

Current Trends in Medical Imaging for Chiropractic

Philip Lowe, M.D.
Radiologist



WIS – your partner in patient care

- 45+ years on the Eastside
- 13 radiologists – subspecialty trained
- 2 Sites, 4 MRI's – includes a large opening (70 cm), short bore, high-field 1.5T Espree MRI - 2 CT's, 1 PET/CT, 5 new U.S., 2 Xray, 1 Fluor, 2 DEXA systems
- IntegradWeb remote view
- Extended weekday and weekend hours for MRI
 - 6am-7pm, Mon-Fri; 7-3:30pm, Sat-Sun (Bellevue)
 - 8-5:30pm, Mon-Fri; 8-4:30 Saturday



WIS is committed to the Chiropractic Community

- New equipment:
 - Short Bore, large opening 1.5T Espree MRI w/TIM
 - Fast, flexible 1.5T Symphony MRI w/TIM
 - PACS with remote access
 - Phone System
 - Voice Dictation
 - 5 new Antares Ultrasound Systems
- Work with all insurance providers
- Discount plan for non-insured and low income
 - Payment plans also available



WIS Committed to Patient Comfort

- Espree – faster scan times, large opening, short bore, new technology MRI
- Symphony w/Tim – faster scan times, better resolution
- Music, warmed blankets and eye pillows
- Highly trained, experienced staff (0 turnover)
- Easy scheduling process
- Extended weekday and weekend hours to meet their needs



Brandie Ellington and the Espree



What to look for in a radiology group

- Quick turn around time for reports
- Electronic report and image access
- High field (1.5T) MRI to accommodate large and/or claustrophobic patients
- Flexible protocols
- Easy access to a radiologist
- Easy Scheduling





Dr. Philip Lowe

- **Medical School:** Chicago Medical School

Residency: Mount Sinai Hospital

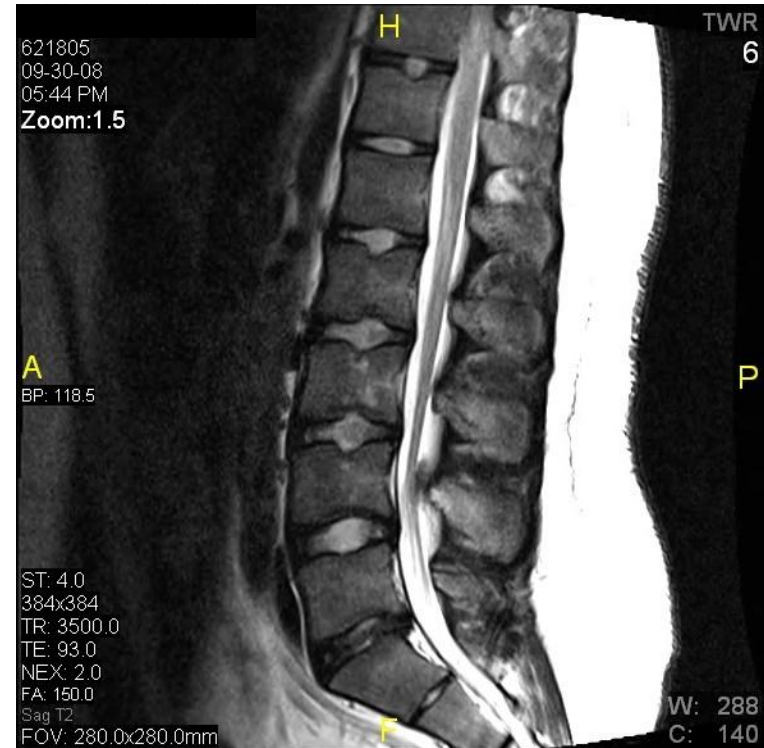
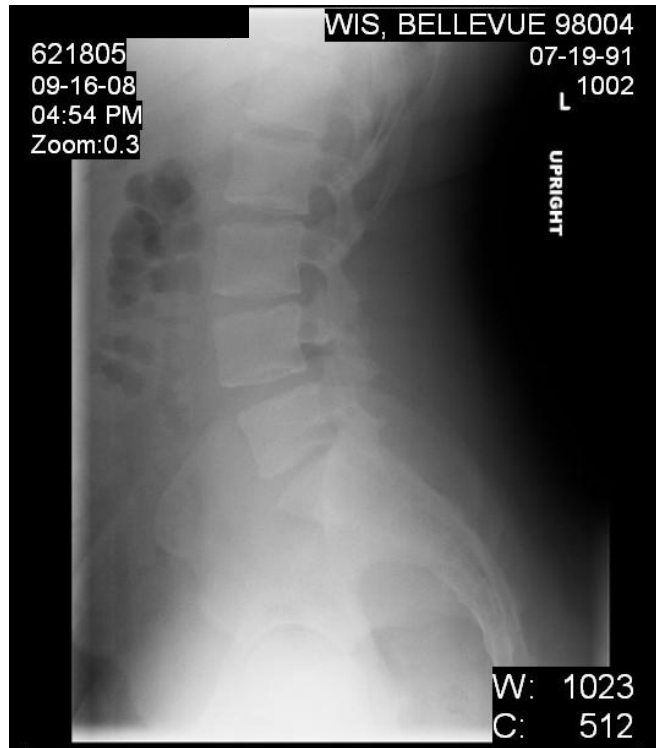
Board Certification: American Board of Radiology, 1989

Fellowship: University Hospital, Denver, Colorado

Subspecialty Interests: Musculoskeletal Radiology and
Body Imaging



X-ray or MRI?



- An x-ray clearly shows the contrast between soft tissue and bone density.
- An MRI shows a superior contrast between the various types of soft tissue



When do I order an MRI?

- When radiation is an issue
- When soft tissue is in question
- C-spine – exam of choice for disc disease, cord/root compression
- T-spine – exam of choice for disc disease, cord/root compression
- L-spine – exam of choice for disc disease, cord/root compression
- When you need to need to visualize abnormalities that might be obscured by bone with other imaging methods.



What are the advantages and disadvantages of MRI vs CT?

■ Advantages

- No ionizing radiation
- Fewer artifacts from dense bone and metal clips
- Imaging in multiple planes without moving the patient
- Signals from tissues are dependent on several chemical and physical properties, which may be studied independently



What are the advantages and disadvantages of MRI vs CT?

■ Disadvantages

- Slower scanning time than CT
- No motion is vet important
- High initial cost of the scanner **(\$1.5 – 2.1M)**
- Special site planning and shielding - **\$100 to \$500K**
- Danger to patients with cerebral aneurysm clips, pacemakers, unknown metal fragments in eyes
- Unknown effects of high magnetic fields
- Claustrophobia in magnet



MRI Imaging Protocols

MRI Protocols - High Field

NEURO

Brain	wo	w
1 Rtn	<input type="checkbox"/>	<input type="checkbox"/>
2 Trauma/H.A.	<input type="checkbox"/>	<input type="checkbox"/>
3 MS	<input type="checkbox"/>	<input type="checkbox"/>
4 SZ	<input type="checkbox"/>	<input type="checkbox"/>
5 PF	<input type="checkbox"/>	<input type="checkbox"/>
6 Tumor	<input type="checkbox"/>	<input type="checkbox"/>
7 Stroke	<input type="checkbox"/>	<input type="checkbox"/>
8 IAC	<input type="checkbox"/>	<input type="checkbox"/>
9 Lmtd IAC	<input type="checkbox"/>	<input type="checkbox"/>
10 Basal Ganglia	<input type="checkbox"/>	<input type="checkbox"/>
11 CN/ Skull	<input type="checkbox"/>	<input type="checkbox"/>
12 Pituitary	<input type="checkbox"/>	<input type="checkbox"/>
13 Brain/ Orbits	<input type="checkbox"/>	<input type="checkbox"/>
14 Brain/ Sinuses	<input type="checkbox"/>	<input type="checkbox"/>
15 XRT Planning	<input type="checkbox"/>	<input type="checkbox"/>
16 Biopsy Loc.	<input type="checkbox"/>	<input type="checkbox"/>
17 Uncooperative	<input type="checkbox"/>	<input type="checkbox"/>
18 Pediatric	<input type="checkbox"/>	<input type="checkbox"/>

MRA/MRV Brain & Neck

- 1 MRA COW
- 2 MRV Dural Sinus
- 3 MR CSF Flow
- 4 MRA Carotid (w/wo)

FACE & NECK

	wo	w
1 Dissection Neck	<input type="checkbox"/>	<input type="checkbox"/>
2 ST Neck	<input type="checkbox"/>	<input type="checkbox"/>
3 Orbit Only	<input type="checkbox"/>	<input type="checkbox"/>
4 Sinus Only	<input type="checkbox"/>	<input type="checkbox"/>
5 TMJ	<input type="checkbox"/>	<input type="checkbox"/>

Pt Name: _____ Date: _____

Radiologist: _____

SPINE

C spine	wo	w
1 Rtn C spine	<input type="checkbox"/>	<input type="checkbox"/>
2 MS/Cord	<input type="checkbox"/>	<input type="checkbox"/>
3 Trauma	<input type="checkbox"/>	<input type="checkbox"/>
4 Post-Op / Infection	<input type="checkbox"/>	<input type="checkbox"/>
5 Cranio-Cervical Jct	<input type="checkbox"/>	<input type="checkbox"/>
T spine	wo	w
1 Rtn	<input type="checkbox"/>	<input type="checkbox"/>
2 MS / Cord	<input type="checkbox"/>	<input type="checkbox"/>
3 Trauma	<input type="checkbox"/>	<input type="checkbox"/>
4 Post-Op/Infection	<input type="checkbox"/>	<input type="checkbox"/>
L-spine / Sacrum	wo	w
1 Rtn	<input type="checkbox"/>	<input type="checkbox"/>
2 Trauma	<input type="checkbox"/>	<input type="checkbox"/>
3 Post-Op / Infection	<input type="checkbox"/>	<input type="checkbox"/>
4 Conus Medullaris	<input type="checkbox"/>	<input type="checkbox"/>

Sacrum & Coccyx

- 1 Rtn
- 2 Lmtd

Scoliosis

- 1 Rtn
- 2 Lmtd

NEUROGRAMS

	wo	w
1 Brachial Plexus	<input type="checkbox"/>	<input type="checkbox"/>
2 Lumbosacral Plexus	<input type="checkbox"/>	<input type="checkbox"/>
3 Elbow	<input type="checkbox"/>	<input type="checkbox"/>
4 Wrist	<input type="checkbox"/>	<input type="checkbox"/>
5 Knee-Peroneal Nerve	<input type="checkbox"/>	<input type="checkbox"/>
6 Ankle-Tarsal Tunnel	<input type="checkbox"/>	<input type="checkbox"/>
7 Lat Femoral Cutaneous	<input type="checkbox"/>	<input type="checkbox"/>

BODY VASCULAR

- 1 Aorta Dissection Thoraco/Abdominal(w/wo)
- 2 Stent Graft/AAA (Aorta) **Planning** (w/wo)
- 3 Stent Graft/AAA (Aorta) **Followup** (w/wo)
- 4 Pulmonary Angio (w)
- 5 Thoracic MRA/MRV (w/wo)
- 6 Subclavian/Thoracic Outlet MRA/MRV (w/wo)
- 7 Mesenteric MRA/MRV (w/wo)
- 8 Renal (w/wo)
- 9 Pelvic MRA (w/wo)
- 10 Runoff (w)
- 11 Hand MRA (w)
- 12 Abd/Pelvic DVT (w/wo)
- 13 Pelvic DVT (w/wo)
- 14 Lower Extremity DVT (w/wo)

Place iStat Results Here

Magnevist GFR(MDRD) _____

Multihance Creatinine(non iStat) _____

Amount _____

Site Of Injection _____

Contrast Note: _____

JOINTS

Shoulder

- 1 Std(wo)
- 2 Arthrogram(w)
- 3 Post IV Gad Non Arthro(w)

Sternoclavicular Jt

- 1 Std(wo)

Elbow

- 1 Std(wo)
- 2 Bicep Tendon(wo)
- 3 Arthrogram(w)
- 4 Post IV Gad Non Arthro(wo)

Wrist

- 1 Std(Ligament)(wo)
- 2 Fracture(wo) ___Scaphoid___Lunate
___Whole Wrist
- 3 Arthrogram(w)
- 4 Post IV Gad Non Arthro(w)
- 5 Mass/Ganglion

Finger

- 1 Std - specify digit

Hip

- 1 Std (wo)
- 2 Arthrogram (w)
- 3 Post IV Gad Non Arthro (w)

Knee

- 1 Std (wo)
- 2 Trauma / ACL (wo)
- 3 Cartilage/Osteochondritis (wo)
- 4 Arthrogram (w)
- 5 Post IV Gad Non Arthro (w)
- 6 Patellar/Quadriceps tendon rupture (wo)

Patient Name: _____ Date: _____

Radiologist: _____



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MRI Imaging Protocols

MRI Protocols - High Field

NEURO			MUSCULOSKELETAL					
Brain			C spine			Shoulder		
	WO	W		WO	W			
1 Rtn			1 Rtn Cspine			1 Std(wo)		
2 Trauma/H.A.			2 MS/Cord			2 Arthrogram(w)		
3 MS			3 Trauma			3 Post IV Gad Non Arthro(w)		
4 SZ			4 Post-Op / Infection					
5 PF			5 Cranio-Cervical Jct					
6 Tumor						Sternoclavicular Jt		
7 Stroke						1 Std(wo)		
8 IAC			T spine					
9 Lmtd IAC			1 Rtn	WO	W			
10 Basal Ganglia			2 MS / Cord			1 Std(wo)		
11 CN/ Skull			3 Trauma			2 Bicep Tendon(wo)		
12 Pituitary			4 Post-Op/Infection			3 Arthrogram(w)		
13 Brain/ Orbits						4 Post IV Gad Non Arthro(wo)		
14 Brain/ Sinuses			L-spine / Sacrum					
15 XRT Planning			1 Rtn	WO	W			
16 Biopsy Loc.			2 Trauma			Wrist		
17 Uncooperative			3 Post-Op / Infection			1 Std(Ligament)(wo)	WO	W
18 Pediatric			4 Conus Medullaris			2 Mass/Ganglion	<input type="checkbox"/>	<input type="checkbox"/>
						3 Arthrogram(w)		
			Sacrum & Coccyx			4 Post IV Gad Non Arthro(w)		
			1 Rtn			5 Fracture(wo)___Scaphoid___Lunate___Whole Wrist		
			2 Lmtd					
MRA/MRV Brain & Neck			Scoliosis					
1 MRA COW			1 Rtn			Finger		
2 MRV Dural Sinus			2 Lmtd			1 Std - specify digit	WO	W
3 MR CSF Flow							<input type="checkbox"/>	<input type="checkbox"/>
4 MRA Carotid (w/wo)			Neurograms					
				WO	W			
			1 Brachial Plexus			Hip		
Face & Neck						1 Std (wo)		
1 Dissection Neck (w/wo)	WO	W	2 Lumbosacral Plexus			2 Arthrogram (w)		
2 ST Neck			3 Elbow			3 Post IV Gad Non Arthro (w)		
3 Orbit Only			4 Wrist					
4 Sinus Only			5 Knee-Peroneal Nerve			Knee		
5 TMJ			6 Ankle-Tarsal Tunnel			1 Std (wo)		
			7 Lat Femoral Cutaneous			2 Trauma/ACL (wo)		
						3 Cartilage/Osteochondritis (wo)		
						4 Arthrogram (w)		
						5 Post IV Gad Non Arthro (w)		



MRI Ordering Guide

BODY PART	REASON FOR EXAM	PROCEDURE TO PRE-CERT	CPT CODE
Spine: Cervical	Arm/Shoulder Pain and/or Weakness Degenerative Disease Neck Pain Disk Herniation Post-Op Fusion Radiculopathy Syrinx	MRI Cervical Spine Without Contrast	74141
	Discitis Osteomyelitis Multiple Sclerosis Myelopathy Tumor/Mass/Cancer/Mets Vascular Lesions AVM	MRI Cervical Spine Without and With Contrast	72156



MRI Ordering Guide

Spine: Thoracic	Back Pain Compression Fx (no malig/mets Degenerative Disease Disk Herniation Radiculopathy Trauma Vertebroplasty Planning (w/no hx malig)	MRI Thoracic Spine Without Contrast	72146
	Compression Fx (no malig/mets Discitis Osteomyelitis Multiple Sclerosis Myelopathy Syrinx Tumor/Mass/Cancer/Mets Vascular Lesions AVM Vertebroplasty Planning (w/no hx malig)	MRI Thoracic Spine Without and With Contrast	72157
Spine: Thoracic	Back Pain Compression Fx (no malig/mets Degenerative Disease Disk Herniation Radiculopathy Trauma Vertebroplasty Planning (w/no hx malig)	MRI Thoracic Spine Without Contrast	72146



MRI Ordering Guide

Spine: Lumbar	<p> Back Pain Compression Fx (no malig/mets) Degenerative Disease Disk Herniation Radiculopathy Sciatica Spondylolthesis Stenosis Trauma Vertebroplasty Planning (w/no hx malig) </p>	<p> MRI Lumbar Spine Without Contrast </p>	<p>72148</p>
	<p> Compression Fx (no malig/mets) Discitis Osteomyelitis Post-Op Tumor/Mass/Cancer/Mets Vertebroplasty (w/no hx malig) </p>	<p> MRI Lumbar Spine Without and With Contrast </p>	<p>72158</p>



Does an MRI show me?

- Inflamed and/or compressed nerve root?
- Disiccated sequestration?
- Central, formial, and lateral stenosis?
- Measure level of inflammation?
- Can it tell you that the disorder is healable on its own or not?
- Show signs of joint instability?
- Facet Arthropathy?
- Baastrups?
- Suspected dural sac deformation?
- Neurogenic claudication?



Does an MRI?

- Do dynamic imaging of facet joint fluid?
- Identify High Intensity Zones?
- Show Type 1 end plate changes?



When do I order an CT?

- When is it preferred over an x-ray?
- When is preferred over an MRI?
- Radiation issues?
 - CT of C-spine = 8 mSv
 - CT of T-spine = 10 mSv
 - CT of L-spine = 10 mSv



Gadolinium and NSF

- **We use the updated ACR Screening Recommendations on Gadolinium-Based MR Contrast Agents, Renal Disease Patients, and Nephrogenic Systemic Fibrosis (NSF)**
 - Prior to elective Gadolinium Based MR Contrast Agent (GBMCA) administration, a recent (e.g., last 6 weeks) Glomerular Filtration Rate (GFR) assessment be reviewed for patients with a history of:
 - ◆ Renal disease (including solitary kidney, renal transplant, renal tumor)
 - ◆ Age >60
 - ◆ History of Hypertension
 - ◆ History of Diabetes
 - ◆ History of severe hepatic disease/liver transplant/pending liver transplant. For patients in this category only, it is recommended that the patient's GFR assessment be nearly contemporaneous with the MR examination for which the GBMCA is to be administered.
- iStat blood draws used to test patients who meet above criteria prior to having MRI done.



Case Study #1

- 17 y/o male status post lumbar puncture 11 days ago
- c/o low back pain and bilateral lower extremity weakness, left greater than right
- Presented with symptoms of Guillain-Barre syndrome.
- MRI ordered to confirm differential diagnosis



Guillain-Barre Symptom (GBS)

- Autoimmune post-infectious or post vaccinal acute inflammatory demyelination of peripheral nerves, nerve roots, cranial nerves.
- Diagnosis:
 - Myelography may show symmetric enlargement of cauda roots.
 - Lumbar puncture typically done in early stages to assess spinal fluid chemistry
 - CT with contrast rarely shows anything – may see symmetrical enhancement of lumbar roots



Guillain-Barre Symptom (GBS)

- MRI should show normal conus in T2WI and may see slight prominence of root size
- T1 C+
 - ◆ Avid enhancement of cauda equina – roots may be slightly thickened, not nodular
 - ◆ Axial images show preferential contrast accentuation of ventral roots in the cauda
 - ◆ Pial surface of distal cord and conus enhances variably
 - ◆ Conus not enlarged



Guillain-Barre Syndrome

- Washington Imaging MRI results
 - Negative for discitis or osteomyelitis
 - Moderate bilateral L5-S1 foraminal stenosis from bilateral L5 spondylolysis and anterolisthesis of L5 on S1.
 - Smooth pial thickening with enhancement of the conus and there is diffuse enhancement of the cauda equina nerve roots consistent with the diagnosis of Guillain-Barre syndrome.



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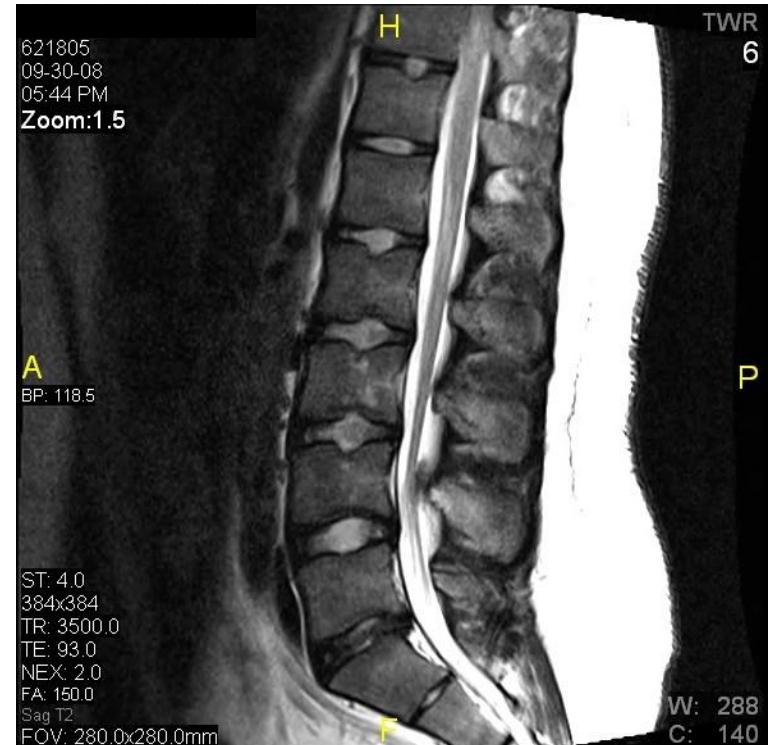


Case Study #2

- 18 y/o male with low back pain referred to WIS by local Chiropractic practitioner
- Possible lumbar spine disc syndrome
- Fall while inner tubing 2 years ago



Case Study #2



Case Study #2

- Washington Imaging findings
 - Mild degenerative disc disease at L5-S1 and Grade 1 retrolisthesis of L5 relative to S1 are noted
 - Posterior bulging of the annulus, facet/ligamentum flavum hypertrophy, and a congenitally shallow central canal results in relative central canal narrowing without overt central canal stenosis at L4-L5 and at L3-L4
 - Multilevel Schmorl's node formation is seen. This raises the possibility of Scheuermann's disease.



Case study # 3

- 25 y/o male
- Positive Lhermitte sign
- Complaints of progressive numbness and weakening of the extremities
- Increasing “mental lethargy”

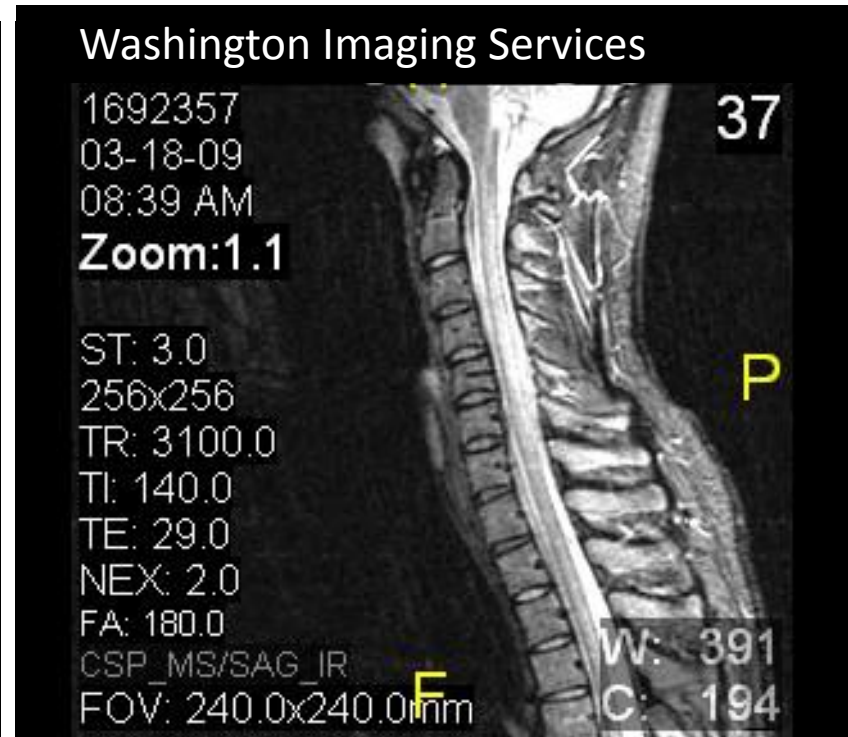
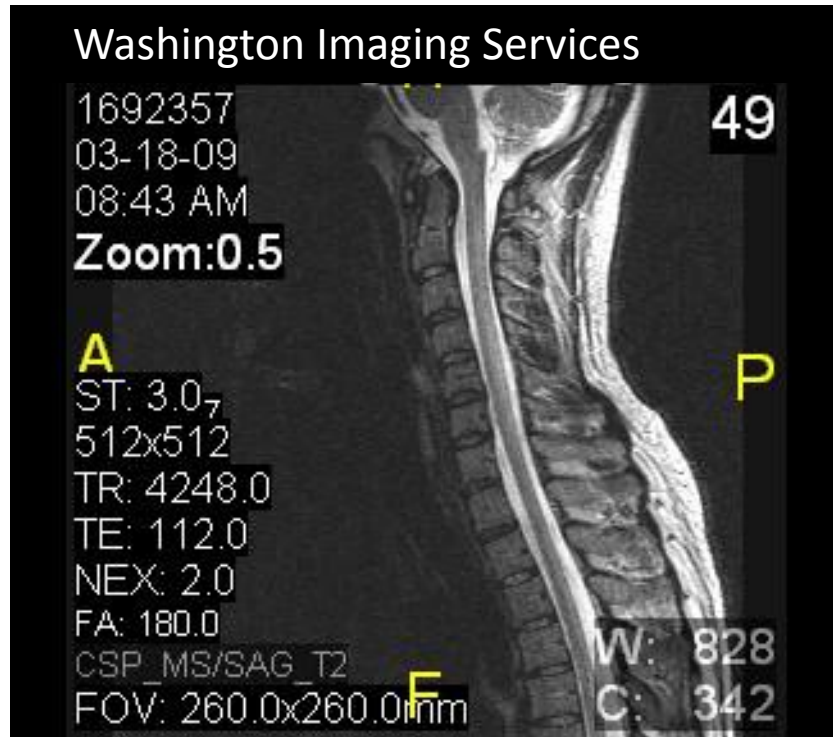


Vitamin B12 Deficiency

- Disease presentation –
 - Mild spinal cord enlargement
 - Abnormal T2 hyperintensity within dorsal columns
 - Abnormal T1 hypointensity within dorsal columns
- Differential Dx – Spinal Cord Infarct



Case Study #3



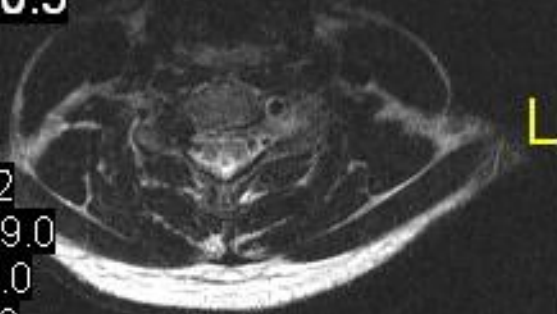
Case Study #3

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C: 404

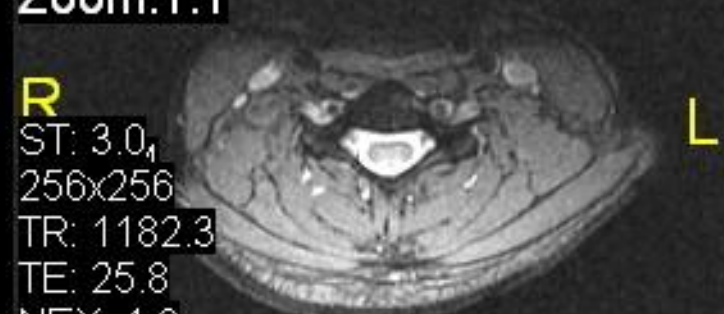


Washington Imaging Services

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NEX: 1.0
FA: 30.0
CSP_MS/AX_MEDIC
FOV: 200.0x200.0mm **P**

W: 391
C: 208



Case study # 4 (Boma)

- 59 y/o male with myelopathy
- Intermittent lower extremity weakness and paresthesias.
- Bowel and bladder incontinence.
- Abnormal intraspinal signal noted in the conus medullaris on earlier lumbar spine MRI



Case study # 4 (Boma)

- Type 1 DAVF normally seen in 5th-7th decade males with progressive lower extremity weakness exacerbated by exercise
- Most common diagnostic clue is a abnormally enlarged , hyperintense distal cord covered with dilated pial veins
- Fistula may arise anywhere from vertebral artery to internal iliac superiorly
- Spinal arteriography is gold standard for confirming diagnosis
- Dynamic contrast-enhanced MRA capable of defining dilated intradural veins; may guide catheter angiography



Case study # 4 (Boma)

- Washington Imaging Findings
 - T2 and STIR bright non-enhancing signal abnormality throughout the lower thoracic spinal cord and conus medullaris.
 - Prominent signal flow-voids consistent with vessels are within the subarchoid space surrounding the lower thoracic spinal cord.
 - Finding suggest venous ischemia from a vascular malformation. Mostly likely a dural arteriovenous fistula.



Case Study #4



Sagittal T2W1 MRI shows multiple flow voids on dorsal surface of cord due to enlarged veins.
Extensive increased signal in cord reflecting edema from venous hypertension



Case Study #4



Case Study #4



References

- WWW.theASSR.org
- WWW.asnr.org

The Proper Terminology for Reporting Lumbar Intervertebral Disk Disorders

Pierre C. Milette, *Centre Hospitalier de l'Université de Montréal (Quebec, Canada)*

Nature enjoys making fun of our classifications.

Pierre Masson (1880–1959)

Despite these somewhat disheartening words from the famous French pathologist, we should not give up solving the present mess associated with the reporting of intervertebral disk abnormalities in imaging studies. The present variations in the usage of language are responsible for confusion and controversy, and also compromise our chances of reaching a consensus on the diagnosis and treatment of disk disorders (1–5). As in other areas of medicine (eg, the TNM classification of tumors), it should be possible for diagnostic radiologists to rally round a

uniform nomenclature. Why has it been impossible so far? The historical lack of interest among traditional physicians, fundamental anatomists, and imaging specialists for the deemed trivial and vulgar issue of low back pain probably has something to do with it. Controversies regarding treatment, especially surgical indications, as well as legal and socioeconomic considerations, have also colored many debates. Over the last 10 years, several articles have dealt with the nomenclature of disk disorders in relation to the interpretation of imaging studies (6–16), but none of the proposed schemes has so far succeeded in generating universal acceptance.

Address reprint requests to Pierre C. Milette, MD, Department of Radiology, Centre Hospitalier de l'Université de Montréal, Saint-Luc Pavilion, 1058 Saint-Denis St, Montreal, Quebec, Canada H2X 3J4.

Index terms: Spine, intervertebral disks; Special reports

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GLOSSARY

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Nomenclature and Classification of Lumbar Disc Pathology

GLOSSARY

Note: Some terms and definitions included in this Glossary are not recommended as preferred terminology, but are included to facilitate interpretation of vernacular and, in some cases, improper use. Preferred definitions are listed first. Confusing or inaccurate alternative definitions are placed in brackets and designated as "Non-Standard."

aging disc: Disc demonstrating the features of normal aging. Spondylosis deformans possibly represents the normal aging process.

anterior displacement: Displacement of disc tissues beyond the disc space into the anterior zone.

anterior zone: Peridiscal zone that is anterior to the mid-coronal plane of the vertebral body.

anulus, annulus (abbreviated form of annulus fibrosus): A multilaminated ligament surrounding the periphery of each disc space, attaching, cranial and caudal, to end-plate cartilage and ring apophyseal bone and blending centrally with nucleus pulposus. Note: Either anulus or annulus is correct spelling. Nomina Anatomica uses both forms whereas Terminologia Anatomica states "anulus fibrosus."^{18,21} Fibrosus, has no correct alternative spelling; fibrosis has a different meaning and is incorrect in this context.

asymmetric bulge: Presence of outer anulus beyond the plane of the disc space, more evident in one section of the periphery of the disc than another, but not sufficiently focal to be characterized as a protrusion. Note: Asymmetric bulge is a morphologic observation of various potential causes and is not a diagnosis. See: bulge.

balloon disc (colloquial): Diffuse displacement of nucleus through the vertebral end plate, commonly seen in severe osteoporosis.

base (of displaced disc): The cross sectional area of disc material at the outer margin of the disc space of origin, where disc material displaced beyond the disc space is continuous with disc material within the disc space. In the crano-caudal direction, the length of the base cannot exceed, by definition, the height of the intervertebral space.

broad-based protrusion: Herniation of disc material extending beyond the outer edges of the vertebral body apophyses over an area greater than 25% (90 degrees) and less than 50% (180 degrees) of the circumference of the disc. See protrusion. Note: Broad based protrusion refers only to discs in which disc material has displaced in association with localized disruption of the anulus and not to generalized (over 50% or 180 degrees) apparent extension of disc tissues beyond the edges of the apophyses. If the base is less than 25%, it is called "focal protrusion." Apparent extension of disc material, formation of additional connective tissue between osteophytes, or overlapping of non-disrupted tissue beyond the edges of the apophyses of over 50% of the circumference of the disc may be described as bulging. See: bulging disc, focal protrusion.

http://www.asnr.org/spine_nomenclature/glossary.shtml

4/16/2009



In Summary

- Thank you for attending this luncheon. Our goal is to be your partner in medical imaging. Please call us with your questions.
- Lynne Giffin – CT Supervisor – 425-688-0100 Ext 8108
- Brandie Ellington – MRI Supervisor - 425-688-0100 Ext 8107
- Radiologist - 425-688-0100 Ext 8152
- Amy Mouw – Marketing Specialist – 425-753-5307

