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Original Articles

Reprints

TORTUROUS VERTEBRAL ARTERIES

Jerrold R. Wildenauer, D.C., FACO

West. St. Paul, Minnesota

HISTORY:

A 44-year-old female presented to our clinic with a history of severe headaches for a 2-week duration. The headaches were on the left side of the head and seemed to radiate up from the left side of the neck. As the intensity of the headache increased she also complained of nausea but denied any visual changes. She had recently consulted her family doctor who placed her on a special diet and prescribe pain medication for the headaches.

EXAMINATION:

Her physical examination did reveal a reduction of the normal cervical range of motion. There was tenderness and hypertonicity of the left cervical paraspinal and upper trapezius musculature. The suboccipital area on the left was also very tender to palpation.

RADIOGRAPHY:

Three views were taken of her cervical spine, which included an APLC, LCN and APOM. Upon reviewing these x-rays, discopathy was noted at the C4-5, 5-6 and 6-7 levels (Figure 1). Also noted was cervical hypolordosis. The APOM did reveal a possible erosion defect on the left side of C2 (Figures 2 and 3). The x-rays were then mailed to a Chiropractic Radiologist who concurred with our findings and agreed that additional tests should be carried out to differentiate torturous vertebral artery from an aneurysm.



Figure 2



Figure 3



Figure 1

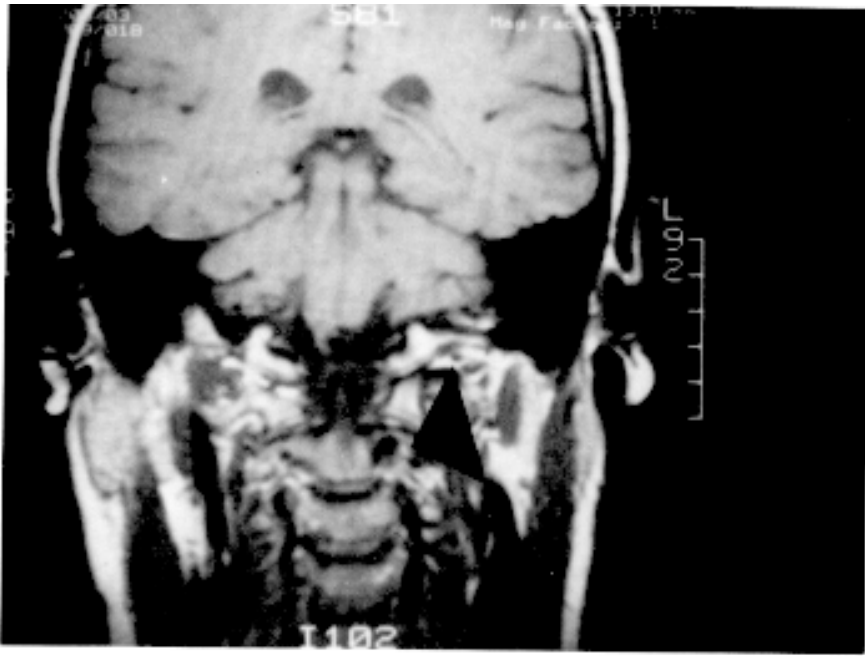


Figure 4

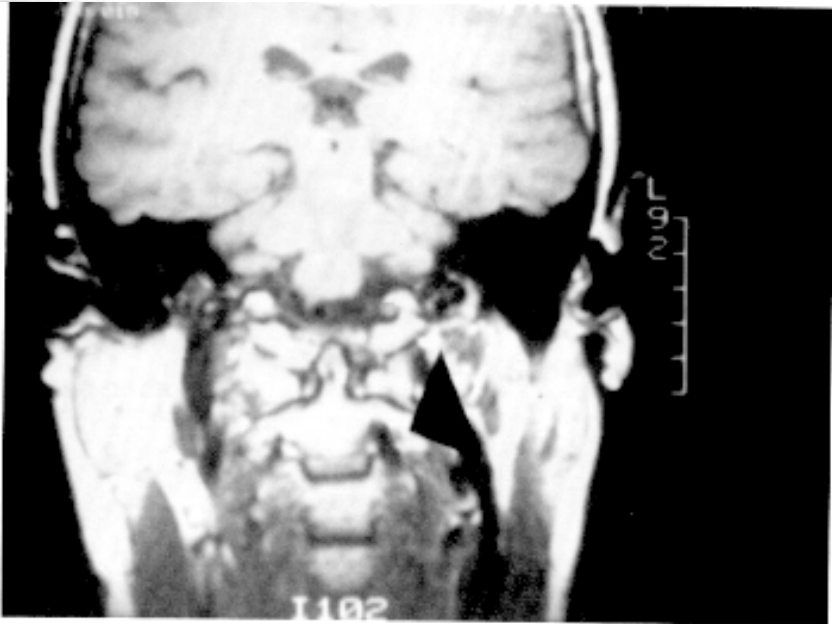


Figure 5

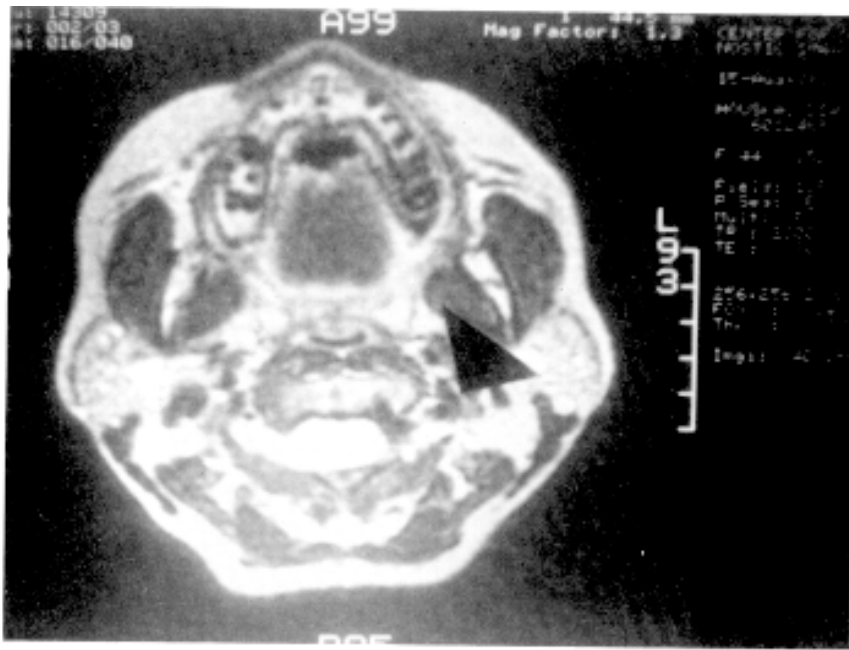


Figure 6

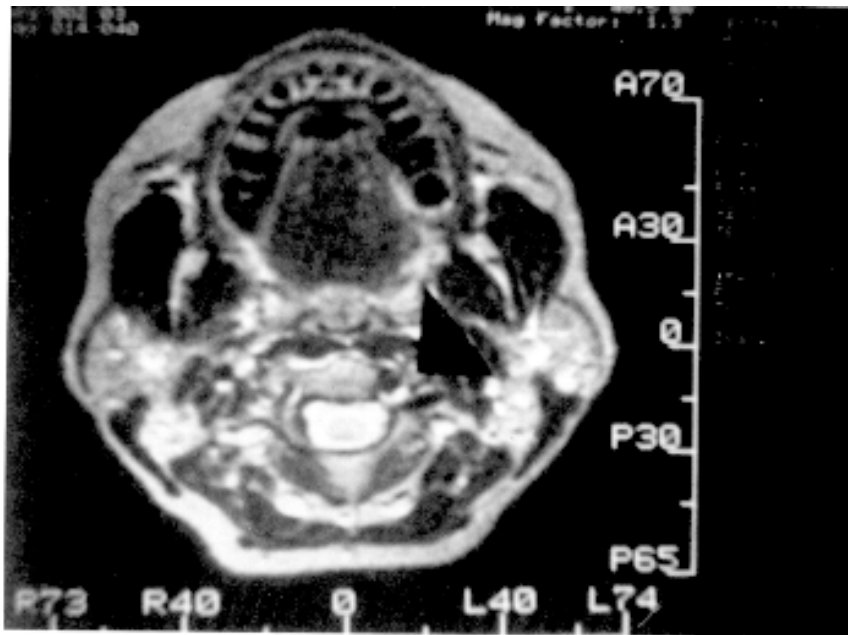


Figure 7

The patient was then referred to a local diagnostic imaging center for a brain and cranial vertebral junction study. The MR scan revealed an anomalous course of the dominant left vertebral artery, which exhibited a torturous loop between C2 and C3 and results in focal indentation of the C2 body. No evidence of a vascular aneurysm was apparent. Figures 4 and 5 are coronal images demonstrating the anomalous course of the left vertebral artery as it emerges from the C3 foramen transversarium. Above the left C-3 foramen, the artery bends medially and anteriorly and slightly indents the C2 vertebral body. Axial images (Figures 6 and 7) of the cranial vertebral junction demonstrate a slightly anomalous course of the descending segment of the left vertebral artery. The vessel makes an anterior and medial loop between the levels of C3 and C2, slightly indenting the C2 body laterally. There is actual indentation and scalloping of the C2 body laterally on the left side.

CONCLUSION:

This case demonstrates the need for the APOM in assessing patients with upper cervical complaints as well as headaches. Fortunately, a benign tortuous artery and not an aneurysm caused the erosion. No additional studies are required for this patient is responded to the cervical manipulation and was released asymptomatic.

VERTEBROPLASTY AND KYPHOPLASTY**AMAZING NEW TECHNOLOGY FOR THORACO-LUMBAR COMPRESSION FRACTURES**

Jerrold R. Wildenauer, D.C., FACO
West St. Paul, Minnesota

HISTORY

A 63-year old male presented to our clinic complaining of intense lumbosacral and sacroiliac pain. There was also a complaint of diffuse pain over the left iliac crest spreading toward the greater trochanter. The patient was severely antalgic, demonstrated early signs and symptoms of shock and began vomiting when escorted to the examination room. Earlier that day he was standing on a stepladder which collapsed beneath him, causing him to fall about 4 feet directly upon his buttocks. The pain was so intense that he was unable to stand. He managed to crawl to his car and drive to our clinic where he was assisted to the examination room.

EXAMINATION

There was a significant reduction in the dorsal lumbar range of motion with a severe left lateral antalgia. Achilles and patellar reflexes were intact and there are no obvious sensory changes. Soto-Hall was positive and referred pain to the thoracolumbar junction. Percussion generated significant pain over the T-12, L-1 and L-2 segments. There was considerable muscle guarding.

RADIOGRAPHY

Radiographic examination included an APLS and LLS view. The lateral view (Figure 1) demonstrated significant osteoporosis of the lumbar spine with moderate aortic calcification. A compression fracture is noted at the L-1 level. An incidental finding of a hemangioma is visualized at T-12. The APLS (Figure 2) reveals the L-1 compression fracture (see Arrow). Also apparent are the vertical striations of the T-12 vertebral body, which represents a common radiographic finding in hemangioma.



Figure 1
Figure 2

DISCUSSION

The compression fracture is the most frequent type of injury involving the vertebral body. It is caused by an acute forward flexion of the spine and the damage is usually limited to the upper portion of the vertebral body. (1) With more extensive compression there is usually some loss in vertebral height posterior as well as inferior. The T-12 / L-1 level is one of the most common levels in which compression fractures occur. (2) The patient was initially given a standard lumbar brace and instructed in the use of the Tens unit and ice to control pain. Over the next seven days he was treated at home using high voltage interrupted galvanic current and acupuncture to control the pain. By this time the patient was ambulatory and was fitted for a chair back brace. During his office visits, we continued the high-voltage galvanic current and used conservative chiromanis distraction. The patient responded remarkably well to conservative care and within four weeks was relatively asymptomatic. If the patient had been a younger individual, his management may have included

casting for 6 weeks to minimize deformity of the vertebral body. Since there were no positive neurological findings, there was no need for a referral in this case.

This case is actually several years old. If the identical case walked through my door today I would handle it differently. Once I established there was in fact a compression fracture I would determine if there was a significant loss of vertebral height. If not, I would refer this patient to a facility that provided the *Vertebroplasty Procedure*. This procedure is designed to provide pain relief within 24 to 48 hours. It is a therapeutic technique that involves filling a vertebral body with acrylic cement and does not require you to be sedated. This procedure is performed using fluoroscopic guidance. An intravenous antibiotic will be given prior to the procedure. Following the local anesthetic injection, a needle is inserted into the vertebral body. Bone cement is then injected into the vertebral body. The clinical success rate for this procedure at a St. Paul Radiological Facility translates to 82 percent with significant relief after 24 hours for the thoracic spine and 88 percent in the lumbar spine.

If there is significant loss of bone height I will then refer the patient to the same facility that for a Kyphoplasty Procedure. This procedure is also designed to provide pain relief but it also restores vertebral height and minimizes the deformity. It is a therapeutic technique that involves inserting balloons into the fractured bone, and then the balloons are inflated to restore the bone to its original shape. The acrylic cement is injected into the bone after the balloons are removed. This procedure is performed using fluoroscopic guidance and does require you to be sedated and given an intravenous antibiotic. Preparation for this procedure includes having nothing to eat or for 8 hours prior to the procedure. Medications may be given with sips of water. If the patient is taking Coumadin it needs to be stopped 72 hours prior to the procedure. Generally, the patients are admitted to the hospital overnight following the procedure for observation.

The acrylic cement is harder than bone and the patients that have had the procedure are amazed at how quickly their pain disappears.

COMMON USES

It is most commonly used to treat the pain associated with osteoporotic compression fractures. It is often used on patients to elderly or frail to tolerate open spinal surgery. It is sometimes used where there is vertebral damage due to a malignant tumor.

BENEFITS vs. RISKS

Benefits

Patients feel significant relief almost immediately. Within 1 to 2 weeks, two-thirds of patients are able to lower their doses of pain medication substantially or totally eliminate it.

Risks

Vertebroplasty is generally a very safe and effective procedure, however, a small amount of orthopedic cement can leak out of the vertebral body which usually does not create a problem unless it moves into the spinal canal which can be potentially dangerous. Other potential complications include neurological symptoms, including numbness or tingling and paralysis (which is extremely rare). There is the potential for infection, increased back pain, and bleeding. There have been rare case reports of a pulmonary embolism of the lungs and even death associated with these procedures.

LIMITATIONS OF VERTEBROPLASTY

1. The procedure cannot serve as a preventive treatment to prevent future fractures.
2. It is not used for arthritic back pain or herniated disc.

3. It is generally not recommended for younger individuals because of the limited experience of the cement in the vertebral body for longer periods of time.

CONCLUSIONS

One of the interesting aspects of a compression fracture at this level is the irritation of the Cluneal Nerve, which was responsible for the referred pain over the left iliac crest and SI area. It was also interesting to note that this severe impact did nothing to deform the T12 vertebral body that contains an obvious hemangioma.

REFERENCES

1. Paul, Lester W, Essentials of Roentgen Interpretation; pp. 150-151.
2. Schaefer, R.C., Chiropractic Management of Sports and Recreational Injuries; pp. 425-426.
3. RadiologyInfo, April 2003 www.radiologyinfo.org

JERROLD R. WILDENAUER, D.C., F.A.C.O.

Abstracts & Literature Review

Rotator cuff tendinopathy / subacromial impingement syndrome: Is it time for a new method of assessment?

INTRODUCTION: Disorders of the shoulder are extremely common, with reports of prevalence ranging from 30% of people experiencing shoulder pain at some stage of their lives up to 50% of the population experiencing at least one episode of shoulder pain annually, and for people over 65 years of age shoulder pain is the most common musculoskeletal problem. In addition to the high incidence, shoulder dysfunction is often persistent and recurrent with 54% of sufferers reporting on-going symptoms after 3 years. To a large extent the substantial morbidity reflects (i) a current lack of understanding of the pathoaetiology, (ii) a lack of diagnostic accuracy in the assessment process, and (iii) inadequacies in current intervention techniques. Pathology of the rotator cuff and subacromial bursa are considered to be the principal cause of pain and symptoms arising from the shoulder. Diagnostic labels given to pathology arising in these structures includes; rotator cuff tendinopathy /tendinosis / tendinitis; supraspinatus tendinopathy / tendinosis /tendinitis, subacromial impingement syndrome, subacromial bursitis, bursal reaction, partial thickness, full thickness and massive rotator cuff tear. Generally these diagnostic labels relate more to a clinical hypothesis as to the underlying cause of the symptoms than definitive evidence of the histological basis for the diagnosis or the correlation between structural failure and symptoms. For the purposes of this paper the terms rotator cuff tendinopathy and subacromial impingement syndrome will be used to cover the spectrum of these soft tissue pathologies.

Lews JS. British Journal of Sports Medicine. October 6, 2008

Book Review

Case History

Case submitted by

Michelle A Wessely, BSc (Chiro), DC, DACBR, FCC (Radiology/UK), DipMED

Clinical history

A 71 year old gentleman presented to the chiropractor with several complaints including no cervical mobility, no hip mobility for 30 years. He had been diagnosed at that time with psoriatic arthropathy. In general he suffered with depression, and having had a stroke in 2003, the vision in his left eye was significantly reduced. He has also had weight loss since the stroke but links this in to the depression that developed at around the same time.

The clinical examination demonstrated that the cervical spine was extremely immobile with a reduction in the range of motion both actively and passively. The orthopaedic tests were difficult to perform due to the general severe restriction in the range of motion in all directions. Cervical compression was negative for pain. The hip examination demonstrated that FABER was mildly positive bilaterally. Internal and external rotation was limited bilaterally both active and passively.

Imaging accompanied the patient and was presented to the chiropractor.

What are your findings?

Figure 1

What are your diagnoses?

Figure 2

Pertinent imaging findings

The most pertinent findings on this lateral view is the near complete ankylosis that is particularly marked along the anterior aspects of the cervical segments with evidence of syndesmophyte formation, except for at C45 where there is a slight anterolisthesis at this level. Also note the increase in the atlantodental interspace, with the possibility of erosions along the superior aspect of the odontoid process. General moderate demineralisation is noted which is likely related to the ankylosis resulting in limited mobility. Ossification is noted in the posterior soft tissues around the spinous processes of C4 through to C7, which represents heterotopic ossification which may be related to the psoriatic arthropathy, one of the seronegative inflammatory spondyloarthropathies. Other findings include enthesopathy (tug lesion) associated with the external occipital protuberance, there is anterior displacement of the cervical gravity line as well as a reduction in the cervical lordosis.

On the AP pelvic view there are again a number of interesting findings. These include the alteration of the shape of both femoral heads most particularly the left (reading right). The left femoral head is deformed, with increased density noted, collapse of the subchondral bone as well as the severely reduced coxofemoral joint space, in a predominantly non-uniform pattern. The right femoral head is also deformed but to a lesser degree with a uniform reduction in the coxofemoral joint space. The sacro-iliac joints are very indistinct and highly suggestive of early stage 3 sacro-iliitis. The appearance to the descending colon is somewhat tubular, thin and suggestive of an ulcerative colitis.

Diagnoses

1. Seronegative inflammatory spondyloarthropathy associated with diffuse marginal syndesmophyte formation, C1-C2 instability, heterotopic ossification about the posterior cervical soft tissues, stage 3 sacro-iliitis bilaterally and psoriatic arthropathy affecting the coxofemoral joint spaces. In addition there is evidence of avascular necrosis of the left femoral head. The bowel pattern of the descending colon is highly suggestive of the pattern found in ulcerative colitis with the “hose-pipe” appearance.

Clinical Pearls

1. The seronegative inflammatory spondyloarthropathies are a group of disorders that are composed of ankylosing or enteropathic spondylitis, reactive arthritis (previously called Reiter's syndrome) and psoriatic arthropathy.
2. In the majority of patients with these conditions, the HLA B27 will be present, though not always.
3. All the seronegative inflammatory spondyloarthropathies may predispose the patient to C1-C2 instability, whether or not there is clinical or radiographic evidence of involvement otherwise.
4. Avascular necrosis is more prevalent in this group of conditions compared to those patients without the inflammatory spondyloarthropathies.

Further reading

[Jacobson JA, Girish G, Jiang Y, Resnick D.](#)

Radiographic evaluation of arthritis: inflammatory conditions.

Radiology. 2008 Aug;248(2):378-389

PMID: 18641245

[Sieper J, Rudwaleit M, Khan MA, Braun J.](#)

Concepts and epidemiology of spondyloarthritis.

Best Pract Res Clin Rheumatol. 2006 Jun;20(3):401-417

PMID: 16777573

[Olivieri I, van Tubergen A, Salvarani C, van der Linden S.](#)

Seronegative spondyloarthritides.

Best Pract Res Clin Rheumatol. 2002 Dec;16(5):723-739

PMID: 12473270

Acknowledgements

The author would like to thank N Franklin for the contribution of this case.





MRI Evidence of Multi-factorial Issues of Lumbar Degeneration – A Chiropractic Orthopedic Self Test

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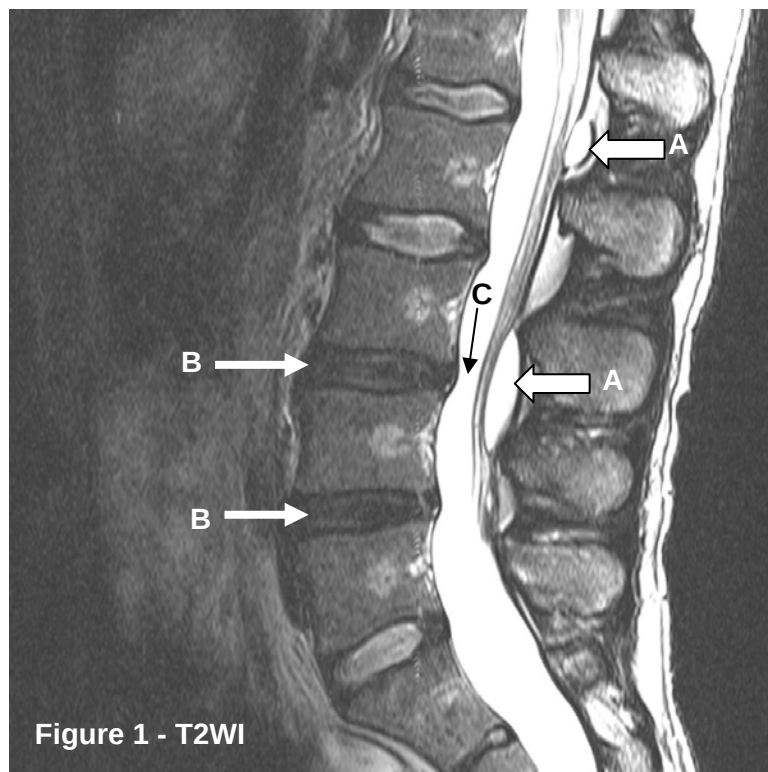
²Post-graduate faculty, New York Chiropractic College, Seneca Falls, NY, USA

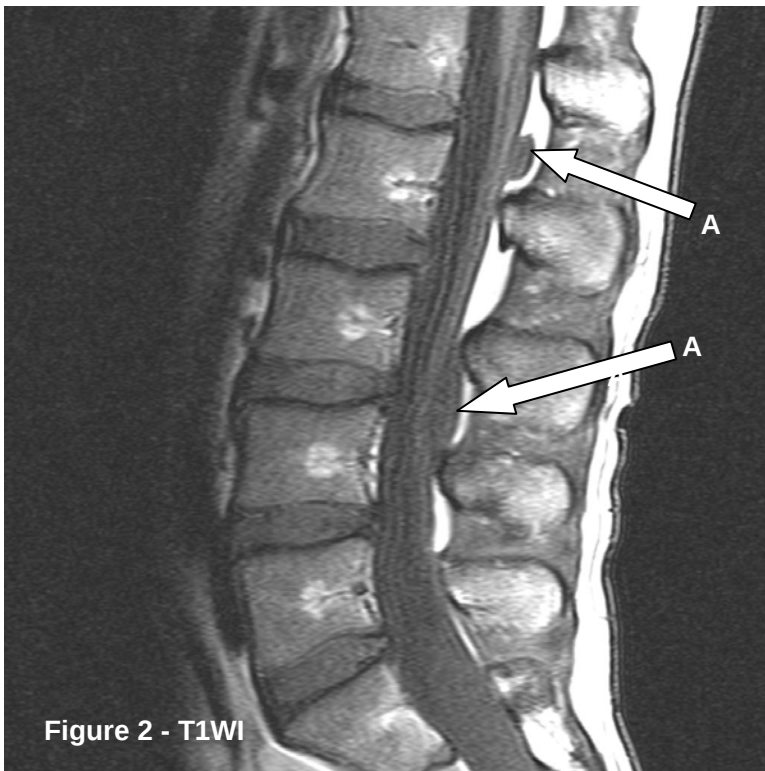
Case Presentation

A 35-year old male presented with a history of chronic lower back pain with reported frequent acute exacerbations. The patient is an avid martial artist. He reported multiple related spinal injuries during training and sparring. In addition, he is a four wheel drive off-roading enthusiast and has experienced exacerbations of pain related to that activity. The patient admittedly did not comply with prior recommendations to discontinue provocative activities.

Despite substantive medical, physical therapeutic and chiropractic interventions, the patient reported persistent pain with associated exacerbations due to his activities of daily living. MRI of the lumbar spine was performed and the neuroradiologist's report revealed non-descript, mild degenerative joint disease.

Review of the initial MRI evaluation of the lumbar spine provided significant clues that may bear clinical relevance to the patient's symptomatic picture. Following are selected images from the patient's MRI study. Please review the following images and describe the findings that may correlate to the patient's clinical picture.





Figures 1 and 2. Describe three findings:

1. _____
2. _____
3. _____

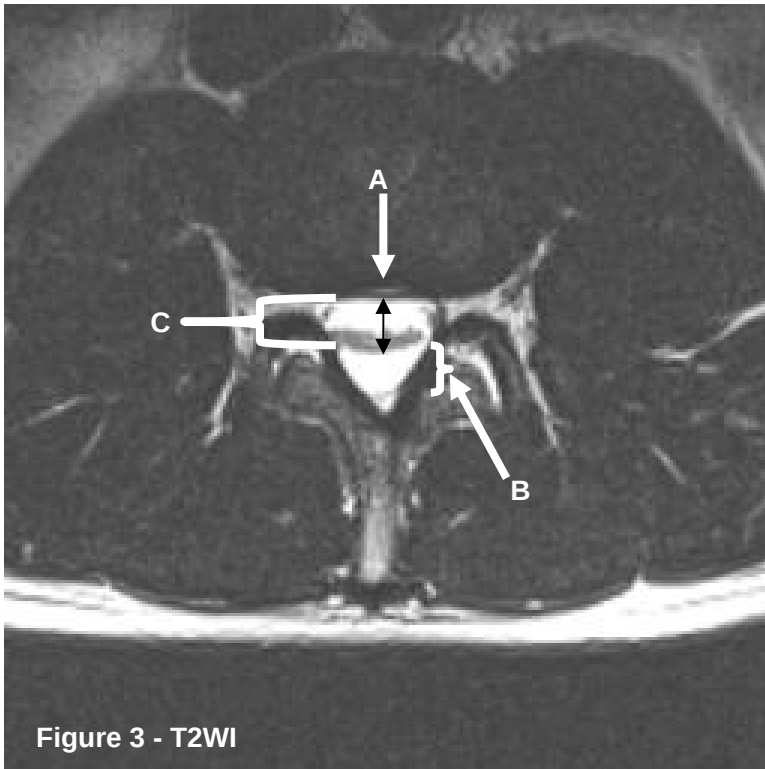


Figure 3. Describe three imaging findings:

- A. _____
- B. _____
- C. _____

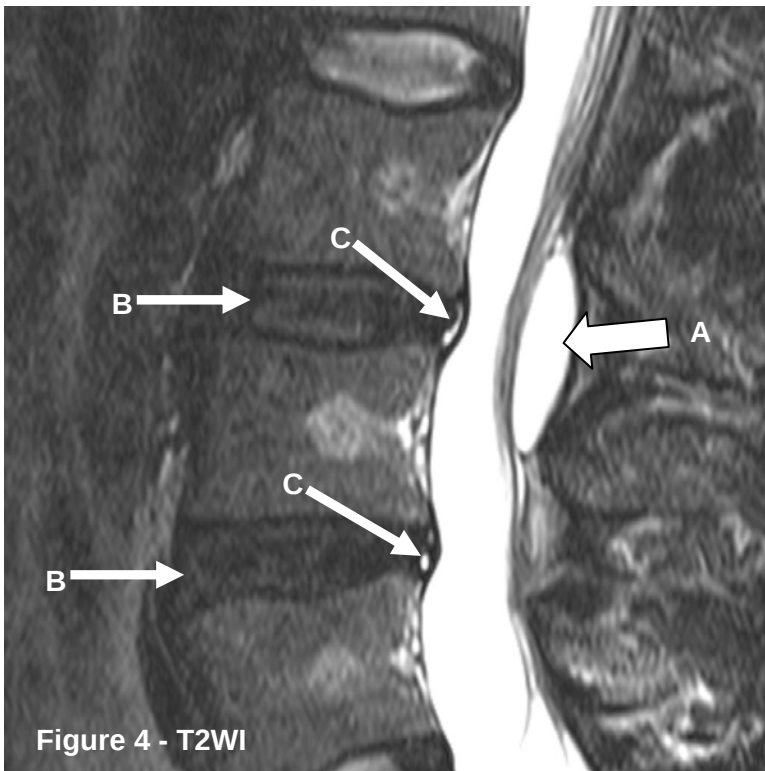


Figure 4. Describe three IVD findings:

- A. _____
- B. _____
- C. _____

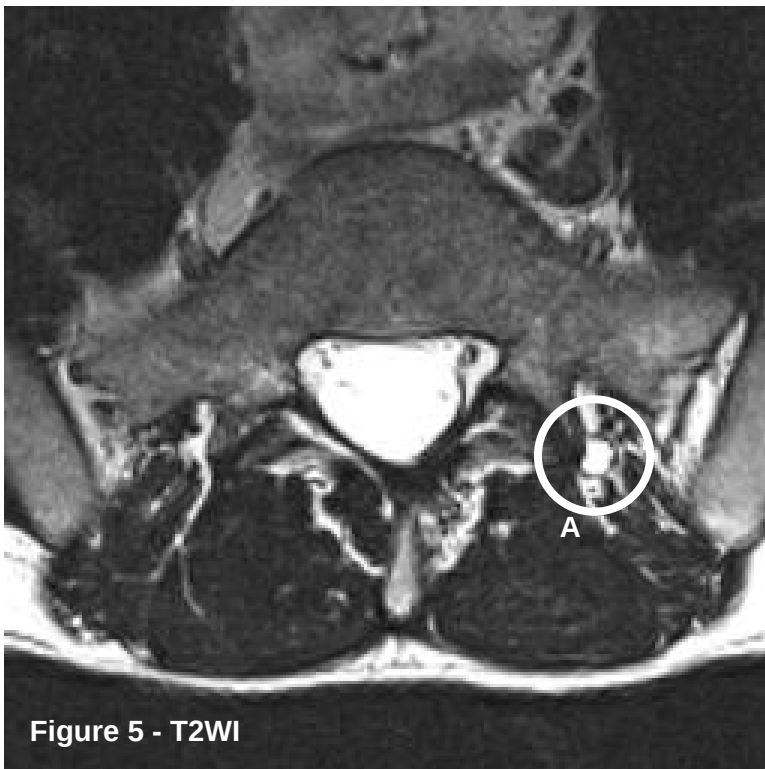


Figure 5. Describe one imaging finding:

A. _____

Self Test Answers:

Figures 1 and 2:

- A. Two posterior epidural cysts are visualized at L1/2 and L3/4.
- B. Decreased signal intensity on T2 weighted image (T2WI) is consistent with disc desiccation/dehydration at L3/4 and L4/5.
- C. Central canal stenosis is visualized at L3/4.

Figure 3:

- A. Faint but visibly increased signal intensity is noted on T2WI of the mid-sagittal posterior IVD that is consistent with a High Intensity Zone (HIZ) and annular tear.
- B. Posterior epidural cyst at L3/4 is noted.
- C. Central canal spinal stenosis is noted. Measurement of the thecal sac revealed an 8mm AP diameter.

Figure 4:

- A. Large posterior epidural cyst at L3/4 is visualized producing central canal stenosis.
- B. Decreased signal intensity affecting L3/4 and L4/5 IVDs consistent with IVD desiccation/dehydration.
- C. HIZs visualized in the posterior annulus of the L3/4 and L4/5 IVDs.

Figure 5:

A. A left L5/S1 posterior zygapophyseal synovial cyst is visualized.

Discussion - Clinical Relevance and Considerations

MRI evaluation may provide important findings that are inherent to the degenerative cascade failure visualized in patients. It is important to recognize that MRI findings should be correlated to the patient's clinical picture. Related to the above case, several MRI findings are revealed that provide a more thorough illustration of the patient's clinical condition.

Posterior spinal epidural cysts are described in the literature (1-3). Inui et al. have documented the importance of the thecal sac AP measurement of less than 8mm in its relation to cauda equina syndrome (4). Griffith described the modified Pfirrmann grading system related to disc desiccation. (5). Annular tears and visualized High Intensity Zones have been documented as pain generators in the literature (6). The prevalence of zygapophyseal synovial cysts is likewise well recognized (7,8).

Specific to this case, the multi-factorial components of visualized degeneration were reviewed with the patient. Strong recommendations to discontinue or alter provocative activities were provided. With improved understanding of his condition, hopefully the patient will improve his compliance to recommendations related to activities of daily living and self care. Chiropractic flexion distraction technique was prescribed. Home core strengthening exercises were provided.

Conclusion

It behooves chiropractic orthopedic practitioners to actively review patients' MRI studies. Medical radiologists may not report clinically important visualized findings that have been described in the orthopedic and neuroradiologic literature. Careful correlation of clinical findings may provide better understanding of the scope of degenerative processes and allow for specific therapeutic recommendations.

References

1. Jinkins JR: Acquired degenerative changes of the intervertebral segments at and suprajacent to the lumbosacral junction A radioanatomic analysis of the nondiscal structures of the spinal column and perispinal soft tissues . *European Journal of Radiology* 2004, 50:134-158.
2. Chen et al: Intraspinal posterior epidural cysts associated with Baastrup's disease: a report of 10 patients. *AJR* 2004, 182:191-194
3. Rajasekaran et al.: Baastrup's disease as a cause of neurogenic claudication: a case report. *Spine* 2003, 28(14):E273-E275.
4. Inui et al.: Clinical and radiologic features of lumbar spinal stenosis and disc herniation with neuropathic bladder. *Spine* 2004, 29(8):869-873.
5. Griffith et al.: Modified Pfirrmann grading system for lumbar intervertebral disc degeneration. *Spine* 2007, Volume 32(24):E708-E712.

6. Saifuddin et al.: The value of lumbar spine magnetic resonance imaging in the demonstration of annular tears. *Spine* 1998, 23(4):453-457.
7. Doyle et al.: Synovial cysts of the lumbar facet joints in a symptomatic population: prevalence on magnetic resonance imaging. *Spine* 2004, 29(8):874-878.
8. LaBan et al.: Progressive enlargement of a lumbar zygapophyseal cyst. *Am J Phys Med Rehabil* 2005, 84(10):821.

CDI CONSULT

A PUBLICATION FOR REFERRING CLINICIANS OF CENTER FOR DIAGNOSTIC IMAGING

INSIDE THIS ISSUE

Essential to concise and accurate communication around findings on diagnostic imaging exams is well-defined terminology and definitions for pathology. In this article, Dr. Tom Gilbert reviews clinical research highlighting terminology adopted by CDI spine radiologists relevant to disc herniations and neural impingement.



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Nomenclature of Lumbar Disc Herniations on MRI

Thomas J. Gilbert, M.D., M.P.P., Spine Radiologist

As radiologists at Center for Diagnostic Imaging (CDI), our goal is to communicate the findings on diagnostic imaging exams in as clear, concise and accurate manner as possible. Fundamental to this process is the adoption and routine use of well-defined and agreed-upon terminology and definitions for pathology.

The purpose of this article is to review this terminology relevant to disc herniations and neural impingement. The terminology outlined in the following article represents a consensus between the North American Spine Society, the American Society of Spine Radiology and the American Society of Neuroradiology.

Lumbar Disc Herniations on MRI

Magnetic Resonance Imaging (MRI) has proven to be more accurate than Computed Tomography (CT) and as

accurate as CT Myelography (CTM) in the detection of disc herniations.^{2, 8,9,11} MRI is more accurate than CT and CTM in the characterization of disc herniations. MRI also allows for direct visualization of neurological structures and of neural displacement and compression.⁷

While the visualization of disc pathology on MRI is unexcelled, performance can be compromised, and both the reliability and reproducibility of MRI interpretations degraded by lack of well-defined criteria and definitions for pathologic diagnoses. For this reason, the spine team at CDI has adopted and routinely uses the consensus terminology outlined below.

Types of Herniations

A disc herniation refers to the expulsion of disc material through
(continued on page 2)

FIGURE 1a

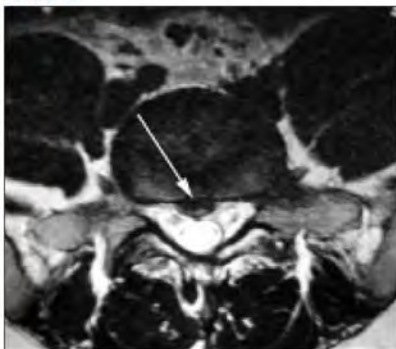


FIGURE 1b



Figure 1- Disc Protrusion. A disc herniation is seen on axial images (Figure 1a), and is contained by the outermost annular fibers on sagittal proton density images (Figure 1b).

(continued from page 1)

an annular tear. The term “herniated nucleus pulposus,” while frequently used, should be avoided because disc herniations will frequently contain fragments of annulus, cartilage and apophyseal bone, in addition to nucleus pulposus.^{4, 16, 17}

With MR imaging, disc herniations can be classified as protrusions, extrusions, and sequestrations. Extruded or sequestered fragments can be further classified as subligamentous or transligamentous. Both the size and signal characteristics of disc herniations can be assessed on MRI and should be reported. These factors may be significant both with respect to the natural history of a herniation, and to surgical planning. If differential features are not well defined, the general term, “disc herniation,” should be used.

With a protrusion, the herniated material does not extend beyond the outermost annular fibers.⁶ A protruding disc fragment on MRI will often have intermediate

FIGURE 2a

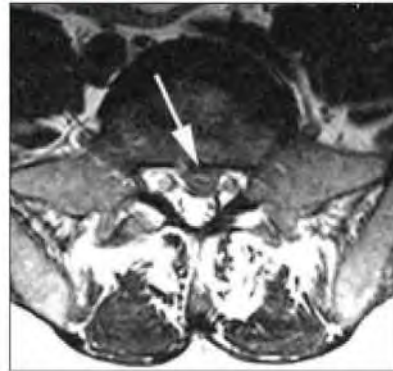


FIGURE 2b



Figure 2- Disc Extrusion. A central disc herniation is seen on axial images (Figure 2a), and extends beyond the margins of the disc annulus on sagittal proton density images (Figure 2b).

or high-signal intensity on proton density and T2-weighted sequences, while the adjacent annular fibers have low-signal intensity. The relationship of the herniated disc material relative to the disc annulus is often appreciated best on sagittal proton density images (Figure 1). Radiculopathy secondary to a protrusion can respond to conservative measures, however, the clinical course is often prolonged compared to patients with extrusions, and the results with surgery may be less predictable.

At CDI, we prefer the term “contained disc herniation” to “protrusion.” Even though the two terms are synonymous, the term protrusion is often misused in general practice. Some readers will use protrusion to refer to any herniation, while others will use it if there is uncertainty as to the presence or type of a herniation, or if they are unwilling to commit to the more definitive term “herniation.” The meaning of term “contained disc herniation” is self-evident.

FIGURE 3a



FIGURE 3b

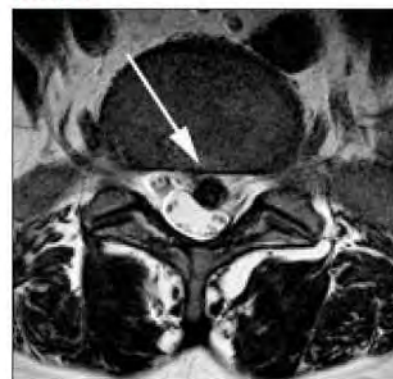


Figure 3- Disc Sequestration. Epidural fat is interposed between the extruded disc fragment and from the parent disc on sagittal T2-weighted images (Figure 3a). The sequestered fragment contacts the medial margin of the traversing left S1 nerve root sleeve on axial T2-weighted images (Figure 3b).

FIGURE 4



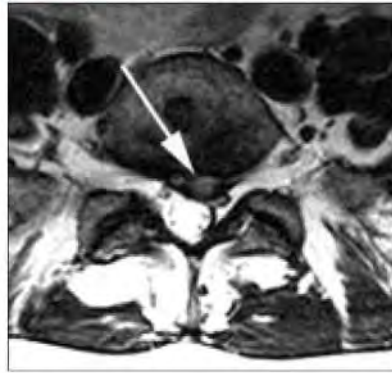
Figure 4- Transligamentous disc herniation. Extruded disc material breaches the posterior longitudinal ligament on the sagittal proton density image.

FIGURE 5a



Figure 5- Paracentral disc herniation. A moderate sized disc herniation deforms the left ventrolateral dural sac on the sagittal T2-weighted image (Figure 5a), and impinges on the traversing nerve root within the subarticular recess (Figure 5b).

FIGURE 5b



With an extrusion, the herniated disc material extends beyond the outermost fibers of the disc annulus, and may extend cephalad or caudal to the level of the disc.⁶ Extension of disc material beyond the outer annular fibers is well defined on sagittal proton density images (Figure 2). Radiculopathy secondary to an extrusion responds to conservative therapy in the majority of cases if the patient's pain can be controlled.^{13, 15} Extruded disc herniations appear to resorb in a significant number of patients, and in fact, show greater resorption than do contained disc herniations.^{3, 5, 10, 14} Exposure to epidural blood flow is felt to be a prerequisite to resorption, as resorption occurs through a process of peripheral vascularization and macrophage infiltration.

A sequester represents a subtype of disc extrusion in which the disc fragment becomes separated from the parent disc.⁶ Disc sequestrations can be diagnosed when high-signal intensity epidural fat is interposed between the disc fragment and the parent disc (Figure 3).

Sequestrations resorb more readily than extruded and protruded disc fragments, and in more than 90% of cases resorb completely on follow up examination.¹ The identification of sequesters is important for planning surgical resection as these may migrate out of view of the immediate surgical field.

Subligamentous and transligamentous herniations also represent subtypes of extrusions and sequestrations and refer to the relationship of the disc fragment with the posterior longitudinal spinal ligament

(PLL). With a subligamentous herniation the disc fragment tracks deep to the PLL. With a transligamentous herniation the disc fragment breaches and extends through the posterior longitudinal spinal ligament.⁶ Transligamentous herniations can be identified on sagittal or axial proton density-weighted images, and show greater resorption than subligamentous extrusions (Figure 4).¹

Location of Disc Herniations

Disc herniations may be central, paracentral, posterolateral, lateral or far lateral. Central herniations occur in the midline (Figure 2), and in patients with a capacious canal, can be quite large without impinging on nerve roots within the dural sac. Paracentral disc herniations occur just to the right or left of midline, and when large can impinge on nerve roots within the subarticular recess (Figure 5).

Posterolateral disc herniations are located on the posterior margin of the disc annulus just medial to the foramen, and frequently impinge on the traversing nerve root within the subarticular recess (Figure 6).

FIGURE 6a



FIGURE 6b



Figure 6- Posterolateral disc herniation. A small caudally extruded posterolateral herniation is seen on a sagittal T2-weighted image (Figure 6a), and impinges on the traversing nerve root within the subarticular recess (Figure 6b).

With caudal migration, herniations can also impinge on the traversing nerve root within the lateral recess at the level of the caudal pedicle (Figure 7). With cephalad migration, herniations can impinge on the exiting nerve root at the entry zone of the neural foramen (Figure 8).

Lateral or intraforaminal disc herniations localize to the lateral margin of the disc, and can impinge on the ganglion within the foramen (Figure 9a). Far lateral or extra-foraminal herniations arise lateral to the foramen, and can encroach on the exiting nerve root distal to the ganglion (Figure 9b). At L5-S1, far lateral disc herniations can impinge on the L5 ganglion and post-ganglionic nerve within the far lateral foramen. The ganglion is confined within the far lateral foramen by the sacral ala inferiorly and the L5 transverse process superiorly.

Grading of Nerve Root Compromise

The extent of nerve root compromise secondary to disc herniations should be graded as follows:

- No compromise
- Contact of disc material with the nerve root
- Displacement of the nerve root
- Compression of the nerve root

This system has proven to be reliable when compared to surgical findings in 250 patients by Pfirrmann et al.¹²

With subarticular recess impingement, the position of the compromised segment of the

(continued on page 5)

FIGURE 7a



FIGURE 7b

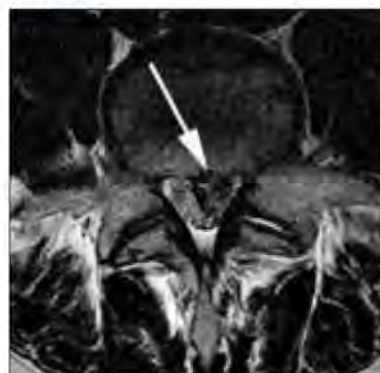


FIGURE 7c



FIGURE 7d



Figure 7 - Caudally extruded posterolateral disc herniation with caudal extrusion. A large caudally extruded disc herniation is seen on sagittal T2-weighted images (Figure 7a). The herniation impinges on the traversing segment of the nerve root within the subarticular recess (Figure 7b) at the level of the caudal pedicle (Figure 7c) and at the entry zone of the caudal foramen (Figure 7d).

FIGURE 8a



FIGURE 8b

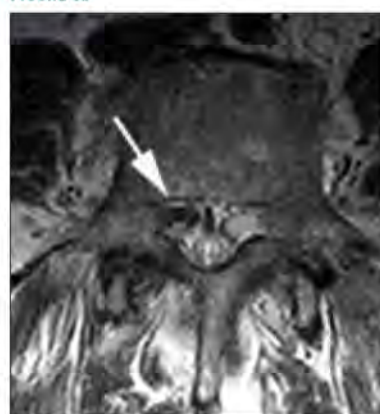


Figure 8 - Posterolateral disc herniation with cephalad extrusion. A cephalad extruded disc herniation is seen on a sagittal and axial T2-weighted images (Figure 8a), and impinges on the exiting nerve root at the entry zone of the neural foramen (Figure 8b).

(continued from page 4)

nerve root relative to take-off of the nerve root sleeve should be noted. Nerve roots within the dural sac are more mobile and are less susceptible to symptomatic impingement. Within the nerve root sleeve, mobility is limited by Hoffman's ligaments, and symptomatic impingement is more likely.

The presence of a conjoined nerve root should also be noted. The mobility of conjoined nerve roots is limited as they are frequently tethered around the adjacent pedicle. The more cephalad nerve root exits within the inferior aspect of the foramen and is more susceptible to impingement at this location. The more caudal nerve root is rightly tethered within the lateral aspect of the lateral recess and is susceptible to impingement at this site.

Conclusion

The radiology report is an important communication tool as it provides referring physicians with the information necessary to diagnose and treat their patients.

Our goal at CDI is to communicate the findings on MRI in as clear, concise, and accurate a manner as possible. Using a common, well-defined, and agreed-upon terminology is fundamental to this process.

Our adoption and routine use of these terms and definitions reflects our commitment to reliable and reproducible interpretations and our overall commitment to quality.

FIGURE 9a



FIGURE 9b



Figure 9 – Lateral intraforaminal disc herniation (Figure 9a) with extruded disc material within the neural foramen on an axial T2-weighted image. With far lateral disc herniation the extruded disc material is located lateral to the neural foramen (Figure 9b).

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References

1. Ahn S, Ahn M, Byun W. "Effect of the transligamentous extension of lumbar disc herniations on their regression and the clinical outcome of sciatica." *Spine* 25.4 (2000): 475-80.
2. Bischoff, R. J., R. P. Rodriguez, et al. "A comparison of computed tomography-myelography, magnetic resonance imaging, and myelography in the diagnosis of herniated nucleus pulposus and spinal stenosis." *J Spinal Disord* 6.4 (1993): 289-95.
3. Bozzao A, Gallucci M, Masciocchi C, et al. "Lumbar Disk Herniation: MR imaging assessment of natural history in patients treated without surgery." *Radiology* 185 (1992):135-141.
4. Brock M, Patt S, Mayer HM. "The form and structure of the extruded disc." *Spine* 17 (1992): 1457-61.
5. Cowan NC, Bush K, Katz DE, Gishen P. "The natural history of sciatica: a prospective radiological study." *Clin Radiol* 46.1 (1992): 7-12.
6. Fardon DE, Milette PC. "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." *Spine* 26 (2001): E93-E113.
7. Hamanishi C, Tanaka S. "Dorsal root ganglia in the lumbosacral region observed from the axial views of MRI." *Spine* 18 (1993):1753-1756.
8. Janssen ME, Bertrand SL, Joe C, et al. "Lumbar herniated disc disease: comparison of MRI, myelography, and post-myelographic CT scan with surgical findings." *Orthopedics* 17 (1994): 121-127.
9. Jia, L. S. and Z. R. Shi. "MRI and myelography in the diagnosis of lumbar canal stenosis and disc herniation. A comparative study." *Chin Med J (Engl)* 104.4 (1991): 303-6.
10. Komori H, Shinomiya K, Nakai O, et al. "The natural history of herniated nucleus pulposus with radiculopathy." *Spine* 21.2 (1996): 225-9.
11. Modic, M. T., T. Masaryk, et al. "Lumbar herniated disk disease and canal stenosis: prospective evaluation by surface coil MRI, CT, and myelography." *Am J Roentgenol* 147.4 (1986): 757-65.
12. Pfirrmann CWA, Dora C, Schmid MR, et al. "MR image-based Grading of Lumbar Nerve Root Compromise due to Disk Herniation: Reliability Study with Surgical Correlation." *Radiology* (2004): 230:583.
13. Saal JA, Saal JS. "Nonoperative treatment of herniated lumbar intervertebral disc with radiculopathy." *Spine* 14.4 (1989): 431-7.
14. Saal JA, Saal JS, Herzog RJ. "The natural history of lumbar intervertebral disc extrusions treated non-operatively." *Spine* 15 (1990): 683-6.
15. Weber H. "The natural history of disc herniations and the influence of intervention." *Spine* 19.19 (1994): 2234-8.
16. Yasuma T, Koh S, Okamura T, et al. "Histologic changes in aging lumbar intervertebral discs." *J Bone Joint Surg [Am]* 72 (1990): 220-9.
17. Yasuma T, Makina E, Saito S, et al. "Histologic development of intervertebral disc herniation." *J Bone Joint Surg [Am]* 68 (1986): 1066-73.

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Editorial Comments

Current Events

HOW CREDENTIAL CREEP IS AFFECTING THE CHIROPRACTIC PROFESSION AND THE ORTHOPEDIC SPECIALTY

Over the past century of its chronicled existence the Chiropractic profession's degree program has progressed from professional certificate, to associate degree, to bachelor degree, and now new pathways have emerged to master and doctoral degree programs. The chiropractic profession is experiencing the credential creep of the health care professions.

With the current standard of academic levels in the health profession the eventual impact of credential creep has become a reality that mandates the chiropractic profession, if it is going to survive and maintain a credible credential, must accelerate along academic pathways. There is an increasing awareness on the part of our patients, as well as other health care professions, of academic credentials to include not only board certified specialties but graduate level degrees as well. Across the board of health care fields there is an increasing need to maintain a higher level of academic credential. Whether we like it or not the public does look at the credentials a provider has following their name. The chiropractic profession can no longer rely on simply a competency model that is not tied to academic degrees.

Along this same path board certified specialties, based on post graduate studies and competency based models, in the future will increasingly become based on graduate level studies as well as certification and re-certification by specialty competency exam. Graduate level degrees will ultimately determine the future of chiropractic specialties. Those specialties that do not progress to a graduate level of study will fall short of the bar with credible credentials. The Academy of Chiropractic Orthopedists position on this issue is one of increasing awareness and proactive development of graduate level pathways.

A graduate level of education will further increase and develop the skills and knowledge base of current chiropractic physicians that are board certified orthopedic specialists for present and future clinical, hospital and academic demands. If the orthopedic specialist is to be viewed at the same level of competency, in their respective field of neuro-musculoskeletal management, as their medical and osteopathic counterparts then it is essential to possess equal if not greater credentials. With the increased level of responsibility demanded of the chiropractic physician in the clinical, hospital and academic settings the doctor of chiropractic, board certified in orthopedics, possessing degrees at the master or doctoral academic level will possess the skills and knowledge to excel in these areas. This makes the orthopedic specialty graduate level study program an appropriately recommended academic credential for specialty certification, re-certification and maintaining ones credentials and privileges.

The chiropractic college system has served the profession well over the decades. Now through a team effort of leading educators and academicians the orthopedic coalition has developed a Master of Science (MSc) program in Physical Medicine and Rehabilitation (PM&R). This program will meet the future needs of accelerated credentials and the criteria for orthopedic board specialty certification. The Academy strongly supports the board certified orthopedist continuing their education through traditional pathways as well as obtaining further education along the graduate level master and doctoral programs that meet the criteria demanded of the orthopedic specialty field.

Please visit the Academy web site www.dorthoacademy.com often for the latest developments and encourage your respective alma mater to offer the Master of Science (MSc PM&R) program.

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President
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