural deficits rather than progressive or constant deficits

Neural effects typically occur during transitioning movements – arising from chair, rolling over in bed

Fact that patient can remain comfortable while sitting can be falsely reassuring

The Spine Journal ■ (2014) ■

Clinical Study

Sensitivity of magnetic resonance imaging in the diagnosis of mobile and nonmobile L4–L5 degenerative spondylolisthesis

Benjamin D. Kuhns, MS[a,b], Shalen Kouk, BS[a,b], Colin Buchanan, MD[a,c], Daniel Lubelski, BA[a,d], Matthew D. Alvin, MBA, MA[a,b], Edward C. Benzel, MD[a,c,d], Thomas E. Mroz, MD[a,c,d,*], James Tozzi, MD[e]

[a]Department of Orthopaedic and Neurological Surgery, Cleveland Clinic Center for Spine Health, The Cleveland Clinic, 9500 Euclid Ave., S-80, Cleveland, OH 44195, USA
[b]Case Western Reserve University School of Medicine, 10900 Euclid Ave., Cleveland, OH 44106, USA
[c]Department of Neurological Surgery, The Cleveland Clinic, 9500 Euclid Ave., Cleveland, OH 44195, USA
[d]Cleveland Clinic Lerner College of Medicine, 9500 Euclid Avenue NA21, Cleveland, OH 44195, USA
[e]Department of Orthopaedic Surgery, Washington Hospital Center, 110 Irving St Nw, Washington, DC 20010, USA

Received 29 March 2014; revised 19 July 2014; accepted 5 August 2014

Abstract

BACKGROUND CONTEXT: Lumbar degenerative spondylolisthesis (LDS) is often diagnosed by conventional supine magnetic resonance imaging (MRI). Numerous studies have shown, however, that the degree of spondylolisthesis can be reduced or disappears when the patient is supine as compared with standing lateral and flexion-extension (SLFE) radiographs.

PURPOSE: To compare the sensitivity of supine MRI with SLFE radiographs in patients with L4–L5 LDS.

STUDY DESIGN: A retrospective imaging study.

PATIENT SAMPLE: Included patients diagnosed with L4–L5 LDS with both SLFE films and supine MRI.

METHODS: Lumbar degenerative spondylolisthesis was defined radiographically as a slip greater than 4.5 mm. Mobile LDS was defined as a difference of greater than 3% in slip percentage between lateral radiographs and sagittal MRIs. Additional measurements included L4–L5 facet effusion diameter on axial MRIs. Measurements were performed by two independent examiners. The kappa coefficient was used to assess the interobserver agreement.

RESULTS: Of 103 patients assessed, 68% were women and the average age was 66 years. Lumbar degenerative spondylolisthesis was seen on 101 (98%) lateral films and 80 (78%) MRIs. Average slip was 10.0 mm for lateral standing radiographs and 6.6 mm on MRI ($p<.0001$). Fifty (48%) patients were identified with mobile LDS. The positive predictive value of facet joint effusion for mobile LDS increased from 52% for effusions greater than 1 mm to 100% for effusions greater than 3.5 mm.

CONCLUSIONS: This study found that MRI had a sensitivity of 78% for detecting L4–L5 LDS compared with 98% for lateral standing films. We also identified facet effusion size as a marker to predict mobile LDS. These findings suggest that, particularly in the setting of facet effusions, the

FDA device/drug status: Not applicable.

Author disclosures: ***BDK:*** Nothing to disclose. ***SK:*** Nothing to disclose. ***CB:*** Nothing to disclose. ***DL:*** Nothing to disclose. ***MDA:*** Nothing to disclose. ***ECB:*** Royalties: Elsevier Pub (B), Thieme Pub (B); Stock Ownership: Axiomed (NA), Depuy (NA), Orthomems (NA), Turning Point (NA); Consulting: Axiomed; Speaking/Teaching Arrangements: Multiple (Varied); Trips/Travel: Multiple (Varied); Grants: OREF (F, Paid directly to institution); Rawlings: (F, Paid directly to institution). ***TEM:*** Stock Ownership: PearlDiver, Inc., (No monies received); Consulting: Globus Medical (B); Speaking/Teaching Arrangements: AO Spine (B). ***JT:*** Nothing to disclose.

The disclosure key can be found on the Table of Contents and at www.TheSpineJournalOnline.com.

IRB approval (IRB # 13-892) was obtained before the initiation of the study.

* Corresponding author. Department of Orthopaedic and Neurological Surgery, Neurological Institute, Cleveland Clinic Center for Spine Health, Departments of Orthopaedic and Neurological Surgery, The Cleveland Clinic, 9500 Euclid Ave., S-80, Cleveland, OH 44195, USA. Tel.: (216) 445-9232; fax: (216) 363-2040.

E-mail address: mrozt@ccf.org (T.E. Mroz)

http://dx.doi.org/10.1016/j.spinee.2014.08.006

"In this study, we apply an established radiographic criterion to the assessment of the sensitivity of MRI in the diagnosis of L4–L5 LDS. In our cohort, lateral radiographs had a sensitivity of 98% and MRI had a sensitivity of 78% for LDS as defined by flexion-extension radiographs. We also found that facet effusions on axial MRI can predict mobile LDS, particularly if they are greater than 2.5 mm. Thus, when there is clinical suspicion, providers should be encouraged to obtain lateral standing radiographs and MRI to diagnose LDS."

FEATURES OF SEGMENTAL INSTABILITY

Often lack of neural compression on supine MRI

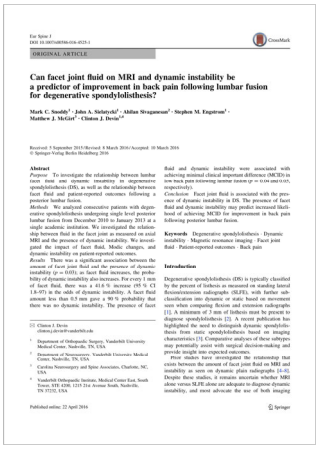
Dynamic spinal stenosis may only be visible when MRI is performed in upright position

There are circumstances in which supine protocol will fail to detect functional and relevant neural insult (occult nerve root irritation)

Supine MRI usually sufficient to demonstrate moderate-sized disc herniation and clear-cut nerve root compression

THE 'SMOKING GUN' OF SEGMENTAL INSTABILITY

- Synovial cyst formation
- Measurable increase in facet joint fluid
- Possible Modic changes
- Ligamentum flavum hypertrophy
- Facet joint enlargement
- Broad-based disc bulging
- Vertebral body anterolisthesis



Eur Spine J
DOI 10.1007/s00586-016-4525-1

ORIGINAL ARTICLE

Can facet joint fluid on MRI and dynamic instability be a predictor of improvement in back pain following lumbar fusion for degenerative spondylolisthesis?

Mark C. Snoddy[1] · John A. Skolasky[2] · Abilan Sivaganesan[2] · Stephen M. Engstrom[3] · Matthew J. McGirt[4] · Clinton J. Devin[1,4]

Received: 5 September 2015 / Revised: 8 March 2016 / Accepted: 10 March 2016

Abstract
Purpose To investigate the relationship between lumbar facet fluid and dynamic instability in degenerative spondylolisthesis (DS), as well as the relationship between facet fluid and patient-reported outcomes following a posterior lumbar fusion.
Methods We analyzed consecutive patients with degenerative spondylolisthesis undergoing single level posterior lumbar fusion from December 2010 to January 2013 at a single academic institution. We investigated the relationship between fluid in the facet joint as measured on axial MRI and the presence of dynamic instability. We investigated the impact of facet fluid, Modic changes, and dynamic instability on patient-reported outcomes.
Results There was a significant association between the amount of facet joint fluid and the presence of dynamic instability ($p = 0.03$); as facet fluid increases, the probability of dynamic instability also increases. For every 1 mm of facet fluid, there was a 41.6 % increase (95 % CI 1.6–97) in the odds of dynamic instability. A facet fluid amount less than 0.5 mm gave a 90 % probability that there was no dynamic instability. The presence of facet fluid and dynamic instability were associated with achieving minimal clinical important difference (MCID) in low back pain following lumbar fusion ($p = 0.04$ and 0.03, respectively).
Conclusion Facet joint fluid is associated with the presence of dynamic instability in DS. Patients with facet fluid and dynamic instability may predict increased likelihood of achieving MCID for improvement in back pain following posterior lumbar fusion.

Keywords Degenerative spondylolisthesis · Dynamic instability · Magnetic resonance imaging · Facet joint fluid · Patient-reported outcomes · Back pain

Introduction

Degenerative spondylolisthesis (DS) is typically classified by the percent of listhesis as measured on standing lateral flexion/extension radiographs (SLFE), with further subclassification into dynamic or static based on subsequent translation seen on flexion and extension radiographs [1]. A minimum of 3 mm of listhesis must be present to diagnose spondylolisthesis [2]. A recent publication has highlighted the need to distinguish dynamic spondylolisthesis from static spondylolisthesis based on imaging characteristics [3]. Comparative analyses of these subtypes may potentially assist with surgical decision-making and provide insight into expected outcomes.

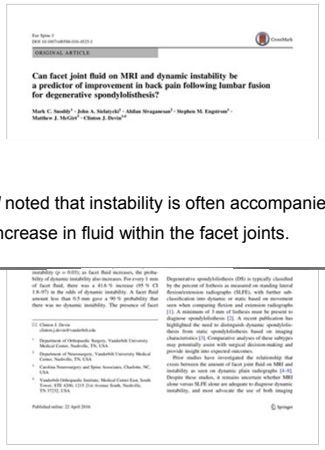
Prior studies have investigated the relationship that exists between the amount of facet joint fluid on MRI and instability as seen on dynamic plain radiographs [4–9]. Despite these studies, it remains uncertain whether MRI alone versus SLFE alone are adequate to diagnose dynamic instability, and most advocate the use of both imaging

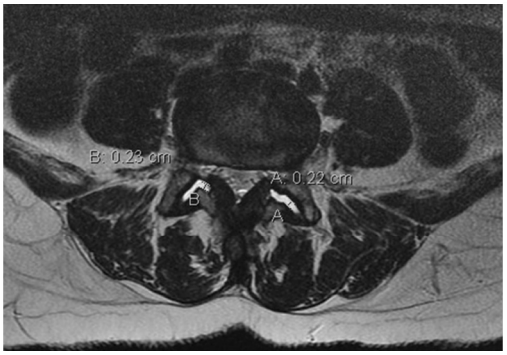
✉ Clinton J. Devin
clinton.j.devin@vanderbilt.edu

[1] Department of Orthopaedic Surgery, Vanderbilt University Medical Center, Nashville, TN, USA
[2] Department of Neurosurgery, Vanderbilt University Medical Center, Nashville, TN, USA
[3] Carolina Neurosurgery and Spine Associates, Charlotte, NC, USA
[4] Vanderbilt Orthopaedic Institute, Medical Center East, South Tower, STE 4200, 1215 21st Avenue South, Nashville, TN 37232, USA

Published online: 22 April 2016

Snoddy *et al* noted that instability is often accompanied by a measurable increase in fluid within the facet joints.





Surgery is usually not first choice for someone with primary complaint of pain – but segmental instability is unique

Age of patient – if young, it may be unlikely that they can avoid surgical stabilisation indefinitely

Individual with disc herniation and nerve compression (but no instability) often requires a microdiscectomy or laminectomy but fusion usually not necessary

Manipulation has a role to play in boosting segmental control, but sometime anatomical realities are too serious

TO FUSE OR NOT TO FUSE

Patient with segmental instability will almost certainly need surgical fusion

Segebarth *et al* described the importance of upright imaging when evaluating lumbar degenerative diseases

Sagittal translation of 4 mm or greater, or 8% or greater, between flexion and extension positions is considered a radiological sign of pathological instability

Signs of progressive neural insult and pathological instability are considered indications for operative management

Routine Upright Imaging for Evaluating Degenerative Lumbar Stenosis

Incidence of Degenerative Spondylolisthesis Missed on Supine MRI

Brad Segebarth, MD, Mark F. Kurd, MD,* Priscilla H. Haug, BA,† and Rick Davis, MD‡*

Study Design: A retrospective cohort.

Background: Degenerative spondylolisthesis (DS) with lumbar stenosis is a well-studied pathology and diagnosis is most commonly determined by a combination of magnetic resonance imaging (MRI) and standing radiographs. However, routine upright imaging is not universally accepted as standard in all practices. To the best of our knowledge, there has been no study investigating the incidence of missed diagnosis of DS evident only on standing lateral or dynamic radiographs when compared with sagittal alignment on MRI.

Objective: The authors hypothesize that supine MRI evaluation alone in lumbar degenerative disease will significantly underestimate the incidence of DS. Secondary hypothesis is that there will be no significant difference in detecting spondylolisthesis when comparing dynamic flexion-extension radiographs to standing lateral radiographs.

Methods: We retrospectively evaluated all patients presenting to spine clinic for degenerative lumbar conditions from July 2004 to July 2006 who had an MRI, upright lateral, and flexion-extension radiographs at our institution. The incidence of DS found on dynamic flexion-extension radiographs but not on MRI was determined. We then reviewed each and compared flexion-extension versus standing lateral views to determine whether there was any significant difference in detecting anterolisthesis.

Results: Of 416 patients with eligible studies, 109 were found to have DS at levels L4–L5, L5–S1, or L3–L4 based on flexion-extension radiographs. Of these, only 78 were found to have a corresponding spondylolisthesis on MRI, leaving 31/109 (28%) of DS levels undiagnosed on MRI. No additional anterolisthesis cases were detected on standing flexion-extension verses standing lateral radiographs.

Conclusions: Routine standing lateral radiographs should be standard practice to identify DS, as nearly 1/3 of cases will be missed on supine MRI. This may have implications on whether or not an arthrodesis is performed on those patients requiring lumbar decompression. Flexion-extension radiographs demonstrated no added value compared with standing lateral x-rays for the purposes of diagnosing DS.

Key Words: degenerative spondylolisthesis, lumbar stenosis, upright x-ray

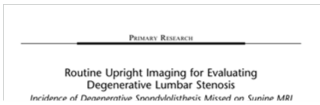
(*J Spinal Disord Tech* 2015;28:394–397)

Degenerative lumbar spinal stenosis is a narrowing of the spinal canal or intervertebral foramina caused by disk protrusions, facet overgrowth, or ligament hypertrophy. This can lead to varying degrees of compression of spinal nerves and roots. Spondylolisthesis describes a pathologic state of 1 vertebra translating in the sagittal plane relative to an adjacent vertebra. Degenerative spondylolisthesis (DS), classified by Wiltse and colleagues[1,2] as type III, is due to long-standing instability, arthritic changes, and degeneration of the intervertebral disk and facet joints. DS occurs most commonly at L4–L5, followed by L5–S1.[3,4]

The presentation of patients with DS often mimics those with lumbar spinal stenosis. Patients note low-back pain, neurogenic claudication, and lower extremity radiculopathy. Initial workup generally involves anterior/posterior and lateral lumbar radiographs. Dynamic radiographs (flexion/extension) are also often used as an economical means to evaluate spondylolisthesis.[5–7] Radiographs are important as it is imperative to detect DS in patients with stenosis as the treatment algorithms differ with regard to surgical management. Initially patients are managed with conservative measures including physical therapy and epidural steroid injections. A small percentage of patients fail conservative management and are considered for surgical intervention. The surgery for DS has been well studied.[1,2,8–16] It is generally accepted that in addition to lumbar decompression, arthrodesis of the unstable region yields higher patient satisfaction. It is less clear whether instrumented fusion yields better clinical results, despite a lower pseudoarthrosis rate.[9]

Before surgical intervention, patients require advanced imaging: magnetic resonance imaging (MRI) or computed tomography myelogram. MRI is the most accurate method

Received for publication April 15, 2014; accepted October 14, 2014.
From the *OrthoCarolina Spine Center; †OrthoCarolina Research Institute, Charlotte, NC; and ‡Health Partners, St Paul MN.
M.F.K. was a past consultant for Gersen Lehman Group and a past consultant for Pacira. R.D. was previously paid a consulting fee, is a consultant for Zimmer, is an expert testimony for SPS, and has royalties from Stryker. The remaining authors declare no conflict of interest.
Reprints: Brad Segebarth, MD, OrthoCarolina Spine Center, 2001 Randolph Road, Charlotte, NC 28207 (e-mail: brad.segebarth@orthocarolina.com).

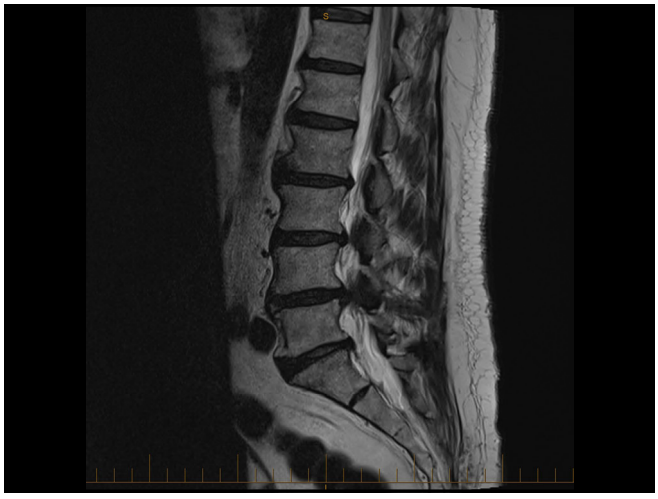


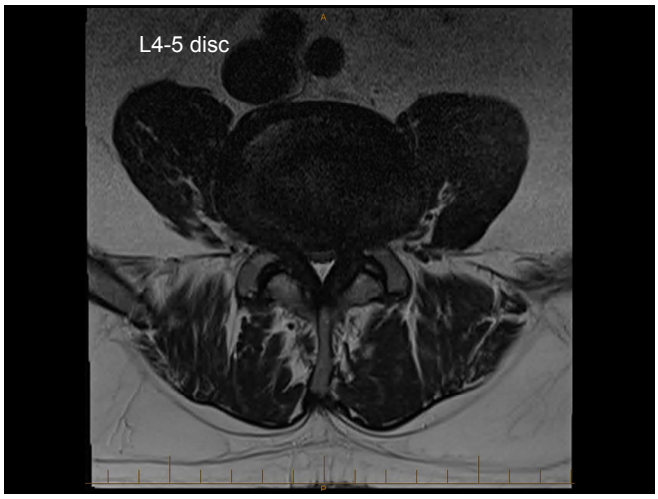
Primary Research

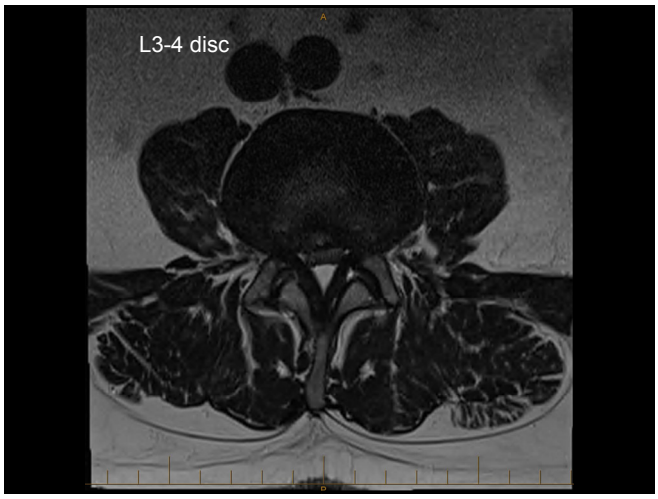
Routine Upright Imaging for Evaluating Degenerative Lumbar Stenosis

Routine standing lateral radiographs should be standard practice to identify DS, as nearly 1/3 of cases will be missed on supine MRI. Failing to detect the segmental instability could result in decompression alone, when decompression and fusion has been shown to yield better results.

Michael is a 70-year-old retired company executive who presents for assessment of bilateral posterior thigh pain that has been troubling him for approximately one year. He also describes aching pain in the right anterior thigh at times, which usually comes on when he starts to walk after first rising in the morning, or getting up from sitting. Michael denies any constant neurological symptoms, such as numbness or perceived weakness. Every two months or so Michael suffers an episode of more severe pain, which extends into the right lateral foot, along with diffuse numb sensations. Michael's symptoms are aggravated by walking and extended periods of standing. He finds relief through sitting. Michael is de-conditioned and has not exercised for years. On assessment, the motor power in his legs is intact, although his Achilles reflexes are faint (particularly on the right side). The *dorsalis pedis* pulses are palpable and synchronous, while there is no evidence of trophic change in the feet. Over the past few months Michael has suffered intermittent cramping in his calves during the night that wakes him from sleep. Interestingly, Michael normally cannot tolerate walking around the supermarket, even for short periods, although he has discovered that he feels much better while wheeling a shopping trolley.

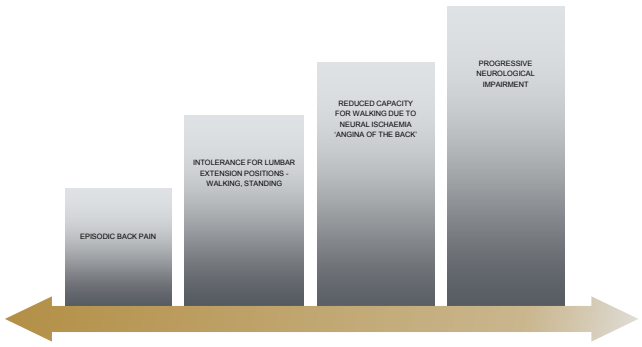



L4-5 disc


L3-4 disc


L3 vertebra

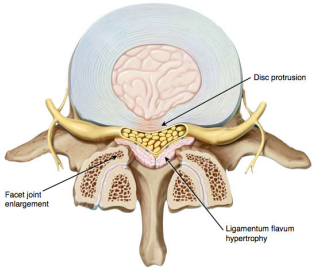
SPECTRUM OF SPINAL STENOSIS



LSS is a clinical syndrome of pain in the buttock or lower extremity (with or without low back pain), and corresponding imaging findings of narrowed spaces around neural and vascular elements in the lumbar spine

The narrowing factors could be intervertebral disc herniation, hypertrophy of ligamentum flavum, hypertrophy of facet joint, spondylolisthesis, osteophyte and ectopic fat tissue

S TO THE CONTENTS ARE MORE IMPORTANT THAN THE



NEUROGENIC INTERMITTENT CLAUDICATION

Ischaemia of the lumbar nerve roots

Vascular claudication is ischaemia of the working tissues

MAJOR FACTORS IN LUMBAR SPINAL STENOSIS

- Biomechanical factors
- Venous engorgement
- Congenital factors

- Inflammatory cascade
- Arterial insufficiency
- Acquired factors

THE VALUE OF THE HISTORY

COOK RULE

- Pain relief upon sitting
- Pain during walking/standing
- Leg pain > back pain
- Bilateral symptoms
- Age > 48 years

- Any leg cramps?
- Improved walking tolerance with the spine in flexion
- Patient report of relief by forward bending

THE VALUE OF THE EXAMINATION

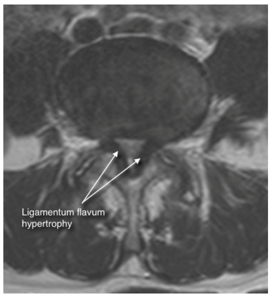
Heavier weighting is on history features in terms of diagnosing lumbar spinal stenosis

Examination focussed on assessing neurological integrity – power, reflexes and sensation

On plain X-rays, calcification of abdominal aorta may provide clues of vascular insufficiency

On MRI look for 'napkin ring' effect on sagittal sequences

Nerve root sedimentation sign



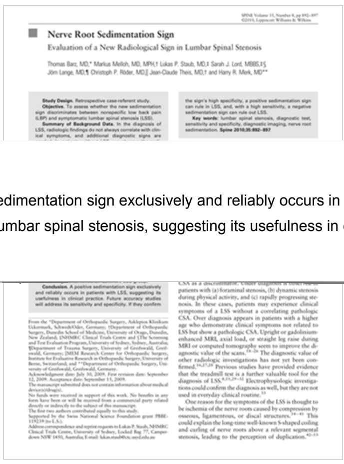
SPINE Volume 35, Number 8, pp 892–897
©2010, Lippincott Williams & Wilkins

Nerve Root Sedimentation Sign

Evaluation of a New Radiological Sign in Lumbar Spinal Stenosis

Thomas Barz, MD,* Markus Melloh, MD, MPH,† Lukas P. Staub, MD,‡ Sarah J. Lord, MBBS,‡§ Jörn Lange, MD,¶ Christoph P. Röder, MD,|| Jean-Claude Theis, MD,† and Harry R. Merk, MD**

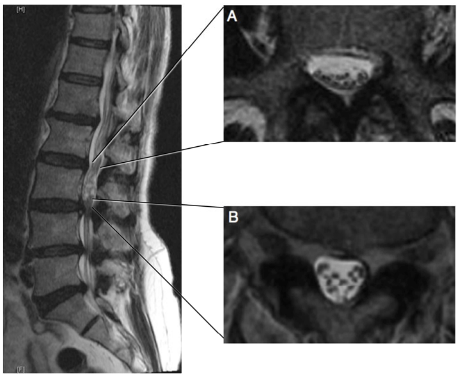
Study Design. Retrospective case-referent study.
Objective. To assess whether the new sedimentation sign discriminates between nonspecific low back pain (LBP) and symptomatic lumbar spinal stenosis (LSS).
Summary of Background Data. In the diagnosis of LSS, radiologic findings do not always correlate with clinical symptoms, and additional diagnostic signs are needed. In patients without LSS, we observe the sedimentation of lumbar nerve roots to the dorsal part of the dural sac on supine magnetic resonance image scans. In patients with symptomatic and morphologic central LSS, this sedimentation is rarely seen. We named this phenomenon "sedimentation sign" and defined the absence of sedimenting nerve roots as positive sedimentation sign for the diagnosis of LSS.



Nerve Root Sedimentation Sign
Evaluation of a New Radiological Sign in Lumbar Spinal Stenosis

"A positive sedimentation sign exclusively and reliably occurs in patients with symptomatic lumbar spinal stenosis, suggesting its usefulness in clinical practice."

NERVE ROOT SEDIMENTATION SIGN



Exploratory Analysis of Clinical Predictors of Outcomes of Nonsurgical Treatment in Patients With Lumbar Spinal Stenosis

Michael J Schneider, DC, PhD,[a] Lauren Terhorst, PhD,[b] Donald Murphy, DC,[c,d] Joel M. Stevans, DC,[e] Rachel Hoffman, DPT,[f] and Jerrilyn A Cambron, DC, PhD[g]

Abstract

Objective: The purpose of this study was to explore potential baseline physical examination and demographic predictors of clinical outcomes in patients with lumbar spinal stenosis.
Methods: This was a secondary analysis of data obtained from a pilot randomized controlled trial. Primary and secondary outcome measures were the Swiss Spinal Stenosis (SSS) Questionnaire and visual analog scale (VAS) for leg pain. Multiple regression models were used to assess 2 different outcomes: SSS at completion of care and VAS at completion of care. Separate regression models were built for each of the 2 outcomes to identify the best subset of variables that predicted improvement. Predictors with a significant contribution were retained in a final "best" model.
Results: Three variables were identified as having an association with SSS score at completion of care: baseline SSS score, qualitative description of leg pain, and age (adjusted R^2 = 33.2). Four variables were identified as having an association with VAS score at completion of care: baseline VAS score, qualitative description of leg pain, body mass index, and age (adjusted R^2 = 38.3).
Conclusion: This study provides preliminary evidence supporting an association between certain baseline characteristics and nonsurgical clinical outcomes in patients with lumbar spinal stenosis. (J Manipulative Physiol Ther 2016;39:88-94)
Key Indexing Terms: *Spinal Stenosis; Manipulation; Chiropractic; Low Back Pain; Complementary Therapies; Lumbar Vertebrae; Radiculopathy*

Lumbar spinal stenosis (LSS) is a syndrome that is characterized by significant buttock or lower extremity pain—which may occur with or without back pain—associated with diminished space available for the neural and vascular elements in the lumbar spine.[1] It is important to note that the diagnosis of the clinical syndrome of LSS requires both imaging evidence of bony narrowing as well as clinical evidence of significant buttock or leg pain.[2] The hallmark symptom of LSS is pain that is typically worse with walking or standing and better with sitting or lying down. The leg pain associated with LSS often leads to significant impairment in ambulation and quality of life. Lumbar spinal stenosis is a significant public health concern due to the high prevalence of this condition in the senior population and the burden caused by its associated physical impairments. It has been cited as the

[a] Associate Professor, Department of Physical Therapy and Clinical and Translational Sciences Institute, University of Pittsburgh, Pittsburgh, PA.
[b] Associate Professor, Department of Occupational Therapy and Clinical and Translational Sciences Institute, University of Pittsburgh, Pittsburgh, PA.
[c] Clinical Director, Rhode Island Spine Center, Pawtucket, RI.
[d] Clinical Assistant Professor, Department of Family Medicine, Alpert Medical School of Brown University, Providence, RI.
[e] Assistant Professor, Department of Physical Therapy, University of Pittsburgh, Pittsburgh, PA.
[f] Private Practice of Physical Therapy, Select Physical Therapy, Staunton, VA.
[g] Professor, Department of Research, National University of Health Sciences, Lombard, IL.
Submit requests for reprints to: Michael J Schneider, DC, PhD, Associate Professor, 433 Clair Drive, Pittsburgh, PA 15241. (e-mail: mjs5@pitt.edu).
Paper submitted January 28, 2015; in revised form June 27, 2015; accepted August 27, 2015.
0161-4754

http://dx.doi.org/10.1016/j.jmpt.2016.01.001

"Clinicians in the fields of chiropractic and physical therapy had empirically noted that stenosis patients who describe their leg symptoms as "heaviness," "numbness," or "weakness" may be less responsive to nonsurgical treatment approaches compared to those who describe their leg symptoms simply as "pain." The results of this analysis support this empirical observation; we found that patients who stopped the treadmill test due to a report of leg "pain" had better outcomes than those who used other descriptive terms such as numbness or heaviness. The neurophysiological mechanisms underlying this association with the qualitative descriptions of leg pain that impairs walking tolerance are unknown."

Associate Professor, Department of Occupational Therapy and Clinical and Translational Sciences Institute, University of Pittsburgh, Pittsburgh, PA.
[c] Clinical Director, Rhode Island Spine Center, Pawtucket, RI.
[d] Clinical Assistant Professor, Department of Family Medicine, Alpert Medical School of Brown University, Providence, RI.
[e] Assistant Professor, Department of Physical Therapy, University of Pittsburgh, Pittsburgh, PA.
Health Sciences, Lombard, IL.
Submit requests for reprints to: Michael J Schneider, DC, PhD, Associate Professor, 433 Clair Drive, Pittsburgh, PA 15241. (e-mail: mjs5@pitt.edu).
Paper submitted January 28, 2015; in revised form June 27, 2015; accepted August 27, 2015.
0161-4754
Copyright © 2016 by National University of Health Sciences.
http://dx.doi.org/10.1016/j.jmpt.2016.01.001

ACRM
AMERICAN CONGRESS OF REHABILITATION MEDICINE
Archives of Physical Medicine and Rehabilitation
journal homepage: www.archives-pmr.org
Archives of Physical Medicine and Rehabilitation 2018;99:2408-19

ORIGINAL RESEARCH

Comprehensive Nonsurgical Treatment Versus Self-directed Care to Improve Walking Ability in Lumbar Spinal Stenosis: A Randomized Trial

Check for updates

Carlo Ammendolia, DC, PhD,[a,b] Pierre Côté, DC, PhD,[a,c,d] Danielle Southerst, DC,[e] Michael Schneider, DC, PhD,[f] Brian Budgell, DC, PhD,[g] Claire Bombardier, MD,[h,i] Gillian Hawker, MD,[h,i] Y. Raja Rampersaud, MD[j]

From the [a]Institute of Health Policy, Management and Evaluation, University of Toronto, Toronto, Ontario, Canada; [b]Rebecca MacDonald Centre for Arthritis & Autoimmune Disease, Mount Sinai Hospital, Toronto, Ontario, Canada; [c]Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada; [d]Faculty of Health Sciences, University of Ontario Institute of Technology and UOIT-CMCC Centre for Disability Prevention and Rehabilitation, Toronto, Ontario, Canada; [e]Occupational and Industrial Orthopaedic Centre, Department of Orthopaedic Surgery, NYU Langone Health, New York, NY; [f]Department of Physical Therapy, University of Pittsburgh, Pittsburgh, PA; [g]Canadian Memorial Chiropractic College, Toronto, Ontario, Canada; [h]Department of Medicine, Division of Rheumatology, University of Toronto, Toronto, Ontario, Canada; [i]Department of Medicine, University of Toronto, Toronto, Ontario, Canada; and [j]Department of Orthopedics, Toronto Western Hospital, University Health Network, Toronto, Ontario, Canada.

Abstract

Objectives: To compare the effectiveness of a comprehensive nonsurgical training program to a self-directed approach in improving walking ability in lumbar spinal stenosis (LSS).

Design: Randomized controlled trial.

Setting: Academic hospital outpatient clinic.

Participants: Participants (N=104) with neurogenic claudication and imaging confirmed LSS were randomized. The mean age was 70.6 years, 57% were women, 84% had leg symptoms for >12 months, and the mean maximum walking capacity was 328.7 m.

Interventions: A 6-week structured comprehensive training program or a 6-week self-directed program.

Main Outcome Measures: Continuous walking distance in meters measured by the Self-Paced Walk Test (SPWT) and proportion of participants achieving at least 30% improvement (minimally clinically important difference [MCID]) in the SPWT at 6 months. Secondary outcomes included the Zurich Claudication Questionnaire (ZCQ), Oswestry Disability Index (ODI), ODI walk score, and the Short-Form General Health Survey subscales.

Results: A total of 48 versus 51 participants who were randomized to comprehensive (n=51) or self-directed (n=53) treatment, respectively, received the intervention and 89% of the total study sample completed the study. At 6 months, the adjusted mean difference in walking distance from baseline was 421.0 m (95% confidence interval [95% CI], 181.4-660.6), favoring the comprehensive program and 82% of participants in the comprehensive group and 63% in the self-directed group achieved the MCID (adjusted relative risk, 1.3; 95% CI, 1.0-1.7; $P=.03$). Both primary treatment effects persisted at 12 months favoring the comprehensive program. At 6 months, the ODI walk score and at 12 months the ZCQ, Medical Outcomes Study 36-Item Short-Form Health Survey-physical function and -bodily pain scores showed greater improvements favoring the comprehensive program.

Conclusions: A comprehensive conservative program demonstrated superior, large, and sustained improvements in walking ability and can be a safe nonsurgical treatment option for patients with neurogenic claudication due to LSS.

Archives of Physical Medicine and Rehabilitation 2018;99:2408-19

Presented to the North American Spine Society Meeting, October 27, 2017, Orlando, FL; International Society for Study of Lumbar Spine, May 31, 2017, Athens, Greece; and American College of Rheumatology Meeting, November 5, 2017, San Diego, CA.
Supported by the Arthritis Society (Canada) (grant no. SOG-13-003). The Canadian Chiropractic Research Foundation, through a Professorship in Spine Award, provided salary support for the chief investigator.
Clinical Trial Registration No.: NCT02592642.
Disclosures: none.

0003-9993/18/$36 - see front matter © 2018 by the American Congress of Rehabilitation Medicine
https://doi.org/10.1016/j.apmr.2018.05.014

ACRM
Archives of Physical Medicine and Rehabilitation
ORIGINAL RESEARCH

"Stationary cycling (forward leaning) was strongly recommended as part of the daily home exercise routine. A written schedule was provided outlining the type, frequency, and intensity of the exercises to be performed. Typically, the recommended cycling duration was 5 minutes at week 1, increasing by 5 minutes each week to a maximum of 30 minutes."

CHIROPRACTIC DEVELOPMENT INTERNATIONAL

THANK YOU

www.cdi.edu.au