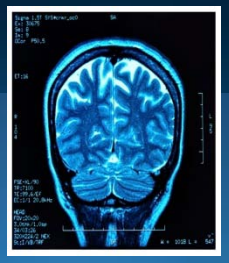
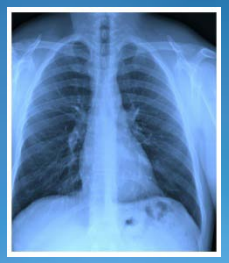
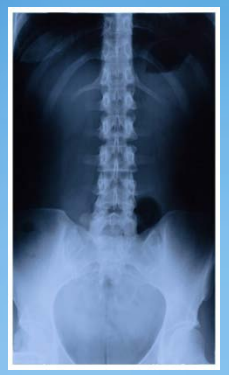
A Clinician's Guide to the Appropriate Utilization of Diagnostic Imaging Studies

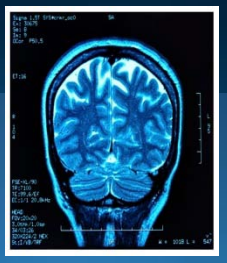


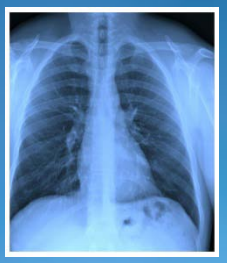


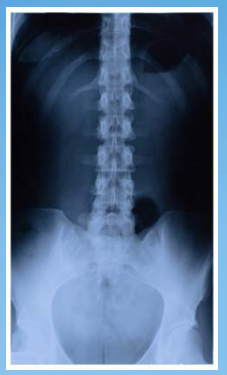


September 19, 2015

Atlantic Medical Imaging







This educational activity is jointly sponsored by
UPSTATE Medical University and
Atlantic Medical Imaging

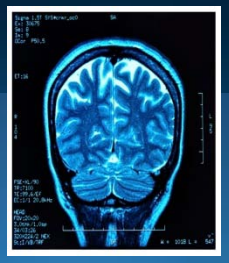
6.0 credits

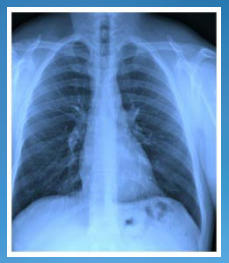
Atlantic Medical Imaging

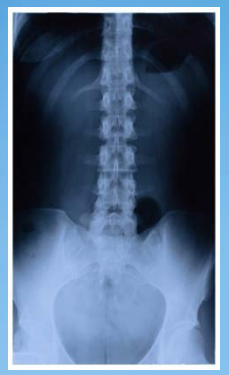
REMINDER

Please complete and return:

- Credit Claim Form
- Course Evaluation Form







Atlantic Medical Imaging

Low Back Pain

Disc Disease: semantics and ongoing debates about cause/effect

RM Glassberg, M.D.

Low Back Pain

- When should you order an imaging study
- Which imaging study should be requested
- Unknown cases

Differential Diagnosis of Low Back Pain

- Back Strain
- Acute disc herniation
- Osteoarthritis
- Spinal Stenosis
- Spondylolysis/Spondylolisthesis
- Ankylosing Spondylitis
- Infection
- Malignancy
- Compression fracture

When should you order an imaging study

Unknown Case #1

- 34 year old male with acute onset low back pain following a lifting injury at work.

- What study should be ordered?

Which study should you order for 34 year old with acute onset back pain?

- MRI L-spine
- CT L-spine
- L spine x-ray
- Bone scan

Do not image uncomplicated acute low back pain

- Acute low back pain (LBP) with or without radiculopathy is one of the most common health problems in the United States and is the leading cause of disability for persons younger than age 45. The cost of evaluating and treating acute LBP runs into billions of dollars annually, not including time lost from work.

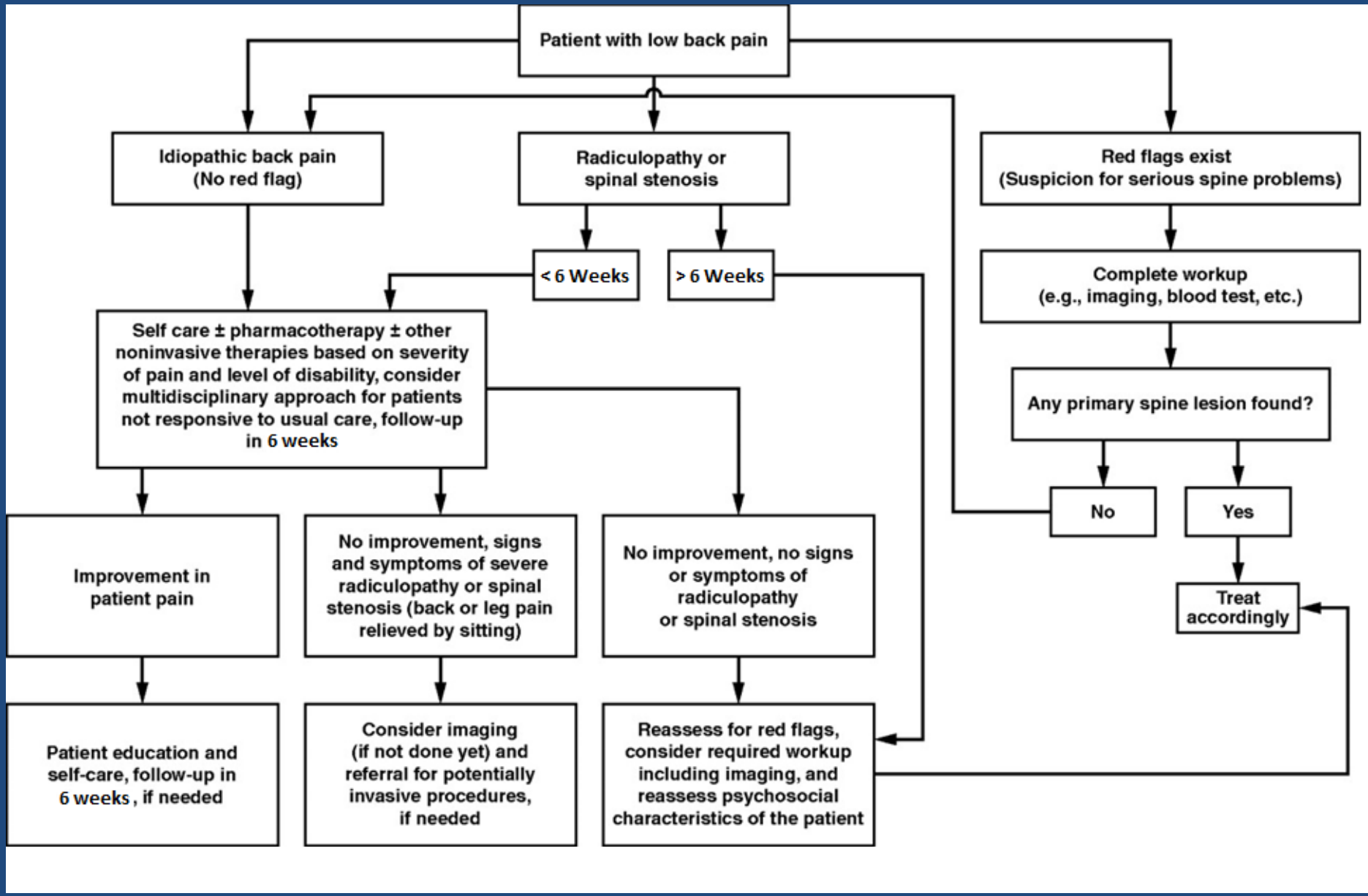
- It is now clear that *uncomplicated* acute LBP or radiculopathy is a benign, self-limited condition that does not warrant any imaging studies.

ACR Guidelines

Consider imaging for those with no improvement after 6 weeks or the following red flags

Indications of a more complicated status include back pain/radiculopathy in the following settings:

- Trauma, cumulative trauma
- Unexplained weight loss, insidious onset
- Age >50 years, especially women, and males with osteoporosis or compression fracture
- Unexplained fever, history of urinary or other infection
- Immunosuppression, diabetes mellitus
- History of cancer
- Intravenous (IV) drug use
- Prolonged use of corticosteroids, osteoporosis
- Age >70
- Focal neurologic deficit(s) with progressive or disabling symptoms, cauda equina syndrome
- Duration longer than 6 weeks
- Prior surgery


Patient with low back pain
Idiopathic back pain
(No red flag)
Radiculopathy or
spinal stenosis
Red flags exist
(Suspicion for serious spine problems)
< 6 Weeks
> 6 Weeks
Complete workup
(e.g., imaging, blood test, etc.)
Self care ± pharmacotherapy ± other noninvasive therapies based on severity of pain and level of disability, consider multidisciplinary approach for patients not responsive to usual care, follow-up in 6 weeks
Any primary spine lesion found?
No
Yes
Improvement in
patient pain
No improvement, signs and symptoms of severe radiculopathy or spinal stenosis (back or leg pain relieved by sitting)
No improvement, no signs or symptoms of radiculopathy or spinal stenosis
Treat accordingly
Patient education and self-care, follow-up in 6 weeks, if needed
Consider imaging (if not done yet) and referral for potentially invasive procedures, if needed
Reassess for red flags, consider required workup including imaging, and reassess psychosocial characteristics of the patient

American College of Radiology (ACR)

- ACR has established **appropriateness criteria** for many clinical situations.
- On the ACR website, you can find these criteria
- http://www.acr.org/Quality-Safety/Appropriateness-Criteria/Diagnostic
- These criteria are a great reference for deciding the best imaging study to order.
- AMI Radiologists

The Profession of Radiology

Appropriateness Criteria (ACR) Low Back Pain

- Variant 1: Uncomplicated acute low back pain and/or radiculopathy, nonsurgical presentation. No red flags.
- Variant 2: Patient with one or more of the following: low velocity trauma, osteoporosis, focal and/or progressive deficit, prolonged symptom duration, age >70.
- Variant 3: Patient with one or more of the following: Suspicion of cancer, infection, and/or immunosuppression.

Appropriateness Criteria (ACR)
Low Back Pain

- Variant 4: Low back pain and/or radiculopathy. Surgery or interventional candidate.
- Variant 5: Prior lumbar surgery.
- Variant 6: Cauda equina syndrome, multifocal deficits or progressive deficit.

Clinical Condition: Low Back Pain

Variant 1: Uncomplicated acute low back pain and/or radiculopathy, nonsurgical presentation. No red flags. (Red flags defined in the text below.)

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without contrast	2		O
X-ray lumbar spine	2		☢☢☢
Myelography and postmyelography CT lumbar spine	2	In some cases postinjection CT imaging may be done without plain-film myelography.	☢☢☢☢
X-ray myelography lumbar spine	2		☢☢☢
Tc-99m bone scan with SPECT spine	2		☢☢☢
CT lumbar spine without contrast	2		☢☢☢
CT lumbar spine with contrast	2		☢☢☢
MRI lumbar spine without and with contrast	2		O
CT lumbar spine without and with contrast	1		☢☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
☢	<0.1 mSv	<0.03 mSv
☢☢	0.1-1 mSv	0.03-0.3 mSv
☢☢☢	1-10 mSv	0.3-3 mSv
☢☢☢☢	10-30 mSv	3-10 mSv
☢☢☢☢☢	30-100 mSv	10-30 mSv

*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as NS (not specified).

Average annual human exposure to ionizing radiation (millisievert)

Radiation source	World[1]	USA[2]	Japan[3]	Remark
Inhalation of air	1.26	2.28	0.40	mainly from radon, depends on indoor accumulation
Ingestion of food & water	0.29	0.28	0.40	(K-40, C-14, etc.)
Terrestrial radiation from ground	0.48	0.21	0.40	depends on soil and building material
Cosmic radiation from space	0.39	0.33	0.30	depends on altitude
sub total (natural)	2.40	3.10	1.50	sizeable population groups receive 10-20 mSv
Medical	0.60	3.00	2.30	world-wide figure excludes radiotherapy; US figure is mostly CT scans and nuclear medicine.
Consumer items	-	0.13		cigarettes, air travel, building materials, etc.
Atmospheric nuclear testing	0.005	-	0.01	peak of 0.11 mSv in 1963 and declining since; higher near sites
Occupational exposure	0.005	0.005	0.01	world-wide average to all workers is 0.7 mSv, mostly due to radon in mines;[1] US is mostly due to medical and aviation workers.[2]
Chernobyl accident	0.002	-	0.01	peak of 0.04 mSv in 1986 and declining since; higher near site
Nuclear fuel cycle	0.0002		0.001	up to 0.02 mSv near sites; excludes occupational exposure
Other	-	0.003		Industrial, security, medical, educational, and research
sub total (artificial)	0.61	3.14	2.33	
Total	3.01	6.24	3.83	**millisievert per year**

Variant 2: Patient with one or more of the following: low velocity trauma, osteoporosis, focal and/or progressive deficit, prolonged symptom duration, age >70 years.

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without contrast	8		O
CT lumbar spine without contrast	6	MRI preferred. CT useful if MRI is contraindicated or unavailable, and/or for problem solving.	☢☢☢
X-ray lumbar spine	6		☢☢☢
Tc-99m bone scan with SPECT spine	4	SPECT/CT may be useful for anatomic localization and problem solving.	☢☢☢
MRI lumbar spine without and with contrast	3		O
CT lumbar spine with contrast	3		☢☢☢
CT lumbar spine without and with contrast	1		☢☢☢☢
Myelography and postmyelography CT lumbar spine	1	In some cases postinjection CT imaging may be done without plain-film myelography.	☢☢☢☢
X-ray myelography lumbar spine	1		☢☢☢
X-ray discography lumbar spine	1		☢☢
X-ray discography and post-discography CT lumbar spine	1		☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Variant 3: Patient with one or more of the following: suspicion of cancer, infection, and/or immunosuppression.

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without and with contrast	8	Contrast useful for neoplasia subjects suspected of epidural or intraspinal disease. See statement regarding contrast in text under "Anticipated Exceptions."	O
MRI lumbar spine without contrast	7	Noncontrast MRI may be sufficient if there is low risk of epidural and/or intraspinal disease.	O
CT lumbar spine with contrast	6	MRI preferred. CT useful if MRI is contraindicated or unavailable, and/or for problem solving.	☢☢☢
CT lumbar spine without contrast	6	MRI preferred. CT useful if MRI is contraindicated or unavailable, and/or for problem solving.	☢☢☢
X-ray lumbar spine	5		☢☢☢
Tc-99m bone scan whole body with SPECT spine	5	SPECT/CT may be useful for anatomic localization and problem solving.	☢☢☢
CT lumbar spine without and with contrast	3		☢☢☢☢
X-ray myelography lumbar spine	2		☢☢☢
Myelography and postmyelography CT lumbar spine	2	In some cases postinjection CT imaging may be done without plain-film myelography.	☢☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Variant 4: Low back pain and/or radiculopathy. Surgery or intervention candidate.

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without contrast	8		O
CT lumbar spine with contrast	5	MRI preferred. CT useful if MRI is contraindicated or unavailable, and/or for problem solving.	☢☢☢
CT lumbar spine without contrast	5	MRI preferred. CT useful if MRI contraindicated or unavailable, and/or for problem solving.	☢☢☢
MRI lumbar spine without and with contrast	5	Indicated if noncontrast MRI is nondiagnostic or indeterminate. See statement regarding contrast in text under "Anticipated Exceptions."	O
Myelography and postmyelography CT lumbar spine	5	MRI preferred. May be indicated if MRI is contraindicated or nondiagnostic. In some cases postinjection CT imaging may be done without plain-film myelography.	☢☢☢☢
X-ray discography and post-discography CT lumbar spine	5		☢☢☢
X-ray lumbar spine	4	Usually not sufficient for decision making without MR and/or CT imaging.	☢☢☢
Tc-99m bone scan with SPECT spine	4	May be particularly useful for facet arthropathy, stress fracture, and spondylolysis. SPECT/CT may be useful for anatomic localization and problem solving.	☢☢☢
X-ray discography lumbar spine	4		☢☢
CT lumbar spine without and with contrast	3		☢☢☢☢
X-ray myelography lumbar spine	2		☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Variant 5: Prior lumbar surgery.

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without and with contrast	8	Can differentiate disc from scar. See statement regarding contrast in text under "Anticipated Exceptions."	O
CT lumbar spine with contrast	6	Most useful in postfusion patients or when MRI is contraindicated or indeterminate.	☢☢☢
CT lumbar spine without contrast	6	Most useful in postfusion patients or when MRI is contraindicated or indeterminate.	☢☢☢
MRI lumbar spine without contrast	6	Contrast often necessary.	O
Myelography and postmyelography CT lumbar spine	5	In some cases postinjection CT imaging may be done without plain-film myelography.	☢☢☢☢
X-ray lumbar spine	5	Flex/extension may be useful.	☢☢☢
Tc-99m bone scan with SPECT spine	5	Helps detect and localize painful pseudoarthrosis. SPECT/CT may be useful for anatomic localization and problem solving.	☢☢☢
X-ray discography and post-discography CT lumbar spine	5		☢☢☢
X-ray discography lumbar spine	4		☢☢
CT lumbar spine without and with contrast	3		☢☢☢☢
X-ray myelography lumbar spine	2		☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Variant 6: Cauda equina syndrome, multifocal deficits or progressive deficit.

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without contrast	9	Use of contrast depends on clinical circumstances.	O
MRI lumbar spine without and with contrast	8	Use of contrast depends on clinical circumstances. See statement regarding contrast in text under "Anticipated Exceptions."	O
Myelography and postmyelography CT lumbar spine	6	Useful if MRI is nondiagnostic or contraindicated. In some cases postinjection CT imaging may be done without plain-film myelography.	☢☢☢☢
CT lumbar spine with contrast	5		☢☢☢
CT lumbar spine without contrast	5		☢☢☢
X-ray lumbar spine	4		☢☢☢
CT lumbar spine without and with contrast	3		☢☢☢☢
Tc-99m bone scan with SPECT spine	2		☢☢☢
X-ray myelography lumbar spine	2		☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Unknown Case

- 81 year old woman with history of osteoporosis presents with acute onset back pain.

- Does she require imaging?

Consider imaging for those with no improvement after 6 weeks or the following red flags

Indications of a more complicated status include back pain/radiculopathy in the following settings:

- Trauma, cumulative trauma
- Unexplained weight loss, insidious onset
- Age >50 years, especially women, and males with osteoporosis or compression fracture
- Unexplained fever, history of urinary or other infection
- Immunosuppression, diabetes mellitus
- History of cancer
- Intravenous (IV) drug use
- Prolonged use of corticosteroids, osteoporosis
- Age >70
- Focal neurologic deficit(s) with progressive or disabling symptoms, cauda equina syndrome
- Duration longer than 6 weeks
- Prior surgery

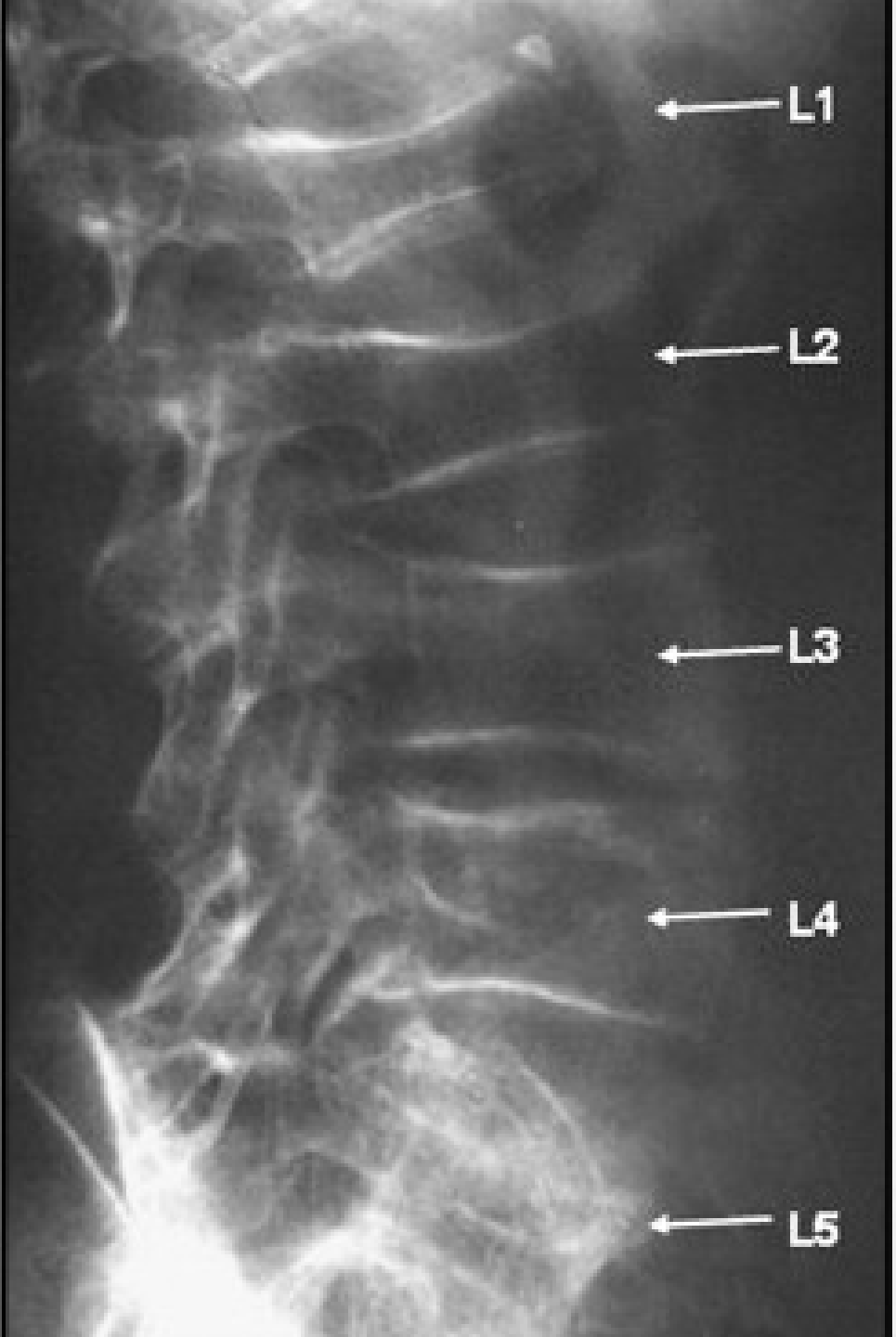
- For the 81 year old osteoporotic, which imaging study should be ordered?

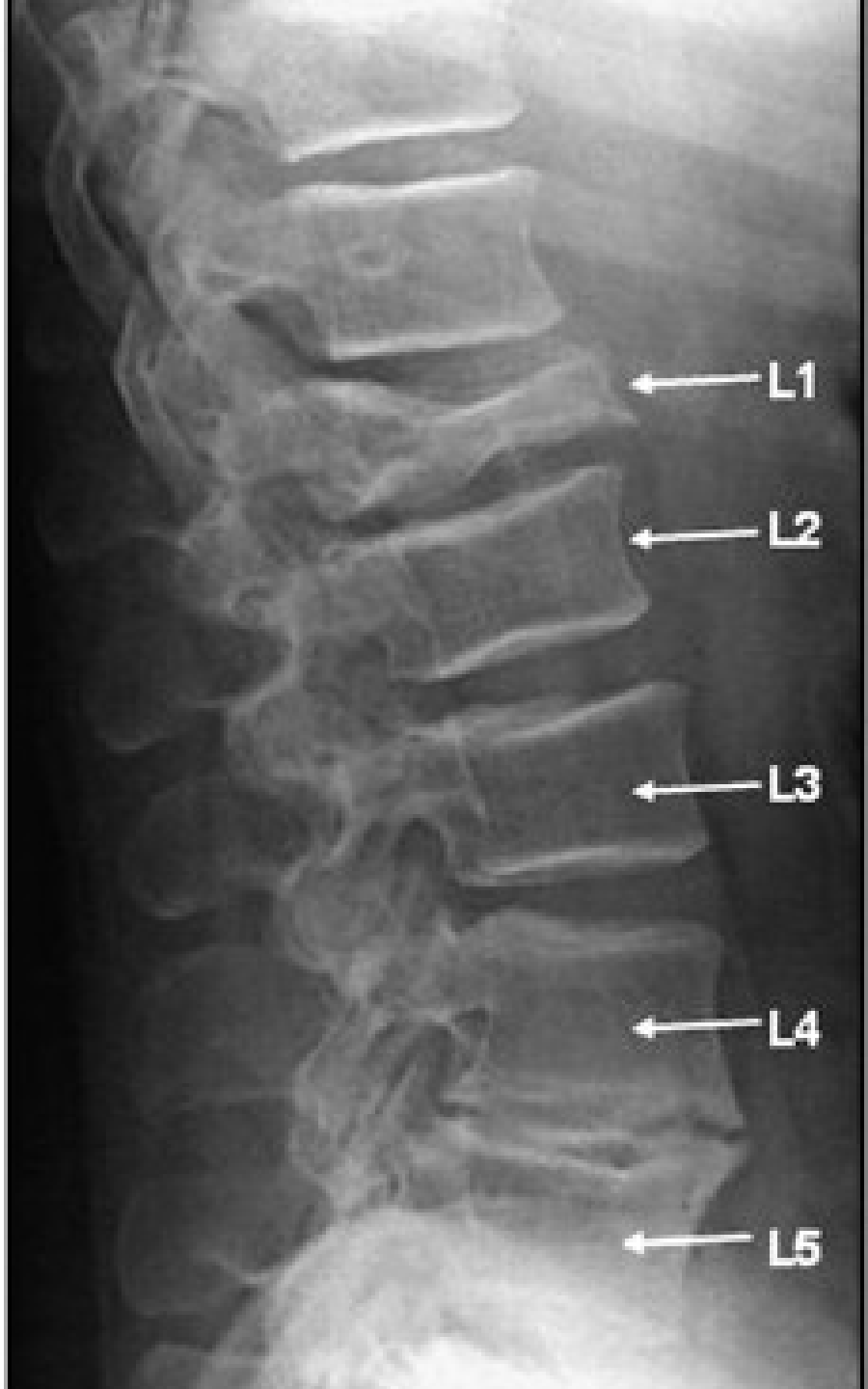
Low Back Pain
Indications for Radiographs

- Radiographs may be useful in any of the red flag categories. Lumbar radiographs may be sufficient for the initial evaluation of the following red flags, with further imaging indicated for treatment planning if findings are abnormal or inconclusive:

- Recent significant trauma (at any age)
- Osteoporosis
- Age >70 years

- The initial evaluation of the LBP patient may also require further imaging if other red flags such as suspicion of cancer or infection are present.

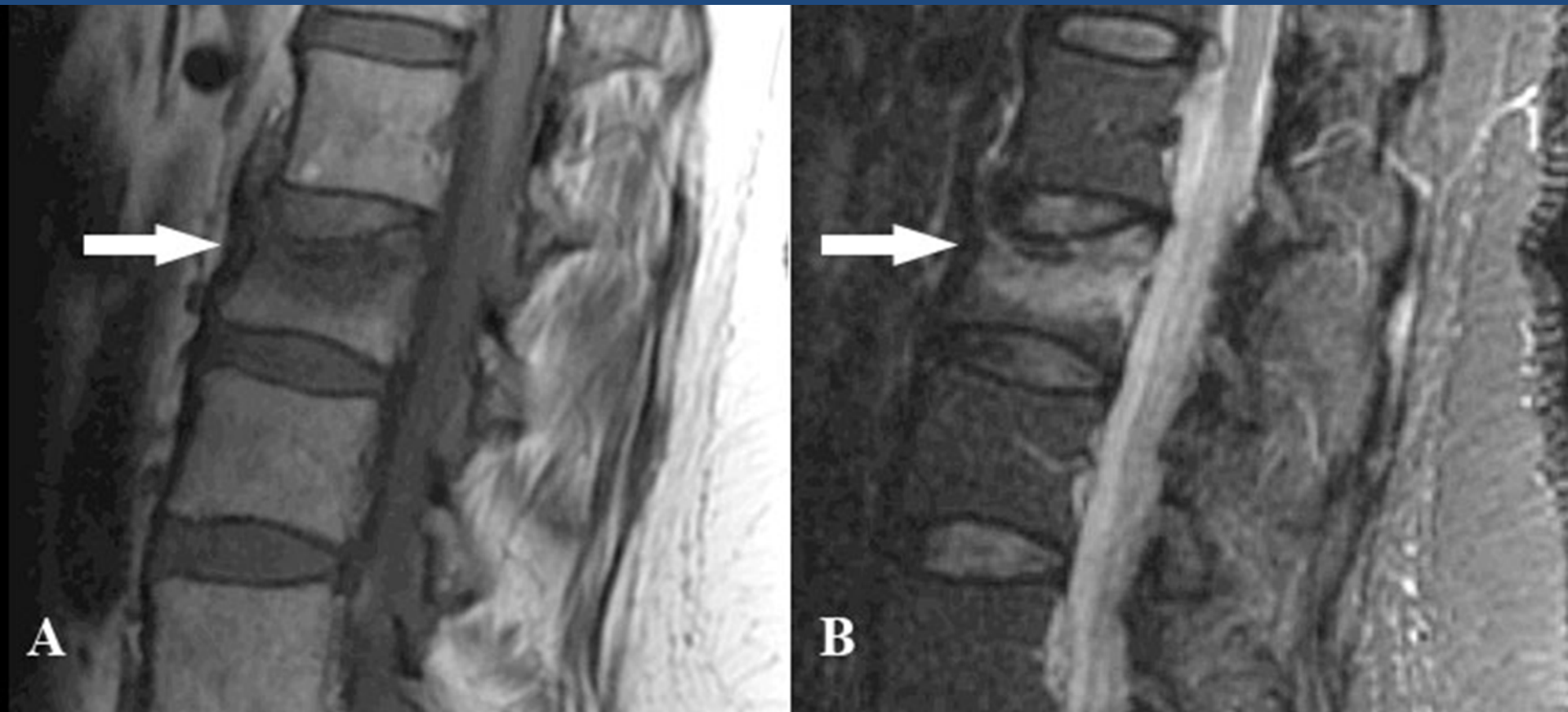

L1
L2
L3
L4
L5


L1
L2
L3
L4
L5

Differentiating Acute vs. Chronic Compression Fractures on MRI

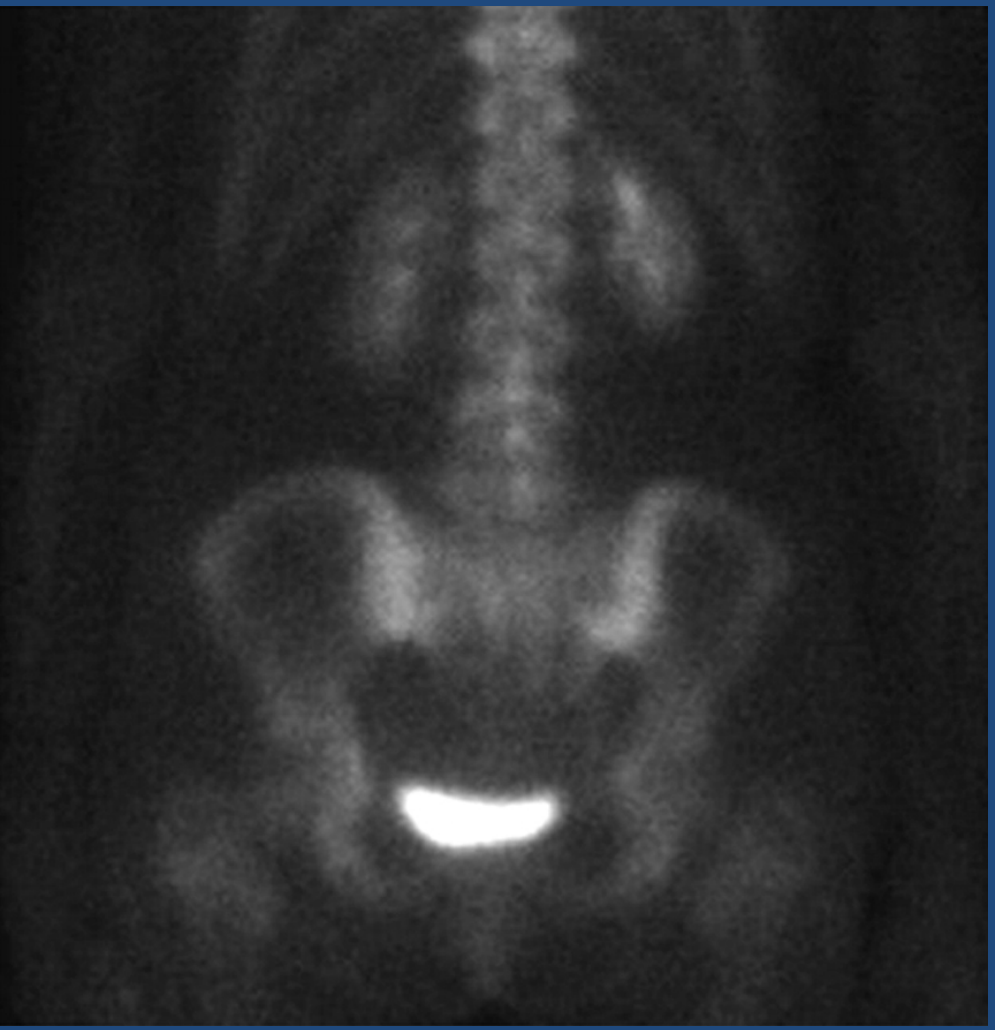
- Acute/Subacute (marrow edema)
- Chronic (normal marrow signal)

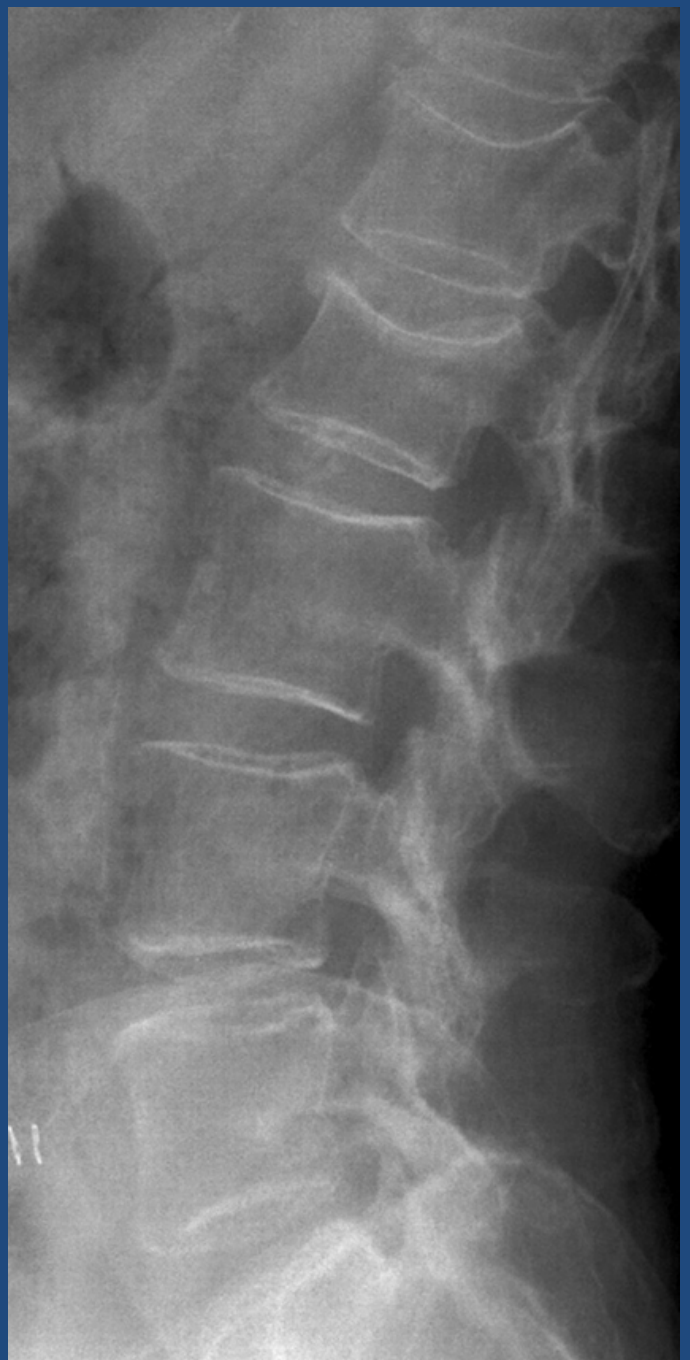
Acute vs Chronic Fracture L2?

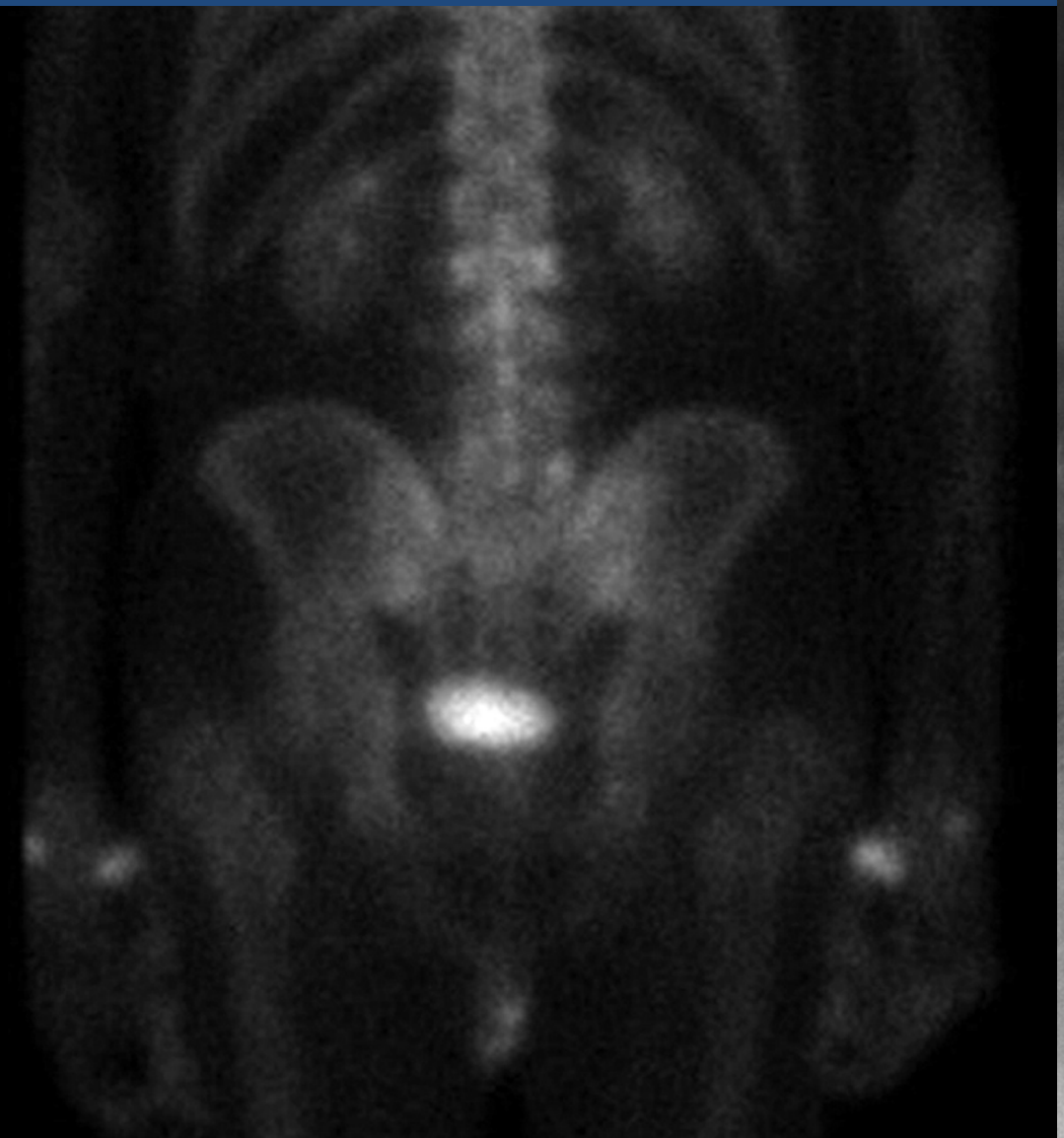


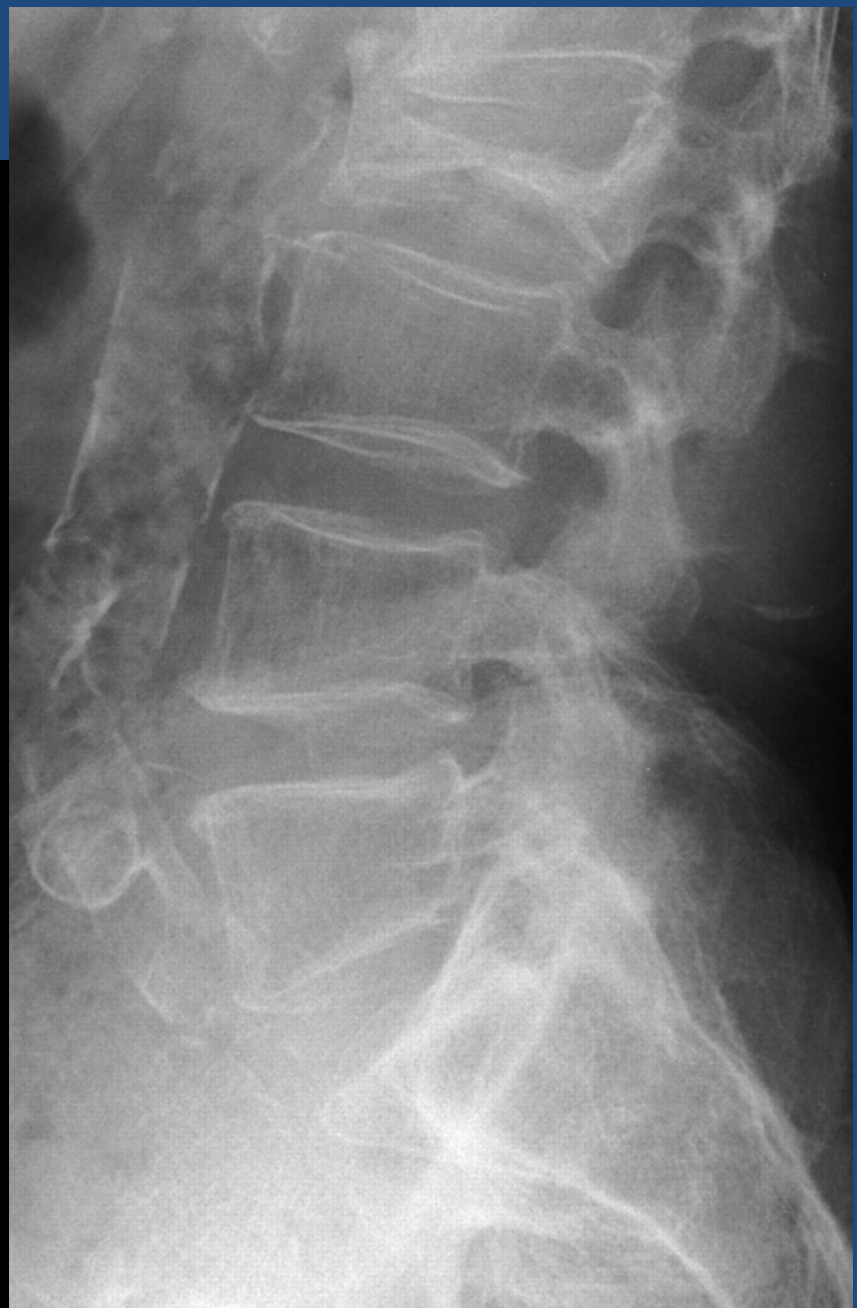
Bone Scan to differentiate acute/subacute vs. chronic fractures

- Total body bone scan using Tc 99m MDP





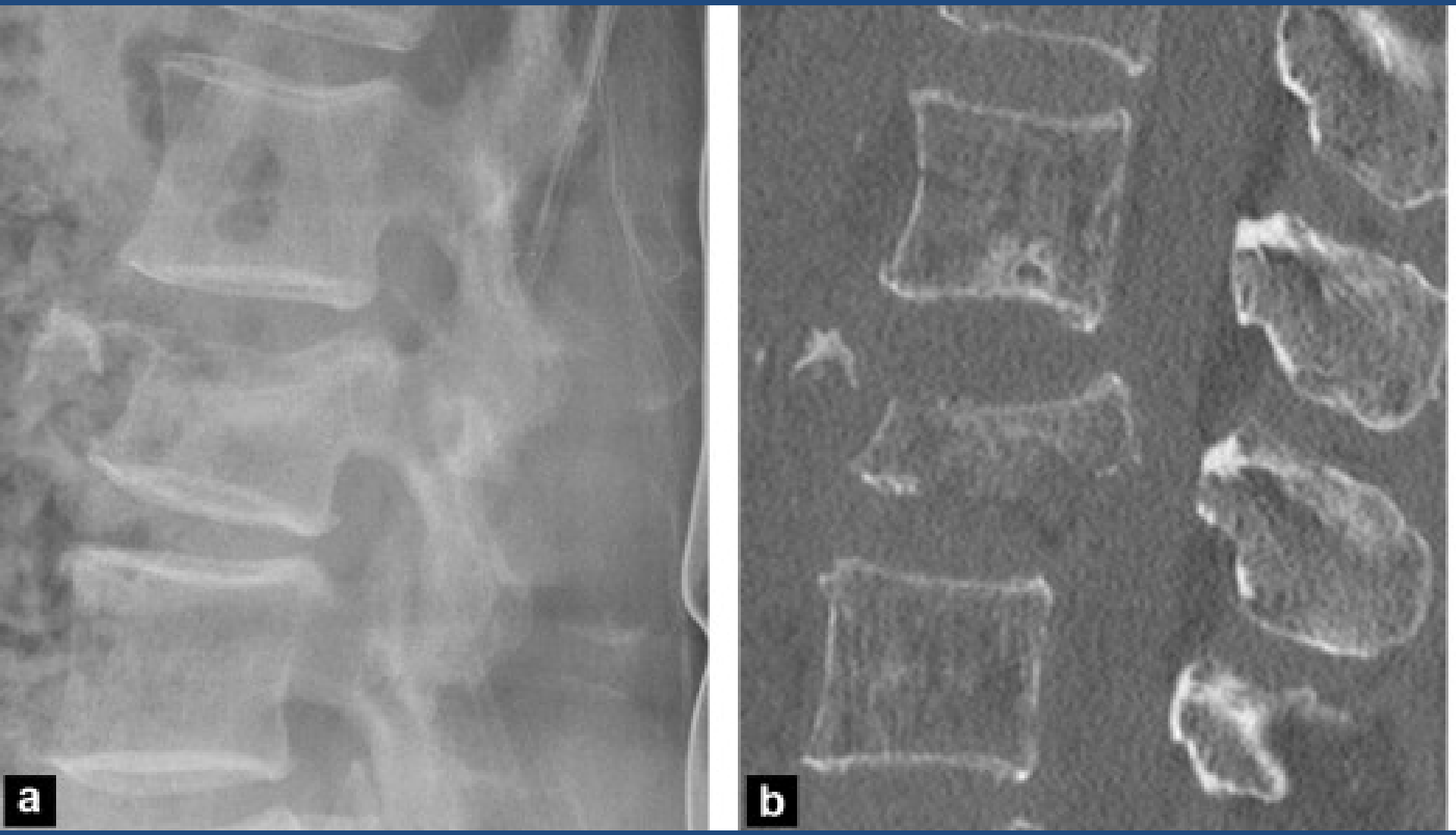




Unknown case

- Trauma (mva) with leg weakness, saddle anesthesia, bladder dysfunction and decreased rectal tone.

Diagnosis?

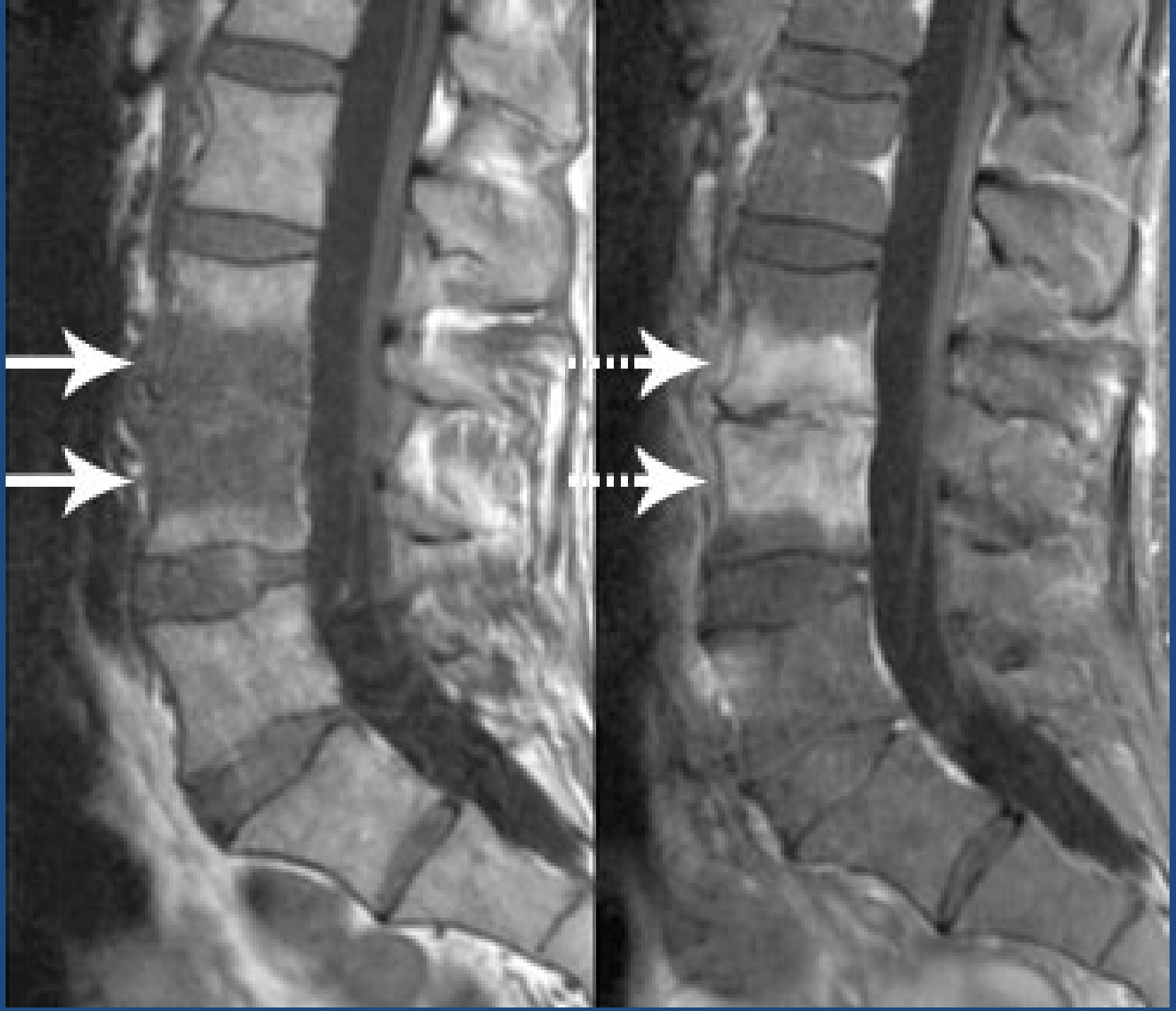


Cauda Equina Syndrome

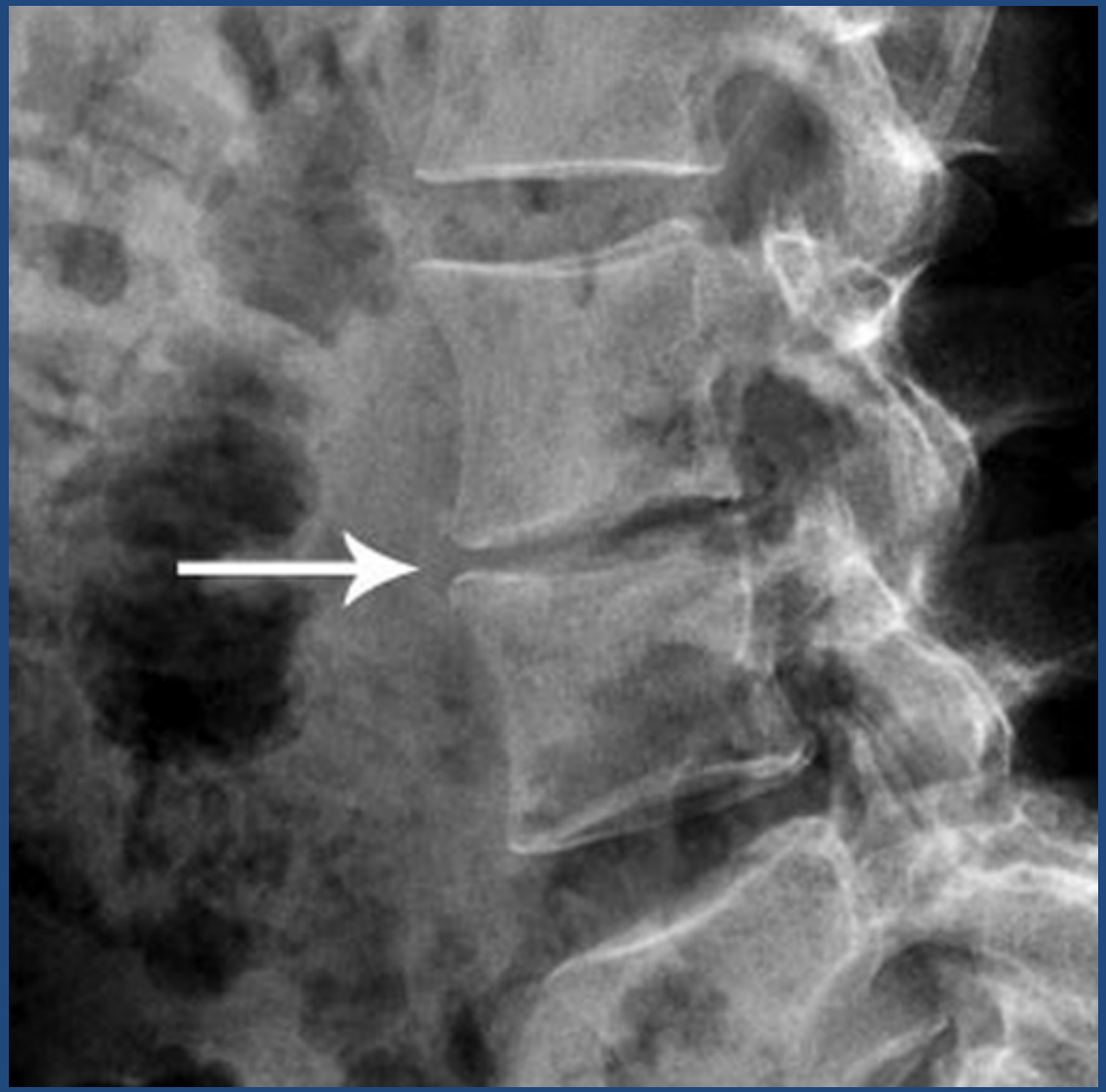
- Results from any lesion that compresses the cauda equina.
- Symptoms include low back pain, sciatica (unilateral or, usually, bilateral), saddle sensory disturbances, bladder and bowel dysfunction, and variable lower extremity motor and sensory loss
- The prognosis for cauda equina syndrome (CES) improves if a definitive cause is identified and management is instituted early.

Unknown case

- 58 year old male with 5 week history of worsening low back pain and fever



Subtle plain film findings



Mission, Vision and Core Values

Mission:

Atlantic Medical Imaging is a quality-driven medical imaging practice committed to clinical excellence by providing innovative service and compassionate care that exceeds expectations.

Vision:

Atlantic Medical Imaging is recognized as the region's premier medical imaging provider of choice - where unparalleled service and care are the top priorities.

Terminology of Spine Imaging

- DDD
- DJD
- Spondylosis
- Spondylolysis/Spondylolisthesis
- Foraminal and central stenosis
- Disc Herniation/Protrusion/Bulge

Disc Pathology

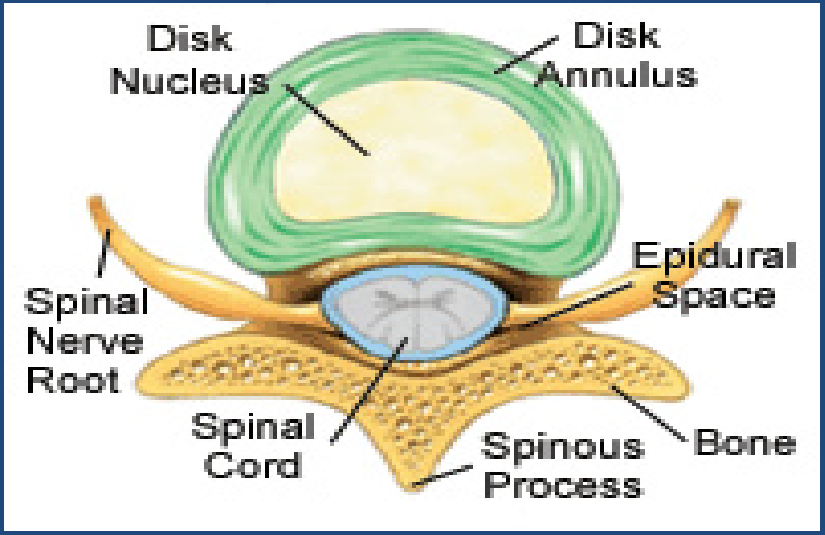
Traumatic vs Degenerative

New vs Old

Anatomy of a Disc

Nucleus Pulposus

Annulus Fibrosis

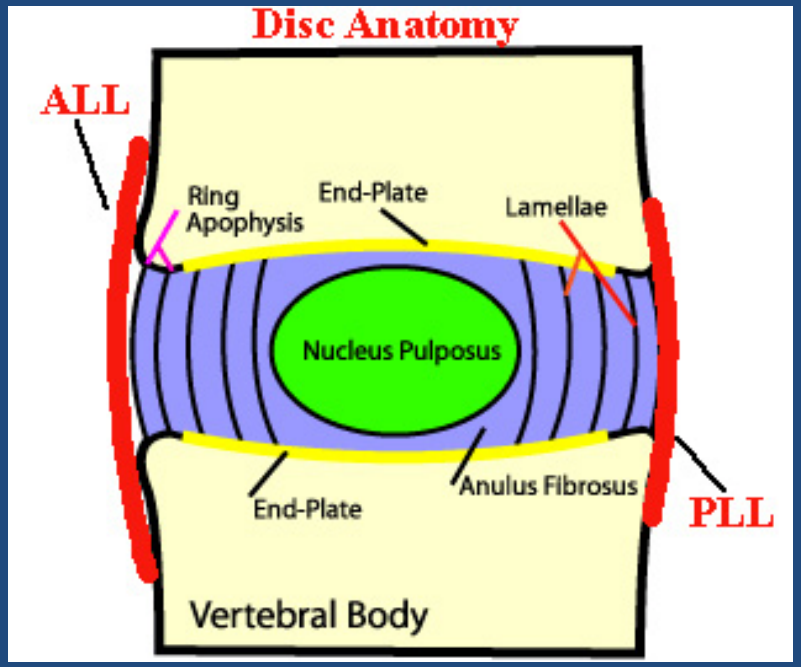


Anatomy of a Disc

Anterior/Posterior Longitudinal Ligaments

End-plate Periosteum

Ring apohysis



Patho-physiology of a Degenerative Disc

- Loss of H2O (water) from nucleus = desiccation
  - Less shock absorption
  - Decreased Height

  - Decreased height……..laxity of ligaments/ST's…….(micro)-motion instability……..(osteo)arthritis

  - Reparation: ligament/capsular, etc. hypertrophy & osteophyte production

More Pathophysiology

*Just as the Nucleus desiccates, so too does the annulus

*Fissures/cracks develop

*Resultant disc Bulge and/or Herniation

*A degenerated Disc is at increased susceptibility of Herniation *

*Degenerative findings co-exist with HNP *

Traumatic Herniation

- Mechanical Force (trauma) causes fissures/cracks which result in disc Bulge and/or Herniation
- Loss of H2O……loss of height……..
- Same degenerative cascade
- Degenerative findings co-exist with HNP

Traumatic vs Degenerative HNP "chicken & the egg"

- Did the degenerative findings precede or come after the HNP?
- Without pre-/post- can be impossible to tell
- How long after a traumatic HNP do degenerative findings appear?
- Degenerative Findings DO NOT exclude Traumatic Etiology

Might all HNP's be Traumatic?

- Degenerative Disc: increased susceptibility for HNP i.e.; less mechanical force (trauma) required
- Why do some HNP's result from simple flexion/extension?
- Why do some MVA's result in HNP and others not?

Standardized/Structured Reporting

- An offshoot of the Healthcare IT revolution
- Digital, voice-recognition dictation
- Radiologist productivity and efficiency
- Referrer preference; efficiency of garnering results
- Patient engagement

Standardized Lexicon

2001:

NASS: North American Spine Society

ASNR: American Society of NeuroRadiology

AANS: American Association of Neurologic Surgeons

AAOS: American Academy of Orthopedic Surgeons

How's Your Disc? Illustrative Glossary of Degenerative Disc Lesions using Standardized Lexicon

Boo, S., MD and Hogg, JP., MD

WVU Health Sciences Center, Dept. of Radiology

May/June 2010

Lumbar Disc Nomenclature: version 2.0 Recommendations of the combined task forces of the NASS, the ASNR and the ASSR

Fardon, D., MD et al

Yale, USC, Wisconsin, Rush, etc.

The Spine Journal, 2014

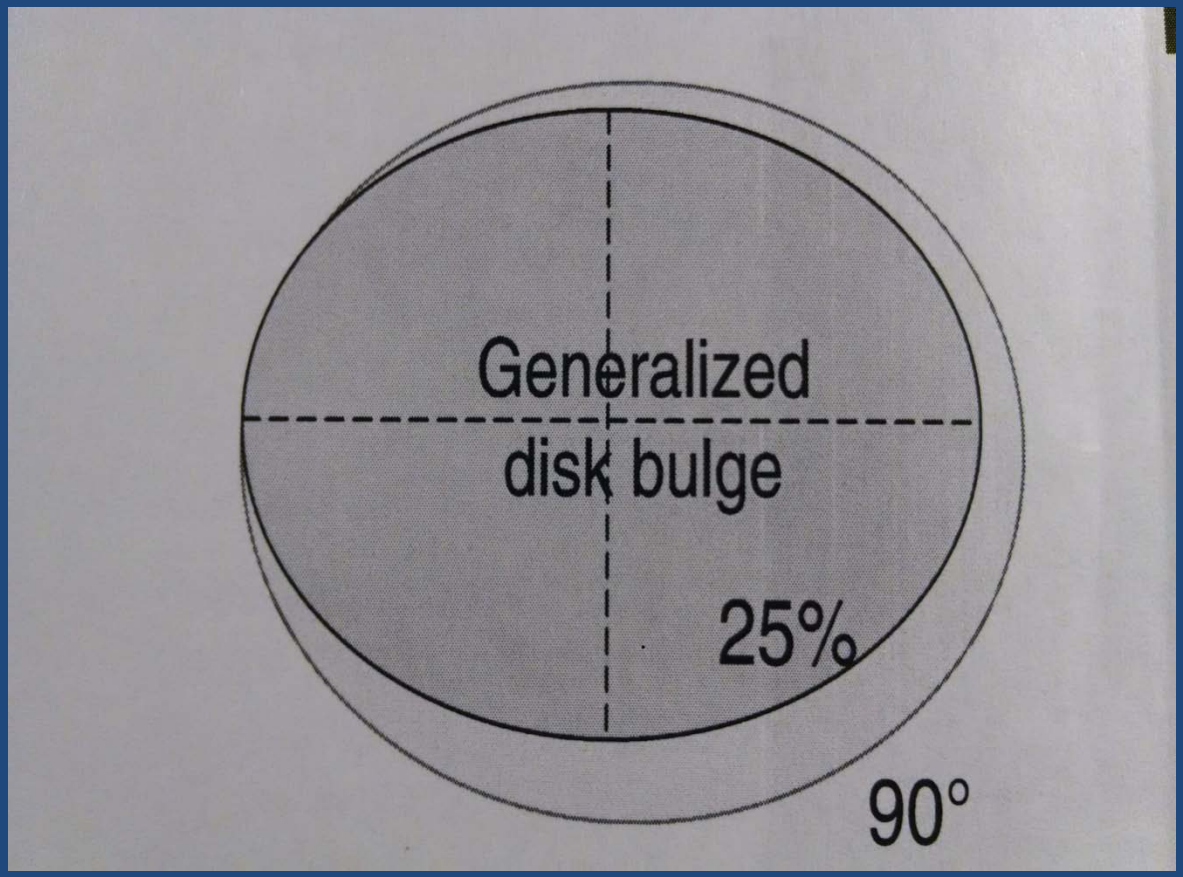
Descriptive

NOT Pathologic

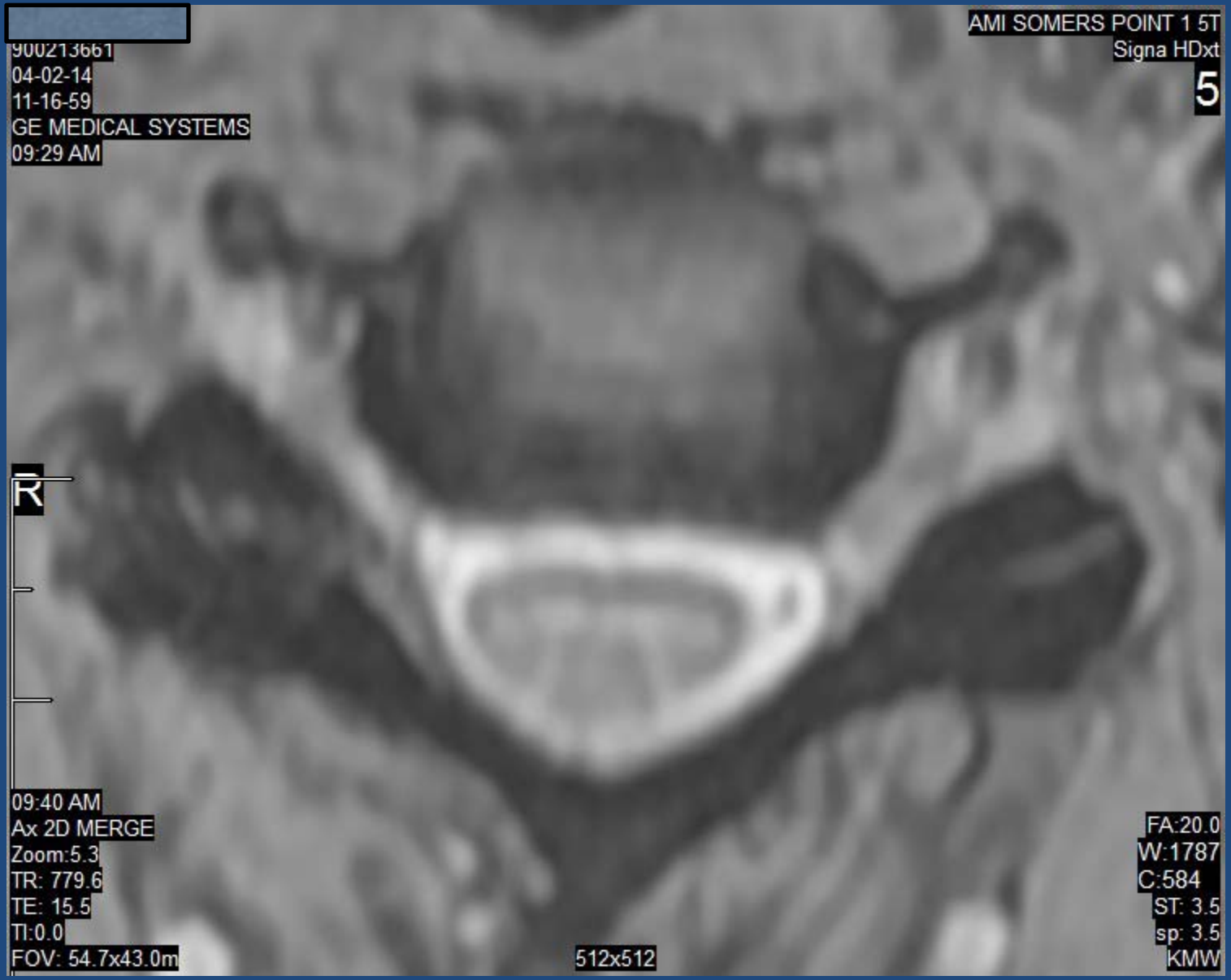
NOT Anatomic

NOT Etiologic/Causality

NOT Clinical

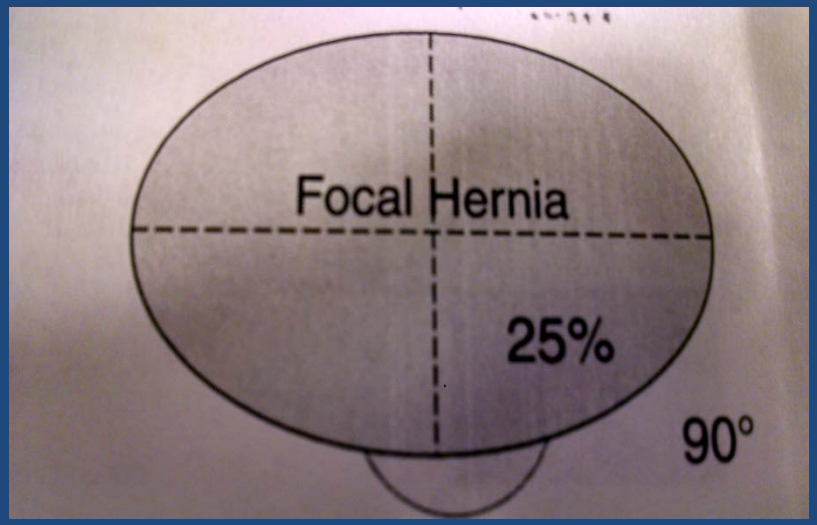


Disc Bulge

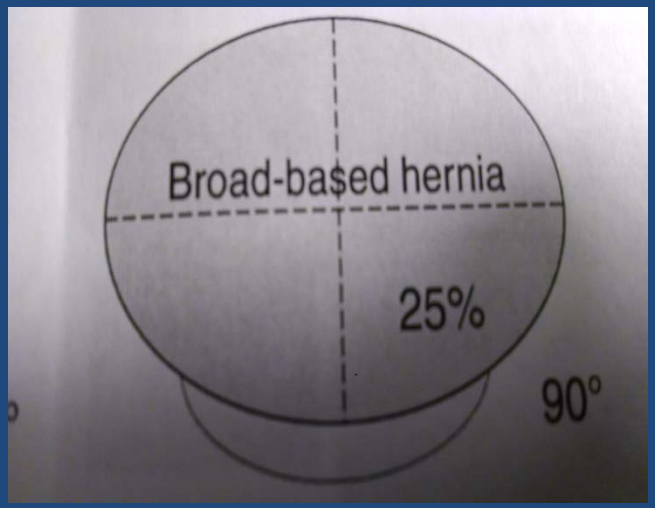

AMI SOMERS POINT 1 5T
Signa HDxt
5
90021366l
04-02-14
11-16-59
GE MEDICAL SYSTEMS
09:29 AM
R
09:40 AM
Ax 2D MERGE
Zoom:5.3
TR: 779.6
TE: 15.5
TI:0.0
FOV: 54.7x43.0m
512x512
FA:20.0
W:1787
C:584
ST: 3.5
sp: 3.5
KMW

HNP: Focal or Broad

Focal/Local

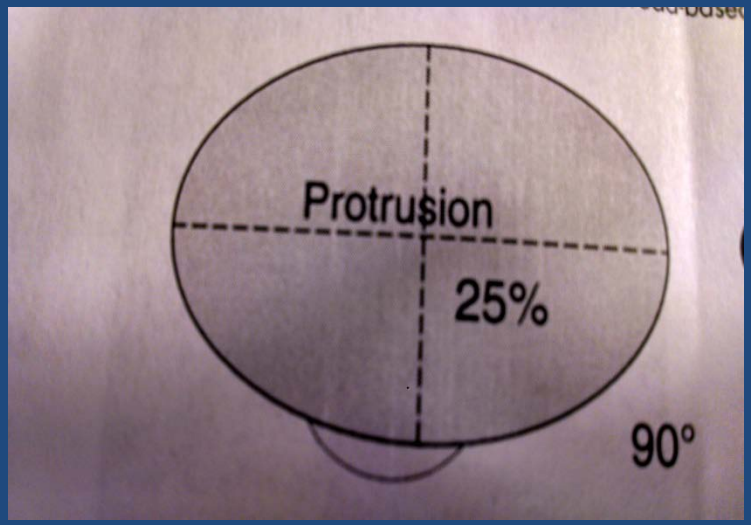


Broad – (Based)

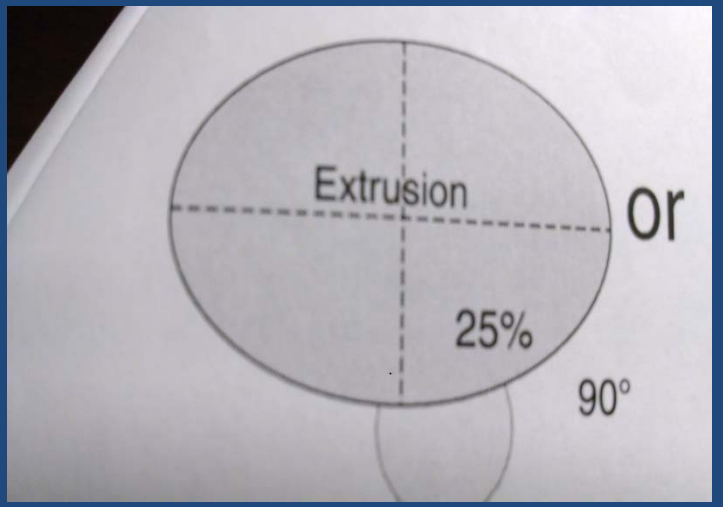


HNP: Protrusion or Extrusion

Protrusion



Extrusion



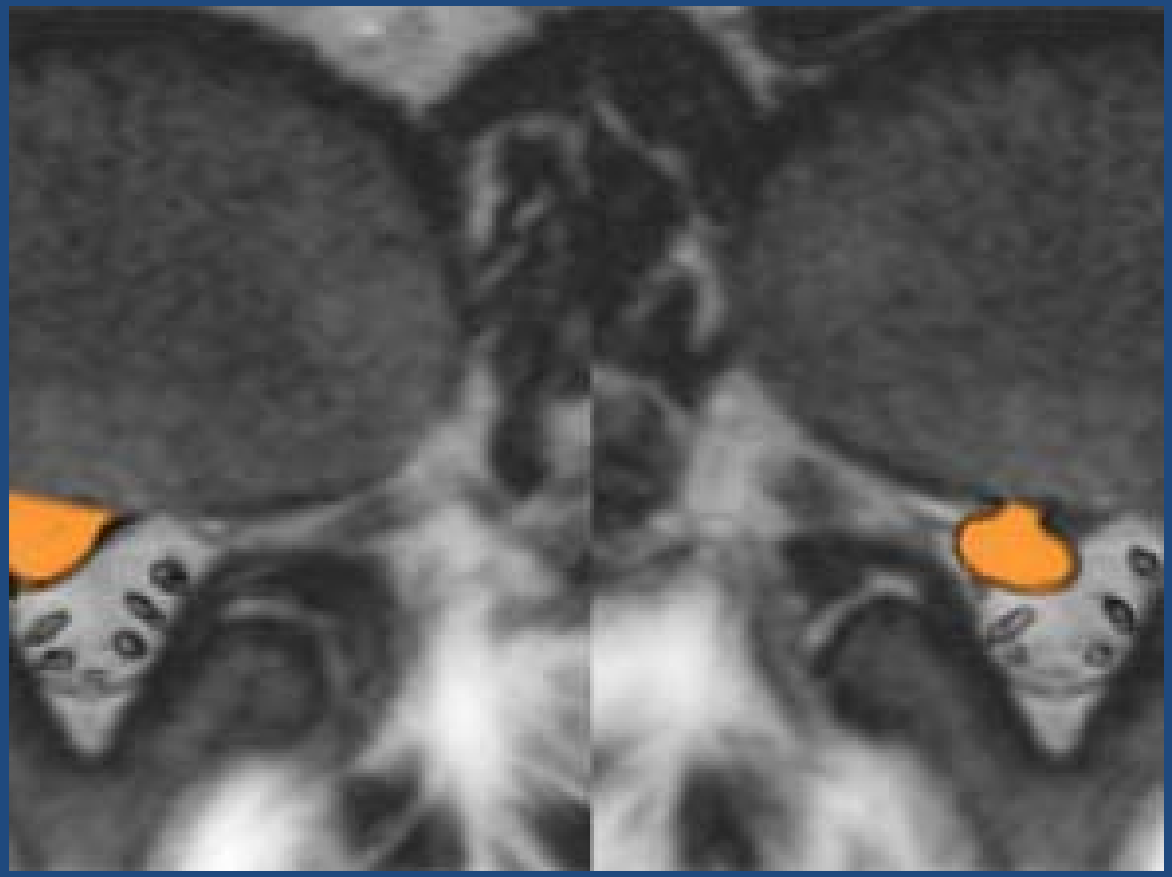
ALL Herniations

Focal/Localized Protrusion

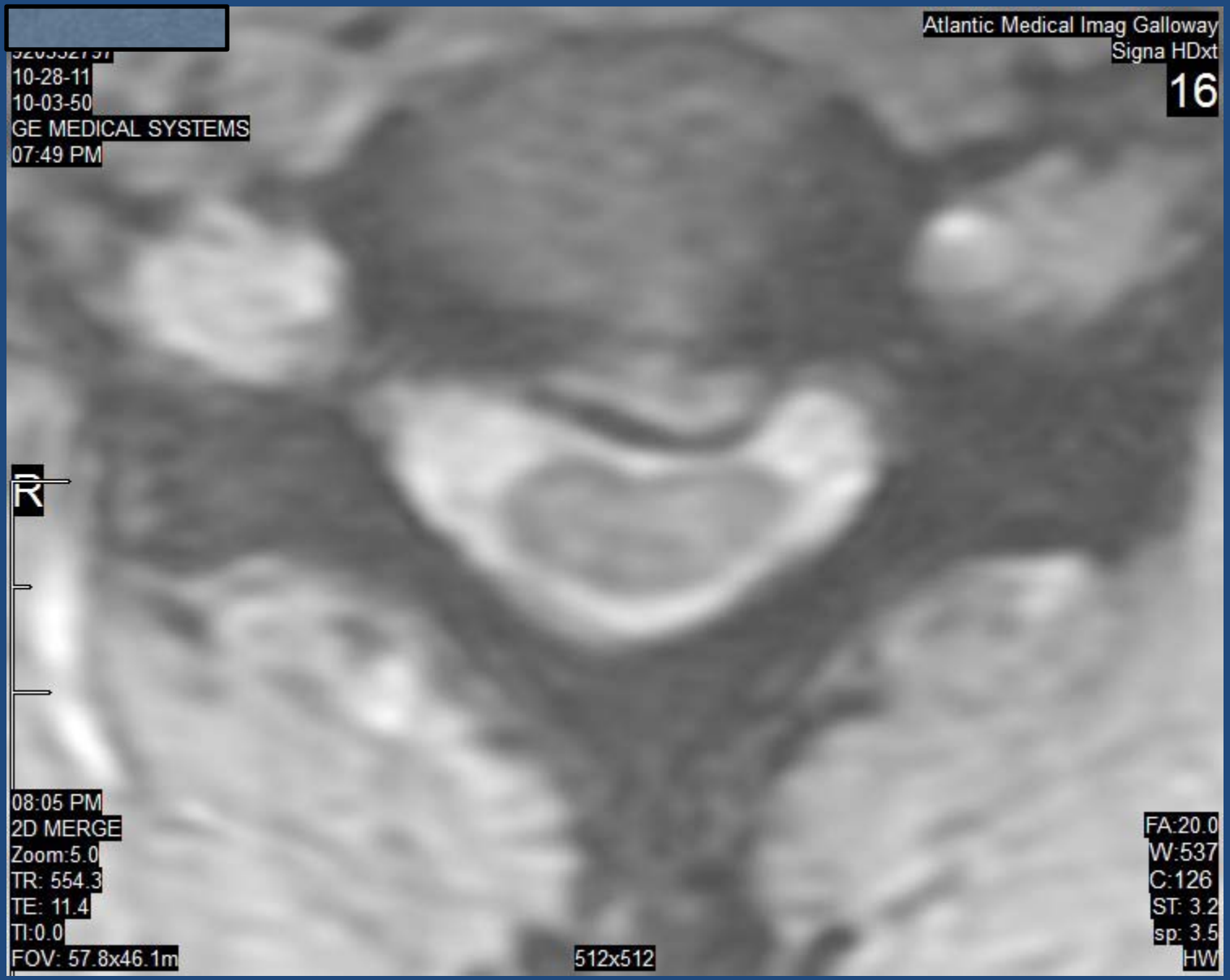
Broad - (based) Protrusion

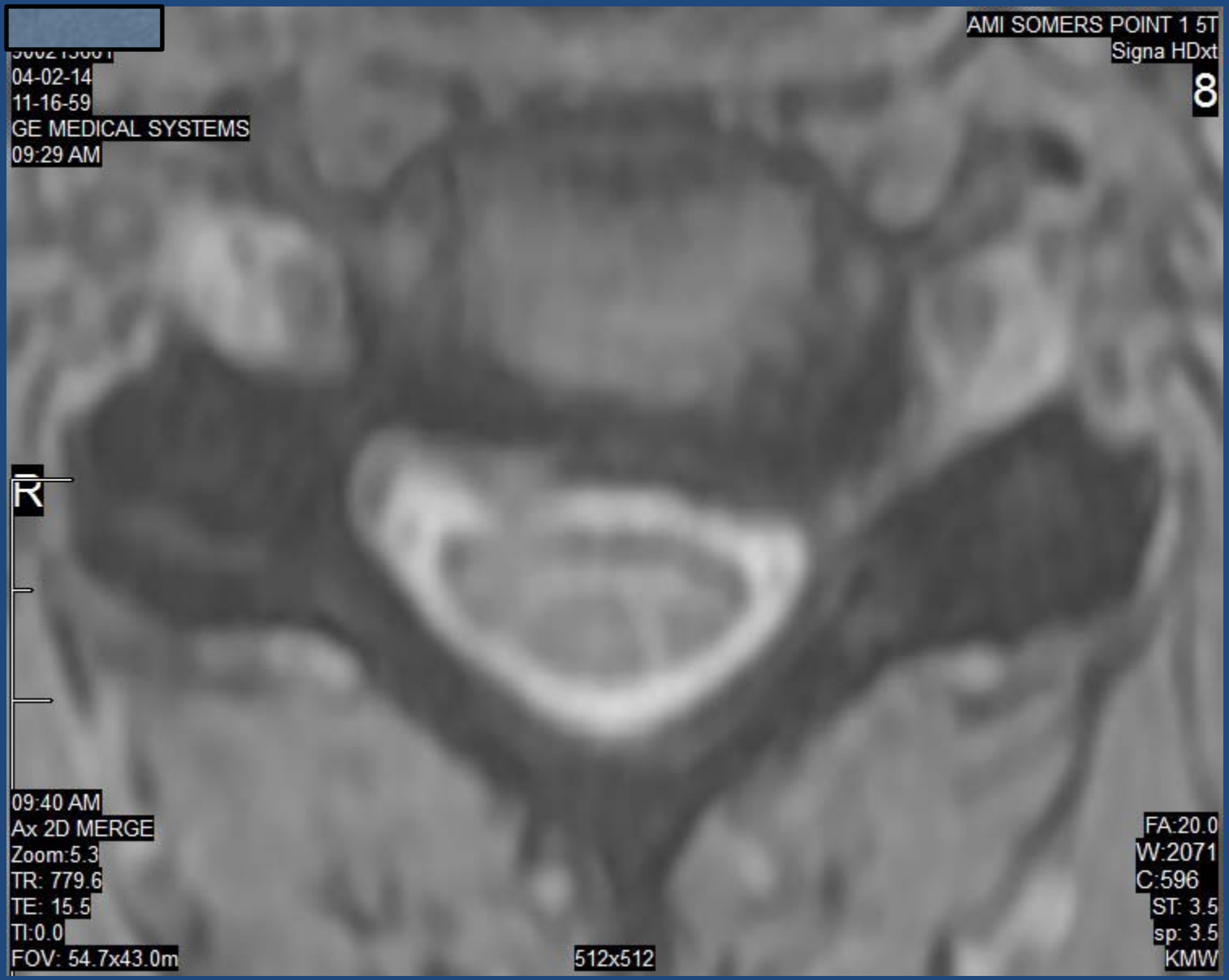
Focal/Localized Extrusion

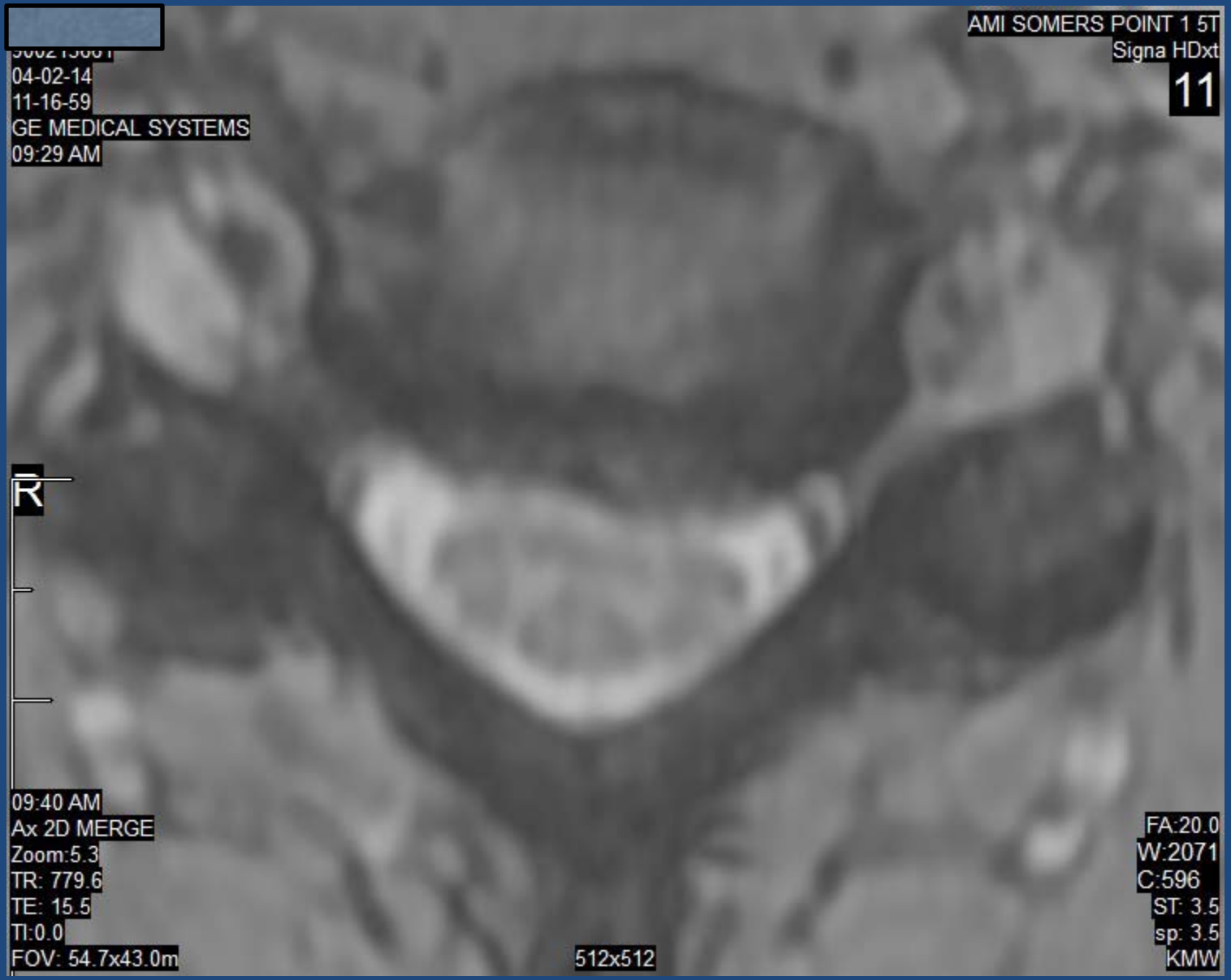
Broad – (Based) Extrusion



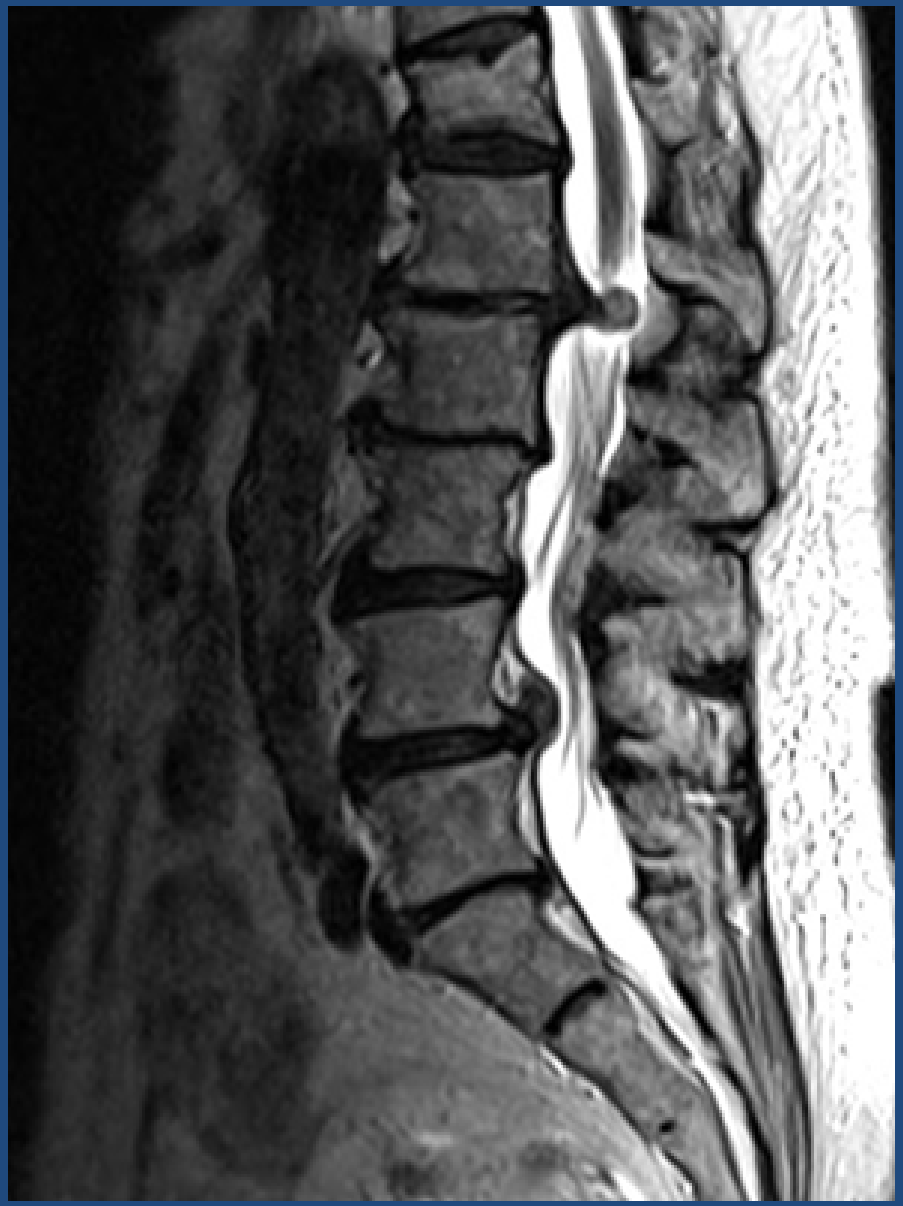
Disc Herniation


Atlantic Medical Imag Galloway
Signa HDxt
16
10-28-11
10-03-50
GE MEDICAL SYSTEMS
07:49 PM
R
08:05 PM
2D MERGE
Zoom:5.0
TR: 554.3
TE: 11.4
TI:0.0
FOV: 57.8x46.1m
512x512
FA:20.0
W:537
C:126
ST: 3.2
sp: 3.5
HW

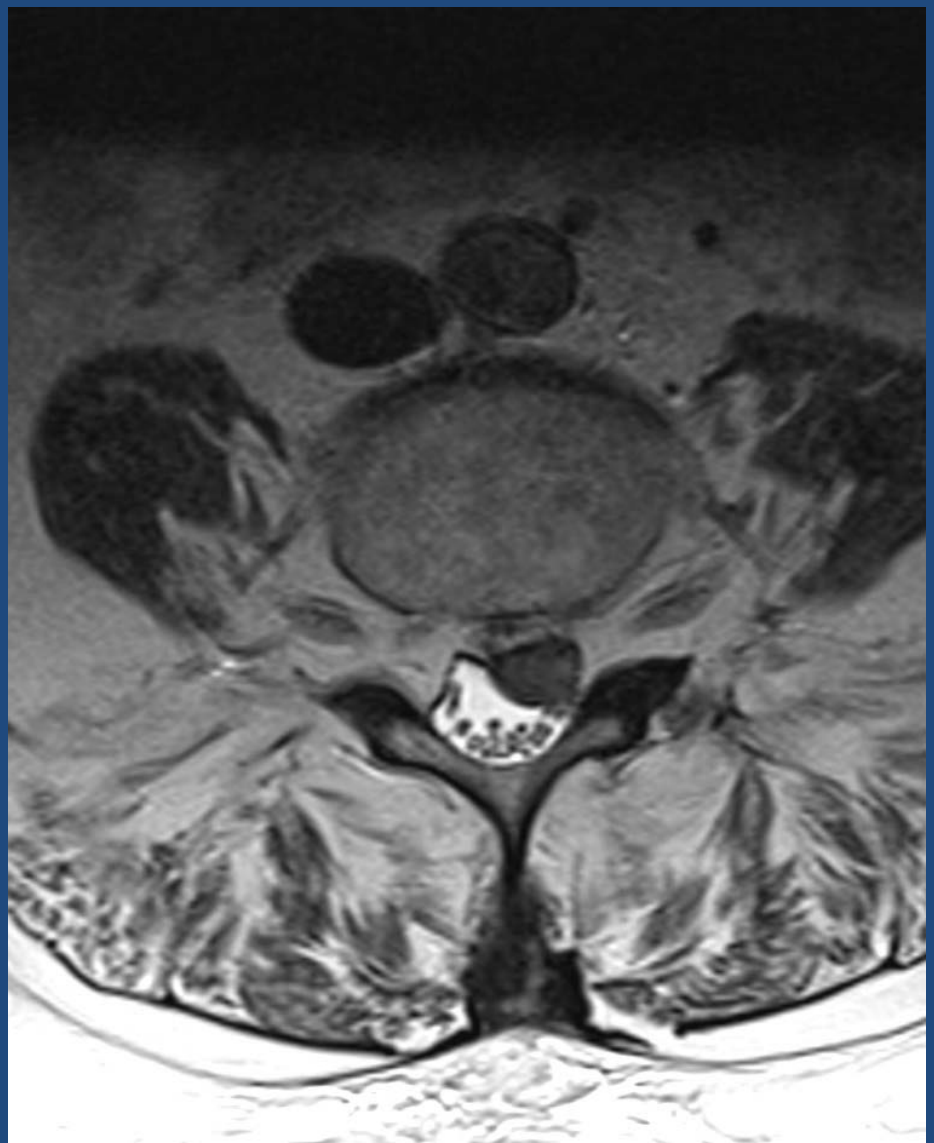

AMI SOMERS POINT 1 5T
Signa HDxt
8
04-02-14
11-16-59
GE MEDICAL SYSTEMS
09:29 AM
R
09:40 AM
Ax 2D MERGE
Zoom:5.3
TR: 779.6
TE: 15.5
TI:0.0
FOV: 54.7x43.0m
512x512
FA:20.0
W:2071
C:596
ST: 3.5
sp: 3.5
KMW


AMI SOMERS POINT 1 5T
Signa HDxt
11
04-02-14
11-16-59
GE MEDICAL SYSTEMS
09:29 AM
R
09:40 AM
Ax 2D MERGE
Zoom:5.3
TR: 779.6
TE: 15.5
TI:0.0
FOV: 54.7x43.0m
512x512
FA:20.0
W:2071
C:596
ST: 3.5
sp: 3.5
KMW

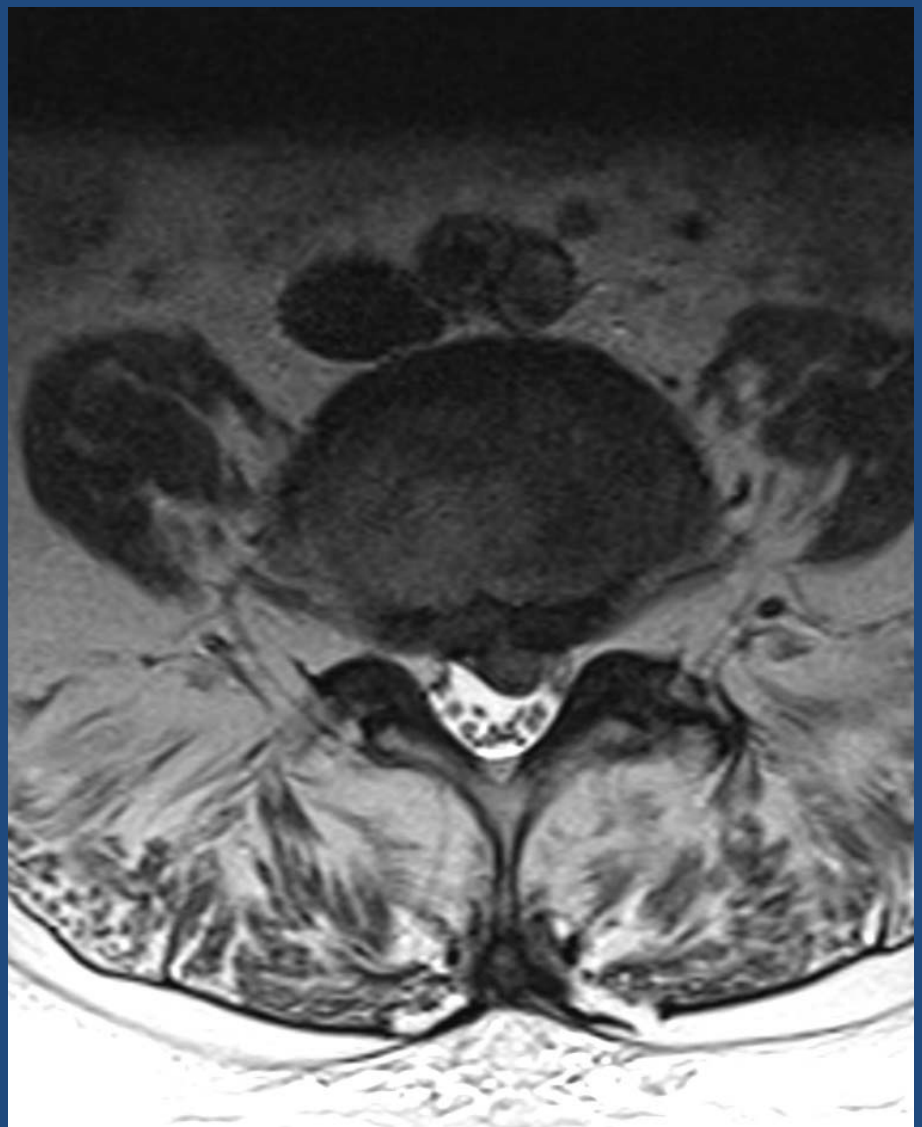
Unknown case



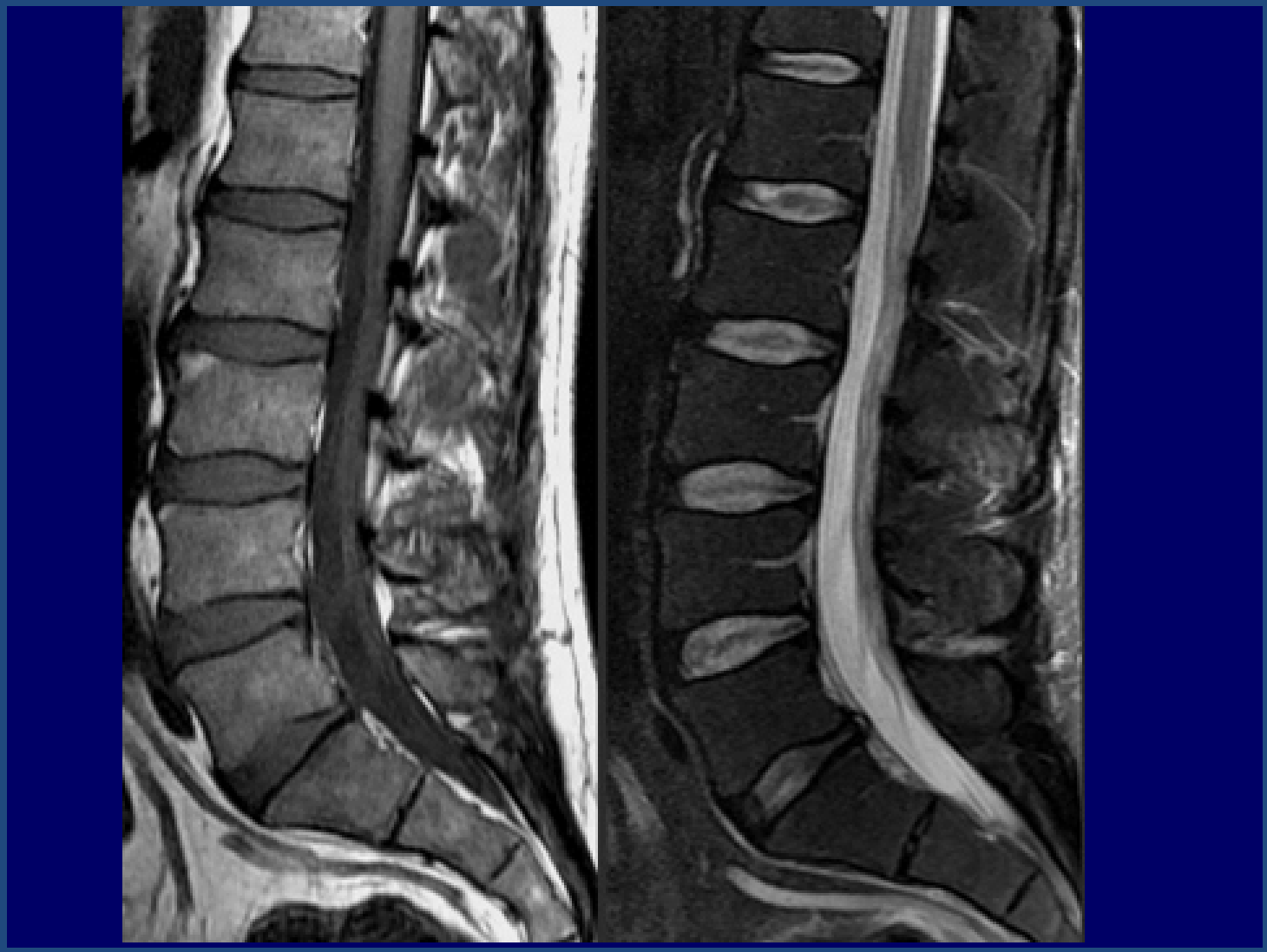
L4-L5



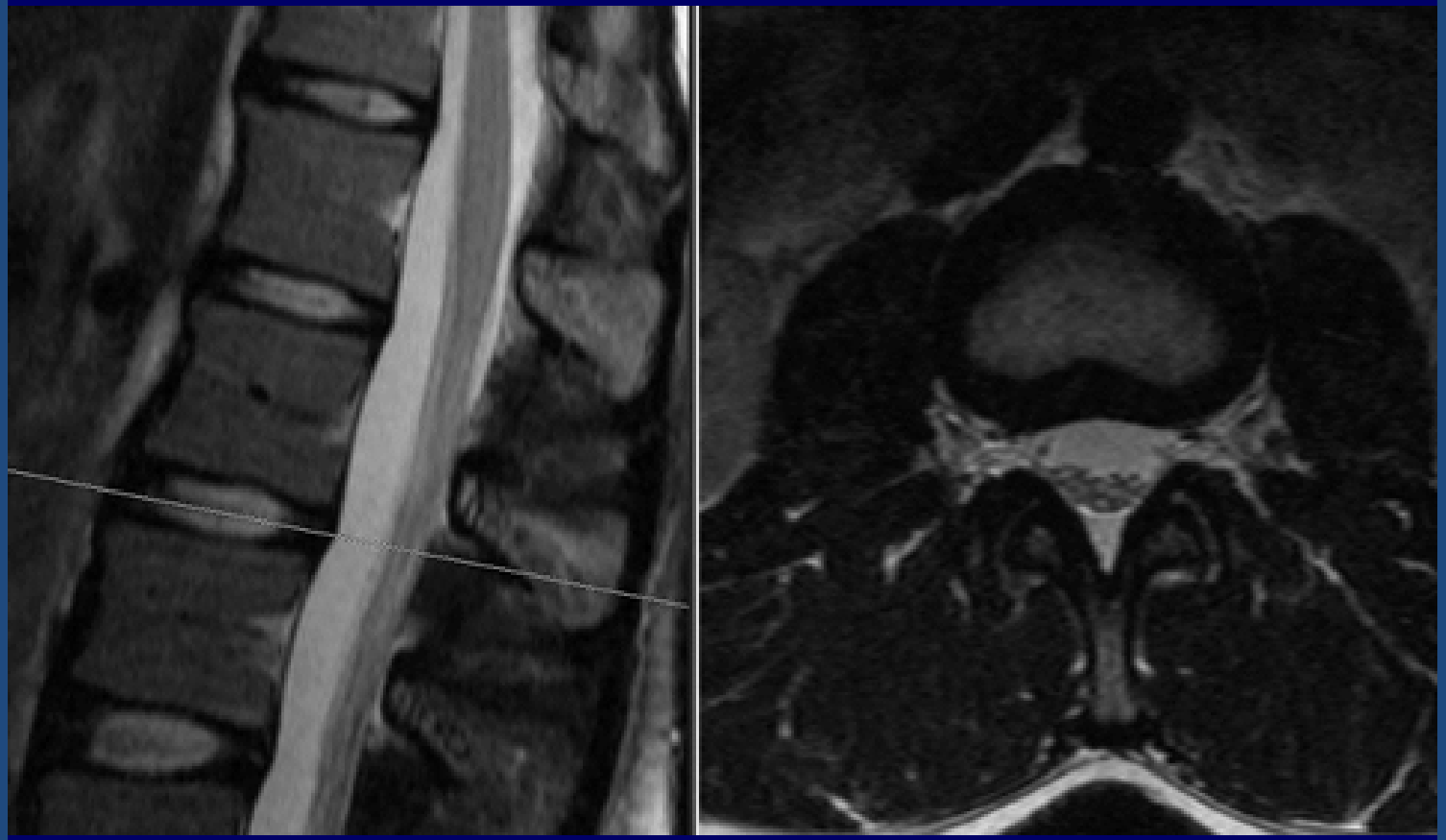
L4-L5



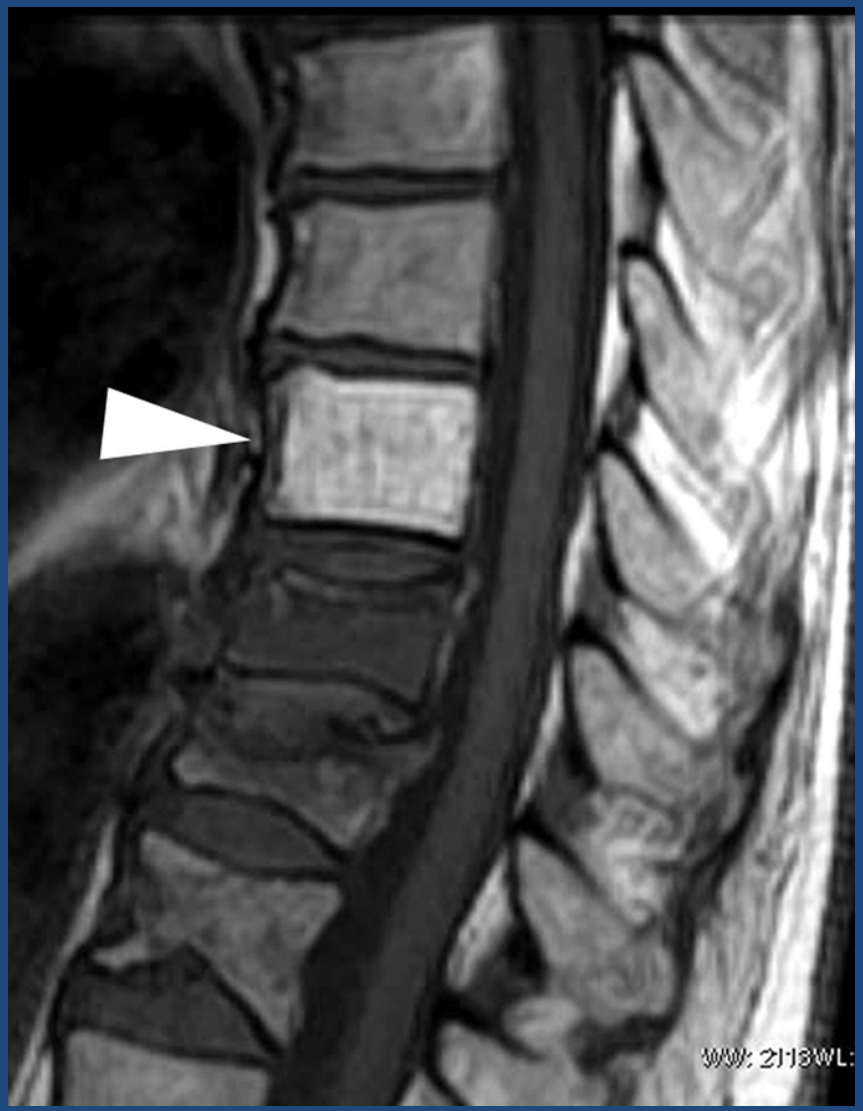
Unremarkable MRI Lumbar Spine



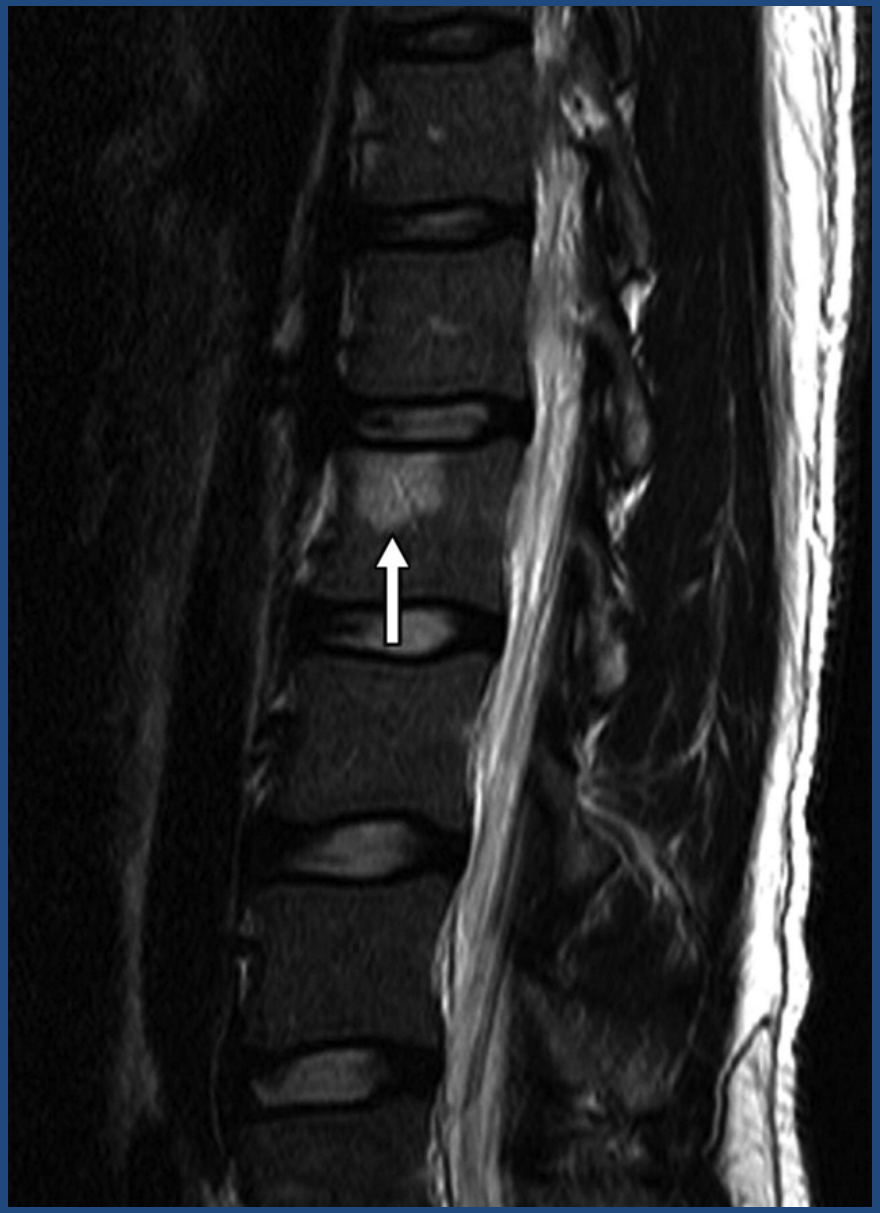
MRI L2-L3 level



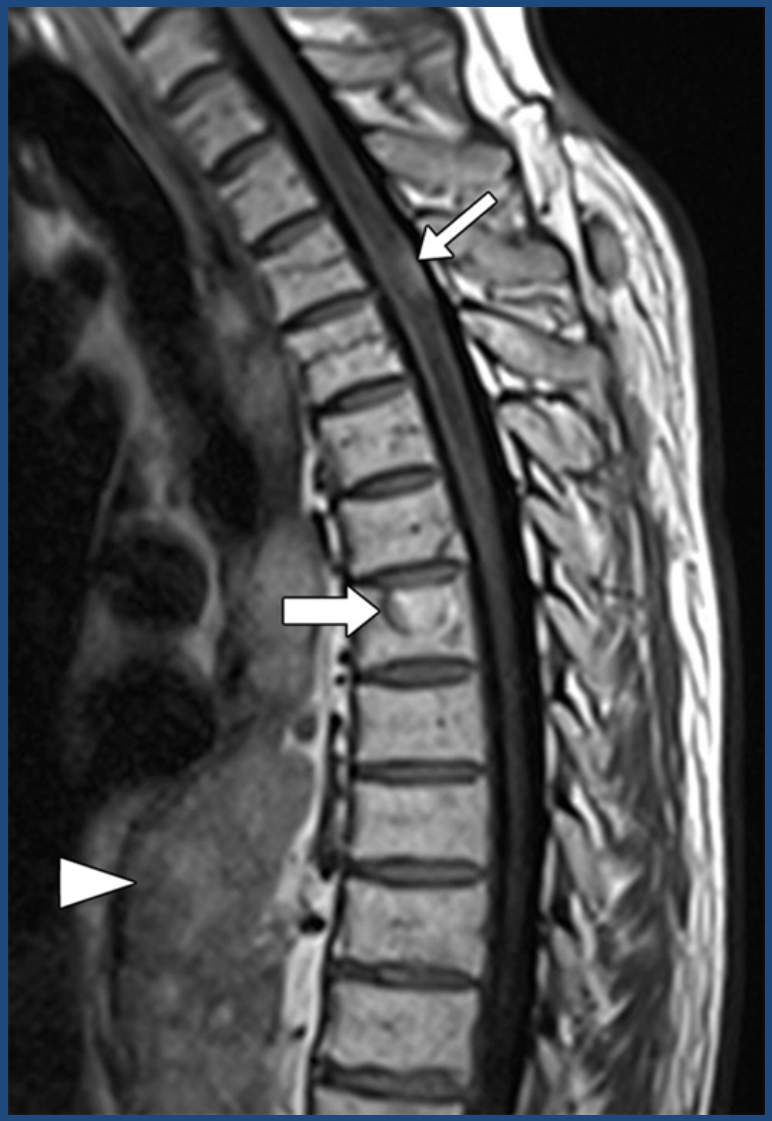
What is your diagnosis?



27-year-old man with vertebral hemangioma

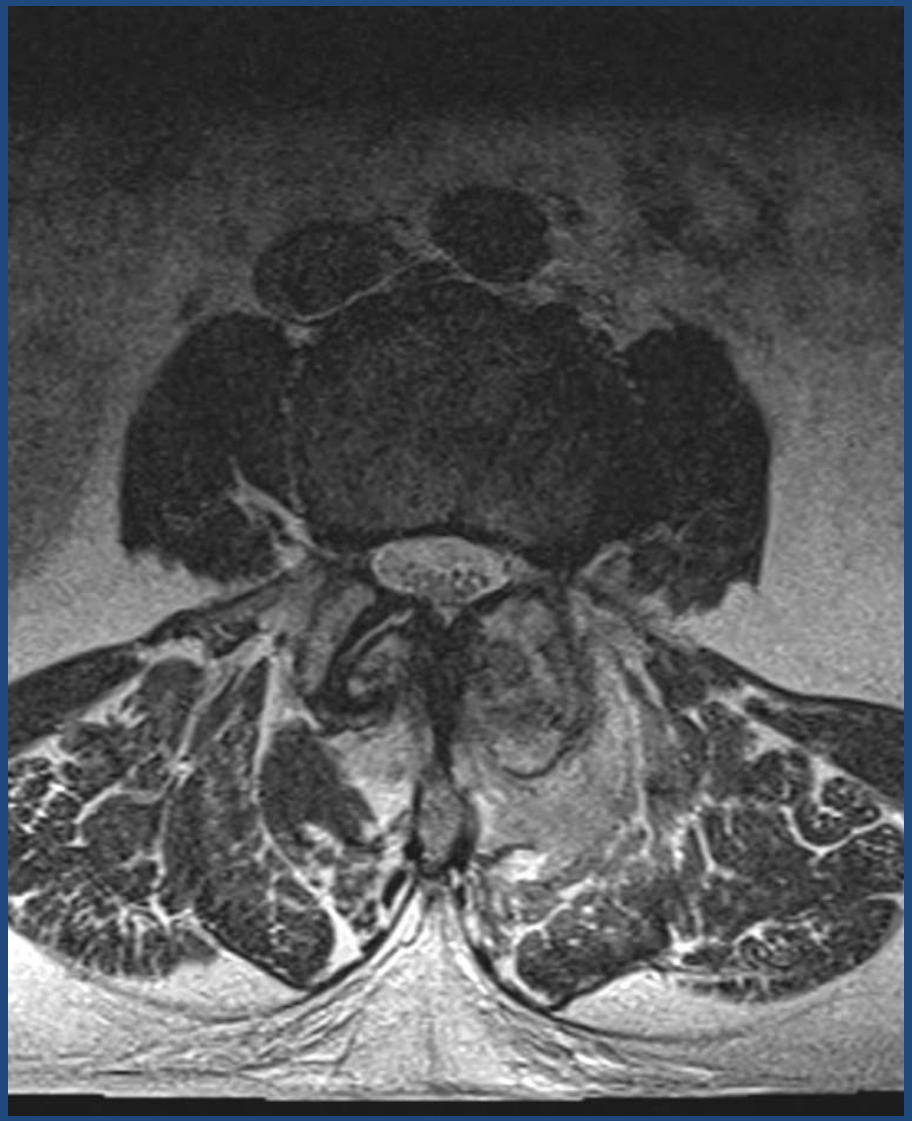


Benign hemangioma?

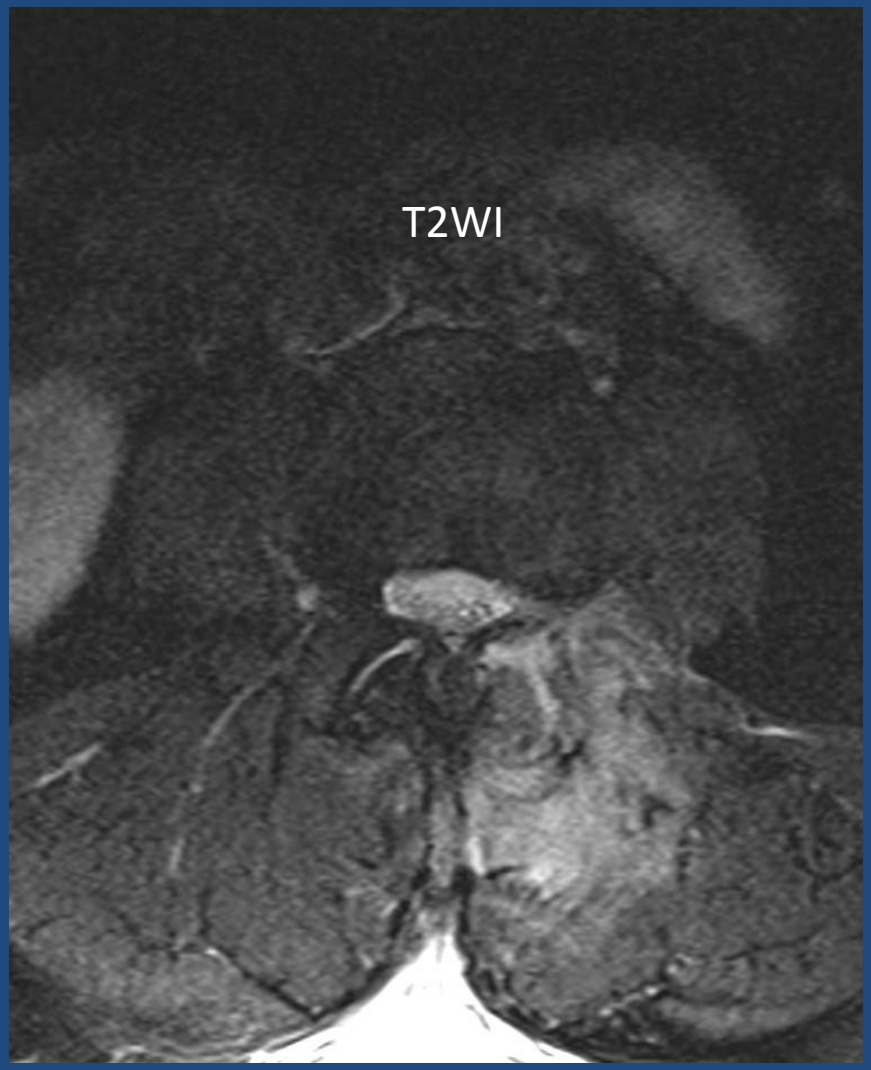


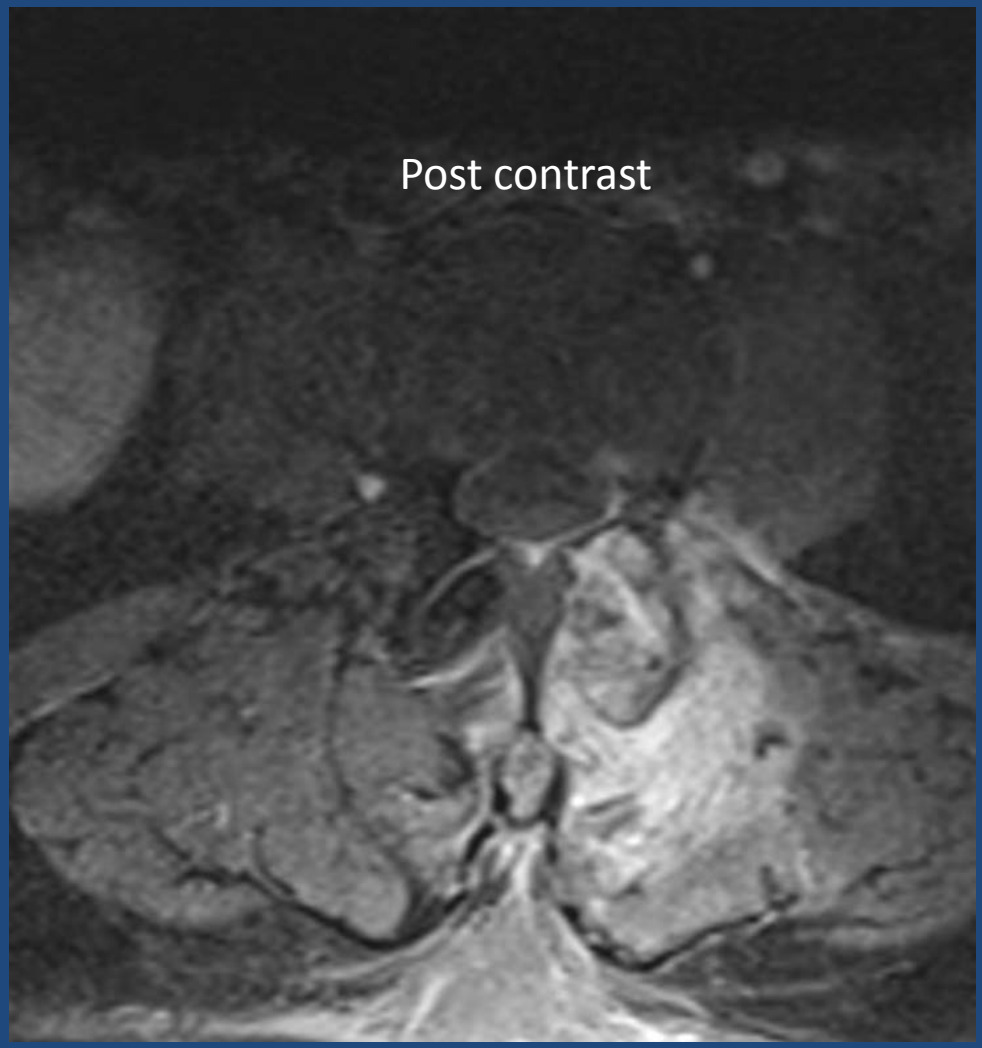
Comparison of Imaging Modalities for the Diagnosis of Vertebral Osteomyelitis		
Modality	**Strengths**	**Weaknesses**
Plain film x-ray	Sensitive when infection well established Readily accessible	Signs do not develop until 10-21 days after start of infection
MRI	Most sensitive for early detection (edema) No radiation exposure	Moderate specificity Contraindications to MR, e.g. claustrophobia, pacer, etc.
CT	More sensitive than plain film for detecting bone and disc erosions	Less sensitive than MR to soft tissue lesions and abscesses Iodinated contrast administered
Gallium-Bone Scan	May be useful if CT and/or MRI equivocal	Low spatial resolution Requires 2 days

Back pain with fever
Diagnosis?

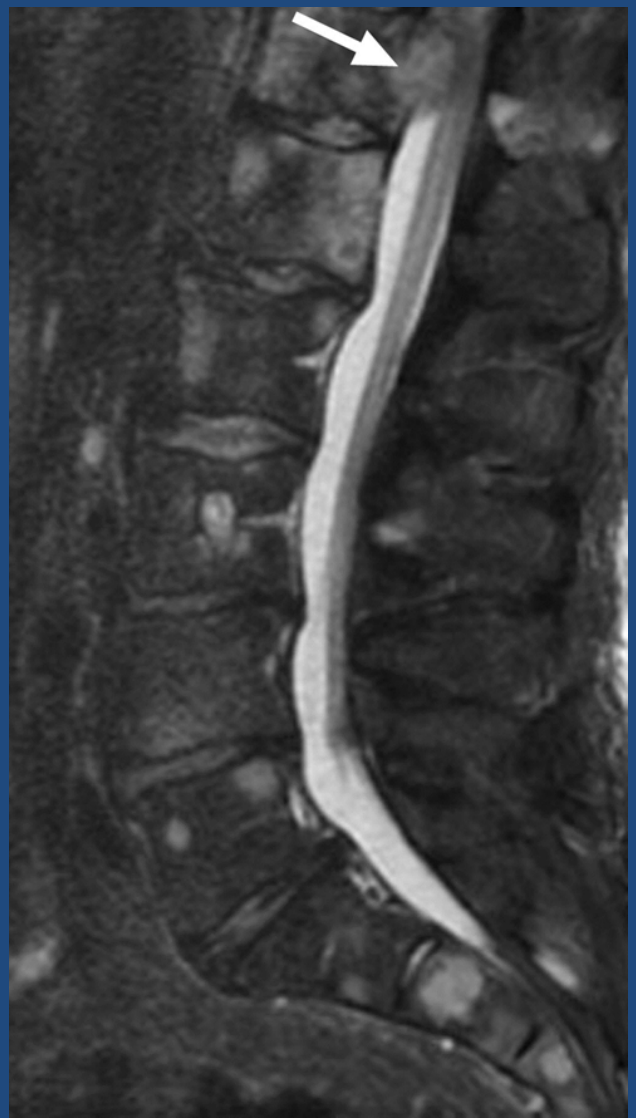


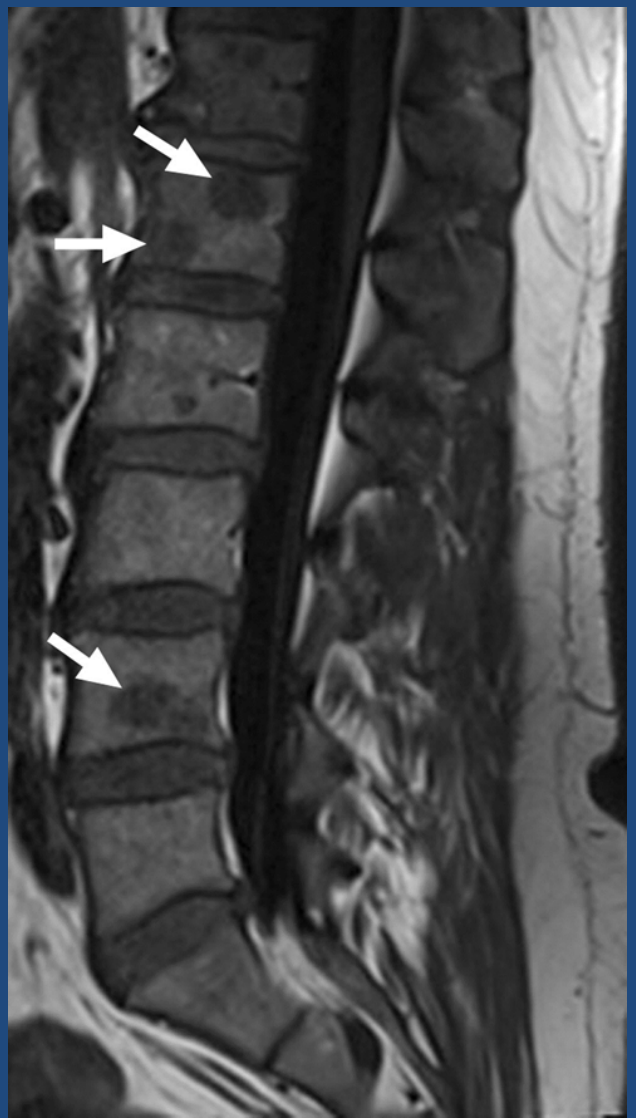
Diagnosis?



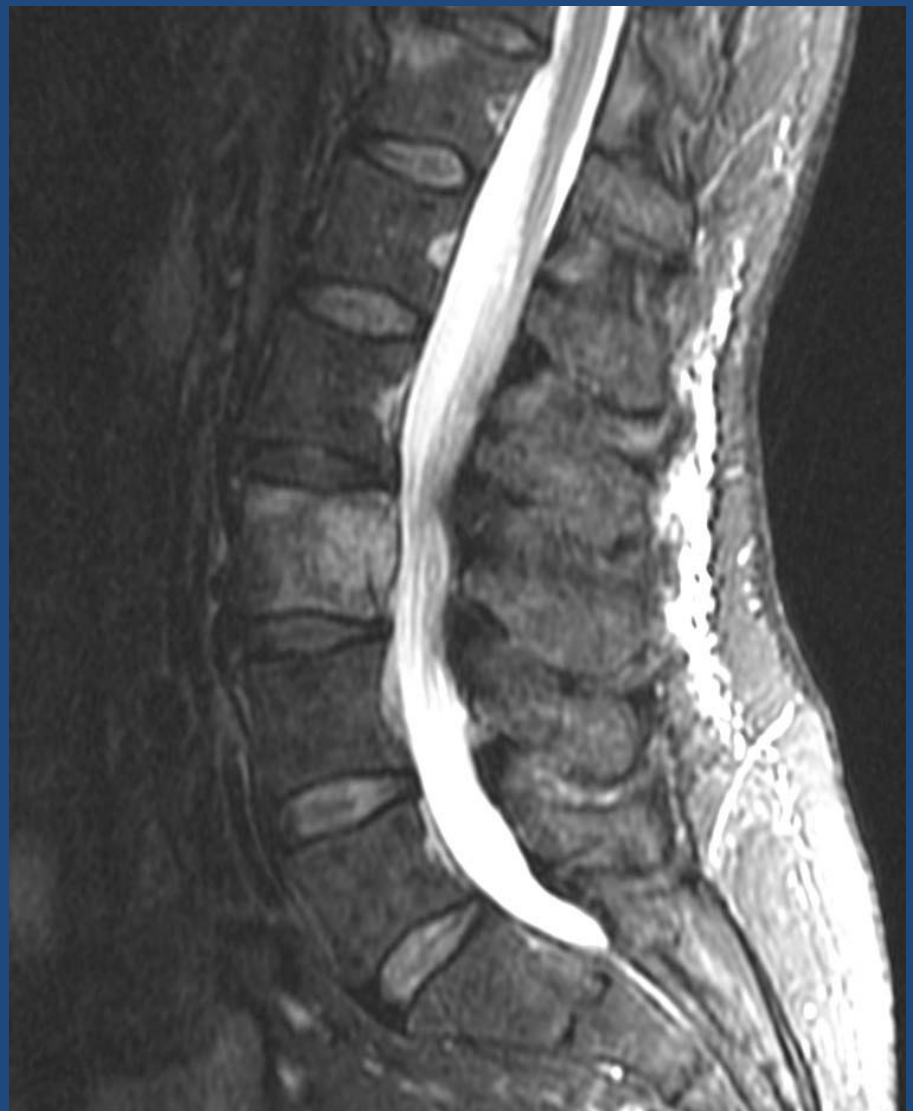


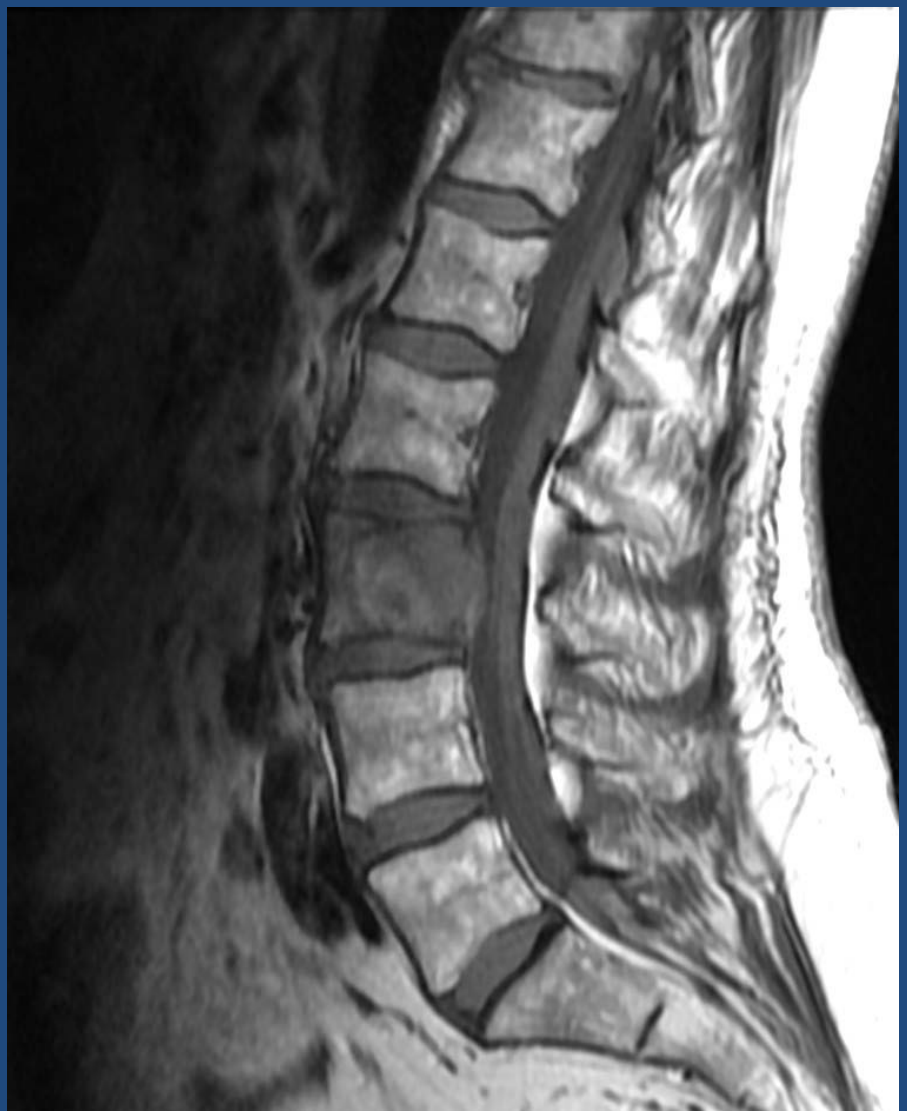
Two different patients with similar findings but two different diagnoses.



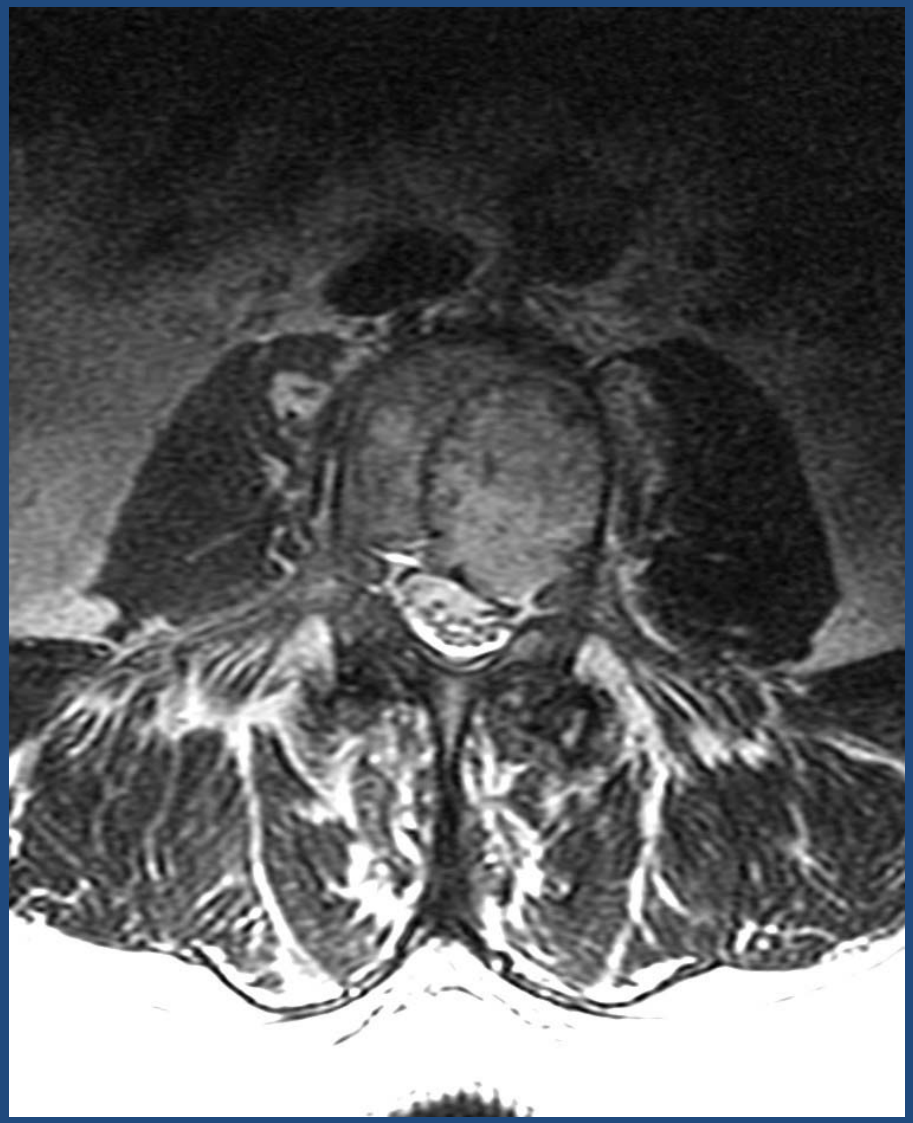


Diagnosis?

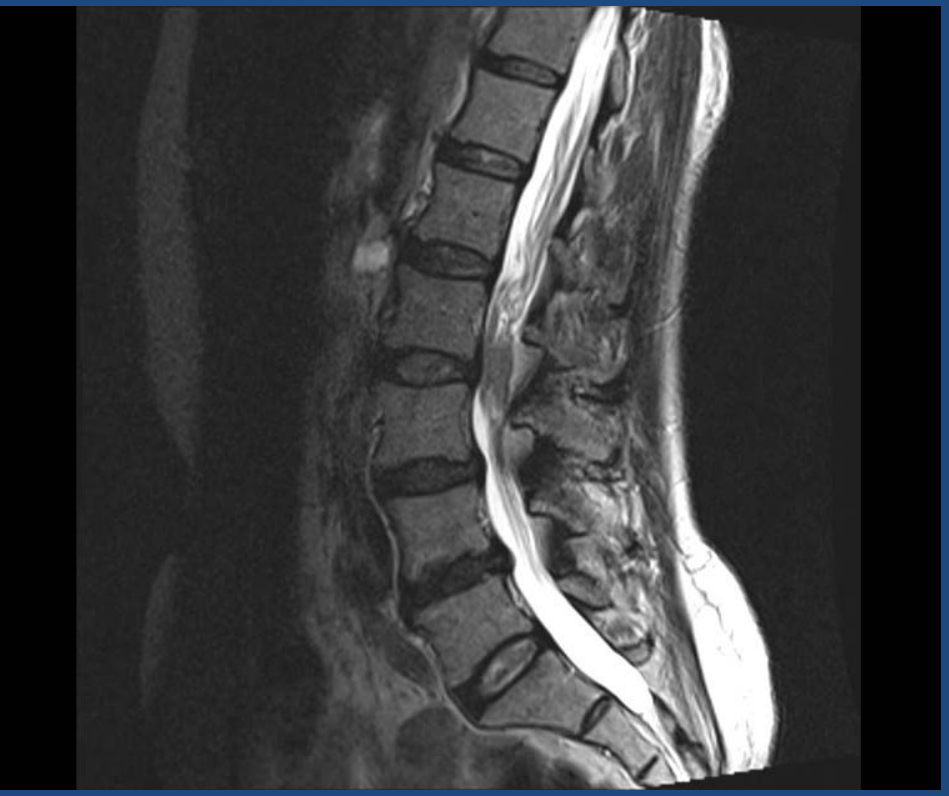


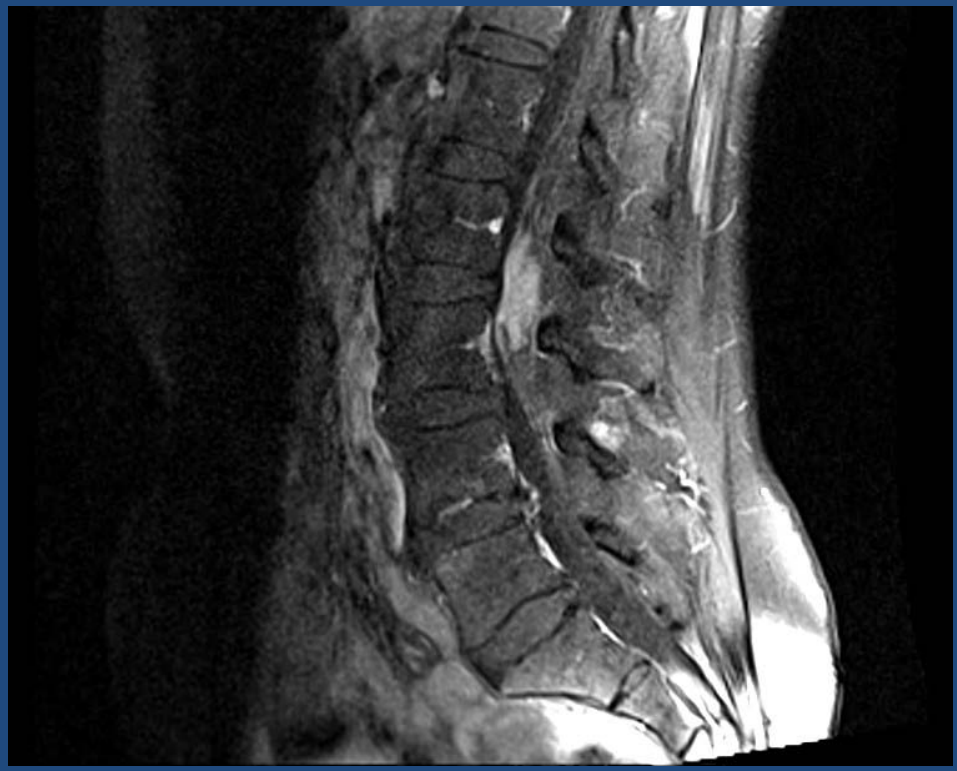


L3

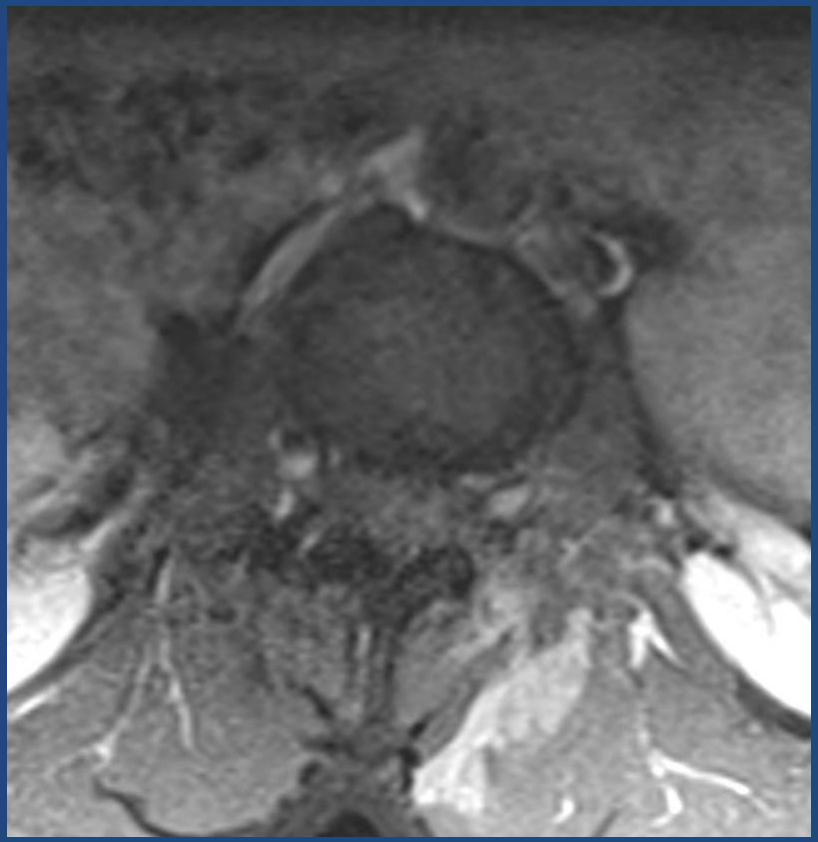


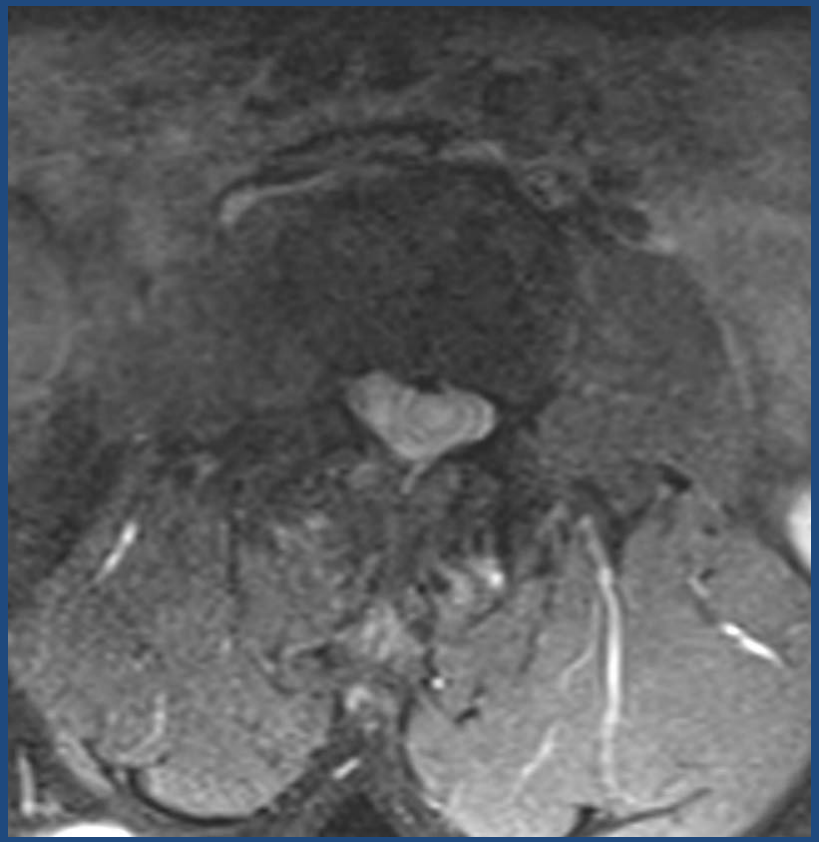
Intradural lymphoma





Intradural lymphoma

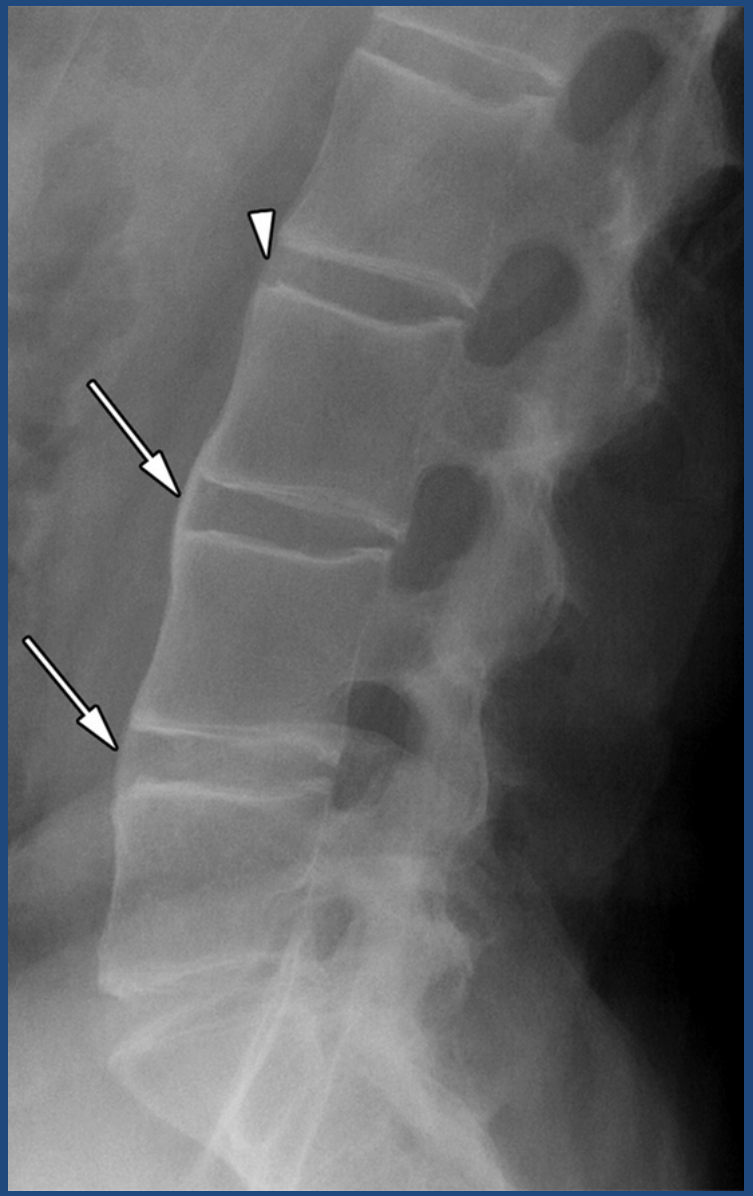




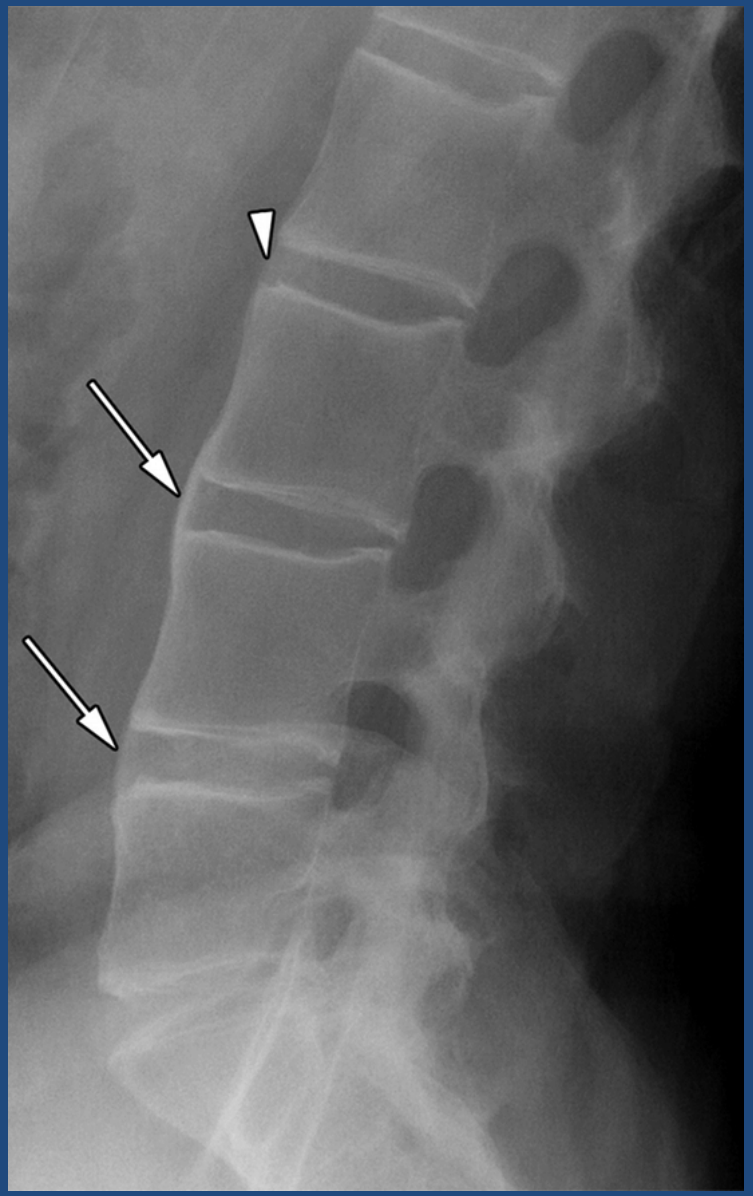
Unknown case

- 36 year old male with low back and buttock pain

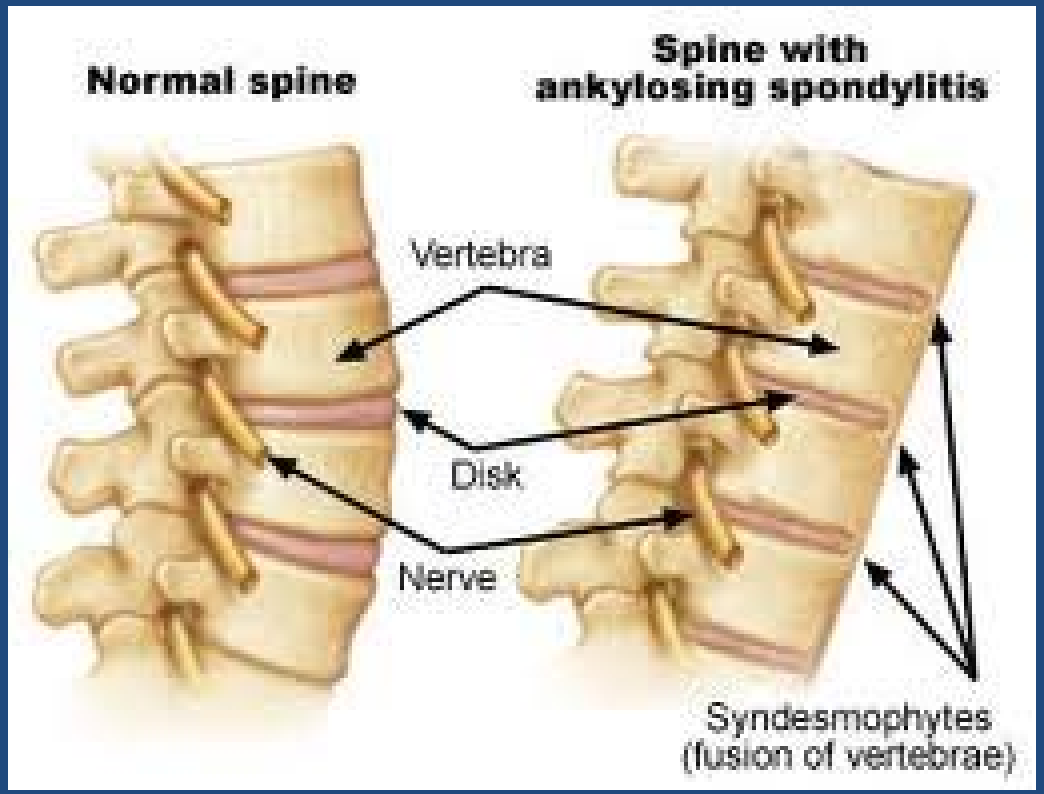
36 year old with low back and buttock pain

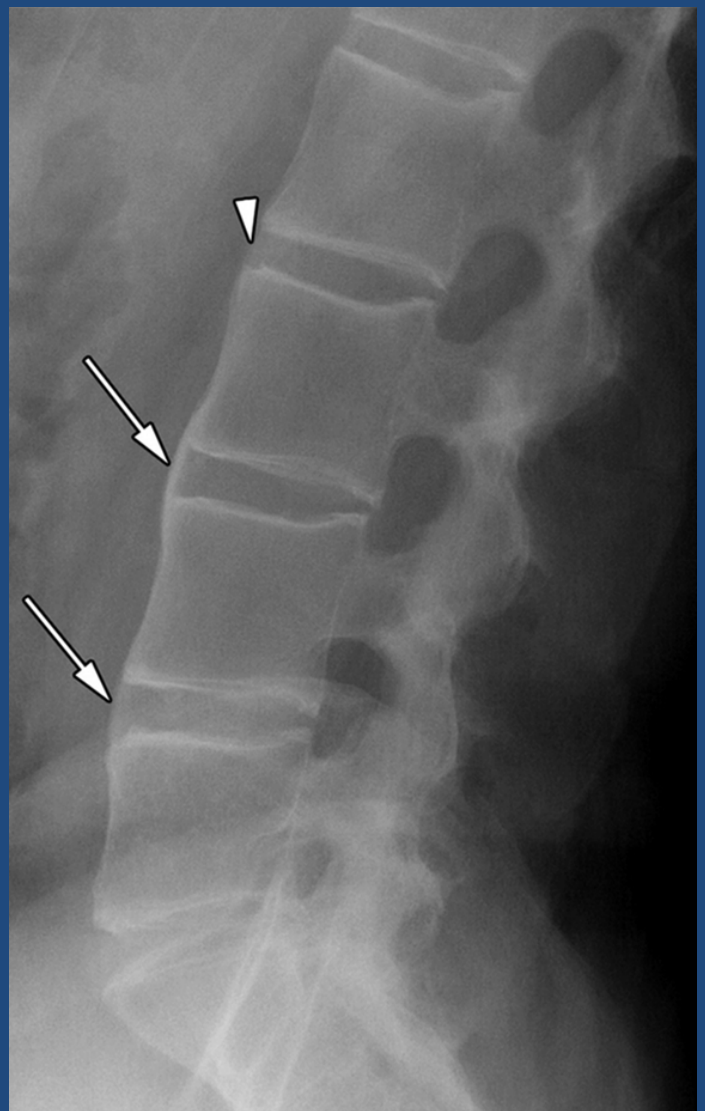


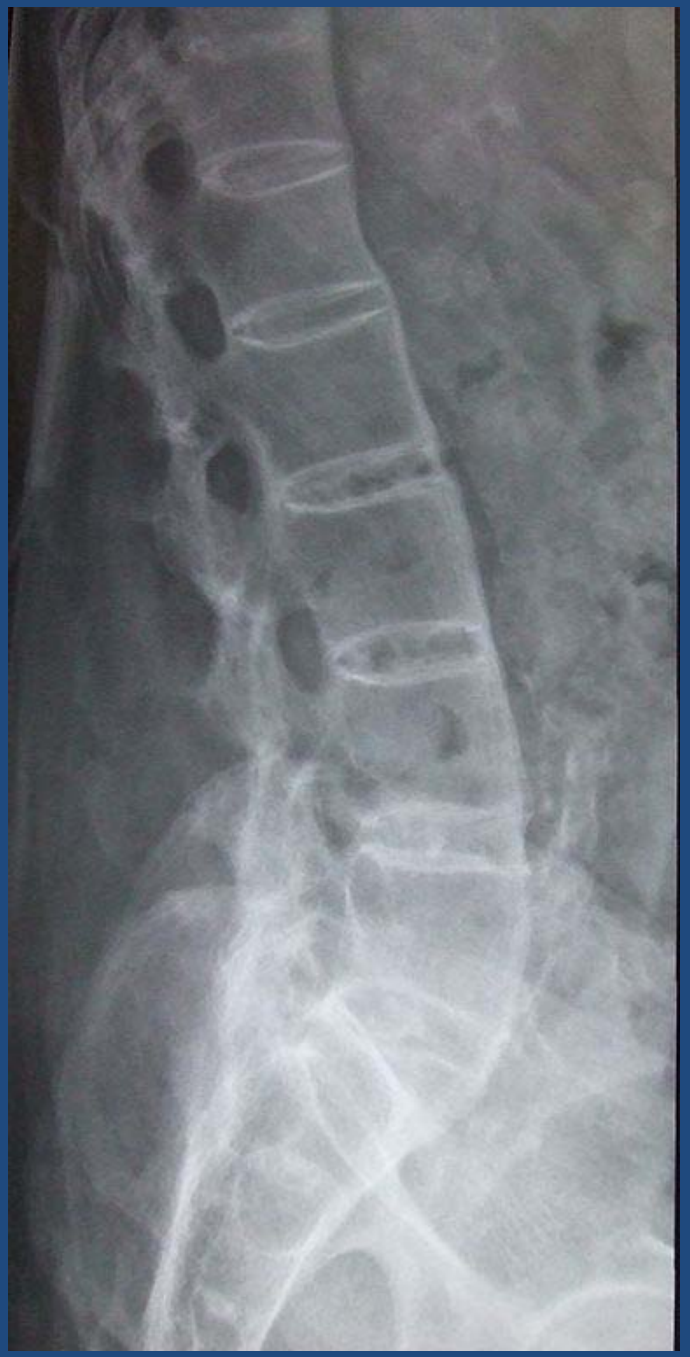
What is the diagnosis?



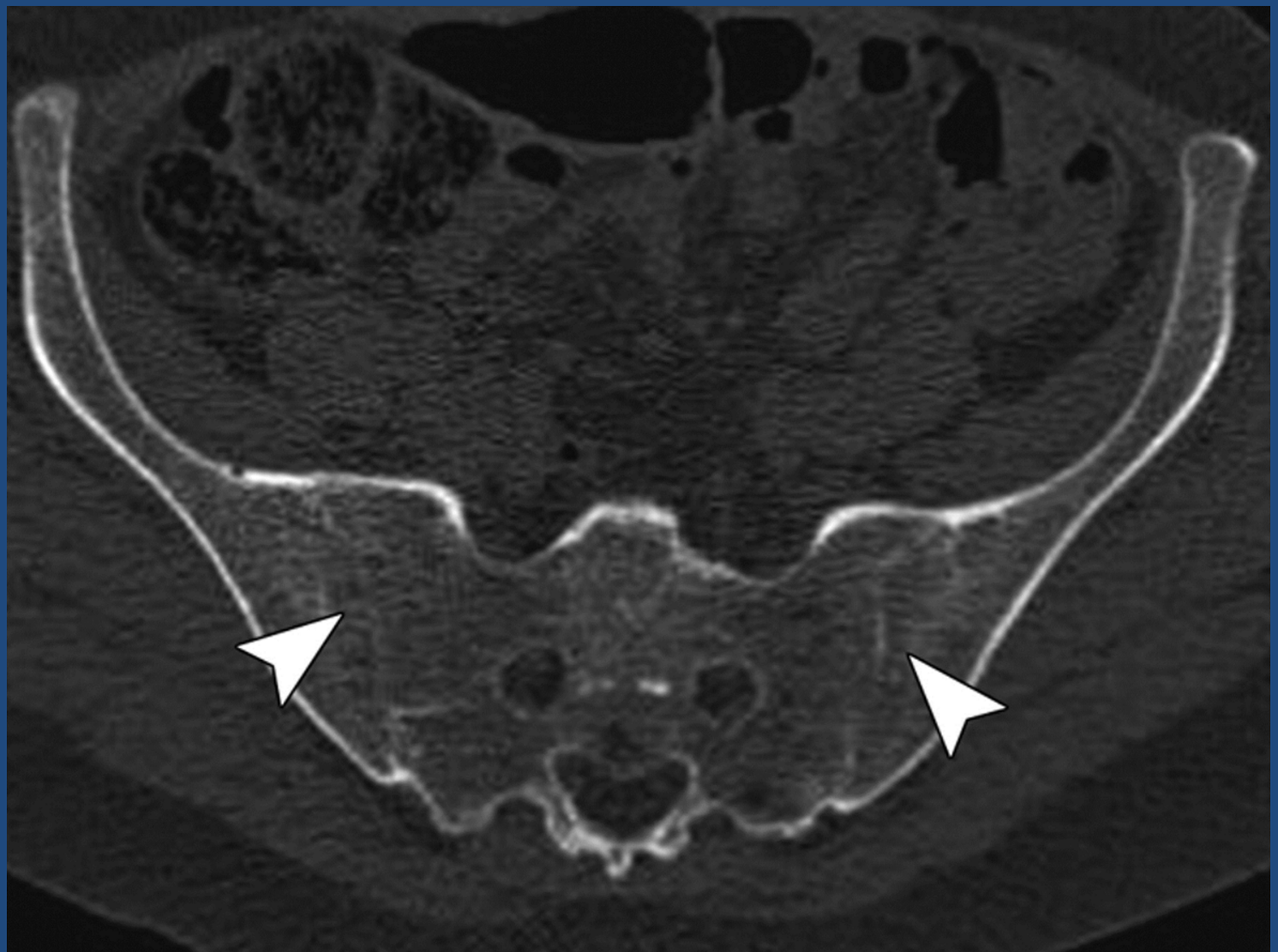
Ankylosing Spondylitis



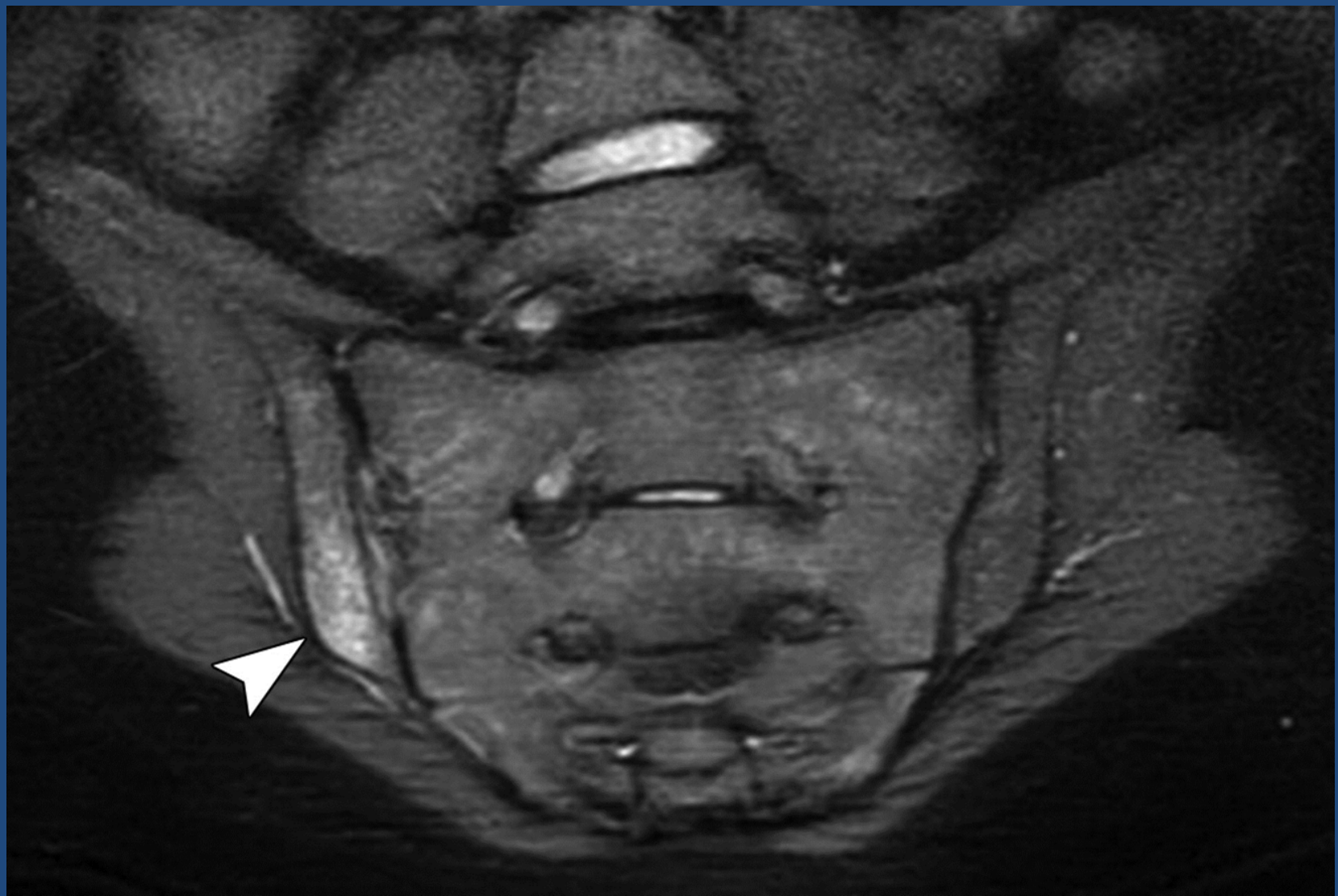




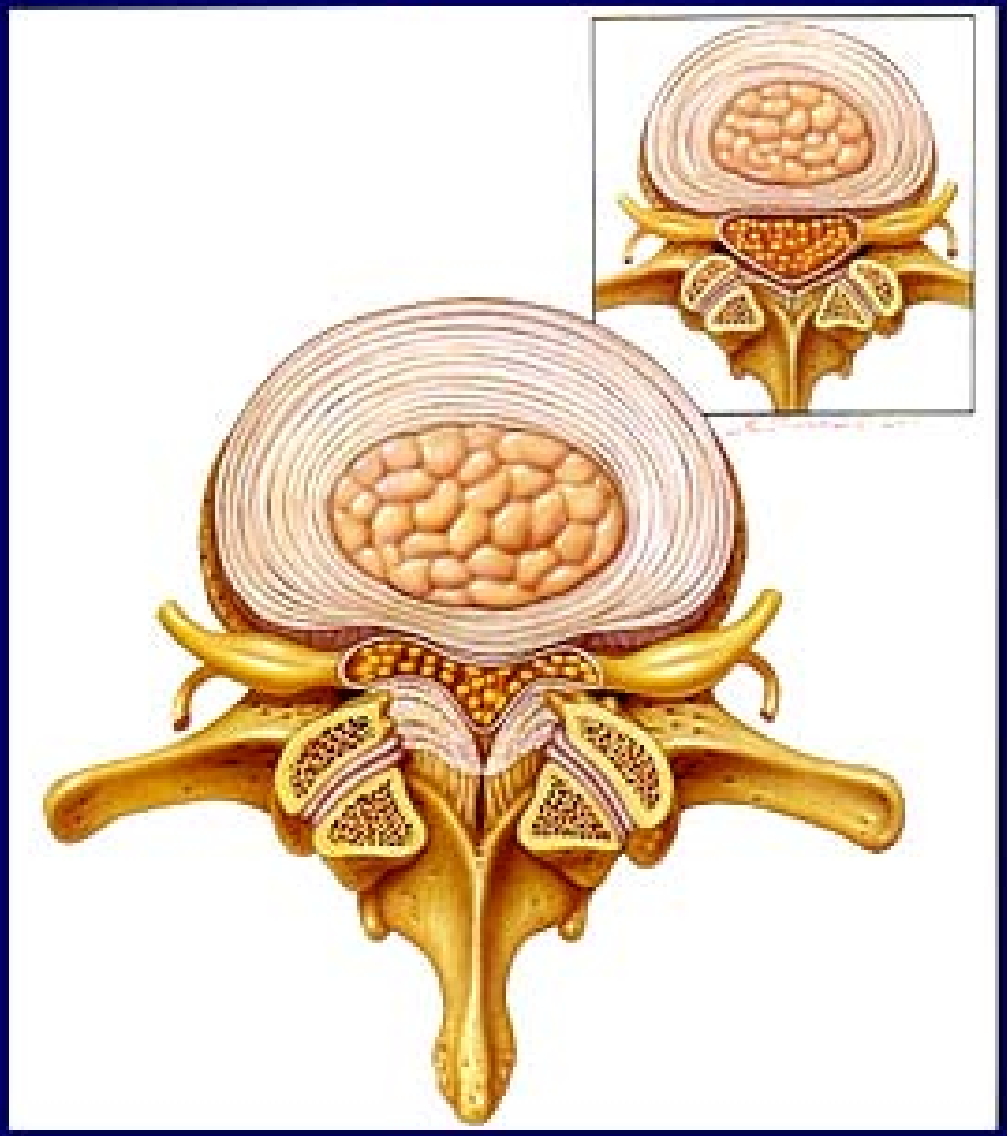
Ankylosing Spondylitis



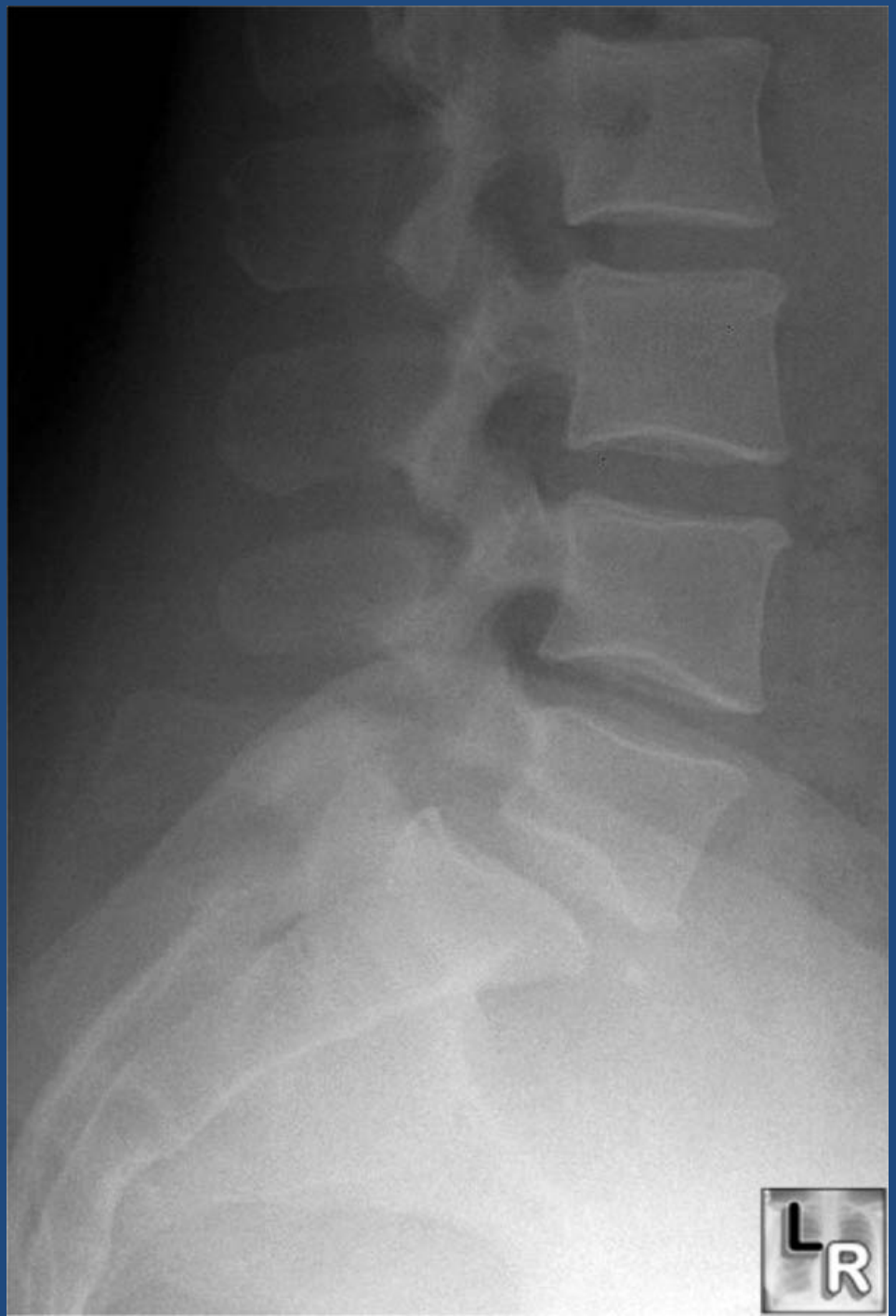
Unilateral Sacroiliitis

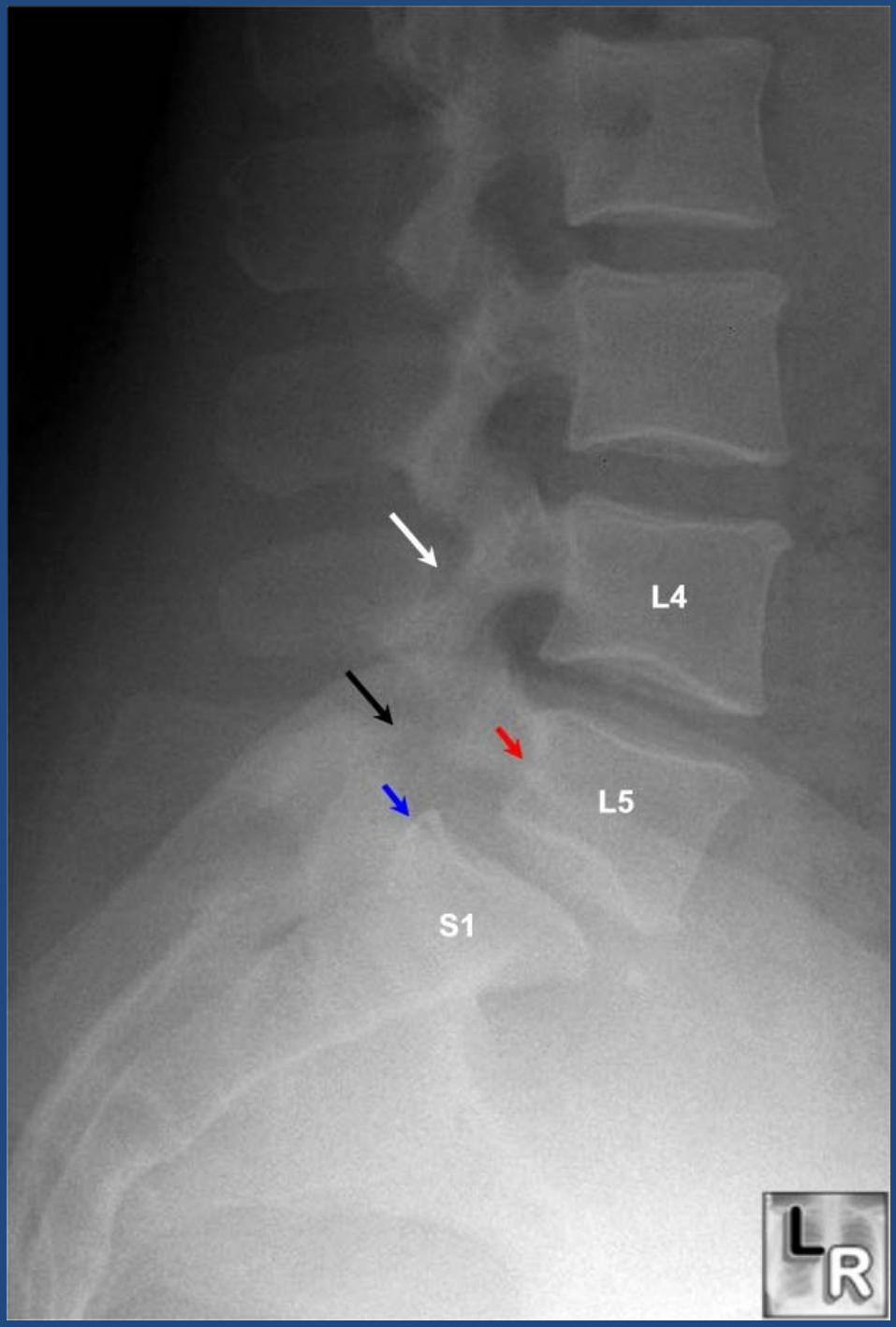


Lumbar Spinal Stenosis



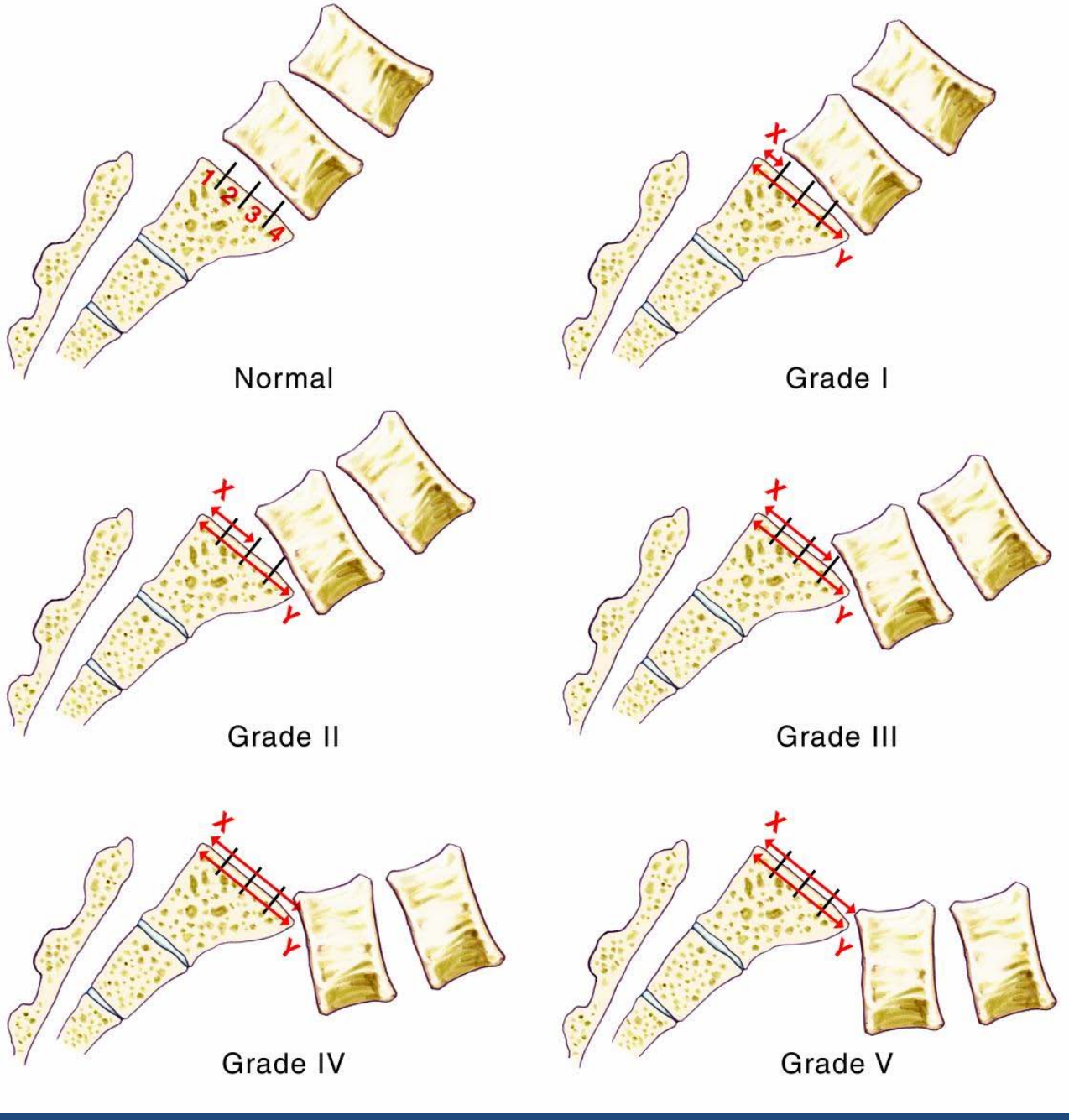
Unknown case
42 year old woman with back pain and bilateral radiculopathy


L
R

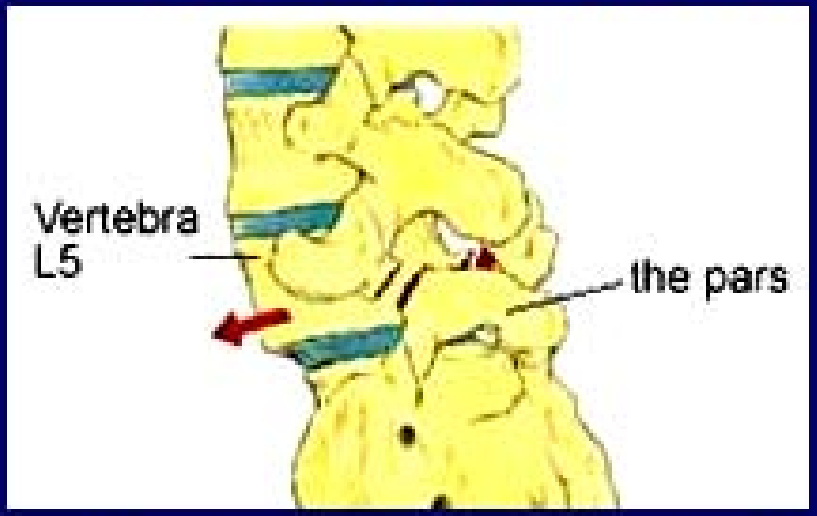

L4
L5
S1
L
R

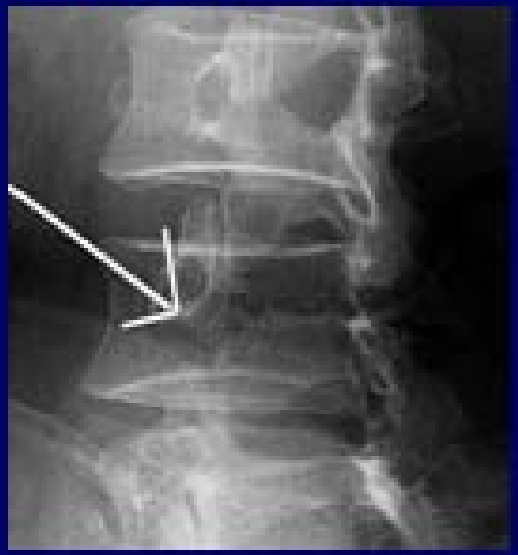
Spondylolisthesis

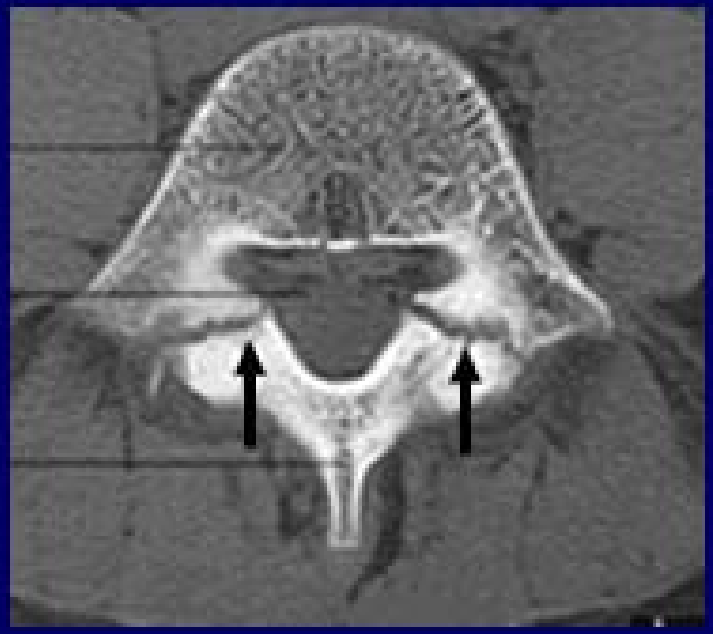
- Grade I is a slip of up to 25%,
- grade II is between 26%-50%,
- grade III is between 51%-75%,
- grade IV is between 76% and 100%, and
- Grade V, or spondyloptosis occurs when the vertebra has completely fallen off the next vertebra.

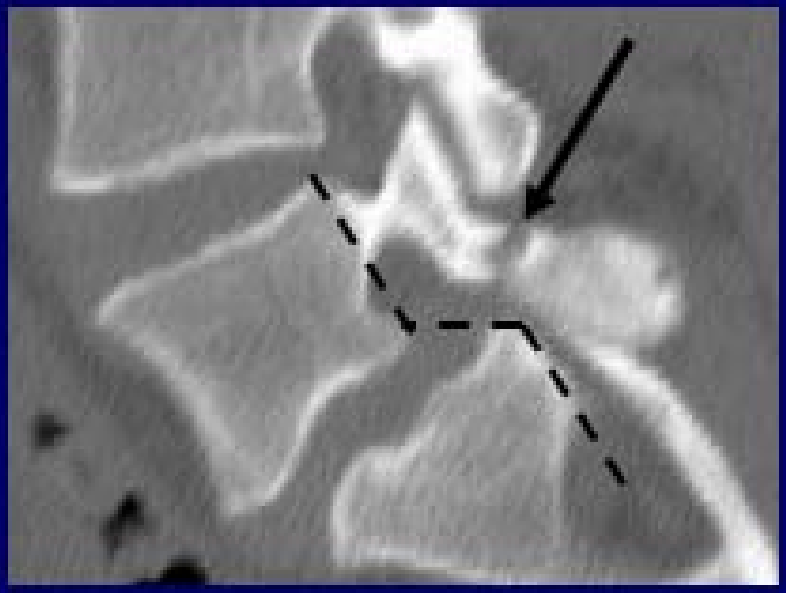

1
2
3
4
Normal
X
Y
Grade I
X
Y
Grade II
X
Y
Grade III
X
Y
Grade IV
X
Y
Grade V

Spondylolysis / Spondylolisthesis

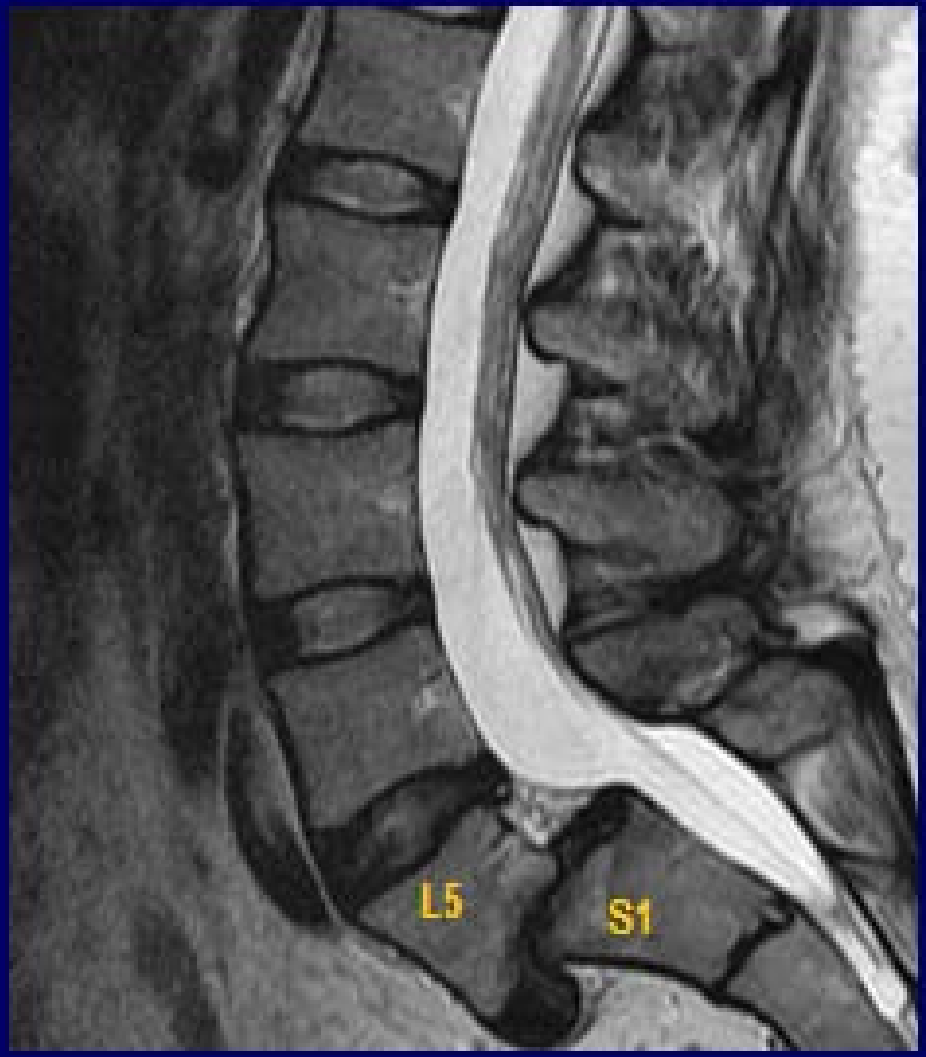


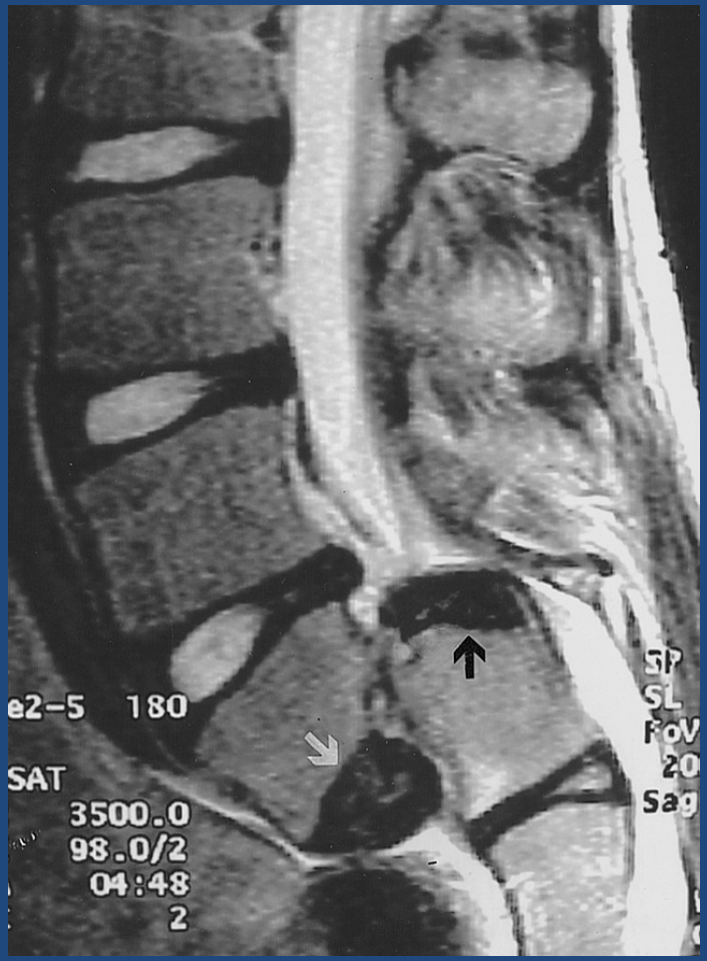






Spondylolisthesis




e2-5 180
SAT
3500.0
98.0/2
04:48
2
SP
SL
FoV
20
Sag

Common distribution of tumors of the spine

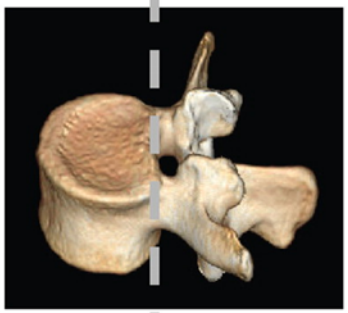
Common distribution of tumors of the spine

Multiple?
-metastasis
-myeloma
-lymphoma
-enostosis
-hemangioma
-eosinophilic granuloma

Involvement of adjacent vertebral levels?
-osteosarcoma
-chondrosarcoma
-myeloma,† plasmocytoma †
-lymphoma
-Ewing sarcoma
-chordoma
-ABC †
-giant cell tumor †

† may extend through the intervertebral disk

Location in vertebra?



Malignant
-metastasis
-myeloma ‡
-plasmocytoma ‡
-lymphoma
-chordoma

Exceptions
-hemangioma
-eosinophilic granuloma
-giant cell tumor ‡

‡ common extension in the neural arch

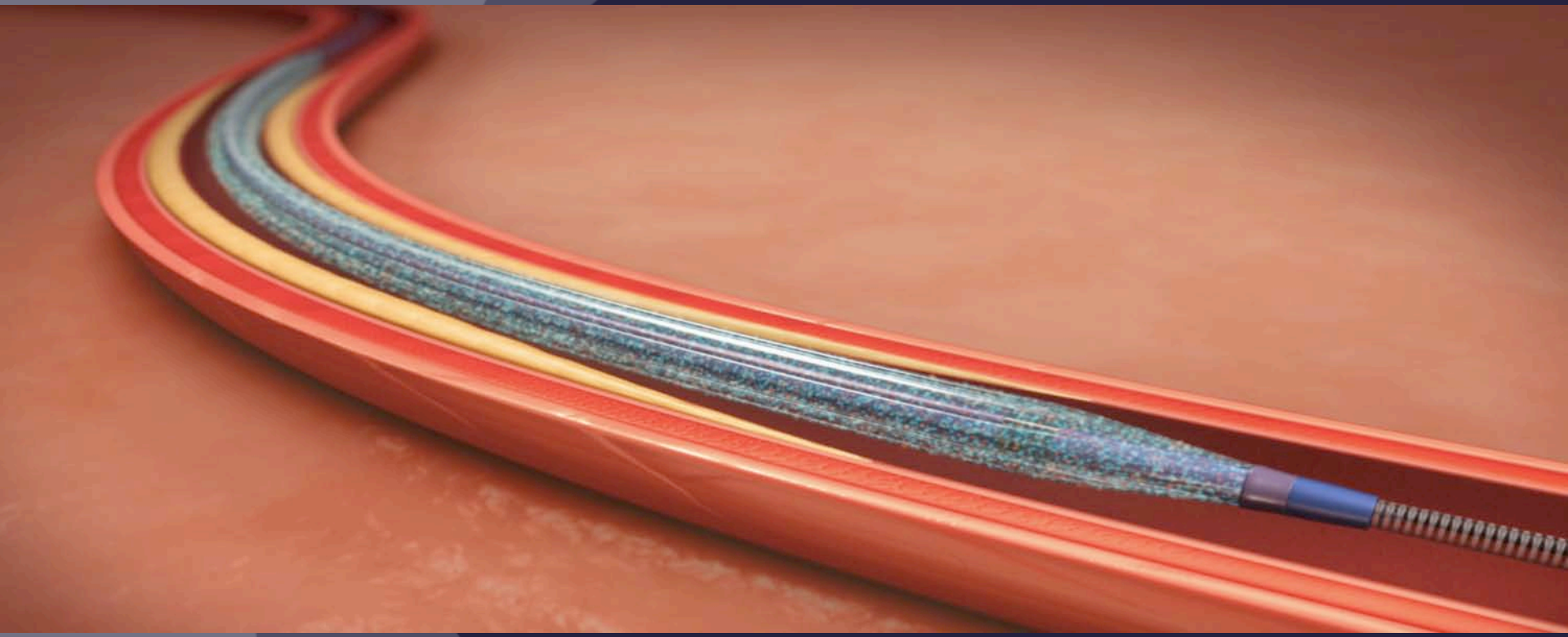
Benign
-osteoid osteoma
-osteoblastoma #
-osteochondroma
-ABC #

Exceptions (sarcomas)
-chondrosarcoma #
-osteosarcoma #
-Ewing sarcoma #

 # common extension in the vertebral body

Thank You.

Peripheral Arterial Disease & Critical Limb Ischemia



Nicholas Petruzzi, MD
Interventional Radiologist
Atlantic Medical Imaging

Atlantic Medical Imaging

Overview

- Claudication & PAD
- Risk Factors and Staging Systems
- Critical Limb Ischemia
- Noninvasive Testing
- Treatment methods
- Case Examples

Atlantic Medical Imaging

Claudication

- Three types
  - Vascular Claudication
    - Typically due to PAD
  - Venous Claudication
    - Typically due to venous insufficiency
  - Neurogenic Claudication
    - Typically due to Lumbar Spinal Stenosis

Differentiating between types

	Vascular Claudication	Venous Claudication	Neurogenic Claudication
Quality of pain	Cramping	"Bursting"	Electric shock-like
Onset	Gradual, consistent	Gradual, can be immediate	Can be immediate, inconsistent
Relieved by	Standing still	Elevation of leg	Sitting down, bending forward
Location	Buttock, thigh, calf	Whole leg	Poorly localized, can affect whole leg
Legs affected	Usually one	One or both	Often Bilateral

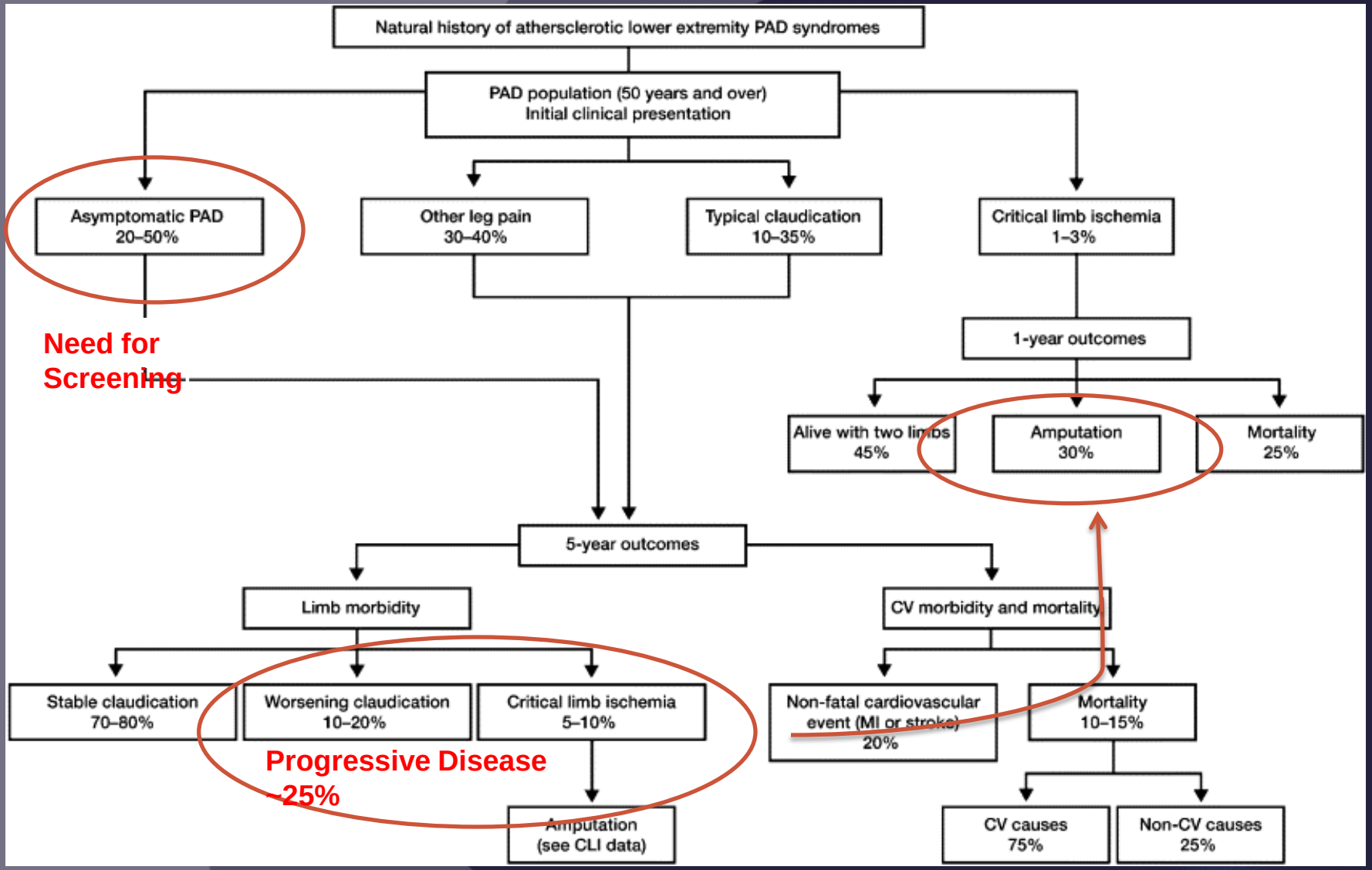
Unfortunately, History alone can miss up to 90% of cases!

Atlantic Medical Imaging

Peripheral Arterial Disease

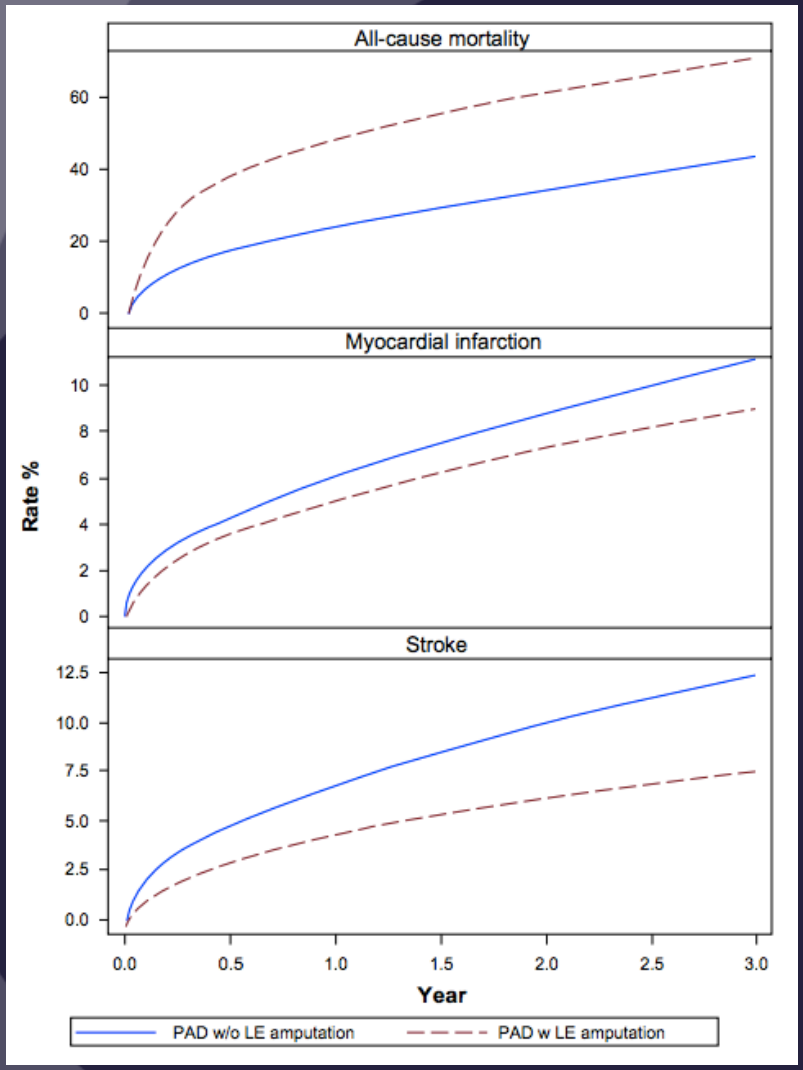
- PAD occurs in approximately 1/3 of all patients
  - Risk increases over age 70
  - Higher risk at age 50 in smokers or DM
- Increased risk of stroke, MI, and cardiovascular death
- Progressive disease in 25% with worsening claudication or limb threatening ischemia
- Results in impaired quality of Life, Limb Loss, and early mortality

Atlantic Medical Imaging



Atlantic Medical Imaging

Lose a Leg, Lose a Life



Double the mortality at 1 year in those patients with PAD + Amputation

Independent of cardiovascular risk factors – Lower rates of stroke and MI

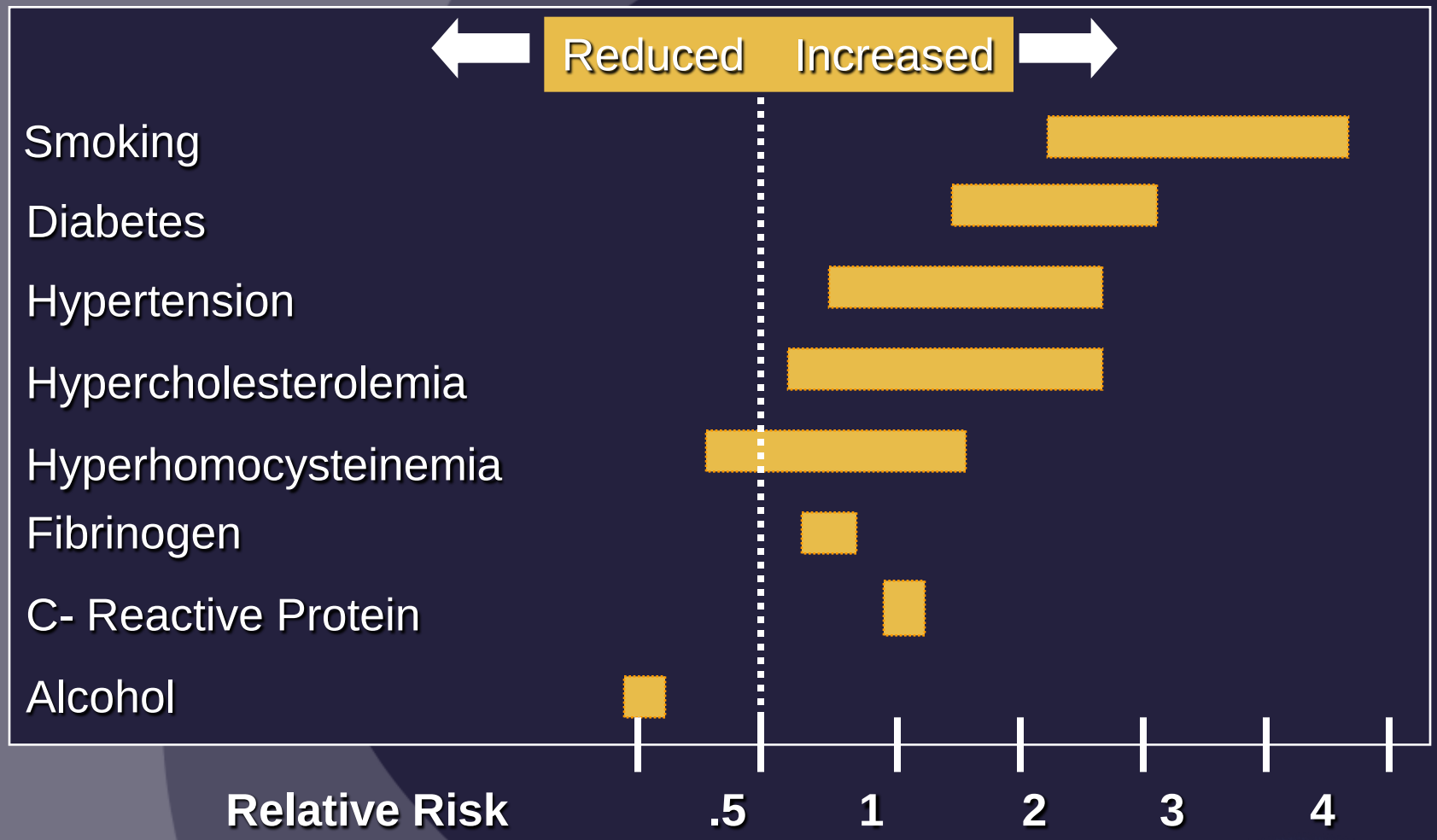
PAD + LE amputation = 48.3% mortality at 1 year

PAD without LE amputation = 24.2% at 1 year

2013 Study from Duke University reviewed Medicare data 2000-2008

Atlantic Medical Imaging

Risk Factors



Data from the Framingham Heart showing the odds ratio for developing intermittent claudication

Atlantic Medical Imaging

Who should undergo testing?

- Symptomatic Patients
  - Vascular claudication, ischemic rest pain, tissue loss, ulceration, trophic changes

- High Risk Patients
  - Age <50 years, with diabetes plus additional RF (smoking, dyslipidemia, hypertension, or hyperhomocysteinemia)
  - Age 50-69 and history of smoking or diabetes
  - Age 70 or older
  - Known atherosclerotic coronary, carotid, or renal disease

Atlantic Medical Imaging

Classification Systems

Fontaine		Rutherford		
Stage	**Clinical**	**Grade**	**Category**	**Clinical**
I	Asymptomatic	0	0	Asymptomatic
IIa	Mild claudication	I	1	Mild claudication
IIb	Moderate to severe claudication	I	2	Moderate claudication
		I	3	Severe claudication
III	Ischemic rest pain	II	4	Ischemic rest pain
IV	Ulceration or gangrene	III	5	Minor tissue loss
		III	6	Major tissue loss

CLI

Critical Limb Ischemia (CLI)

- Critical limb ischemia refers to a condition characterized by chronic ischemic at-rest pain, ulcers, or gangrene in one or both legs attributable to objectively proven arterial occlusive disease.
- Prevalence is 1.5% of all patients over 50
- Will develop in approximately 10% of patients with known PAD over lifetime

J Vasc Surg. 2014 Sep;60(3):686-95.e2. doi: 10.1016/j.jvs.2014.03.290. Epub 2014 May 10.

Diabetic Foot Ulcers (DFU) & PAD

- 65% of DFU have ischemic or neuroischemic component

TABLE 1: Typical features of DFUs according to aetiology

Feature	Neuropathic	Ischaemic	Neuroischaemic
Sensation	Sensory loss	Painful	Degree of sensory loss
Callus/necrosis	Callus present and often thick	Necrosis common	Minimal callus Prone to necrosis
Wound bed	Pink and granulating, surrounded by callus	Pale and sloughy with poor granulation	Poor granulation
Foot temperature and pulses	Warm with bounding pulses	Cool with absent pulses	Cool with absent pulses
Other	Dry skin and fissuring	Delayed healing	High risk of infection
Typical location	Weight-bearing areas of the foot, such as metatarsal heads, the heel and over the dorsum of clawed toes	Tips of toes, nail edges and between the toes and lateral borders of the foot	Margins of the foot and toes
Prevalence (based on[35])	35%	15%	50%

International Best Practice Guidelines: Wound Management in Diabetic Foot Ulcers. Wounds International, 2013.

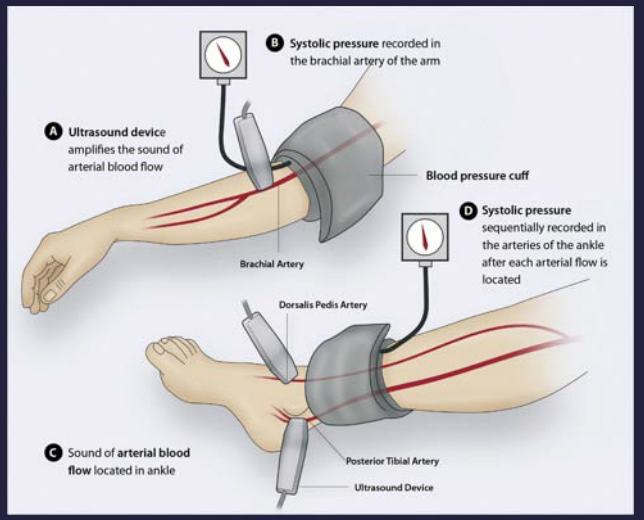
Atlantic Medical Imaging

Noninvasive Vascular Testing

Atlantic Medical Imaging

Ankle Brachial Index

- Workhorse of the lower extremity vascular evaluation
- Easy to perform
  - Blood pressure cuffs, Doppler
  - DP/PT to brachial artery pressure
  - Sensitivity ~ 75%, Specificity ~ 90% Depending on cutoff value (0.90 - 0.95)



Normal	>0.96
Claudication	0.50-0.95
Rest Pain	0.30-0.49
Tissue loss	<0.30
Significant change	0.15 or more

Atlantic Medical Imaging

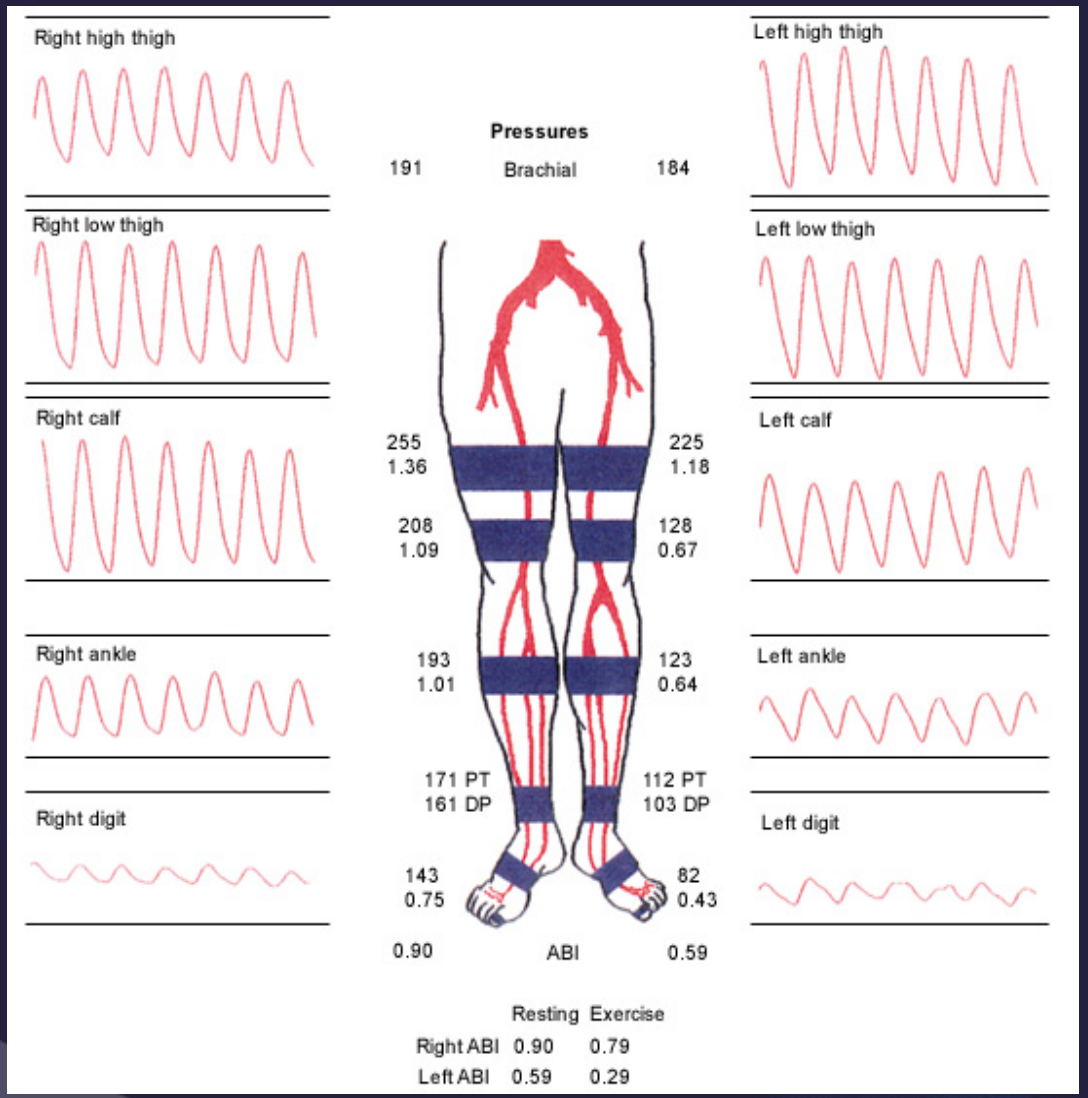
ABI

- If claudication symptoms but normal rest ABI, exercise ABI should be performed [4]
- False negatives
  - Non-compressible vessels
    - Typically diabetics or renal patients
    - May lead to higher than normal ABI (>1.3)
    - Toe pressures may help (>0.7 TBI normal)
  - Concomitant subclavian or brachiocephalic disease

Atlantic Medical Imaging

Pulse Volume Recordings

- Combines segmental pressures with waveforms
- Technique:
  - Pneumatic Cuff inflated at multiple Levels
  - Inflated to 65 mm Hg



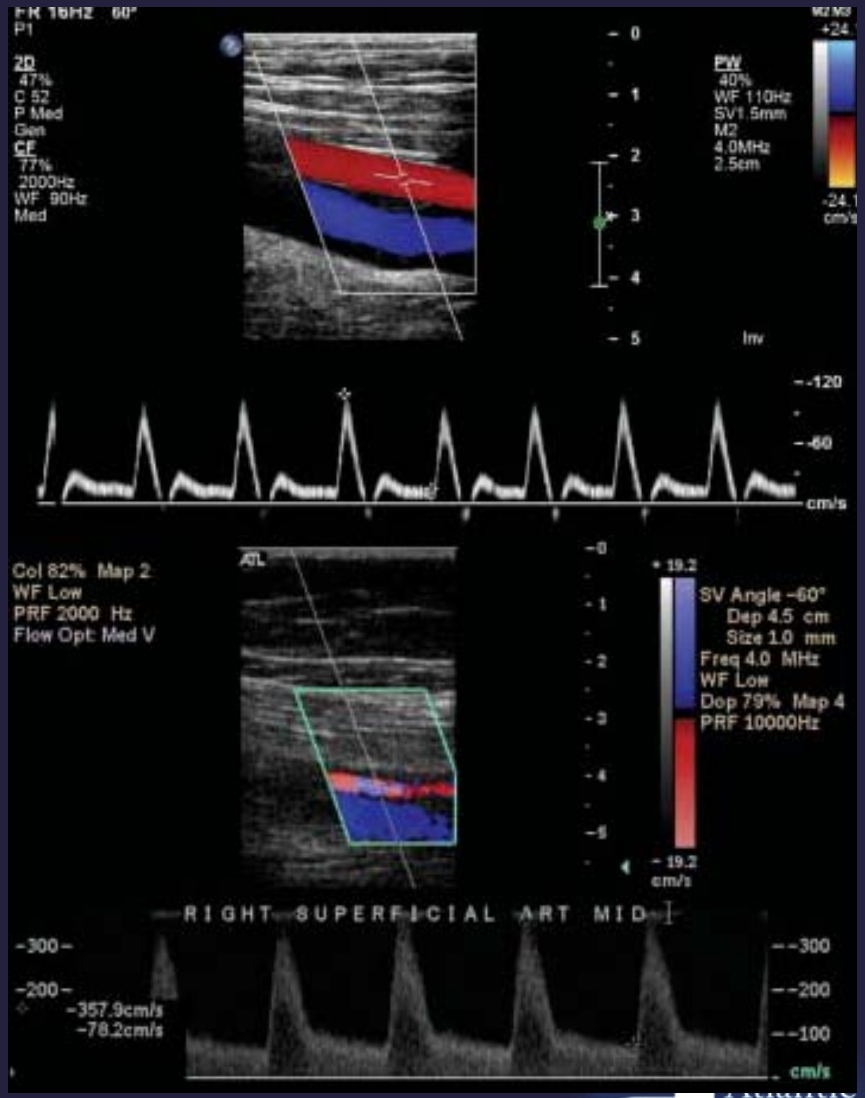
Pulse Volume Recordings

- Advantages:
  - Not Impacted by Calcification
  - More sensitive than ABI
  - Allows for waveform analysis
- Disadvantages:
  - Lacks very specific anatomic information
  - More time consuming than ABI

Atlantic Medical Imaging

Duplex Doppler

- More specific in location of stenosis
- Also screen for AAA
- Great for surveillance of bypass grafts
- Can semi-quantify degree of stenosis
- Overall about 80% sensitivity and 90% specific



Atlantic Medical Imaging

Advanced Testing - CTA

- Advantages
  - Provides good anatomic localization
  - Can give temporal information on delayed imaging
  - Good evaluation of aorto-iliac vessels
  - Speed
  - Ability to evaluate stented arteries
  - Pacer safe
  - Helps determine approach for intervention

Atlantic Medical Imaging

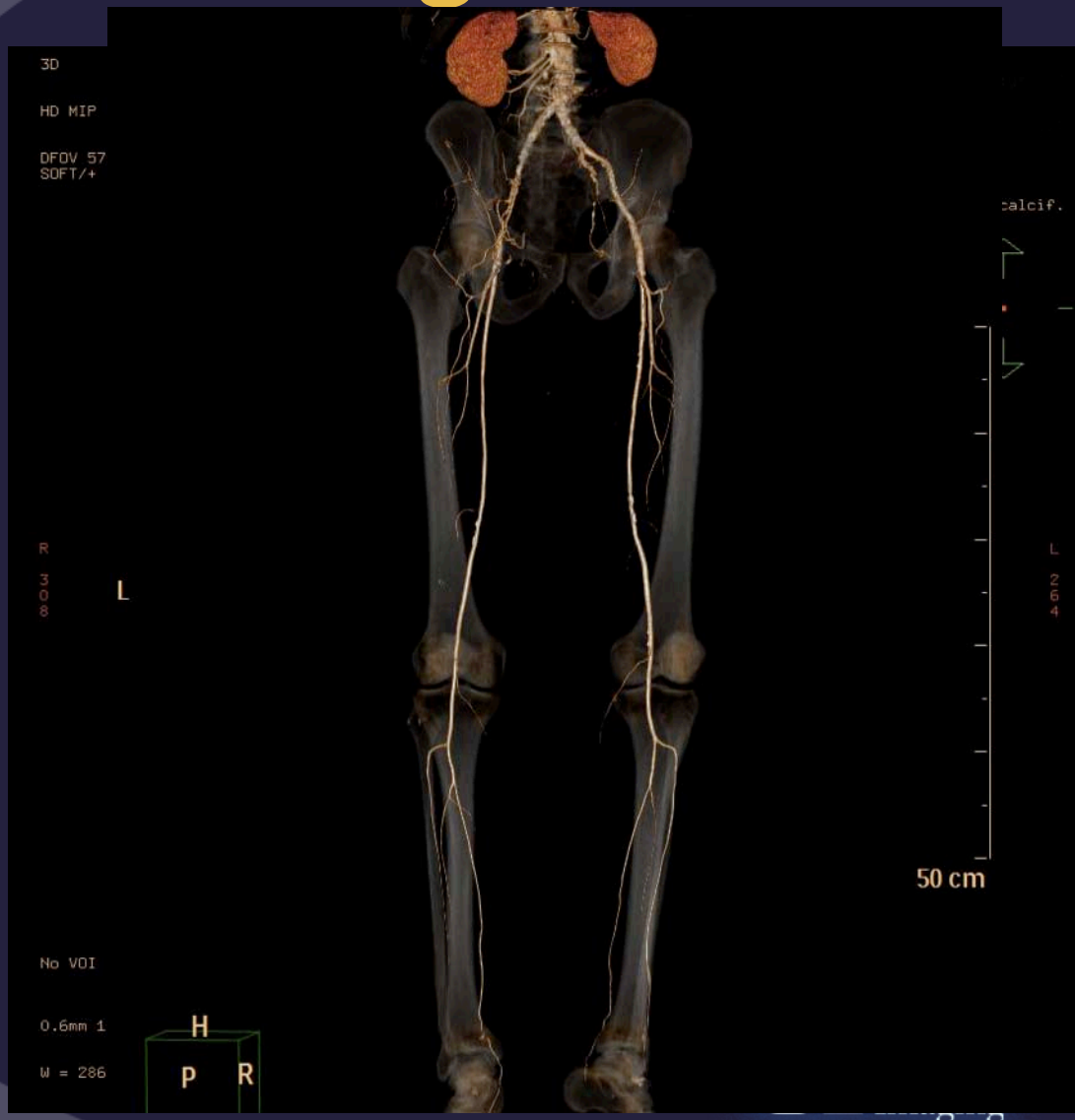
Advanced Testing - CTA

- Disadvantages
  - Dense calcification difficult to assess patency or degree of stenosis
  - Radiation
  - Distal vessel limited (less of an issue now)
  - Renal failure/contrast allergy

Atlantic Medical Imaging

Advanced Testing CTA

- Axial imaging
- Maximal Intensity Projection
- Shaded Surface Display

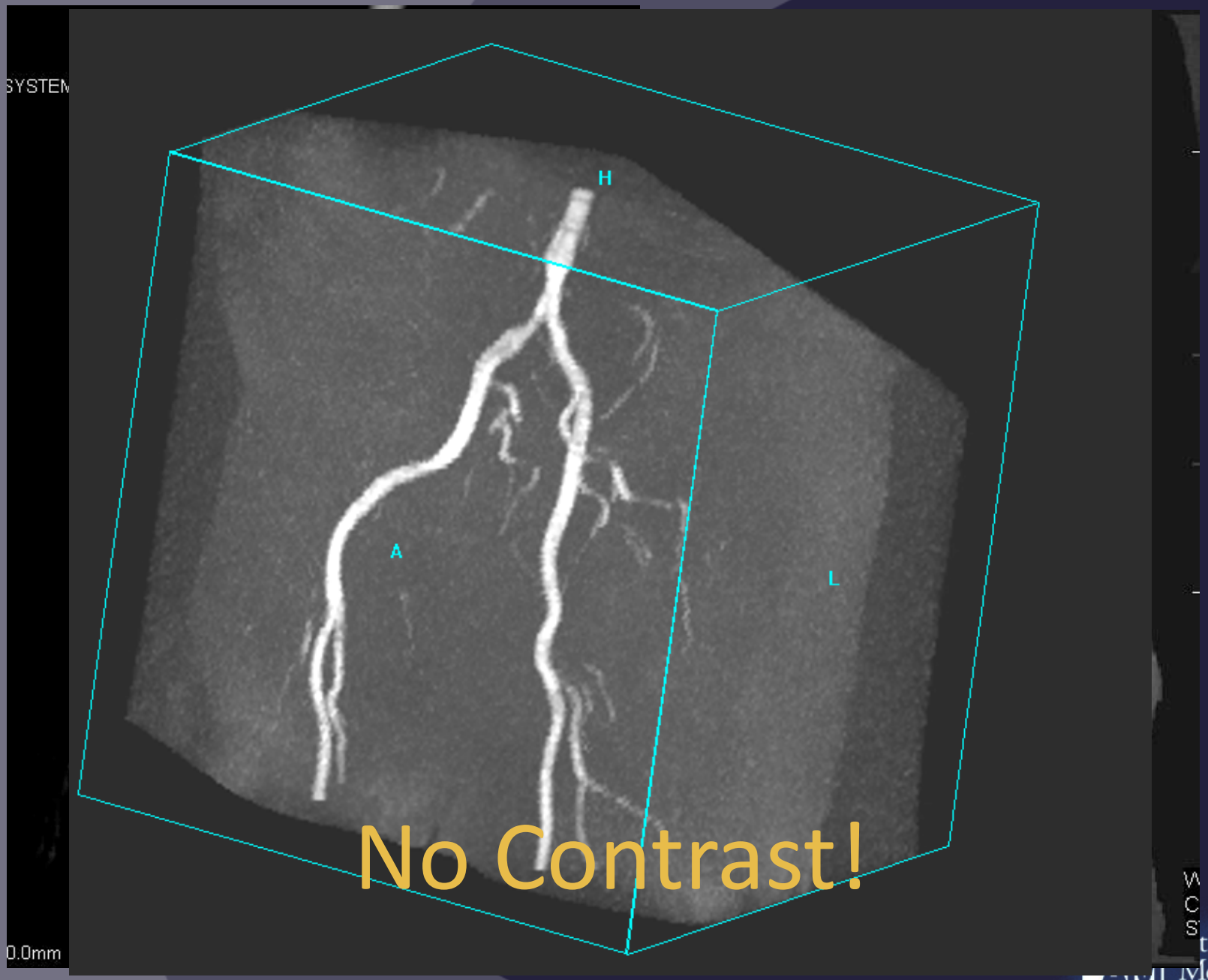


Advanced Testing - MRA

- Advantages
  - Renal Impairment
    - Gad vs. Time of Flight
  - Good anatomic Localization
  - Also gives temporal information
  - No radiation

- Disadvantages
  - Uncooperative patient
  - Claustrophobia
  - Metal artifact
  - Pacemakers/ICDs
  - Lack of visualization of calcium

Atlantic Medical Imaging


H
A
L
No Contrast!

Treatment

- All Patients with PAD
  - Immediate Smoking Cessation
    (Most beneficial modifiable risk factor)
  - Antiplatelet Agents
  - Diabetes Control
  - Blood Pressure Reduction
  - Lipid Control

Management of Symptomatic Pts.

- Intermittent Claudication pts. without lifestyle limitation should undergo a trial of risk factor modification and exercise program
- Claudication pts. with inflow disease or lifestyle limitation should be considered for revascularization
- Critical Limb Ischemia (rest pain or tissue loss) should undergo revascularization as soon as possible
  - AHA Level IA Recommendations

Atlantic Medical Imaging

Detecting PAD in Clinical Practice

- Consider performing ABI testing for at risk population in office
  - Reimburse-able if waveform recorded

- Consider questionnaire:
  - Slow healing wound or ulcers
  - Missing pulses or poor circulation
  - Exertional cramping or fatigue relieved by rest
  - Resting pain in extremity that may disturb sleep
  - Gangrenous or black skin tissue
  - Toes or feet that have become pale or discolored

Atlantic Medical Imaging

Multidisciplinary Approach

- Multidisciplinary foot care teams for non-healing wounds have been shown to reduce amputation rates from 36-86%
- The care provided by the disciplines should coordinate diagnosis, offloading, preventative care, and revascularization
- PCP, Vascular specialist, Podiatrist, wound care, infectious disease, endocrinologist, general surgeon

Sanders LJ, Robbins JM, Edmonds ME. History of the team approach to amputation prevention: pioneers and milestones. J Vasc Surg. 2010 Sep;52(3 Suppl):3S-16S.

Revascularization

Atlantic Medical Imaging

Endovascular First

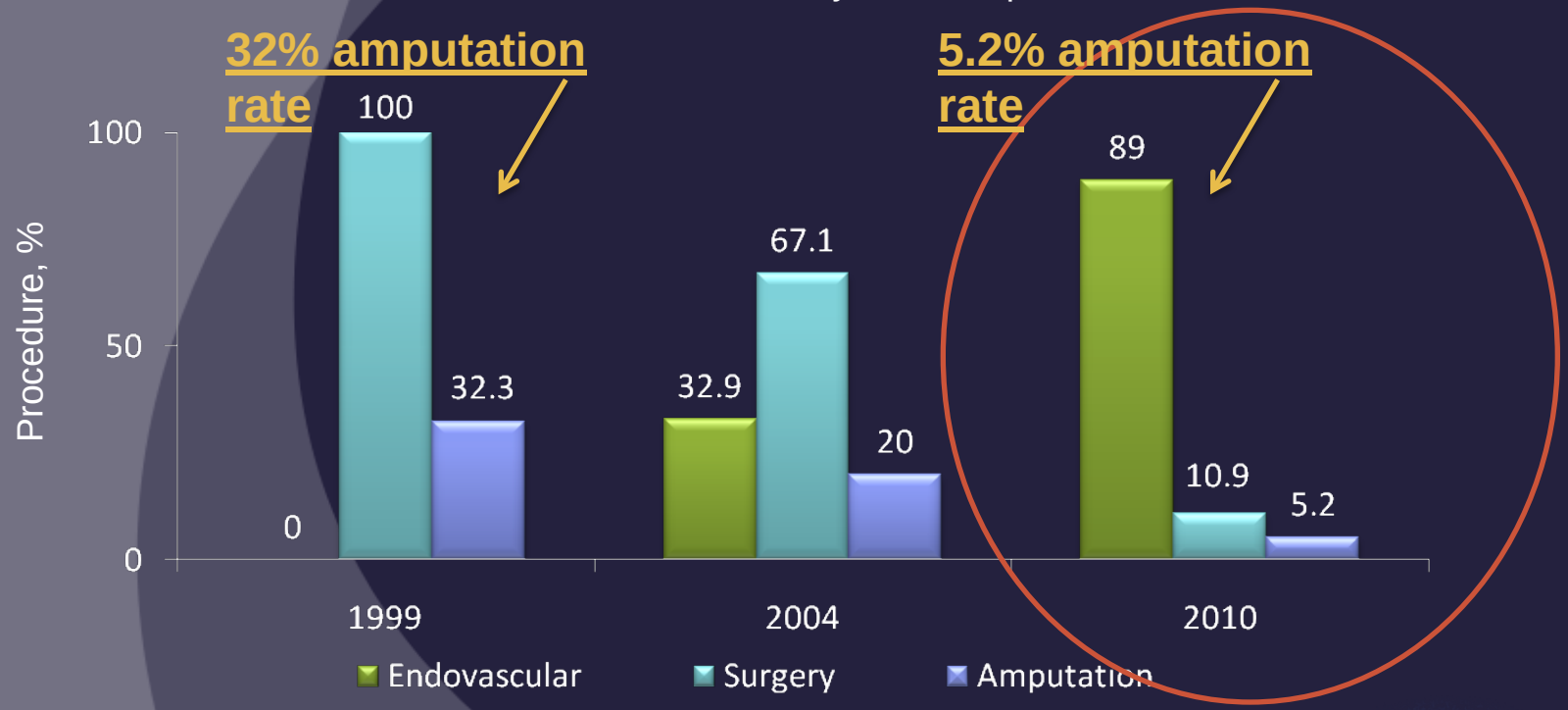
- BASIL trial published in 2005 finalized 2010
  - Prospective RCT of Angioplasty vs. bypass
  - No difference in 5 year amputation free survival
    - This was also using technology from 10 years ago. (First gen stents, no atherectomy, no DES, etc.)
  - Other studies have shown nearly double mortality rates for bypass over endovascular treatment (PREVENT III)

Atlantic Medical Imaging

Amputation rates decrease as Revascularization rates increase

Single Center 12 Year Review[1]

N = 1615 lower extremity vascular procedures



1. Balar NN, Dodla R, Oza P, et al. Endovascular Versus Open Revascularization for Peripheral Arterial Disease. *Endovascular Today.* 2011:61-64

Atlantic Medical Imaging

Open Surgical Role

- Endarterectomy of common femoral artery
  - Can combine for hybrid revasc in fem-pop disease
- Bypass if endovascular treatment fails or is felt to have limited patency
  - Autologous vein bypass preferable
  - Unfortunately low availability in this patient population (30-50% unavailable or poor quality)
  - PTFE comparable patency rates to endovascular (BASIL trial)

Below the Knee Interventions

- No surgical option in below knee disease
- Part of a successful limb salvage program must include the ability to perform complex BTK interventions
- Calcium is disproportionately deposited infrainguinal and below the knee
  - Nearly all diabetics and renal patients

Atlantic Medical Imaging

Calcium / Plaque distribution

- Intra-arterial calcium is disproportionately distributed below the waist (10% above and 90% below).
- Below the waist, the majority (75%) of intra-arterial calcium resides in the infrapopliteal vessels

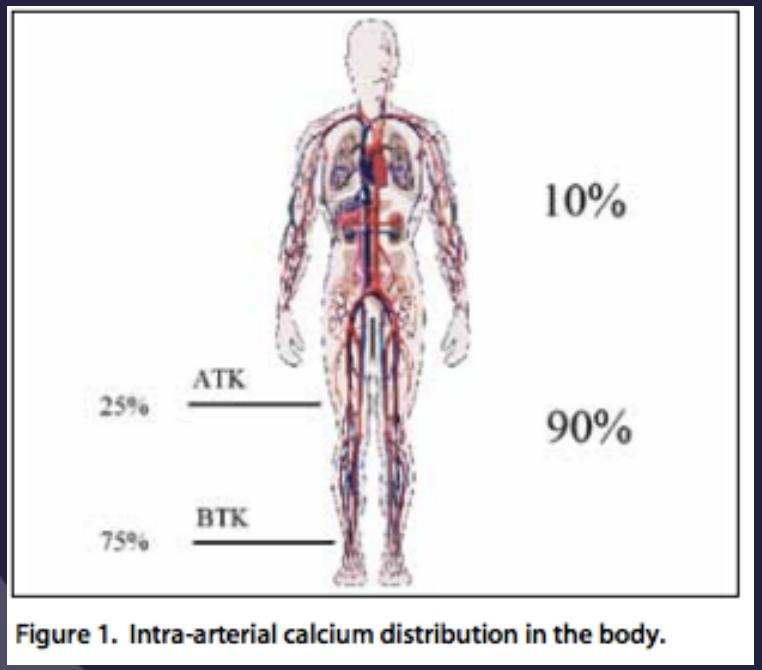


Figure 1. Intra-arterial calcium distribution in the body.

Bishop PD, Feiten LE, Ouriel K, et al. Arterial calcification increases in distal arteries in patients with peripheral arterial disease. Ann Vasc Surg. 2008;22:799-805.

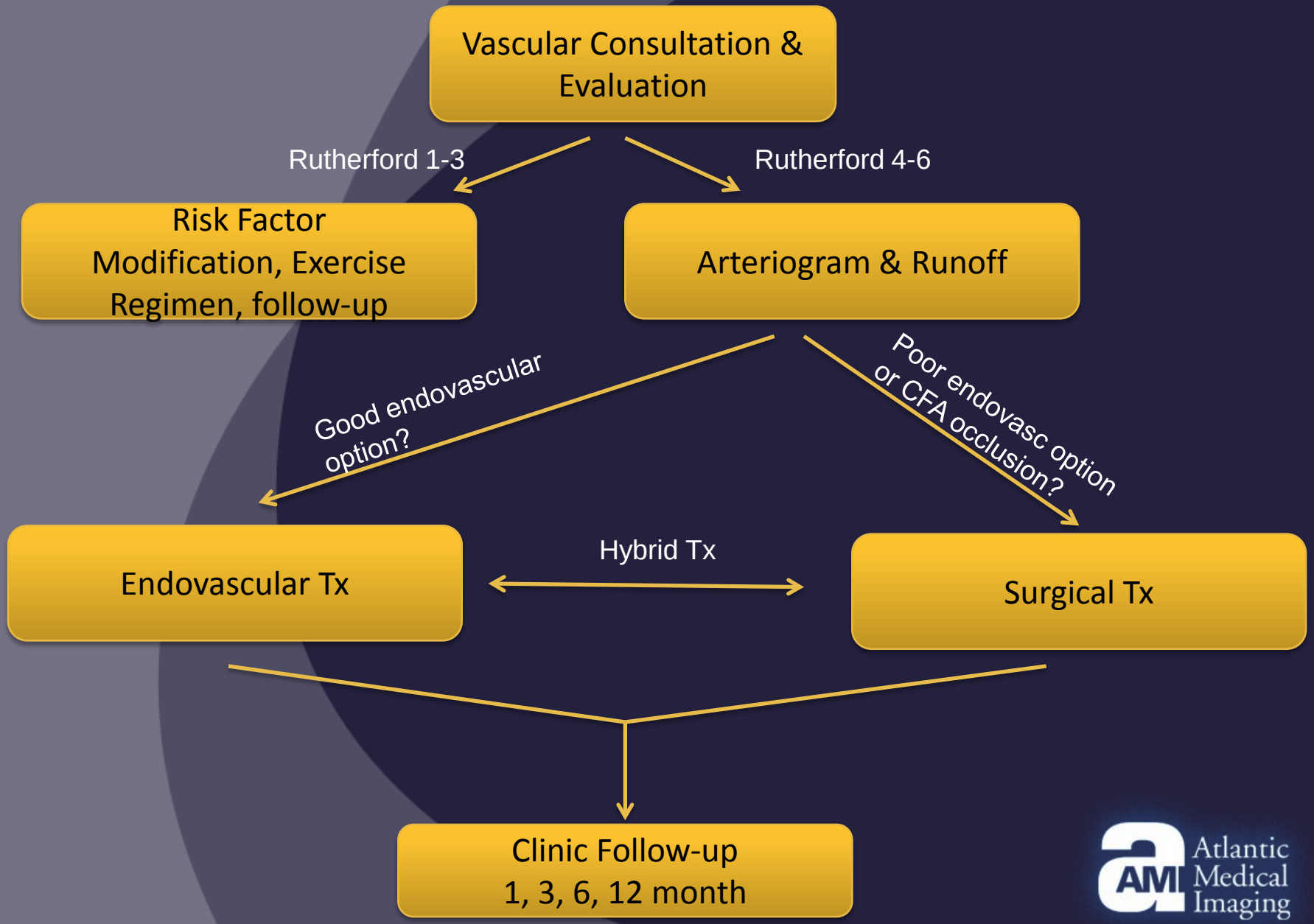
Atlantic Medical Imaging

Maximizing BTK Outcomes

- Requires advanced wire & microcatheter techniques
- Comfort with retrograde pedal access
  - Antegrade failure in 10-15%
- Variety of adjunctive devices on the market to improve patency
  - Most currently used adjunct is atherectomy

Atlantic Medical Imaging

AMI PAD Algorithm



Atlantic Medical Imaging

Preserving options is key

Atlantic Medical Imaging

Jetstream Atherectomy

Atlantic Medical Imaging

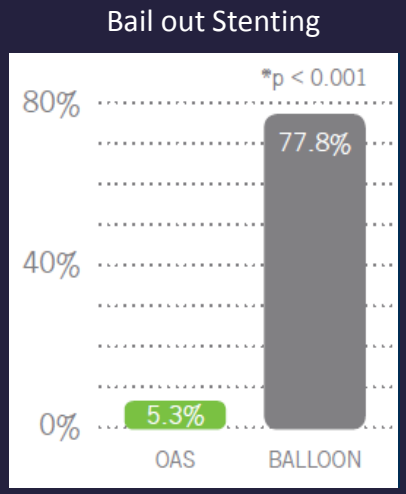
Orbital Atherectomy

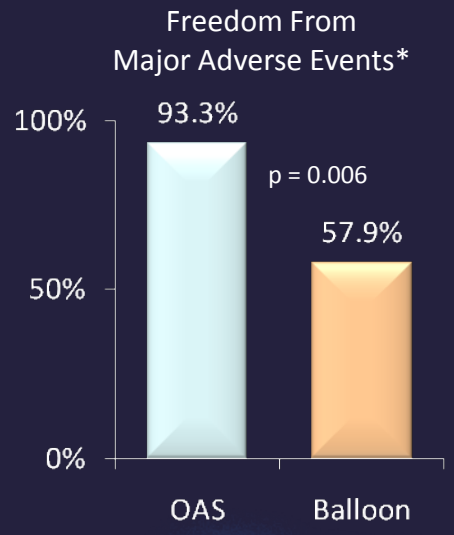
- Used for severely calcified lesions to debulk plaque prior to PTA, especially helpful BTK
- Utilizes diamond coated crown to “sand” away particulate into particles small enough to pass through capillary beds
- Changes vessel compliance, resulting in lower pressures for PTA
- Differential sanding – lower rates of dissection compared to PTA alone

Atlantic Medical Imaging

Orbital Atherectomy

- Compliance 360 study
  - Above knee lesions, 70% lower rate of stent placement
- Calcium 360 study
  - Below the knee, significantly lower restenosis rates & adverse outcomes





J Am Coll Cardiol. 2012;59(13s1):E2085-E2085.

Shammas, N. *J Endovascular Ther*, 2012; 19:480-488.

Atlantic Medical Imaging

Importance of Providing Successful & Durable Interventions

Day of Case

- Increased lab time to manage adverse event
- Increased bail-out stent rate: $1,070-$2,660/each[1]

Durability

- Increased re-intervention rate at $15,000 – 27,000 each[2]

Wound Healing

- Average cost to heal chronic wound = $17,096[3]

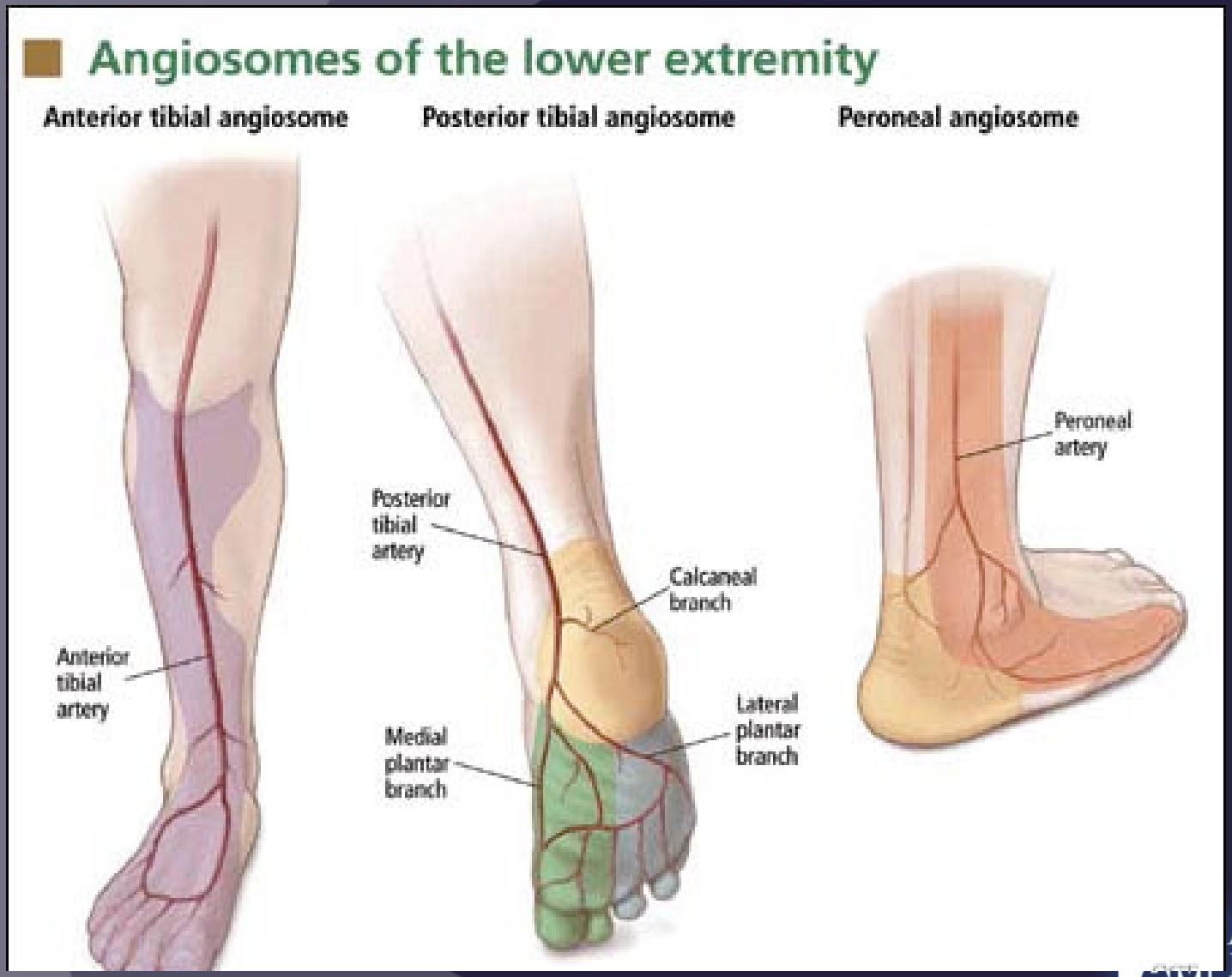
Amputation

- Amputation cost = $20,000 - $60,000[4]
- Annual cost of follow-up care = $49,000[5]
- Annual cost of nursing home: $70,000 – 100,000[5]

1. MRG Report; US Markets for Peripheral Vascular Devices 2011.
2. Jaff MR, Cahill KE, Yu AP, et al. Clinical outcomes and medical care costs among medicare beneficiaries receiving therapy for peripheral arterial disease. *Ann Vasc Surg*. 2010 Ju[illegible]7.
3. Harrington C, Corea J, Zagari M, et al. A Cost Analysis of Diabetic Lower Extremity Ulcers Diabetes Care, 2000;23(9):1333-38.
4. Ollendorf DA, Kotsanos JG, Wishner WI, et al. Potential Economic Benefits of Lower Extremity Amputation Prevention in Diabetes. Diabetes Care, 1998: 21(8):1240-5.
5. Allie DE, Hebert CJ, Ingraldi A, et al. 24 Carat Gold, 14 Carat Gold or Platinum standards in the treatment of Critical Limb Ischemia: Bypass or Endovasc Intervention? J Endovas[illegible]hen 2009; 16.

Atlantic Medical Imaging

Angiosome Concept



Atlantic Medical Imaging

Case Examples

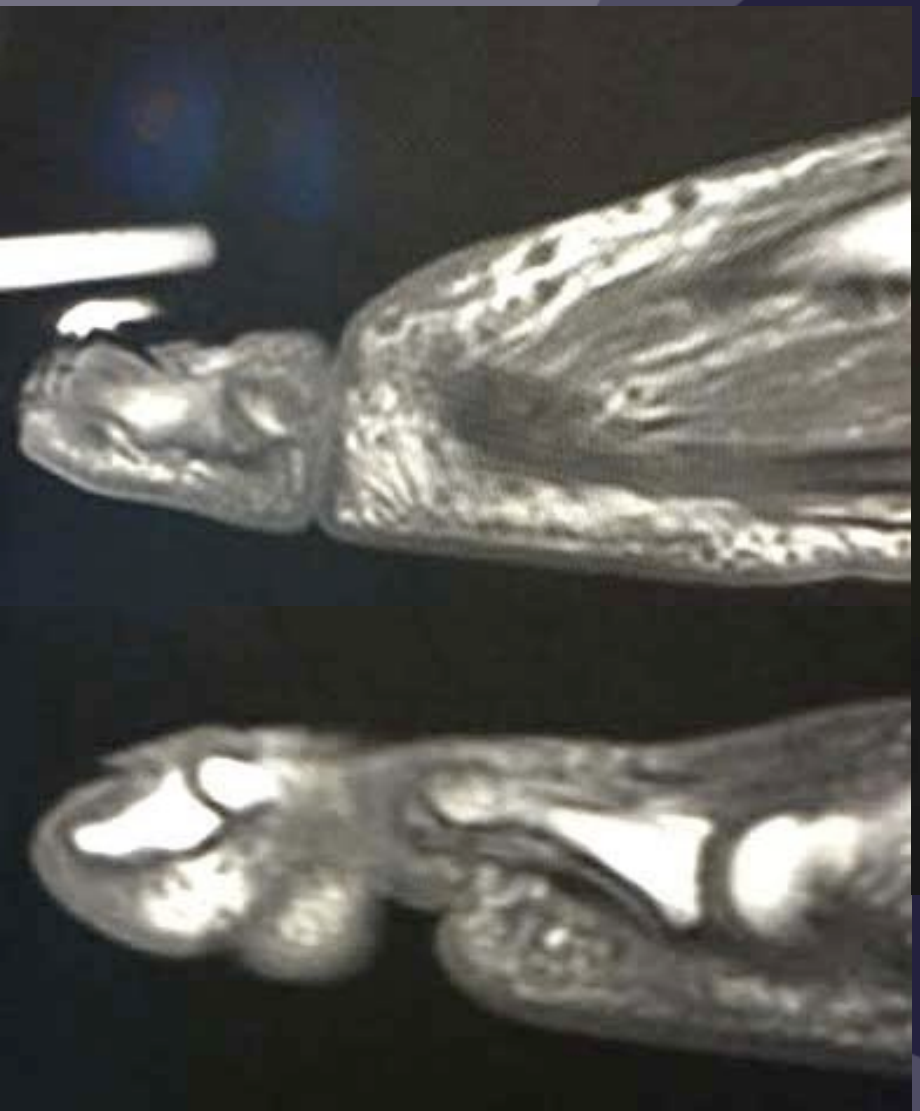
Atlantic Medical Imaging

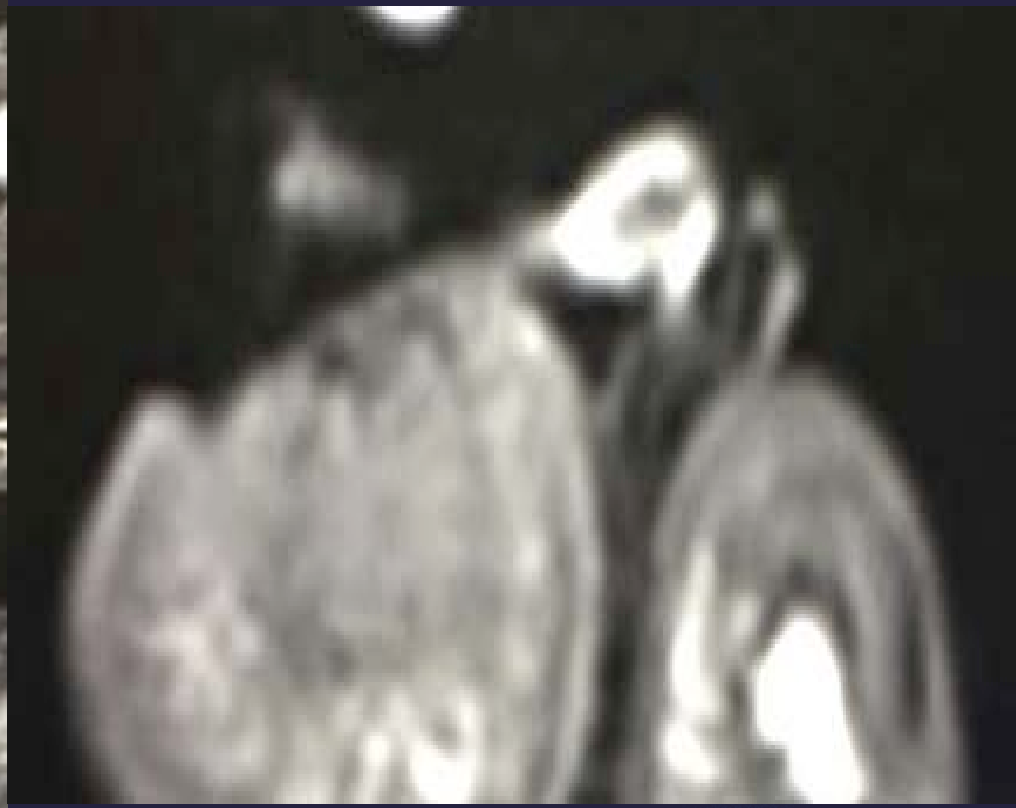
Case

- 69 yo F, diabetes, ESRD on HD, non-healing wound left great toe suspected osteomyelitis
- Poor granulation tissue at margins
- Foot cold, no dopplerable pulses
- Poor wound healing anticipated
- Vascular consultation requested

Atlantic Medical Imaging

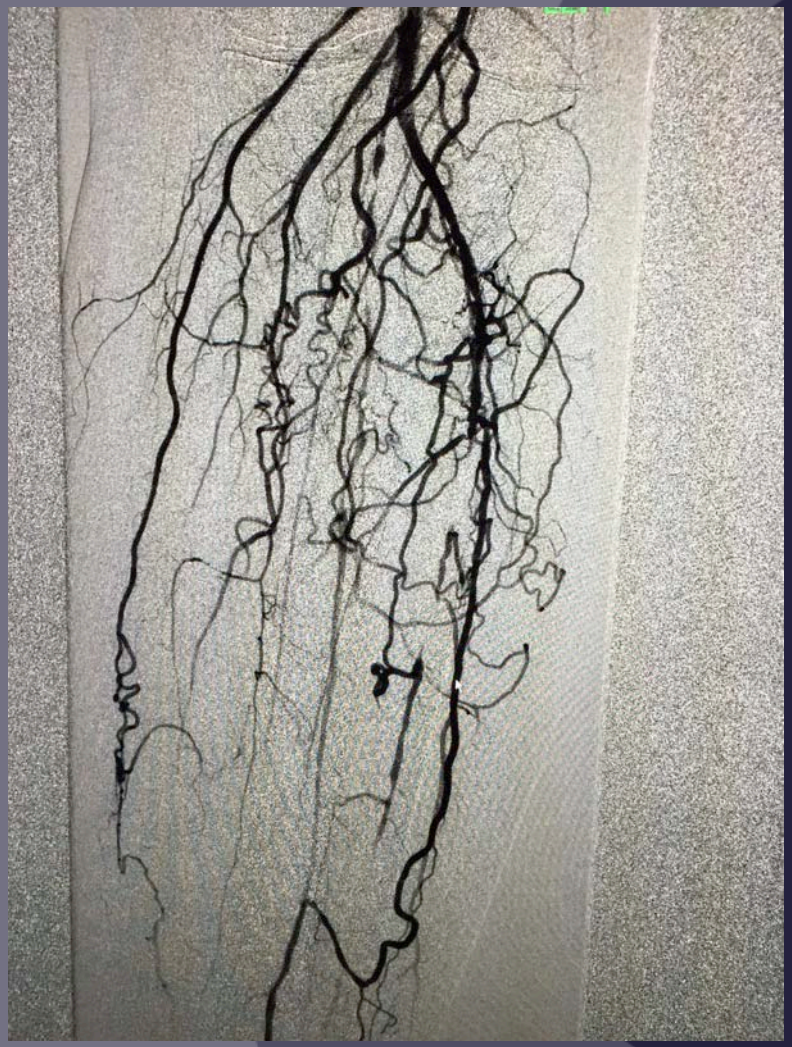
MRI



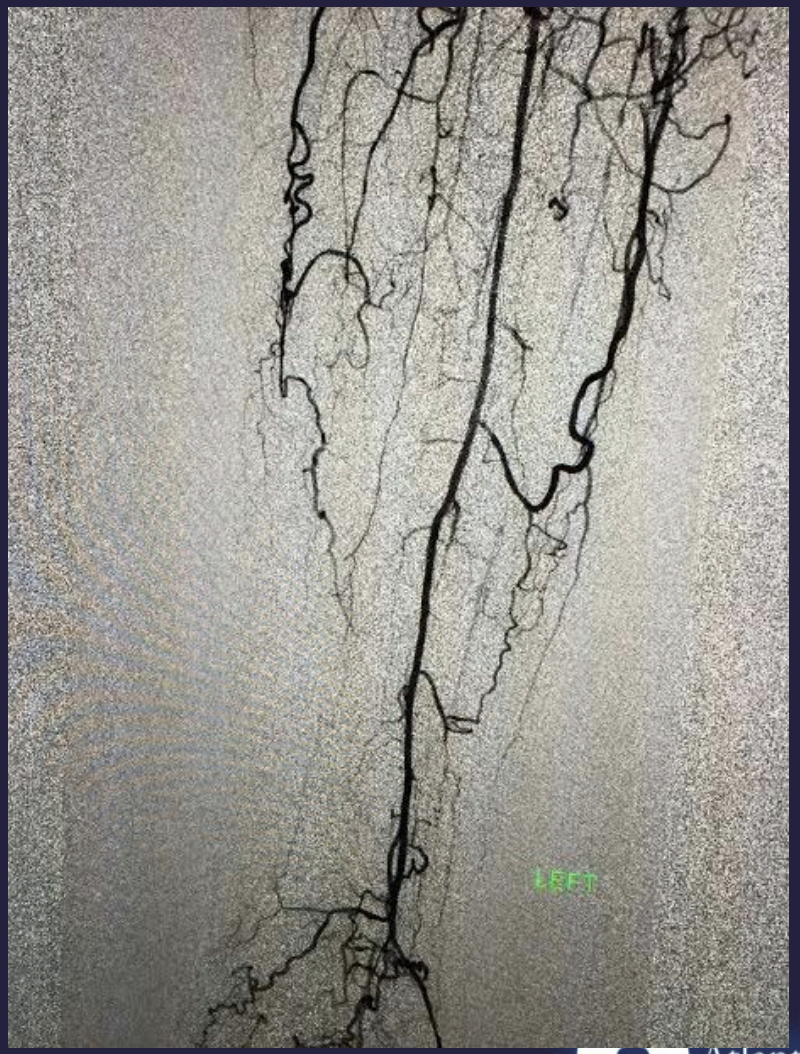


Atlantic Medical Imaging

Arteriogram

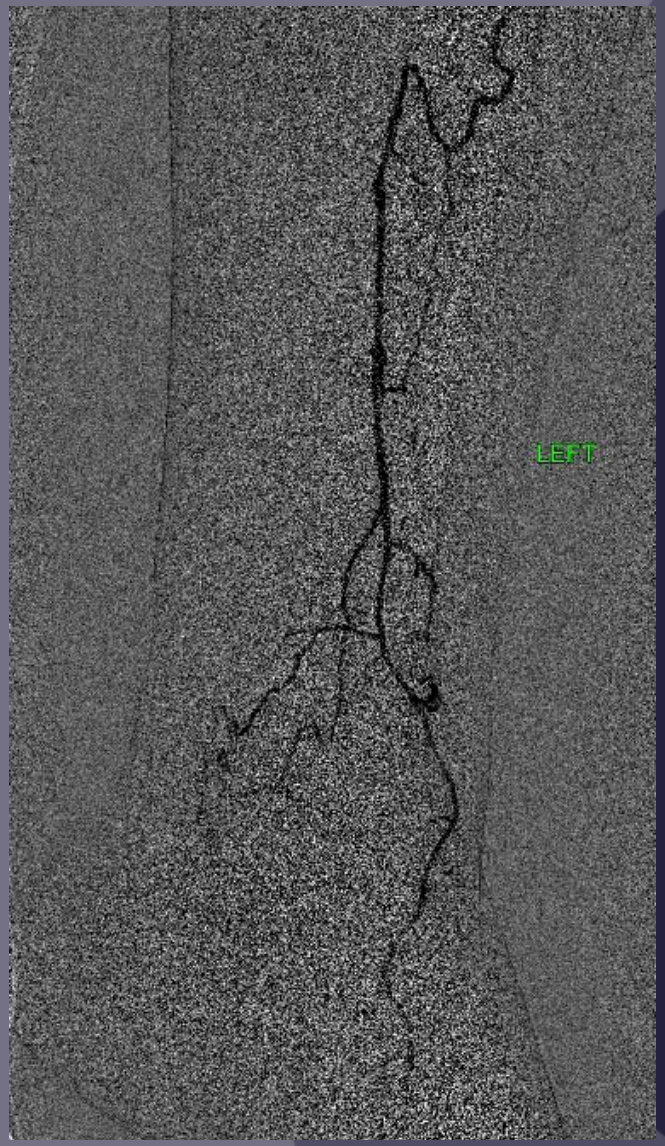


BEFORE

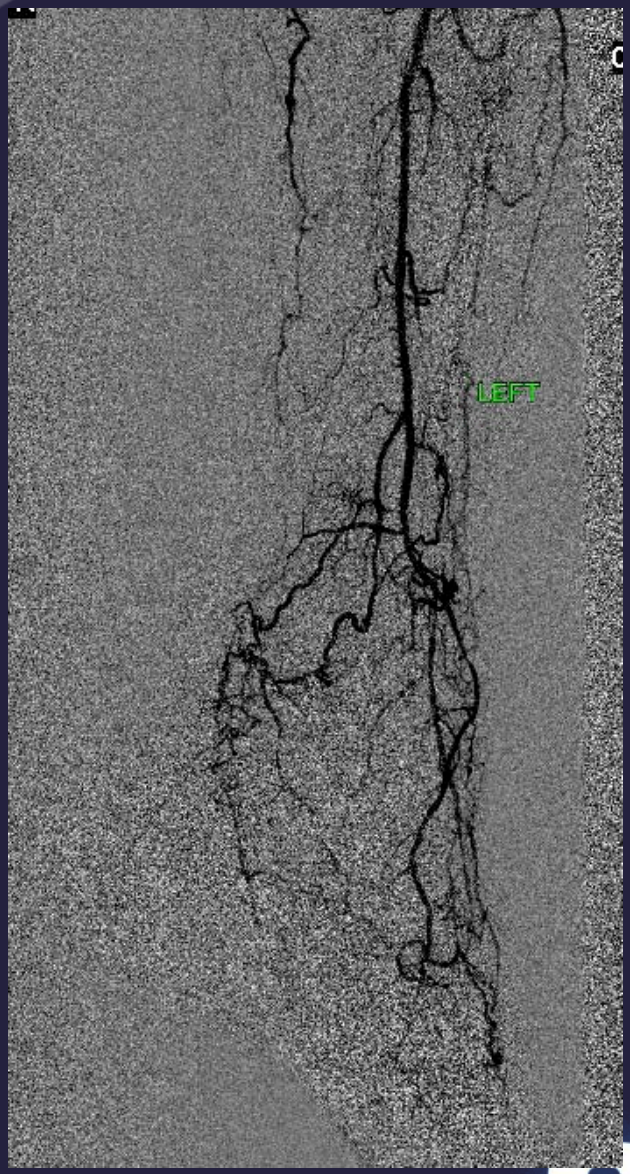


AFTER

Atlantic Medical Imaging



BEFORE



AFTER

Atlantic Medical Imaging

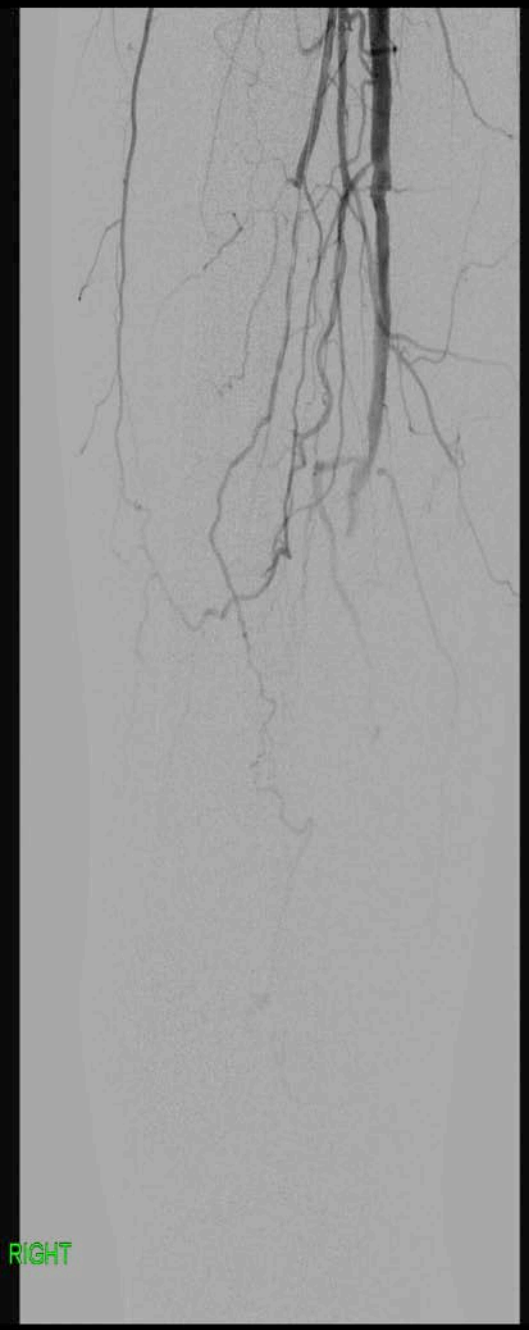
Follow-up

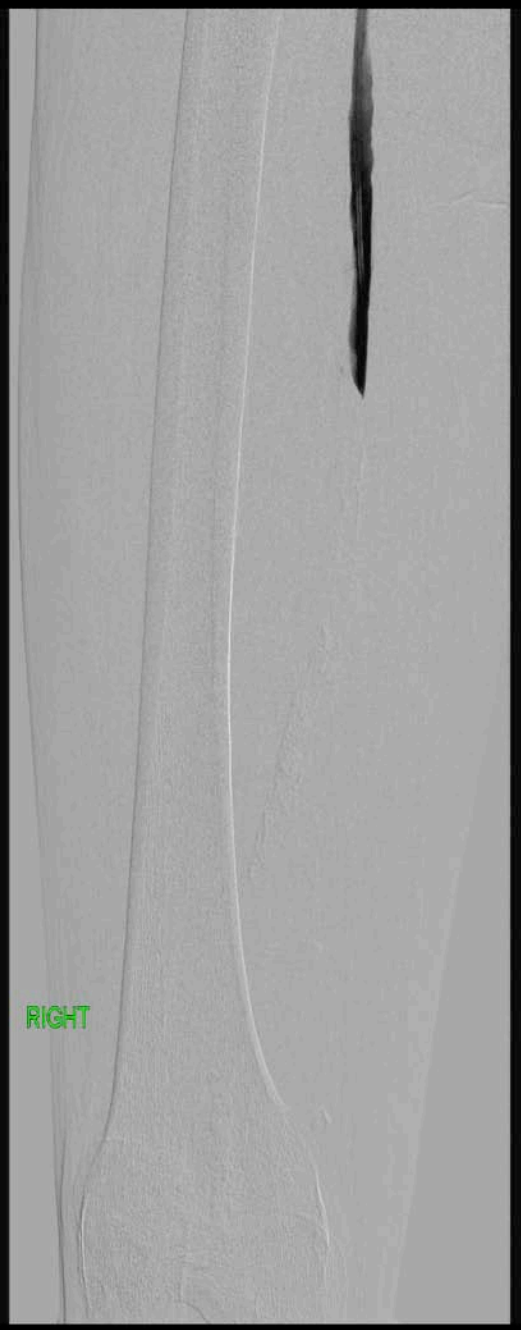
- Foot warm, healing of ulceration
- Patient underwent partial amputation distal phalanx of left hallux with good wound healing
- No evidence of residual infection at 3 months

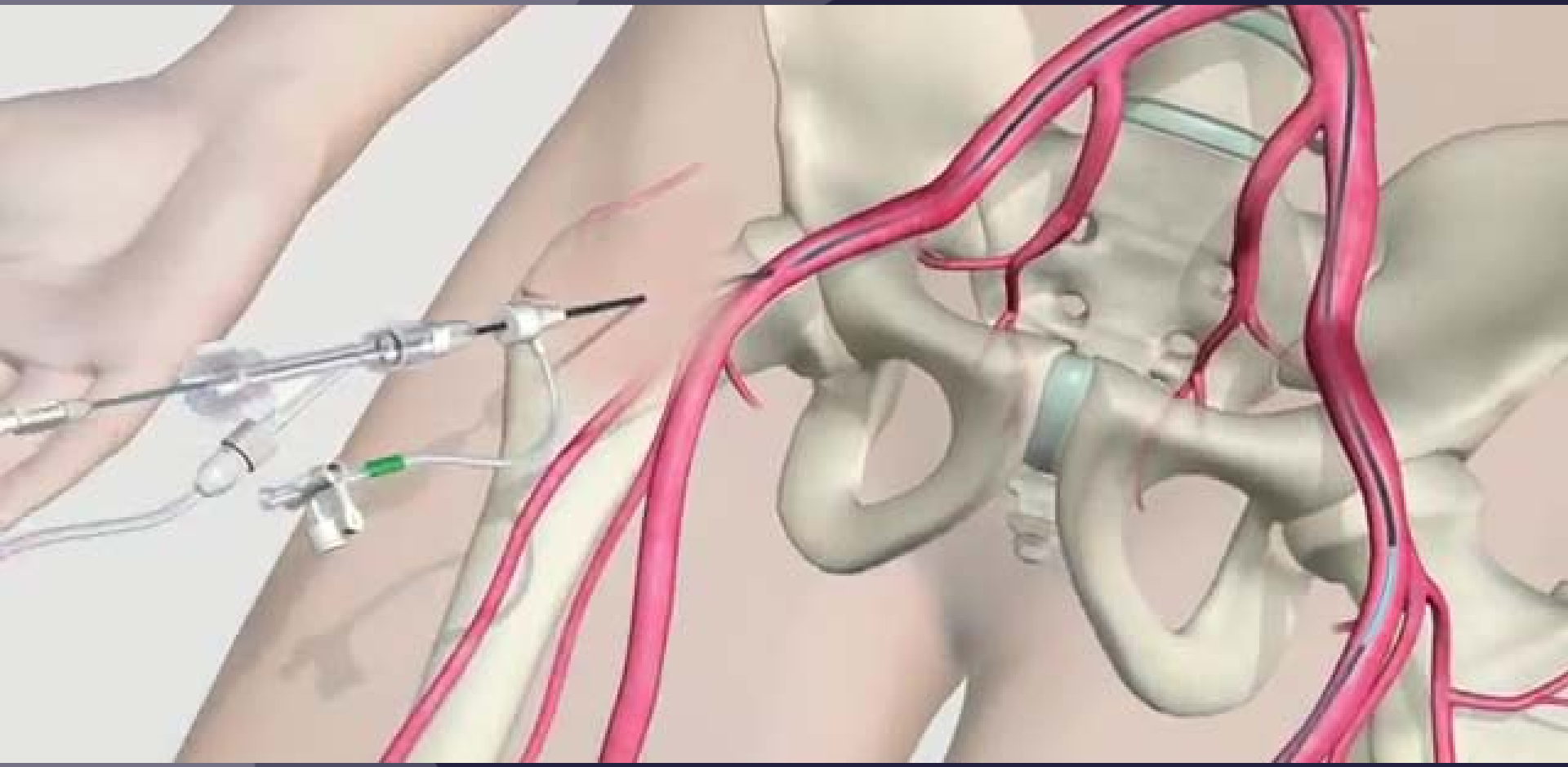
Case

- 54 yo M with very severe right lower extremity rest pain
- Known long segment occlusion of right SFA
- Monophasic faint doppler pulses below
- Very hard calcific plaque could not be crossed from above
- Transpedal approach employed (SAFARI)

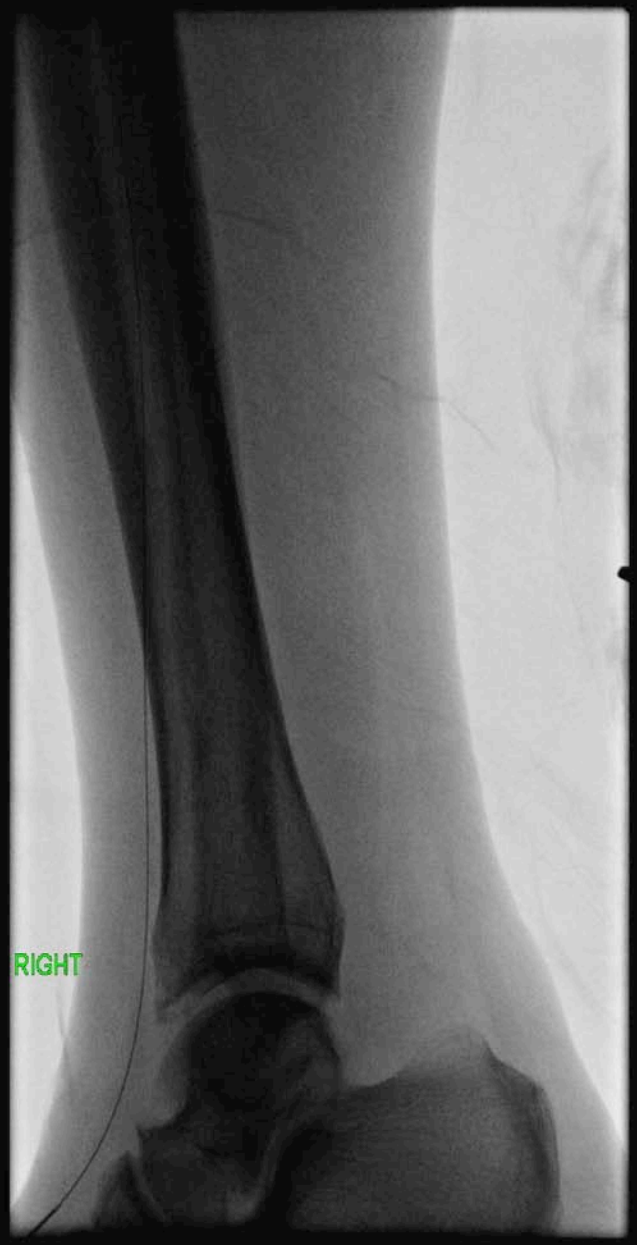
Atlantic Medical Imaging

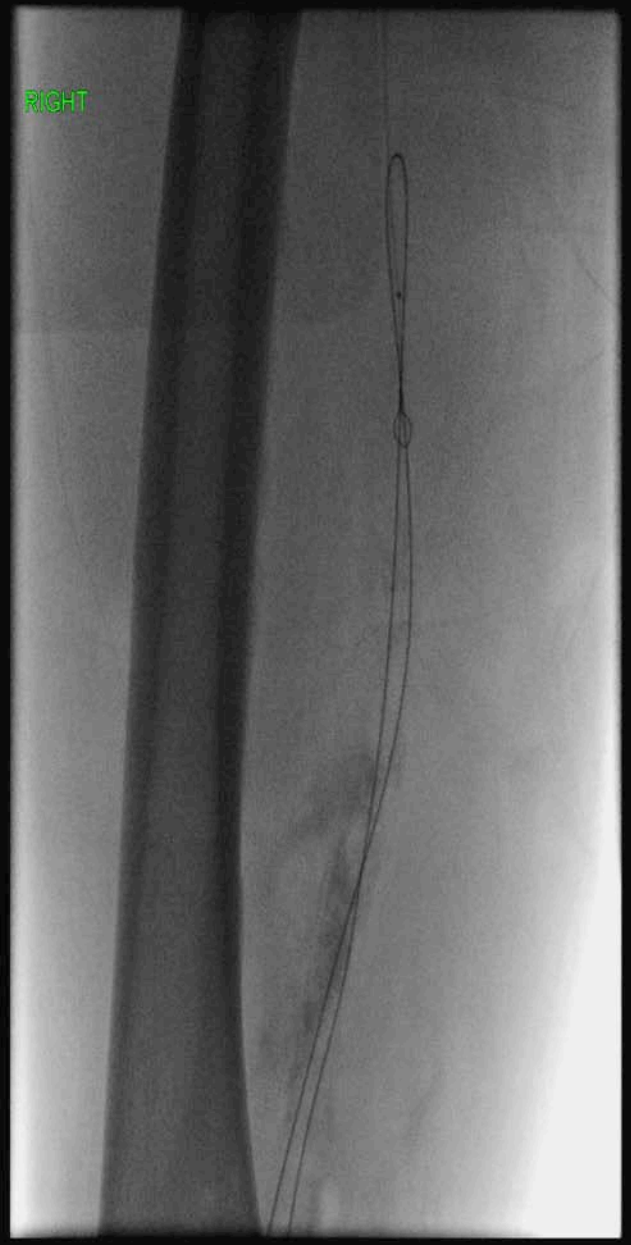

RIGHT

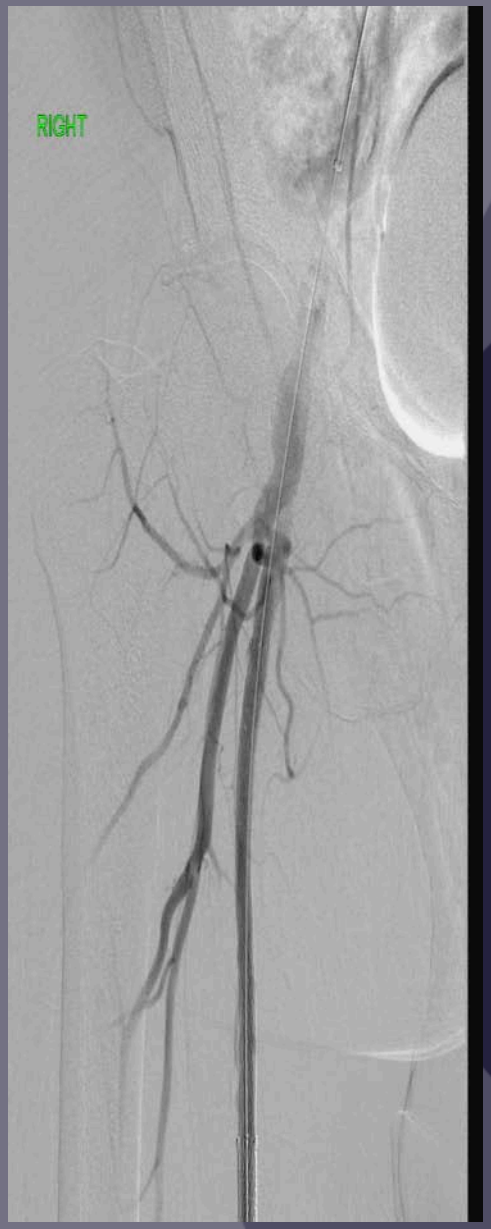

RIGHT

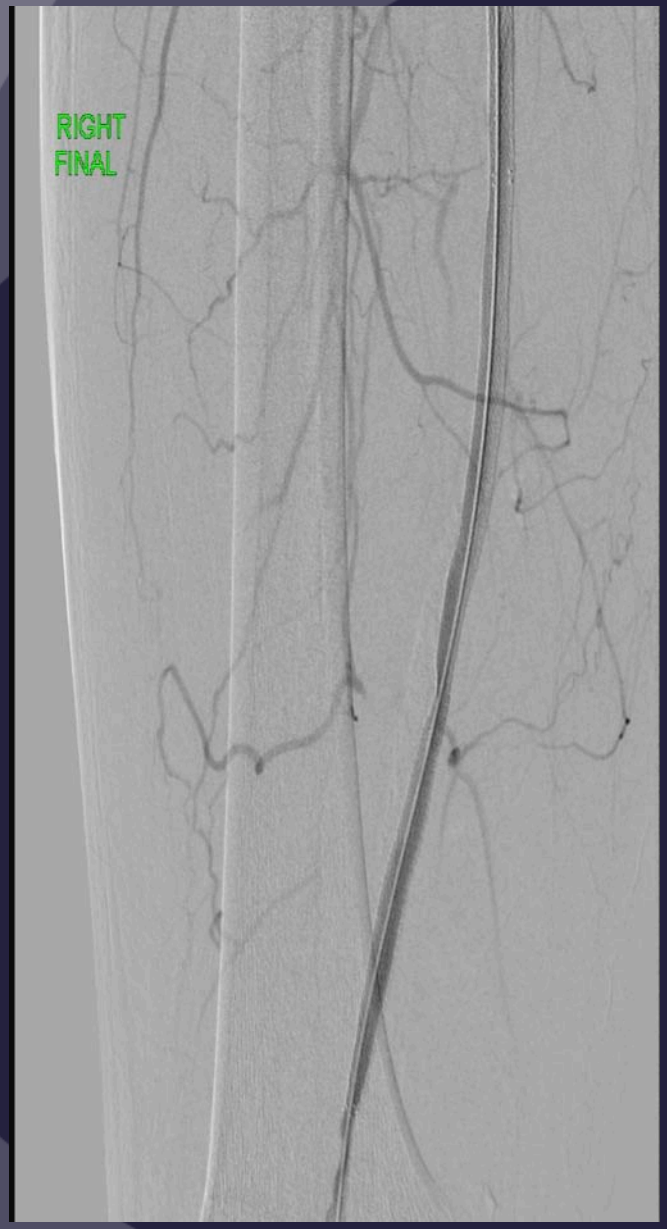


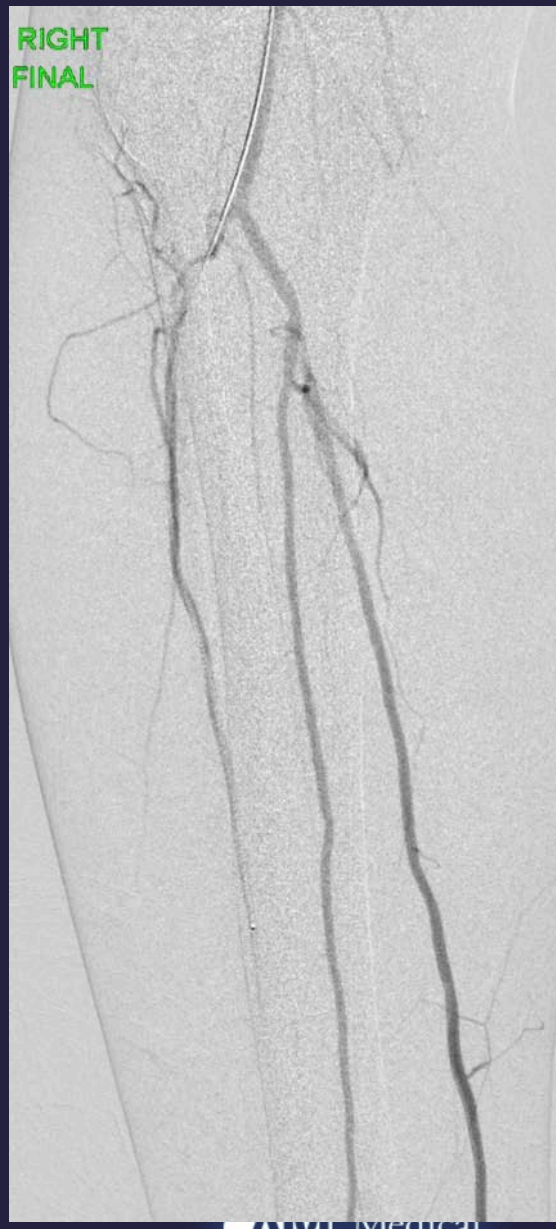
Atlantic Medical Imaging


RIGHT


RIGHT







Follow up

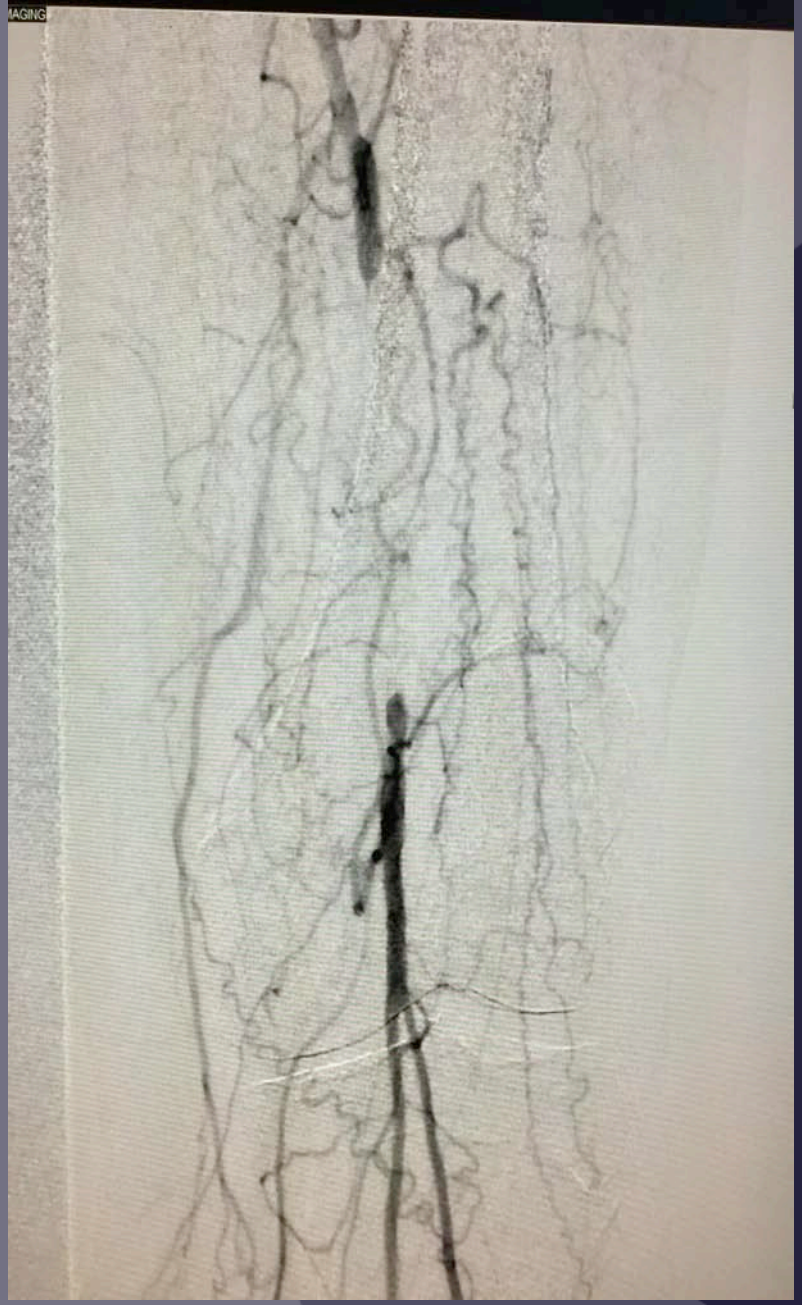
- 3 month course plavix was completed
- 2 + pulses RLE at 6 month follow up
- Complete resolution of Rest Pain

Atlantic Medical Imaging

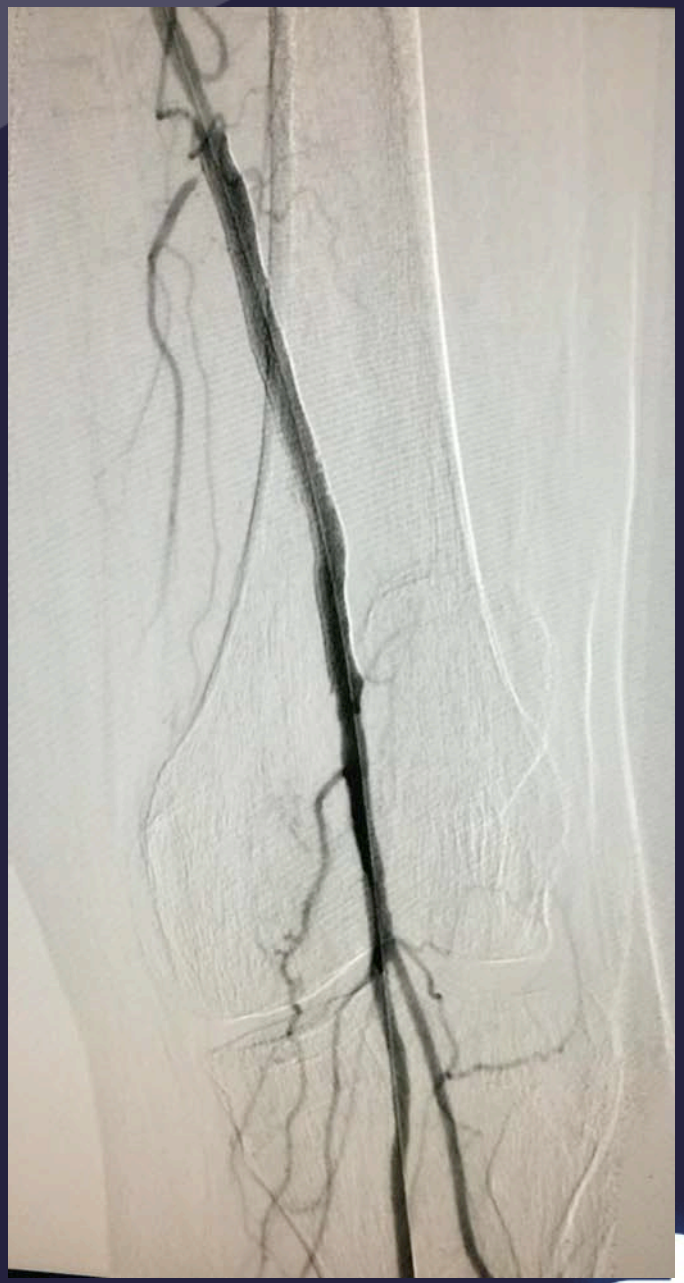
Case

- 66 yo F smoker with severe claudication and rest pain (Rutherford 4)
- ABI 0.54 with abnormal PVR tracings
- Developing ischemic changes on heal

Atlantic Medical Imaging



BEFORE



AFTER

Atlantic Medical Imaging

Follow up

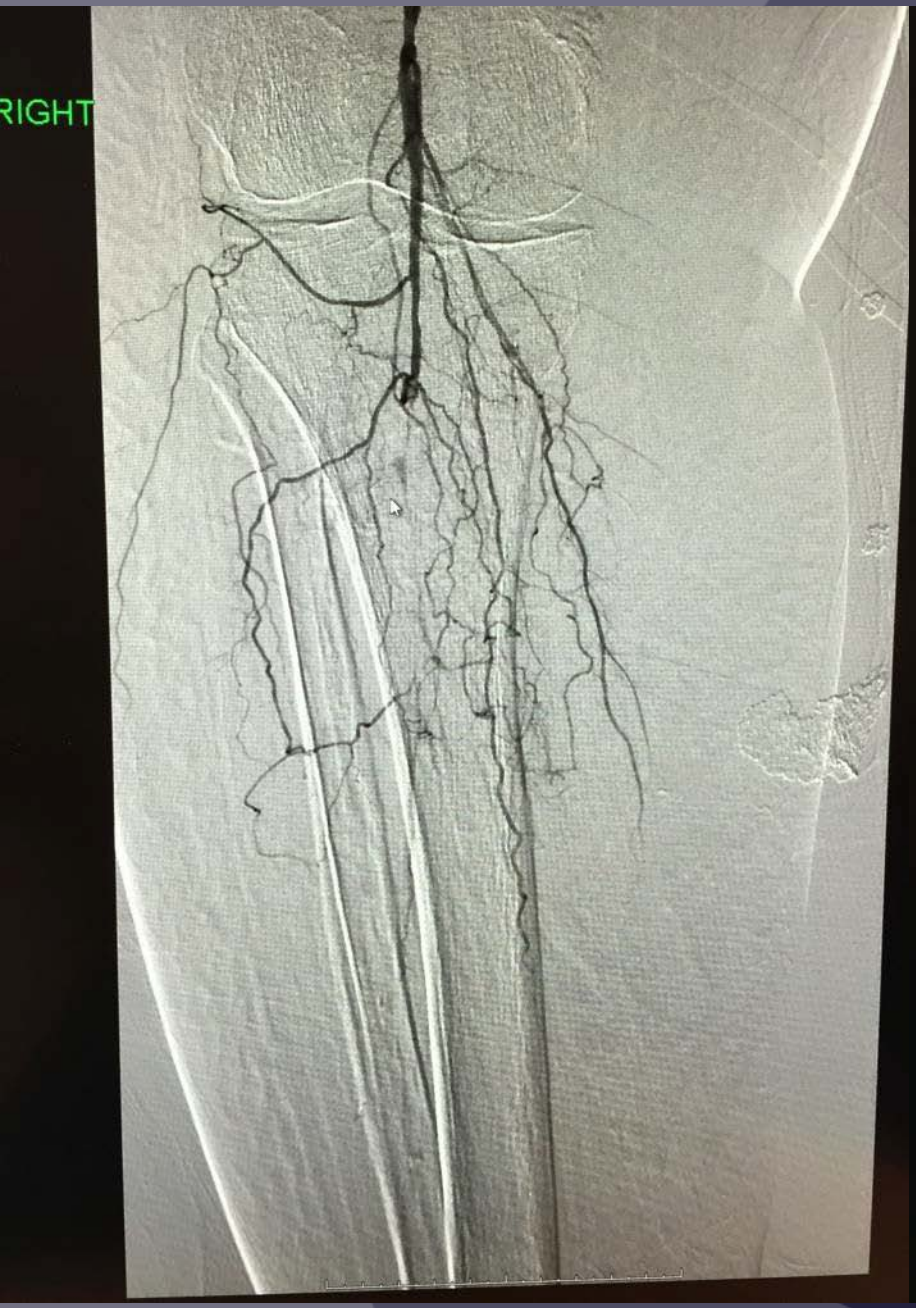
- Atherectomy, PTA, required stenting
- Near immediate improvement of rest pain, ischemic changes and claudication
- 3 month plavix regimen
- Patient quit smoking, began exercising!

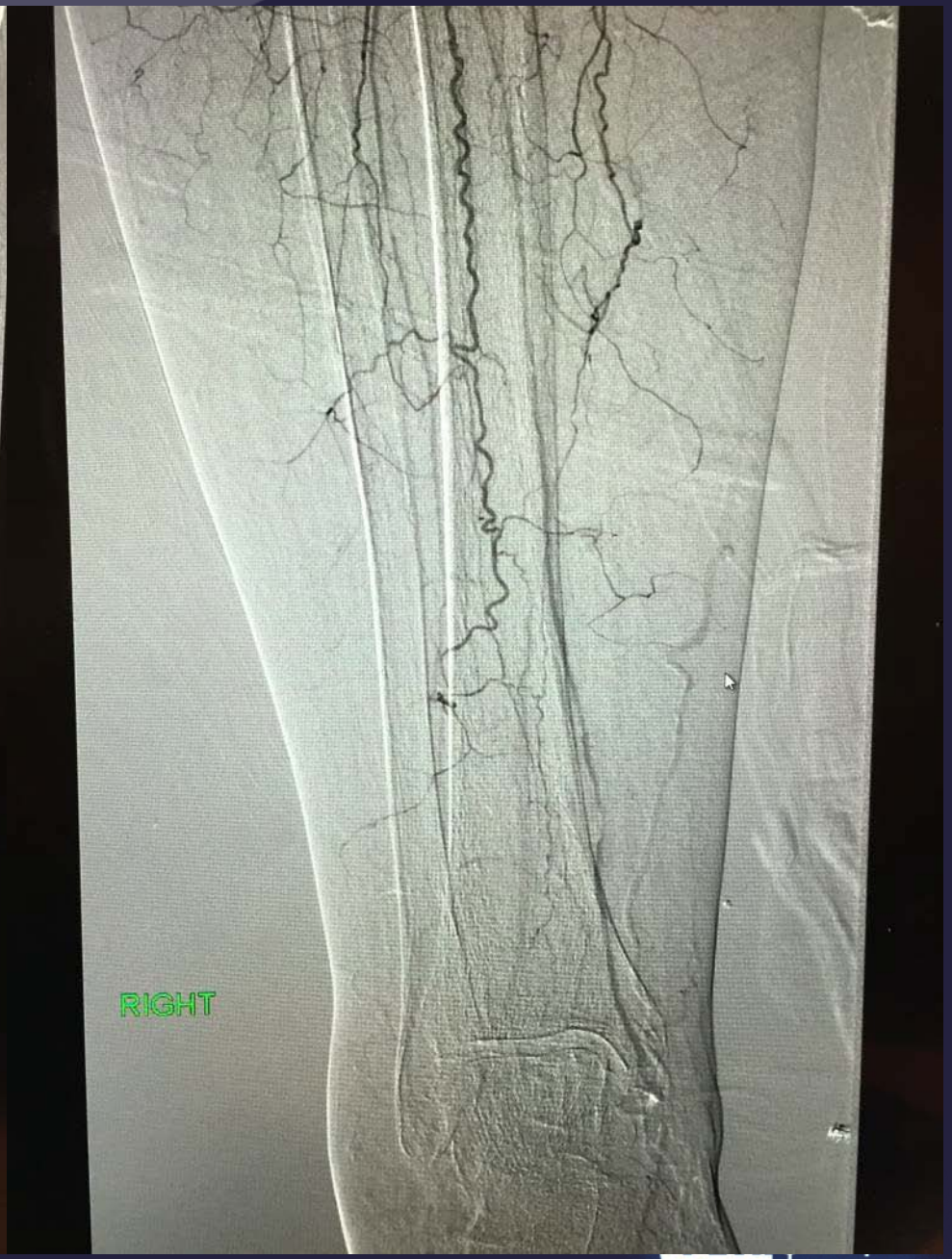
Atlantic Medical Imaging

Case

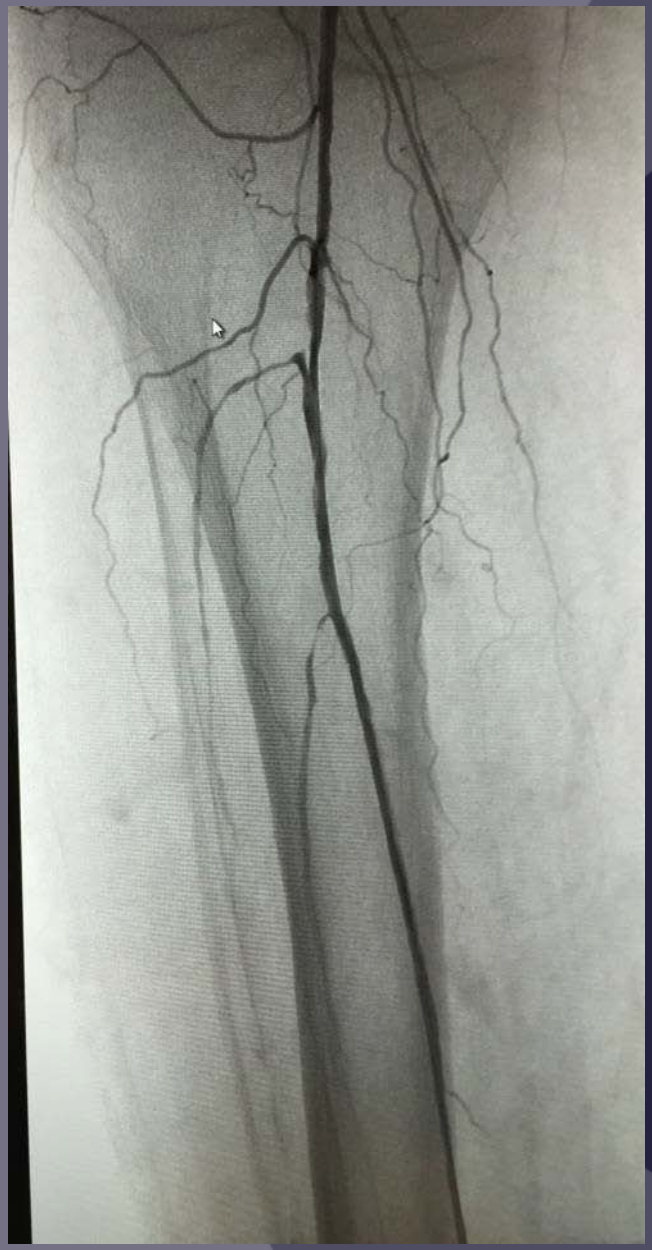
- 78 yo F with non-healing wound on medial ankle and heal (Rutherford 6)
- Hospitalized for planned BKA
- Denied bypass given lack of BTK target vessel

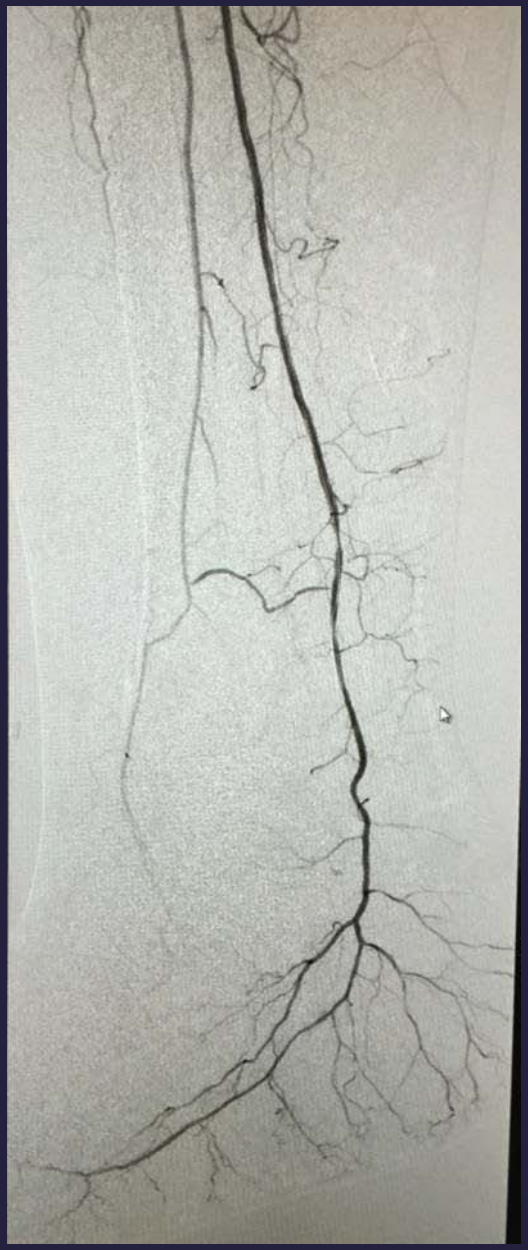
Atlantic Medical Imaging


RIGHT

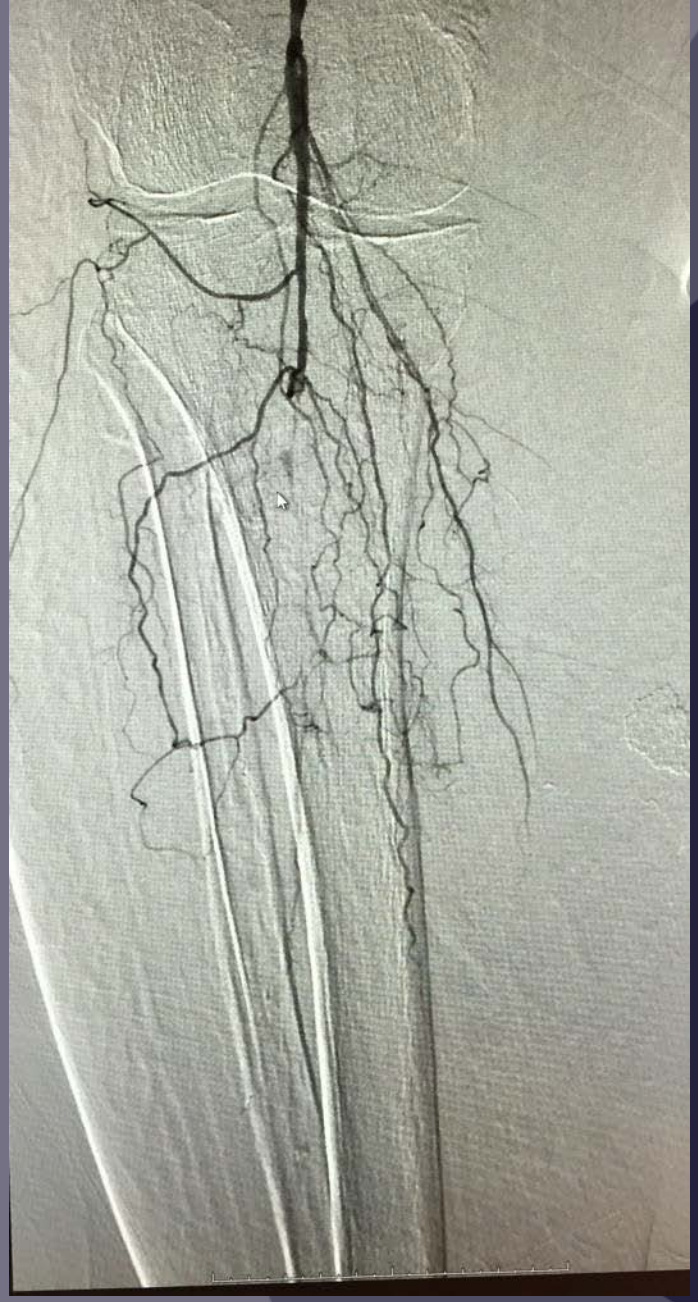

RIGHT

Post

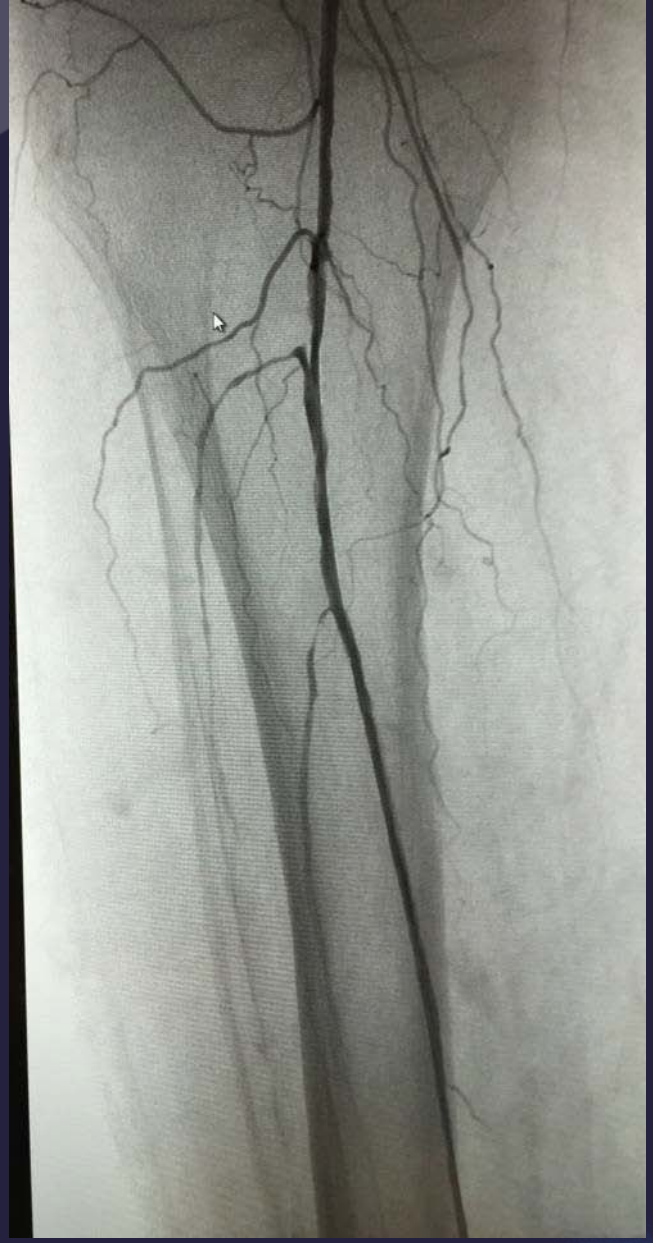




Atlantic Medical Imaging



BEFORE



AFTER

Atlantic Medical Imaging

Follow up

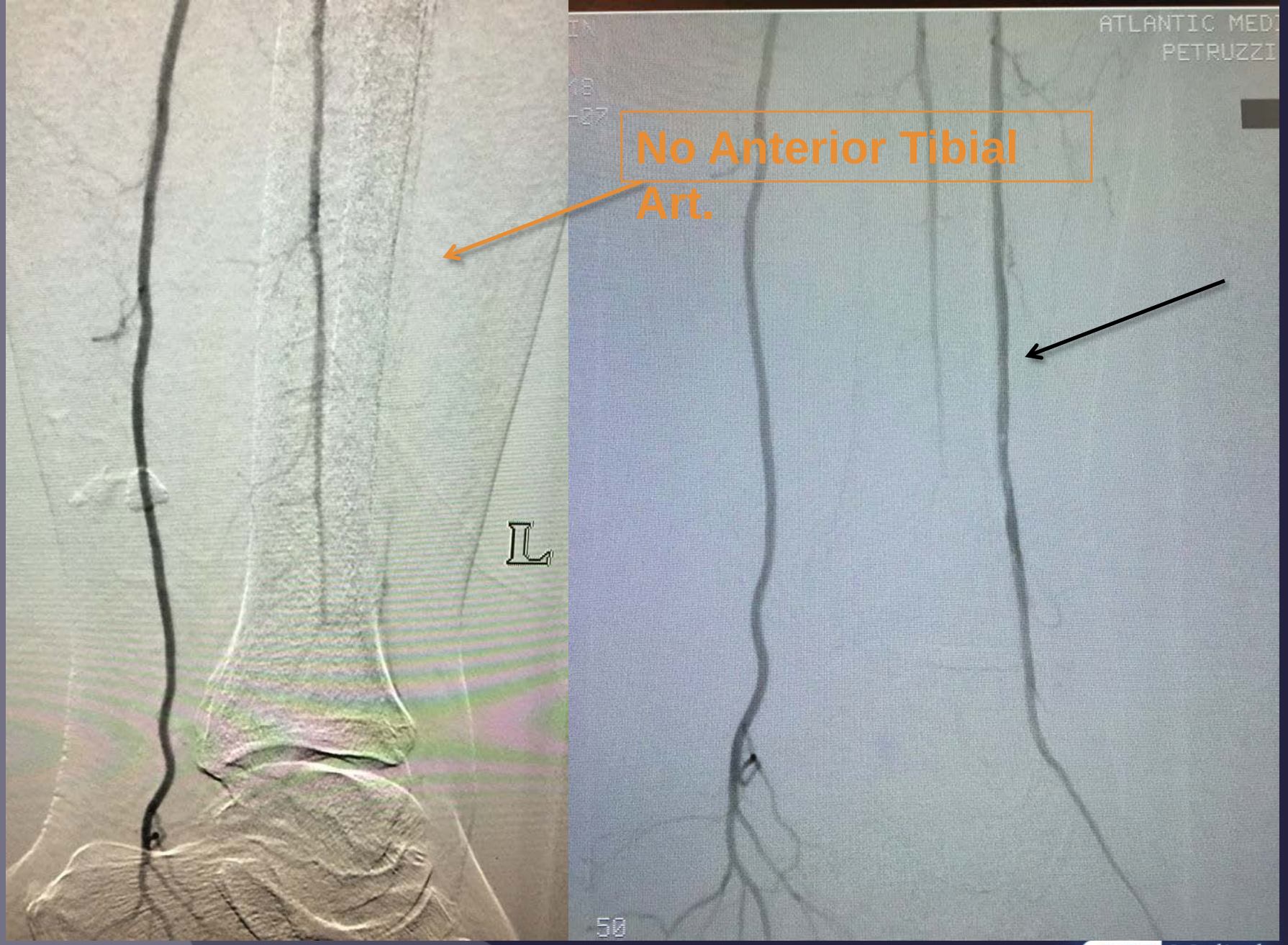
- Performed below the Knee atherectomy + PTA
- Gradual but continued healing of ulceration
- Successful limb salvage

Atlantic Medical Imaging

Case

- 66 yo male, significant past smoking history, presented to podiatrist with forefoot rest pain
- Podiatrist noted absent DP pulses on both feet.
- At vascular consultation, ABIs only mildly diminished but no doppler-able DP on either foot.

Atlantic Medical Imaging



BEFORE

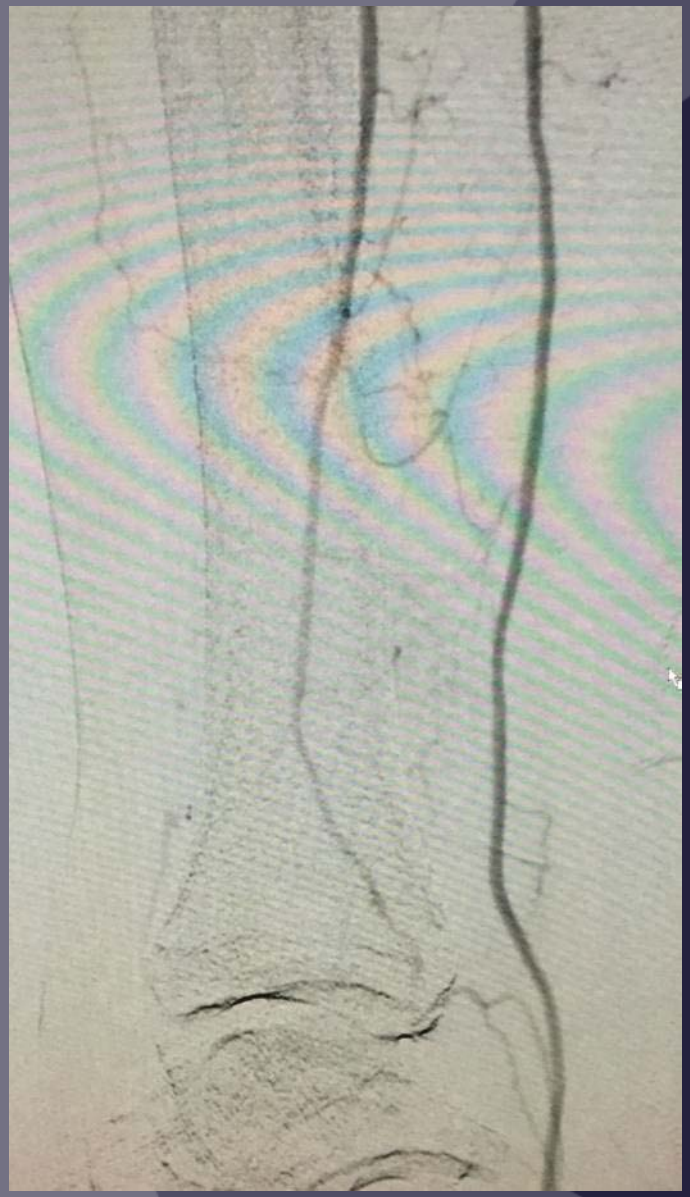
AFTER

AMI Medical Imaging

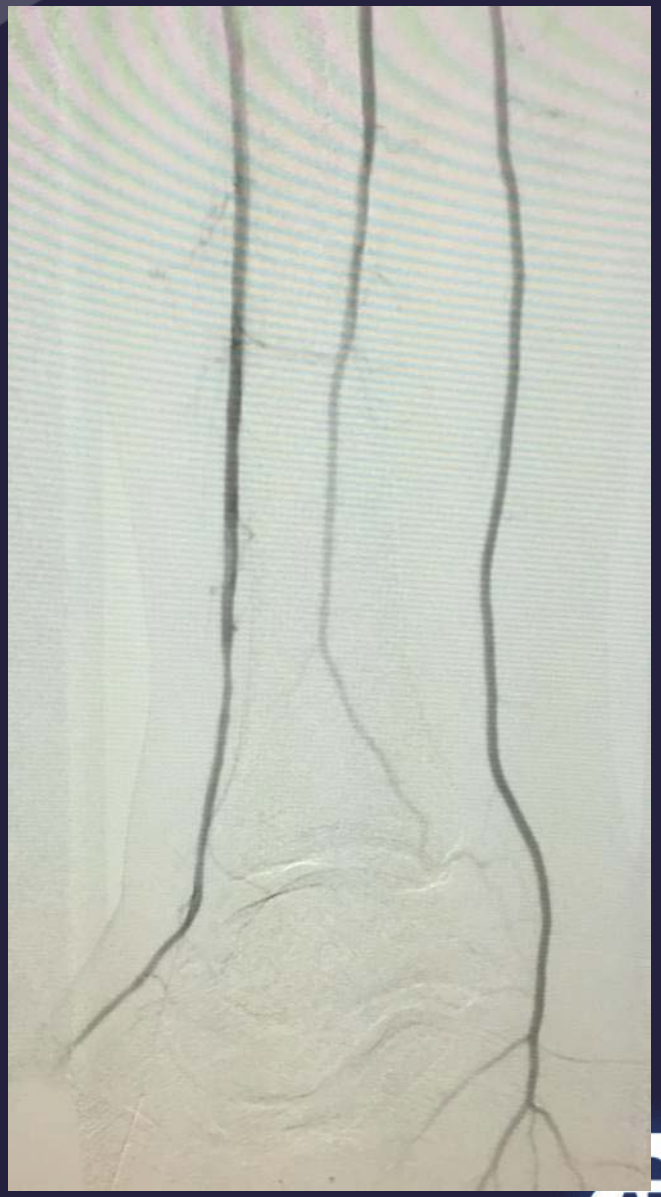
Follow up

- BTK atherectomy and PTA
- Resolved rest pain in left forefoot at 2 week follow-up. 2+ DP noted on exam.
- Returned for right foot arteriogram and revascularization with similar results.

Atlantic Medical Imaging



BEFORE



AFTER

Atlantic Medical Imaging

Follow up

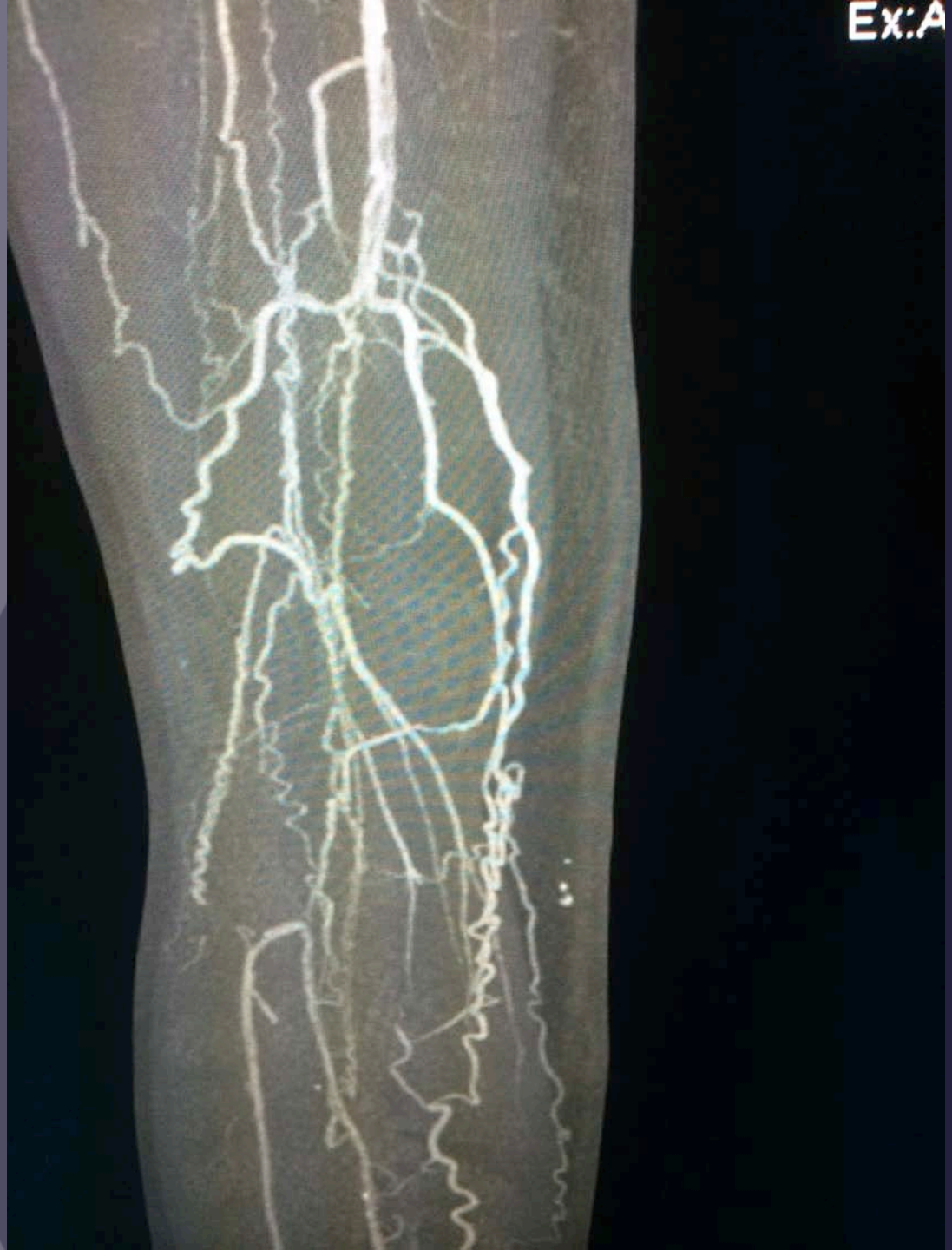
- 6 month follow-up – 2+ DP b/l on exam
  - both AT remain patent
- Denies any rest pain
- Plavix regimen discontinued

Atlantic Medical Imaging

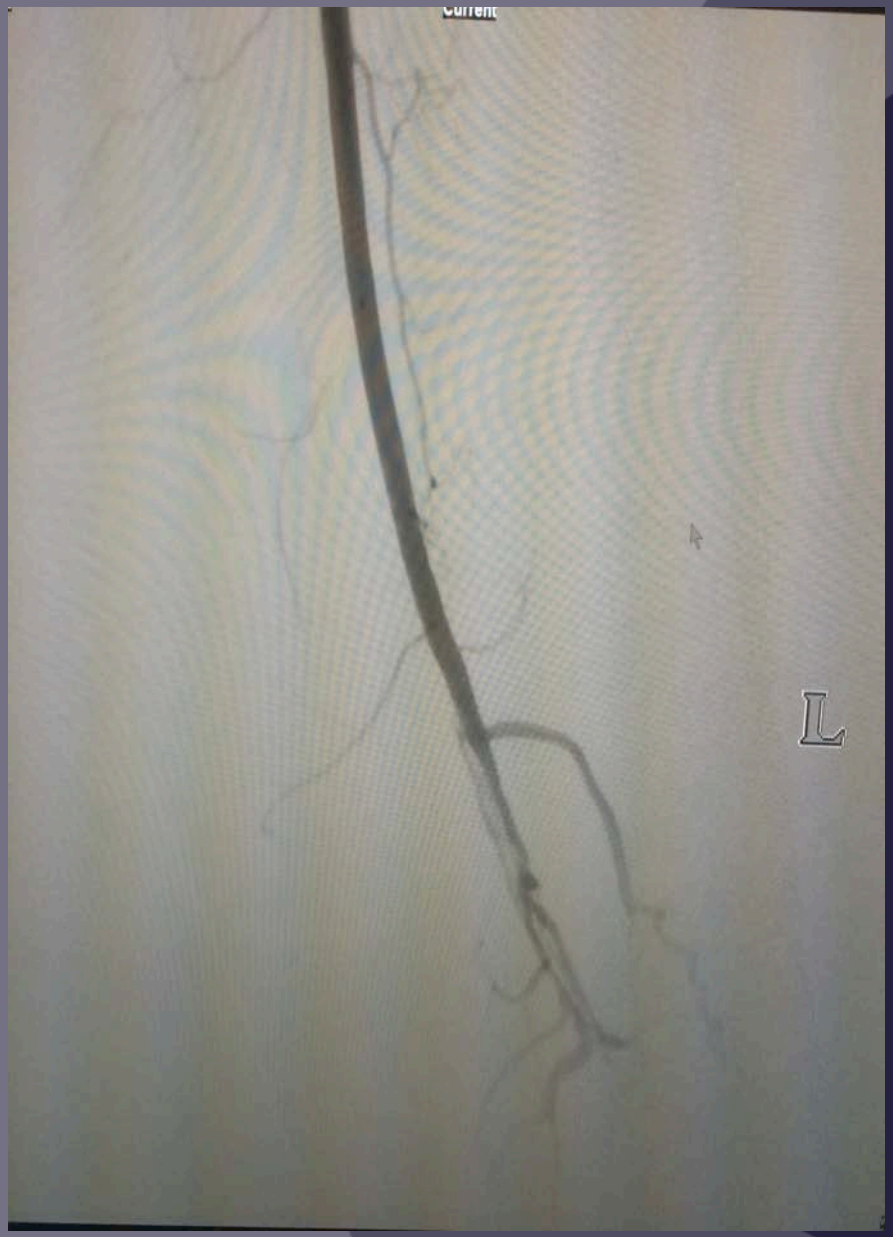
Case

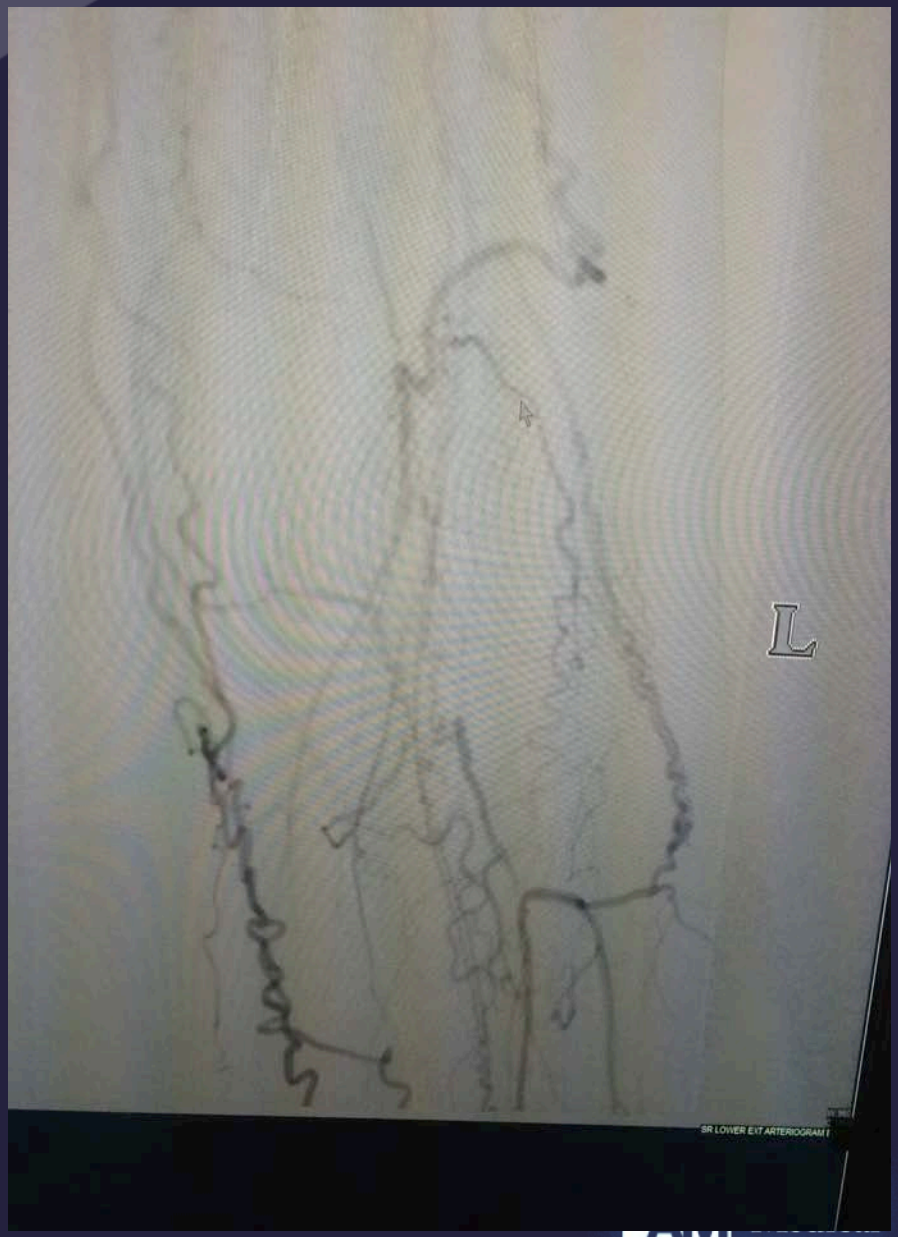
- 68 yo F with prior left lower ext femoro-post tibial bypass, p/w severe claudication and rest pain
- Pre-procedure CTA ordered to evaluation bypass

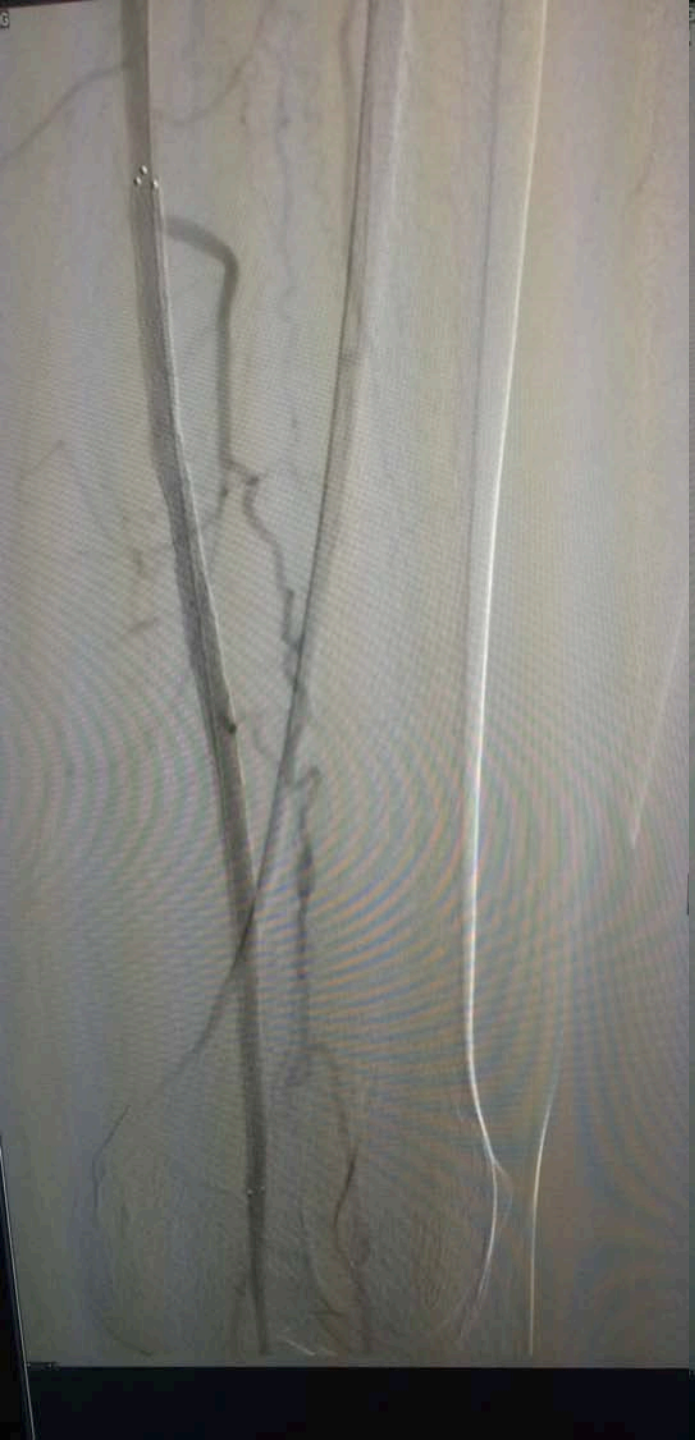
Atlantic Medical Imaging

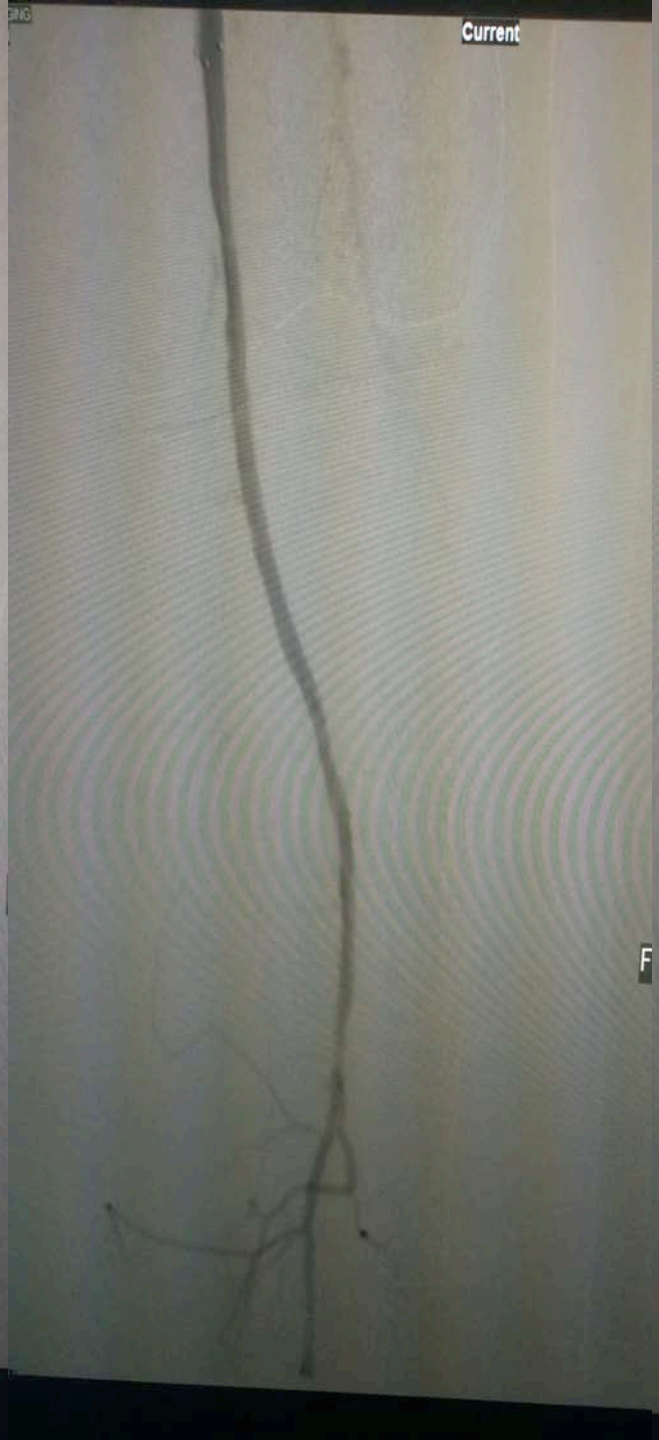


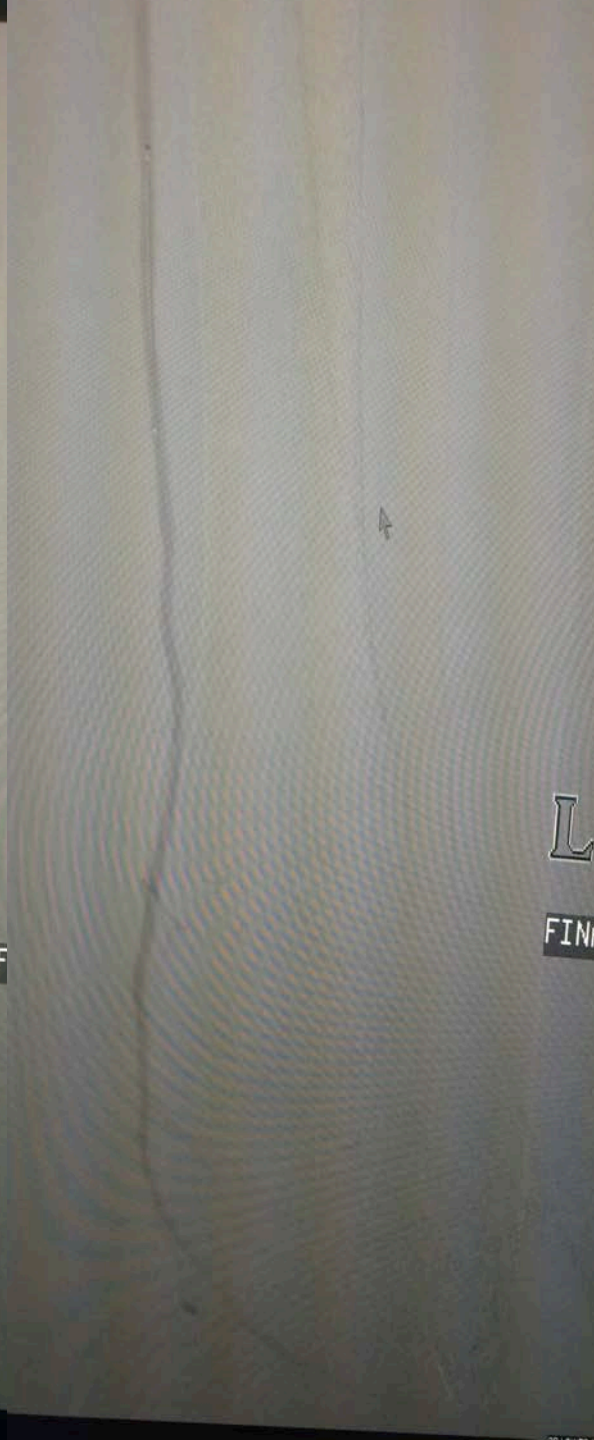
Atlantic Medical Imaging


L


L




Current



Follow-up

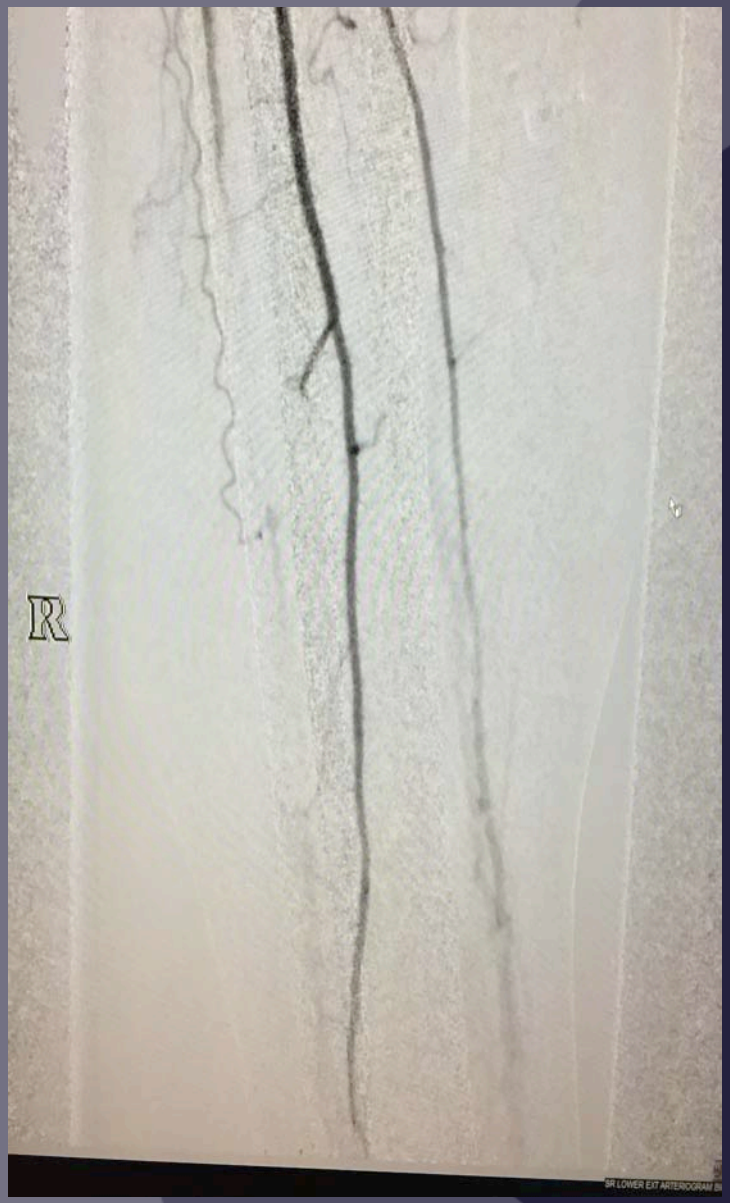
- Patient began 3 month plavix regimen
- Near immediate relief of rest pain and claudication

Atlantic Medical Imaging

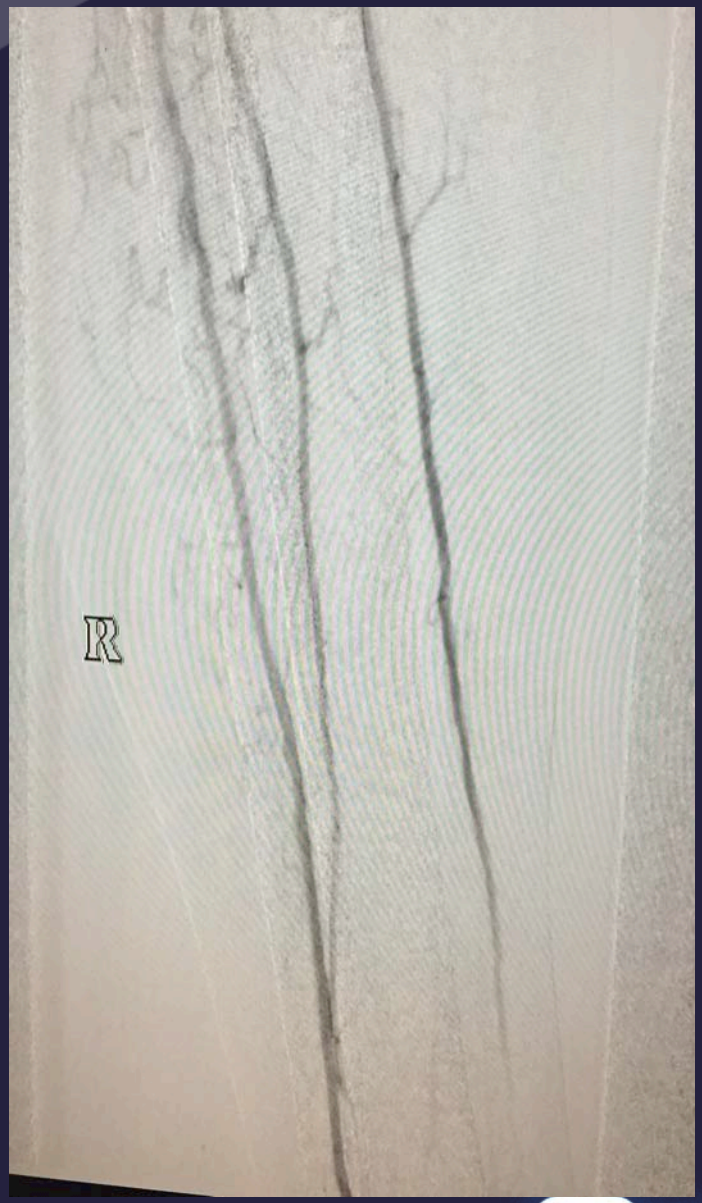
Case

- 79 yo male, DM2, referred for non-healing wound right great toe, non-palpable pulses on exam
- Bilateral diminished ABIs on exam

Atlantic Medical Imaging



BEFORE



AFTER

Atlantic Medical Imaging

Follow up

- BTK atherectomy and PTA
- Newly palpable pulses DP and PT
- 3 month Plavix regimen
- Near complete resolution of DFU at 6 weeks

Atlantic Medical Imaging

Take Home Points

- History alone can miss up to 90% of peripheral arterial disease cases - need for screening!
- PAD is a progressive disease in 25%, including asymptomatic presentations
- Early detection can reduce cardiovascular related morbidity/mortality

Atlantic Medical Imaging

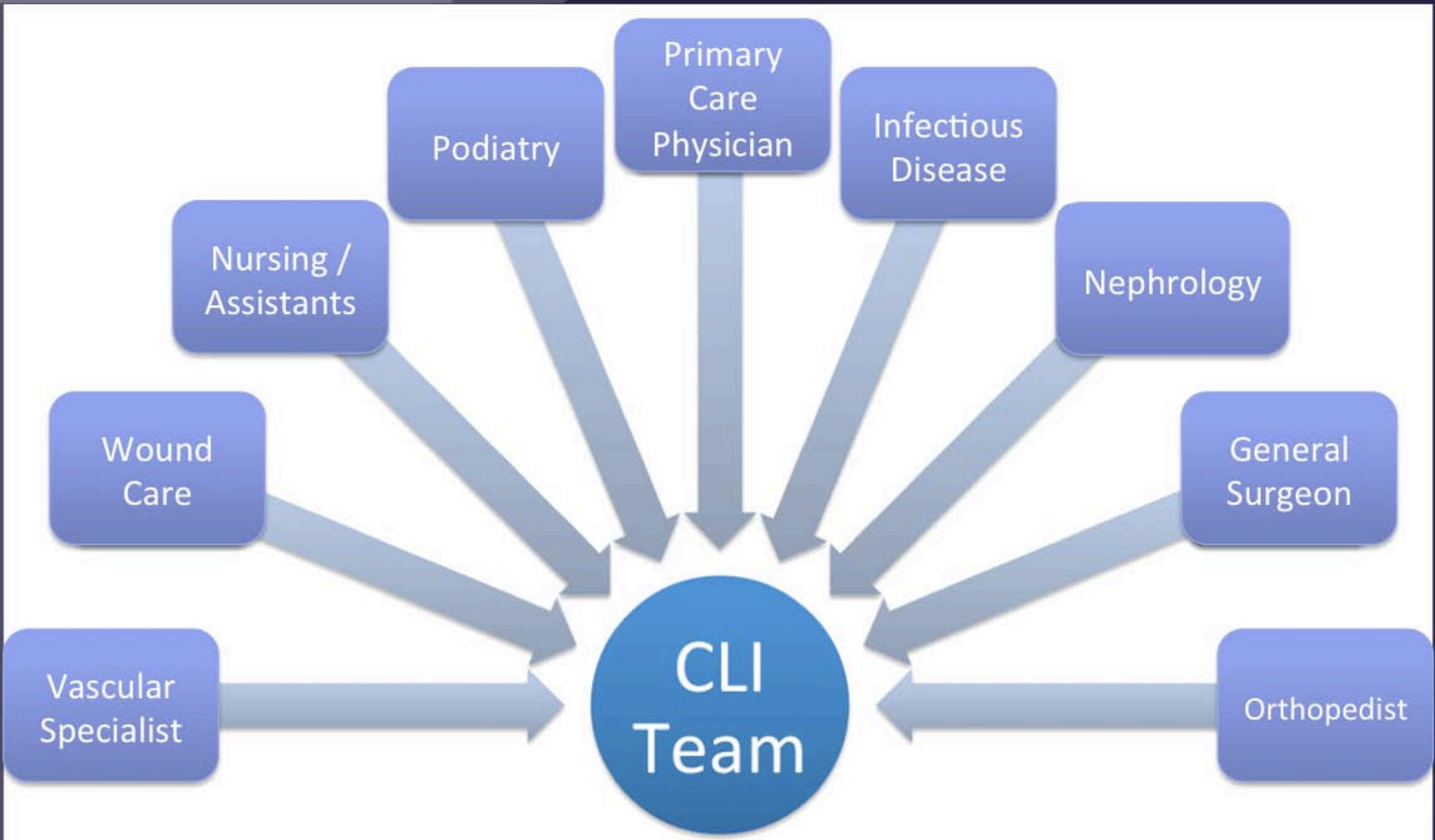
Take Home Points

- ABI/PVRs are screening study of choice but consider advanced modalities or specialist referral in high suspicion cases
- Patients with critical limb ischemia (rest pain, tissue loss, neuro-ischemic ulcers) should be offered revascularization
- Endovascular approach first is now widely considered standard of care
- Maximizing outcomes requires experience with BTK interventions & advanced techniques

Atlantic Medical Imaging

Take Home Points

Combined multispecialty care maximizes chances of limb salvage in CLI



References

1. Hirsch AT, Haskal ZJ, Hertzer NR, et al. ACC/AHA 2005 Practice guidelines for the management of patients with peripheral arterial disease (lower extremity, renal, mesenteric, and abdominal aortic), etc. *Circulation* 2006;113(11):e463-e654 Hooi JD, et al. J Clin Epidem 2004; 57:294
2. Criqui MH et al. N Engl J Med. 1992;326:381-386
3. Nadeau M, et al. The reliability of differentiating neurogenic claudication from vascular claudication based on symptomatic presentation. Can J Surg. Dec 2013 56(6): 372-377.
4. Hirsch AT, Criqui M et al. Peripheral Arterial Disease Detection, Awareness, and Treatment in Primary Care. JAMA 2001; 286: 1317
5. Criqui MH, et al. The generalized nature of atherosclerosis: how peripheral arterial disease may predict adverse events from coronary artery disease. Vascular Medicine. (3):241-245, 1998.
6. J. Dormandy, G. Belcher, P. Broos, B. Eikelboom, G. Laszlo, P. Konrad, et al. Prospective-study of 713 below-knee amputations for ischemia and the effect of a prostacyclin analog on healing. Br J Surg, 81 (1994), pp. 33–37
7. Begelman S, et al. Noninvasive diagnostic strategies for peripheral arterial disease CLEVELAND CLINIC JOURNAL OF MEDICINE VOLUME 73 • SUPPLEMENT 4 OCTOBER 2006
8. Hirsch AT *et al. J Am Coll Cardiol* 2006; **47**:1239–1312.
9. ACCF/AHA Pocket Guideline November 2011. Management of Patients With Peripheral Artery Disease (Lower Extremity, Renal, Mesenteric, and Abdominal Aortic)
10. L. Norgren, WR et al. Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASC II) . Journal of Vascular Surgery. 2007. 45(1): S5-S67

Atlantic Medical Imaging

References

11. McQuade K, et al. Fouryear randomized prospective comparison of percutaneous ePTFE/nitinol selfexpanding stent graft versus prosthetic femoralpopliteal bypass in the treatment of superficial femoral artery occlusive disease. J Vasc Surg. 2010 Sep ;52(3):58490;
12. Kim E, Wattanakit K, Gornik H. Using the ankle-brachial index to diagnose peripheral artery disease and assess cardiovascular risk. Cleve Clin J Med 2012;79:651–61.
13. van Overhagen H1, Spiliopoulos S, Tsetis D. Below-the-knee interventions. Cardiovasc Intervent Radiol. 2013 Apr;36(2):302-11. doi: 10.1007/s00270-013-0550-1. Epub 2013 Jan 26.
14. Schamp KB1, Meerwaldt R, Reijnen MM, Geelkerken RH, Zeebregts CJ. The ongoing battle between infrapopliteal angioplasty and bypass surgery for critical limb ischemia. Ann Vasc Surg. 2012 Nov;26(8):1145-53. doi: 10.1016/j.avsg.2012.02.006. Epub 2012 Jul 25.
15. W. Schuyler Jones, et al. High mortality risks after major lower extremity amputation in Medicare patients with peripheral artery disease . American Heart Journal. May 2013Volume 165, Issue 5, Pages 809–815.
16. Kerr M. Foot care for people with diabetes: the economic case for change. NHS Diabetes, Newcastle-upon-Tyne, 2012. Available at: http://bit.ly/xjY7FS. Accessed March 2013.
17. Pecoraro RE, Reiber GE, Burgess EM. Pathways to diabetic limb amputation. Basis for prevention. Diabetes Care 1990; 13(5): 513-21.
18. International Best Practice Guidelines: Wound Management in Diabetic Foot Ulcers. Wounds International, 2013.
19. Rogers, Lee C. et al. Toe and flow: Essential components and structure of the amputation prevention team Journal of Vascular Surgery , Volume 52 , Issue 3 , 23S – 27S
20. Nehler MR, et al. Epidemiology of peripheral arterial disease and critical limb ischemia in an insured national population. J Vasc Surg. 2014 Sep;60(3):686-95.e2. doi: 10.1016/j.jvs.2014.03.290. Epub 2014 May 10.
21. Sanders LJ, Robbins JM, Edmonds ME. History of the team approach to amputation prevention: pioneers and milestones. J Vasc Surg. 2010 Sep;52(3 Suppl):3S-16S.

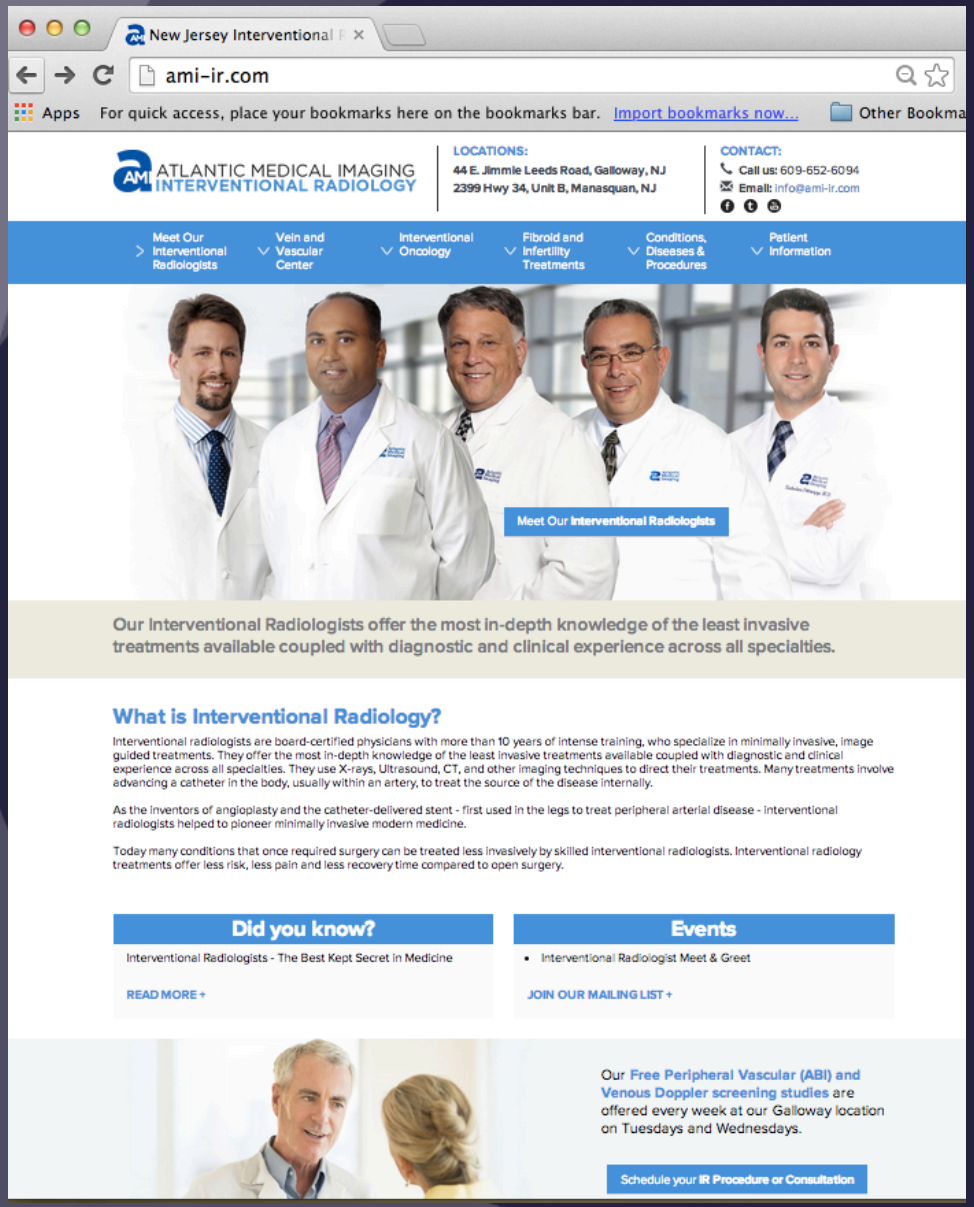
Atlantic Medical Imaging

The AMI IR Vascular Clinic

- Our Primary Goal = Limb Salvage!
- Complete clinical evaluation and management of suspected PVD
  - Arterial and Venous comprehensive treatment
  - Both Hospital and outpatient settings
- Cutting edge endovascular techniques
- Multidisciplinary involvement
  - Surgical, Podiatric, Infectious Disease, etc.
- Complete noninvasive vascular testing/imaging
- Free ABI screening studies

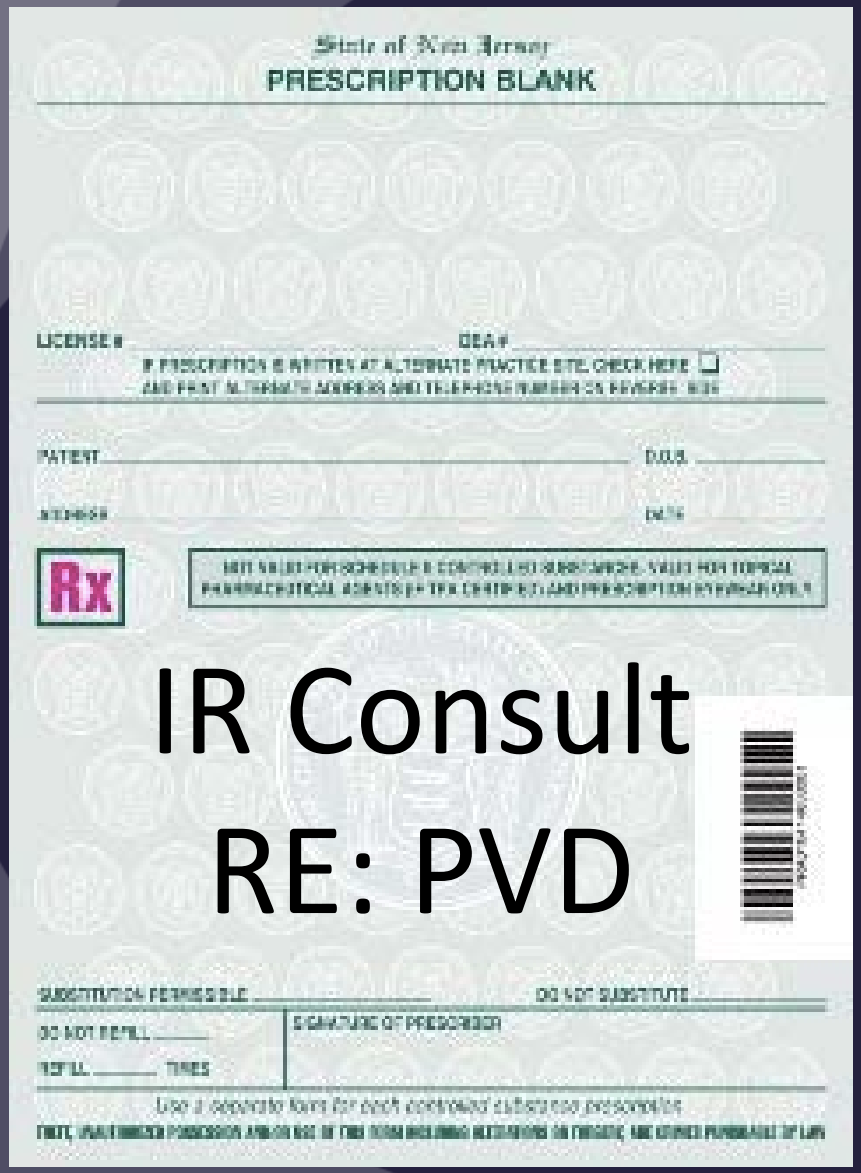
Atlantic Medical Imaging

Patients and Providers can schedule testing or consultation online at AMI-IR.com



Atlantic Medical Imaging

Referring a Patient



Atlantic Medical Imaging

Thank You

Atlantic Medical Imaging

IS YOUR PRACTICE ICD-10 READY?

Presented by:
Ginny Ruane, RN, MSN, CPC
Precision Healthcare Management, LLC

PHM
REVENUE PROTECTION & ENHANCEMENT

Readiness Assessment Components

- Internal Staff
  - ICD-10 Training & familiarity to recognize ICD-10 code sets & documentation needs
  - Pre-Certification of services such as high tech radiology. ICD-9 codes up to 9/30/2015 and ICD-10 for 10/1/2015 services and forward.
- Payers
  - Payer readiness & claim testing, review updated Local Coverage Determinations (LCDs) from Medicare to determine ICD-10 guidelines for medical necessity
- Vendors/Systems
  - All software enhancements completed?
  - Has billing system been updated to include ICD-10 codes?
  - Has a cross walk been built between the most common ICD-9 codes to ICD-10?
- Physician Education & Training

PHM
REVENUE PROTECTION & ENHANCEMENT

Prepare for “Revenue Disruption”

- Insufficient documentation will require review by front office staff and physicians.
- Coder productivity is expected to drop by 10 to 25% which will mean a slower through-put of gross billings out the door.
- Payer Denials are expected to increase especially when documentation is lacking from a medical necessity perspective.
- Despite third party payers saying that they are ready to accept ICD-10 codes, problems will likely occur which will impact cash flow similar to when the 5010 Claim change occurred back in 2011 & 2012.

PHM
REVENUE PROTECTION & ENHANCEMENT

ICD-10 Example- Injury/Trauma

- ICD-10 has expanded categories for “injuries”
- A 7th character extension defines the encounter type:
  - “A” for initial encounter
  - “D” for subsequent encounter (active follow-up treatment)
  - “S” for Sequala (treating complications of injury or late effects)

- Documentation of injuries should include:
  - Specific Location of injury or trauma
  - Mechanism of injury (i.e. how & where it occurred, external causes)
  - Size
  - Depth of Injury

PHM
REVENUE PROTECTION & ENHANCEMENT

Injury Examples- ICD-10

Appropriate Physician Documentation

- "Left ankle sprain. Patient slipped on wet leaves on their driveway getting out of their car. Initial encounter for this problem."
- "Right knee injury. Patient was playing basketball and landed wrong and felt their knee twist. Initial encounter."

Documentation not ideal for ICD-10

- "Knee swelling and pain."
- "Shoulder pain. Patient fell."

- *In the above examples, the laterality is missing and the mechanism of the injury is missing.*
  - *In the first example, which knee and where did the fall occur and is this the initial encounter?*
  - *In the second example, which shoulder is injured and where did the fall occur? Was it work related? Is this the initial visit or subsequent encounter or late effect of a fall from the past?*

PHM
REVENUE PROTECTION & ENHANCEMENT

Neoplasm Coding in ICD-10

- ICD-9 classified neoplasm by site & behavior
- ICD-10 classifies neoplasms by site, behavior & morphology
  - Need to document:
    - Site/laterality
    - Behavior (benign, carcinoma in-situ, malignant, uncertain behavior, unspec)
    - Primary or secondary
    - Cell type or subtype
    - Acuity
  - ICD-10 appropriate example- “female patient with two malignant neoplasms of the left breast; one in the upper-outer quadrant and one in the lower-inner quadrant; primary”

PHM
REVENUE PROTECTION & ENHANCEMENT

Fracture Coding in ICD-10

- Initial
  - Open vs. closed (if not specified then closed is assumed)
  - Displaced vs. non-displaced (if not specified then displaced is assumed)
  - Traumatic vs. pathological
  - Specify Site of fracture
- Subsequent
  - Routine healing vs. delayed healing

PHM
REVENUE PROTECTION & ENHANCEMENT

Fracture Coding Example

- Subsequent encounter
  - Patient returns for x-rays one month after the date of injury
  - Radiologist's impression is routine healing of right subtrochanteric femur fracture. There is no indication of delayed healing, malunion or non-union.
  - ICD-10 Code is S72.21XD- displaced subtrochanteric fracture of right femur, subsequent encounter for closed fracture with routine healing

PHM
REVENUE PROTECTION & ENHANCEMENT

What Last Minutes Steps Should I Take?

- Practice ICD-10 documentation and coding prior to October 1, 2015. That way your practice will know what your gaps will be from a documentation & physician education perspective.
- Cross-walk your top 30 to 50 ICD-9 codes so that you can expedite workflow starting 10/1/2015 for those indications that are more straight-forward.
- Track your rejected claims after 10/1/2015 and pay attention to payer problems. Try to correct as soon as possible to minimize revenue disruption.
- Review pre-authorizations that were issued prior to 10/1/2015 but that were not yet scheduled for the service. These authorizations may need to be re-done and updated to ICD-10 coding requirements.

PHM
REVENUE PROTECTION & ENHANCEMENT

QUESTIONS?

Thank you!

PHM
REVENUE PROTECTION & ENHANCEMENT

PROSTATE MRI

Stephen McManus, MD

David Levi, MD

Prostate MRI - *Indications*

- INITIAL DETECTION, STAGING, PRE-ACTIVE SURVEILLANCE, RECURRENT TUMOR LOCALIZATION, RADIATION THERAPY PLANNING
- INITIAL DETECTION
  - Clinically suspected prostate cancer before or after TRUS negative biopsy
- STAGING in patients with biopsy proven prostate cancer
  - Low risk: confirm absence of more significant tumor to differentiate between active surveillance versus surgery
  - Intermediate risk: detect extra-capsular disease, assess neurovascular bundles
  - High risk: detect extra-capsular disease, nodes and bones
- RADIATION THERAPY PLANNING
  - Limit collateral damage
- RECURRENT TUMOR LOCALIZATION
  - PSA relapse after definitive therapy

Dynamic Contrast-enhanced–magnetic Resonance Imaging Evaluation of Intraprostatic Prostate Cancer: Correlation with Radical Prostatectomy Specimens

Philippe Puech, Eric Potiron, Laurent Lemaitre, Xavier Leroy, Georges-Pascal Haber, Sebastien Crouzet, Kazumi Kamoi, and Arnauld Villers

OBJECTIVES To determine the diagnostic performance of dynamic contrast-enhanced–magnetic resonance imaging (DCE-MRI) in the identification of intraprostatic cancer foci related to cancer volume at histopathology, in patients with clinically localized cancer treated by radical prostatectomy, with whole-mount histopathologic sections as the reference standard.

METHODS Eighty-three consecutive radical prostatectomy specimens from patients referred for a prostate-specific antigen elevation were correlated with prebiopsy MRI. MRI results ranked on a 5-point scale were correlated with the findings of histopathology maps in 8 prostate sectors, including volume, largest surface area, and percentage of Gleason grade 4/5. The area under the receiver operating characteristic curve was used.

RESULTS Median prostate-specific antigen was 8.15 ng/mL. DCE-MRI was suspicious in 55 (66%) out of 83 patients. A separate cancer foci (mean 2.55 per patient) was present in 212 (34%) of 664 octants and DCE-MRI was suspicious in 68 of 212. Sensitivity and specificity of DCE-MRI at score 3.4 or 5 for identification of cancer foci at any volume was 32% and 95%, respectively. For identification of cancer foci > 0.5 mL, the sensitivity and specificity were 86% and 94%, respectively, with the under the receiver operating characteristic curve of 0.874. Mean volume of DCE-MRI detected and missed cancers were 2.44 mL (0.02-14.5) and 0.16 mL (0.005-2.4), respectively. Sensitivity and specificity of DCE-MRI for identification of > 10% of Gleason grade 4/5 were 81% and 82%, respectively.

CONCLUSIONS DCE-MRI can accurately identify intraprostatic cancer foci. Possible applications are guidance for biopsies, selection of patients for watchful waiting, and focal treatment planning. UROLOGY 74: 1094–1100, 2009.

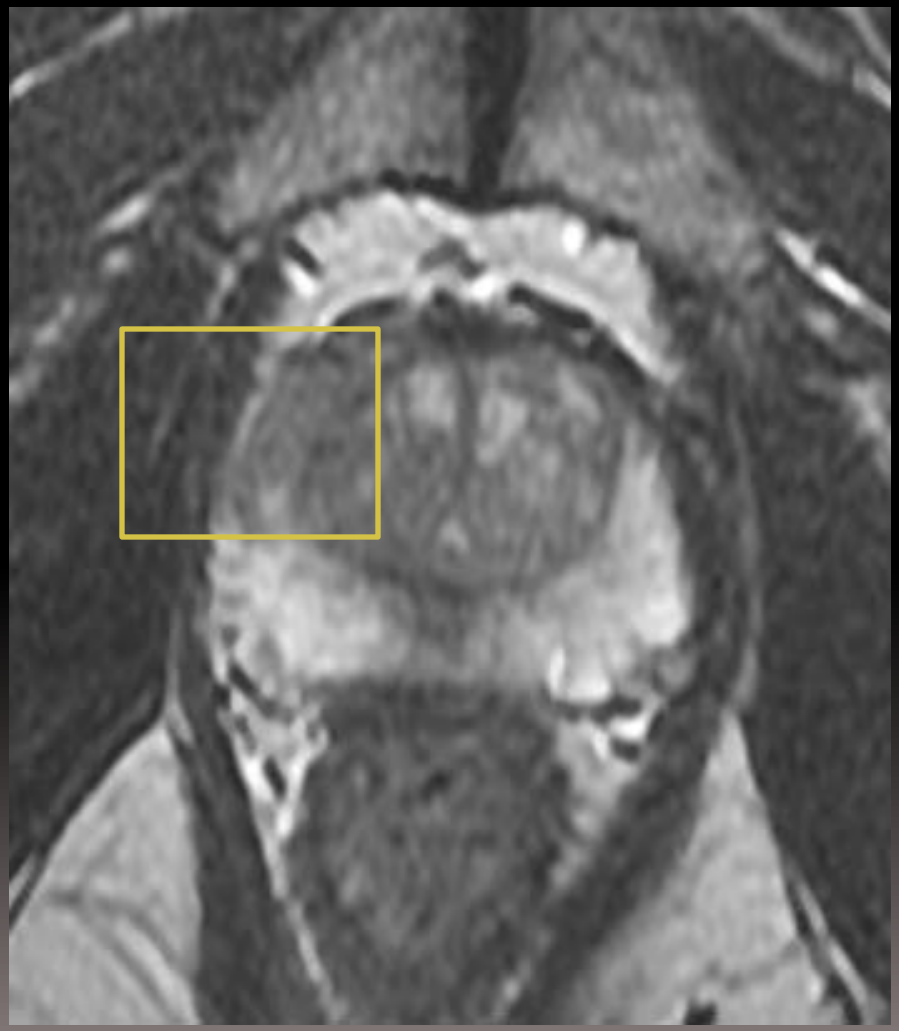
The detection of a prostatic cancer relies on systematic biopsies in case of increased prostate-specific antigen (PSA) or abnormal digital rectal examination. Magnetic resonance imaging (MRI) is commonly used after a negative systematic transrectal ultrasound (TRUS)-guided biopsy and a high cancer suspicion, to find an abnormality and/or to detect extraprostatic or lymph node invasion. A better knowledge of preoperative cancer characteristics, that is, location, size, surface area, cancers than in benign prostate tissues.[1] It was shown that prostate MRI using a high-resolution pelvic phased-array (PPA) coil either stand alone[2] or combined with endorectal coil[3] and of T1-weighted imaging (T1-WI) sequences may result in higher localization rates due to better signal homogeneity, especially in the anterior compartment.[4] Current MRI protocols can combine other MRI sequences including proton spectroscopy or diffusion-weighted imaging.[5,6] In a recent review of the

DETECTION

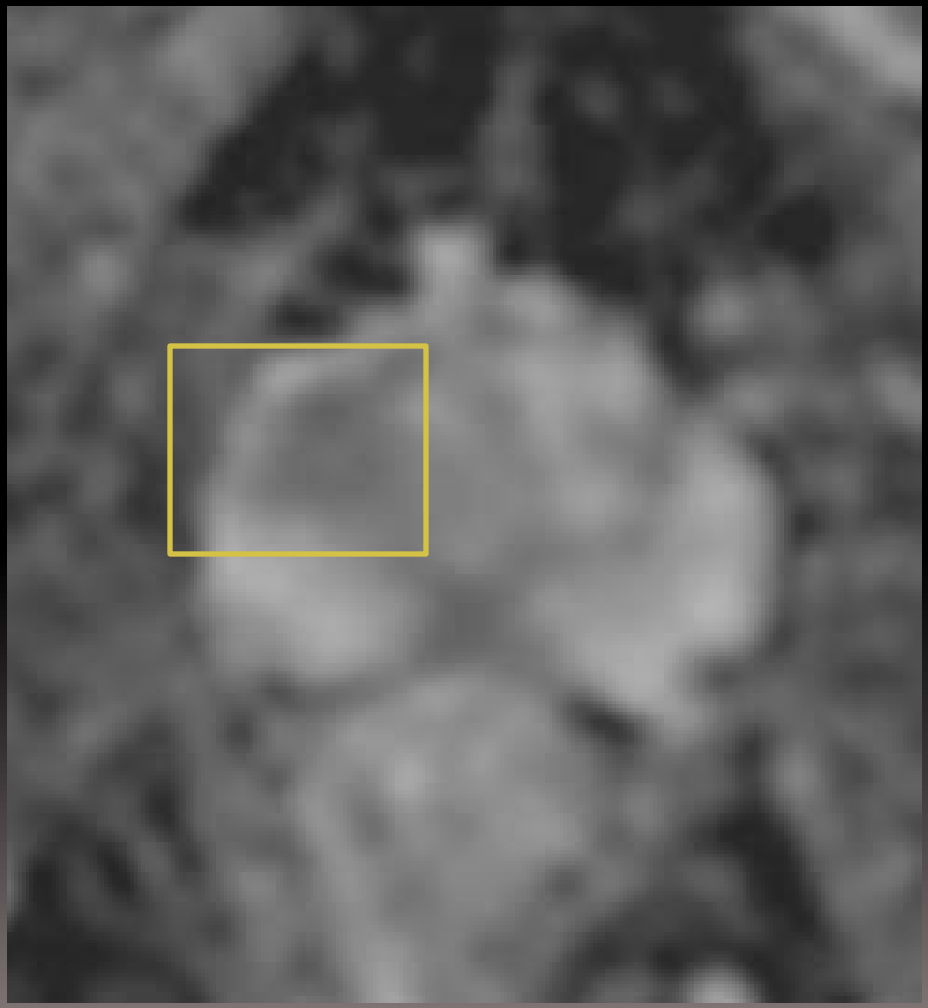
- 83 patients
  - Pre-biopsy MRI followed by radical prostatectomy
  - Specimens compared with pre-biopsy MRI results
- PPV of MRI was 76% (68/90)
- NPV of MRI was 75% (498/664)
- For cancer > 0.5 cc:
  - sensitivity of 86%
  - specificity of 94%

Puech P, Potiron E, Lemaitre L, et al. Dynamic contrast-enhanced-magnetic resonance imaging evaluation of intraprostatic prostate cancer: Correlation with radical prostatectomy specimens. Urology 2009;74:1094-99.

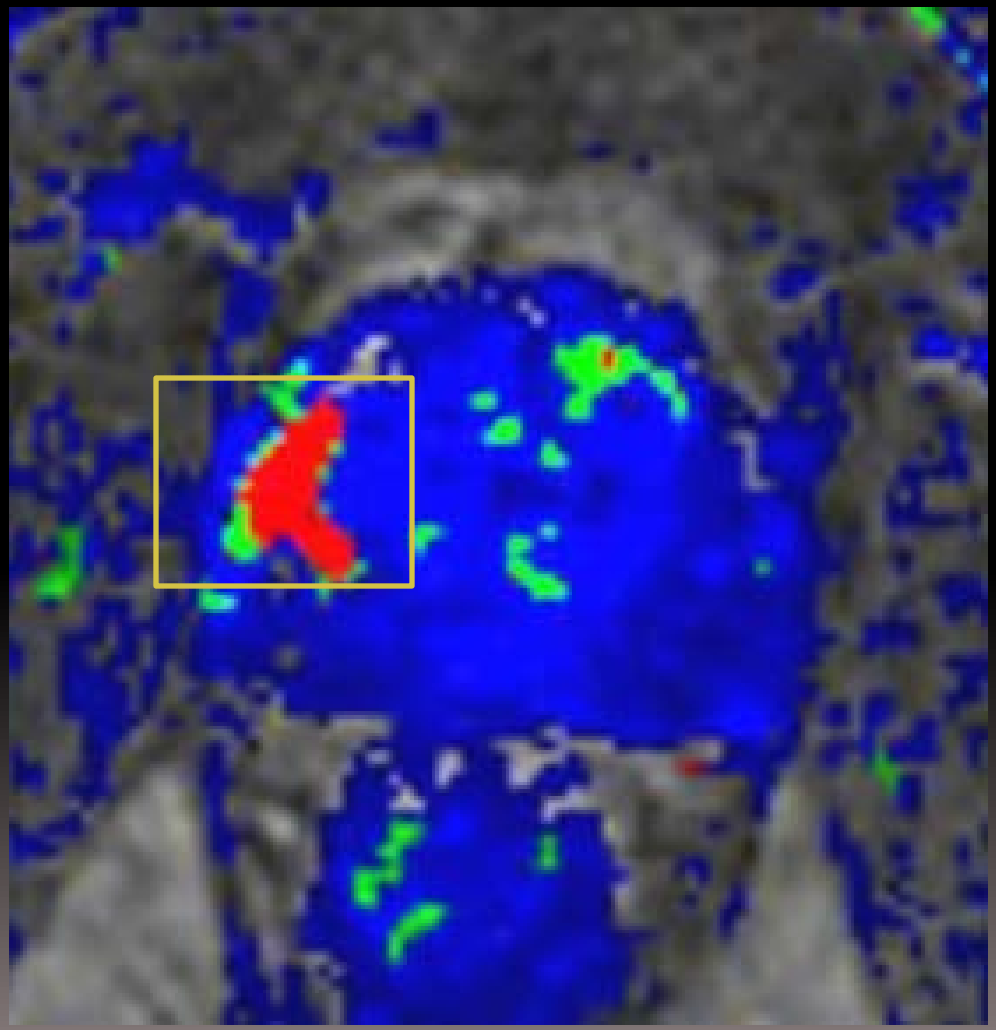
65 yo PSA=5.9
Negative TRUS biopsy



ADC map= restricted diffusion



Color Map = Rapid wash in & washout



Targeted re-biopsy: Gleason 6 cancer

Staging low risk patients prior to active surveillance

Percentage of men under active surveillance for insignificant prostate cancer reclassified as significant cancer at 2 years is :

20–30%

BJUI

Preoperative nomograms incorporating magnetic resonance imaging and spectroscopy for prediction of insignificant prostate cancer

Amita Shukla-Dave[*†], Hedvig Hricak[†], Oguz Akin[†], Changhong Yu[‡], Kristen L. Zakian[*†], Kazuma Udo[§¶], Peter T. Scardino[§], James Eastham[§] and Michael W. Kattan[‡]

Departments of [*]Medical Physics, [†]Radiology and [‡]Urology, Memorial Sloan-Kettering Cancer Center, New York, NY, [†]Department of Quantitative Health Sciences, Cleveland Clinic, Cleveland, OH, USA, and [¶]Department of Urology and Department of Urology and Microbiology, Faculty of Medicine, Saga University, Saga, Japan

Accepted for publication 10 June 2011

Study Type – Prognosis (case series)
Level of Evidence 4

What's known on the subject? and What does the study add?
Nomograms are available that combine clinical and biopsy findings to predict the probability of pathologically insignificant prostate cancer in patients with clinically low-risk disease. Based on data from patients with Gleason score 6, clinical stage ≤ T2a and PSA <20 ng/ml, our group developed the first nomogram models for predicting insignificant prostate cancer that incorporated clinical data, detailed biopsy data and findings from MRI or MRI/MRSI (BJU Int. 2007;99(4):786–93). When tested retrospectively, these MR models performed significantly better than standard clinical models with and without detailed biopsy data.

We prospectively validated the previously published MR-based nomogram models in a population of patients with Gleason score 6, clinical stage ≤ T2a and PSA <10 ng/ml. Based on data from this same population, we also developed two new models for predicting insignificant prostate cancer that combine MR findings and clinical data without detailed biopsy data. Upon initial testing, the new MR models performed significantly better than a clinical model lacking detailed biopsy data.

OBJECTIVES

- To validate previously published nomograms for predicting insignificant prostate cancer (PCa) that incorporate clinical data, percentage of biopsy cores positive (%BC+) and magnetic resonance imaging (MRI) or MRI/MR spectroscopic imaging (MRSI) results.
- We also designed new nomogram models incorporating magnetic resonance results and clinical data without detailed biopsy data. Nomograms for predicting insignificant PCa can help physicians counsel patients with clinically low-risk disease who are choosing between active

- There were four models incorporating MRI or MRI/MRSI and clinical data with

and similarly to the more comprehensive clinical model.

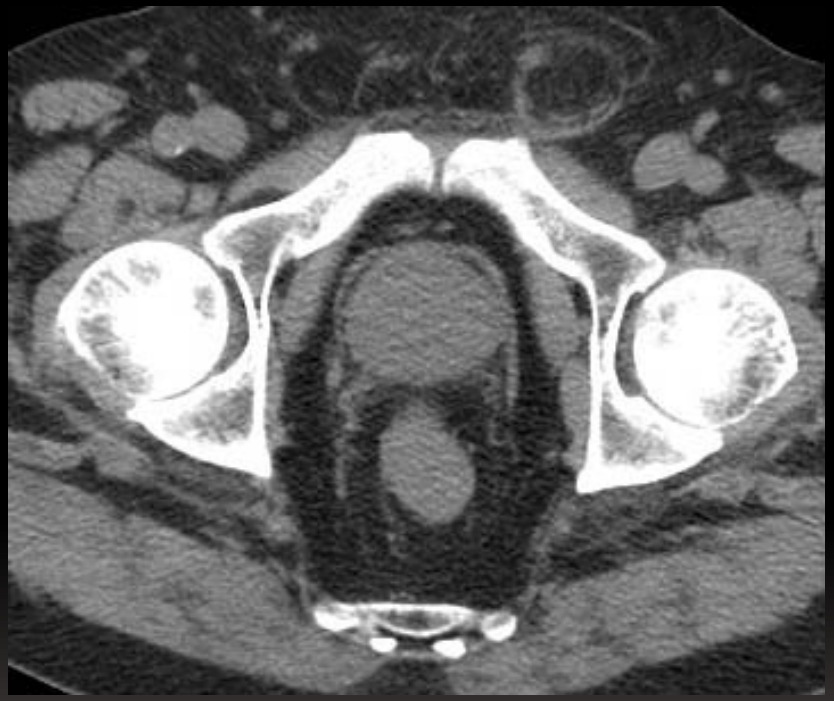
Low risk patients

- 181 low risk prostate cancer patients
- All had MRI before prostatectomy
- At surgical pathology, Gleason score was upgraded in 56% of patients
- MRI performed better than regular clinical models in predicting likelihood of insignificant disease

Shukla-Dave A, Hricak H, Akin O, et al. Preoperative nomograms incorporating magnetic resonance imaging and spectroscopy for prediction of insignificant prostate cancer. BJU International 2011;109:1315-22.

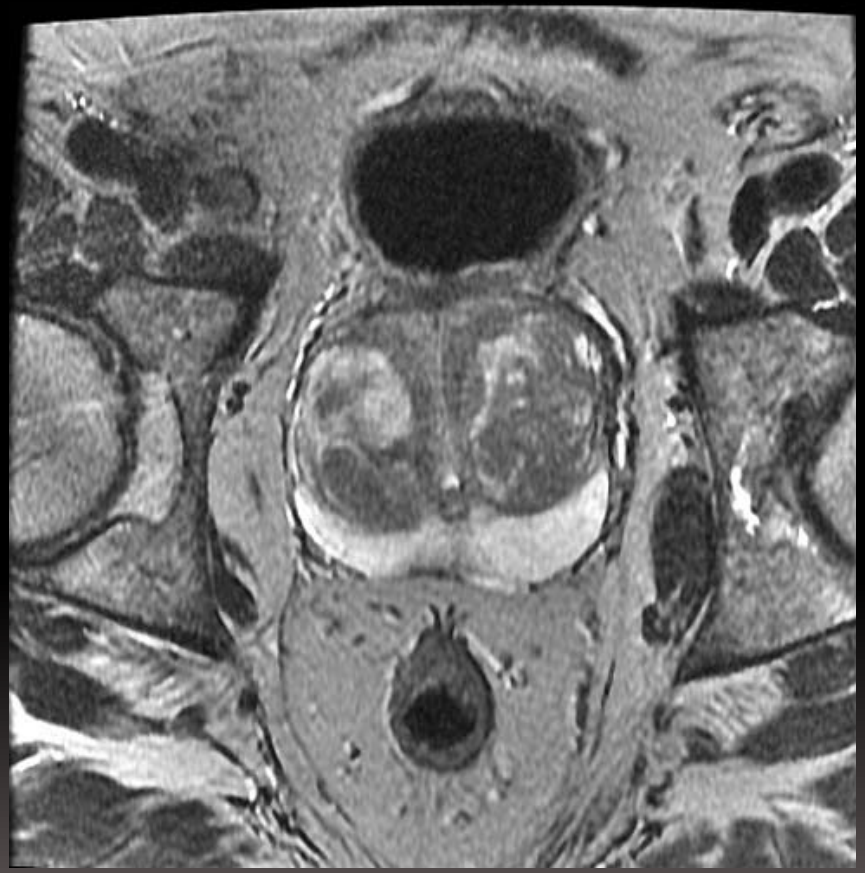
Imaging for radiation therapy planning

- CT typically used for external beam therapy due to ability to acquire 3D data set
- CT however is limited by:
  - Poor organ delineation
  - Ability to acquire images only in axial plane



MRI for radiation therapy planning

- MRI offers three main benefits:
  - Better spatial resolution = detailed anatomy and less collateral damage
  - Multiplanar acquistion
  - Target lesions for boosting



Strahlentherapie
und Onkologie

Original Article

Definition of the CTV Prostate in CT and MRI by Using CT–MRI Image Fusion in IMRT Planning for Prostate Cancer

Bettina Hentschel[1], Wolfgang Oehler[1], Dirk Straußß[1], Andreas Ulrich[2], Ansgar Malich[2], Bettina Hentschel[3]

Purpose: To determine the prostate volumes defined by using MRI and CT scans, as well as the difference between prostate delineation in MRI and CT in three dimensions (3D). A further goal was to use MRI to identify subgroups of patients in whom seminal vesicle irradiation can be avoided.

Methods and Materials: A total of 294 patients with biopsy-proven prostate cancer (MRI stages: T_1, 16 [5%]; T_2, 84 [29%]; T_3, 191 [65%]; T_4, 3 [1%]) underwent pelvic CT and MRI scans before intensity-modulated radiation therapy (IMRT) planning. 3D images were used to compare the prostate volumes defined by superimposed MR and CT images. Prostate volumes were calculated in cm^3.

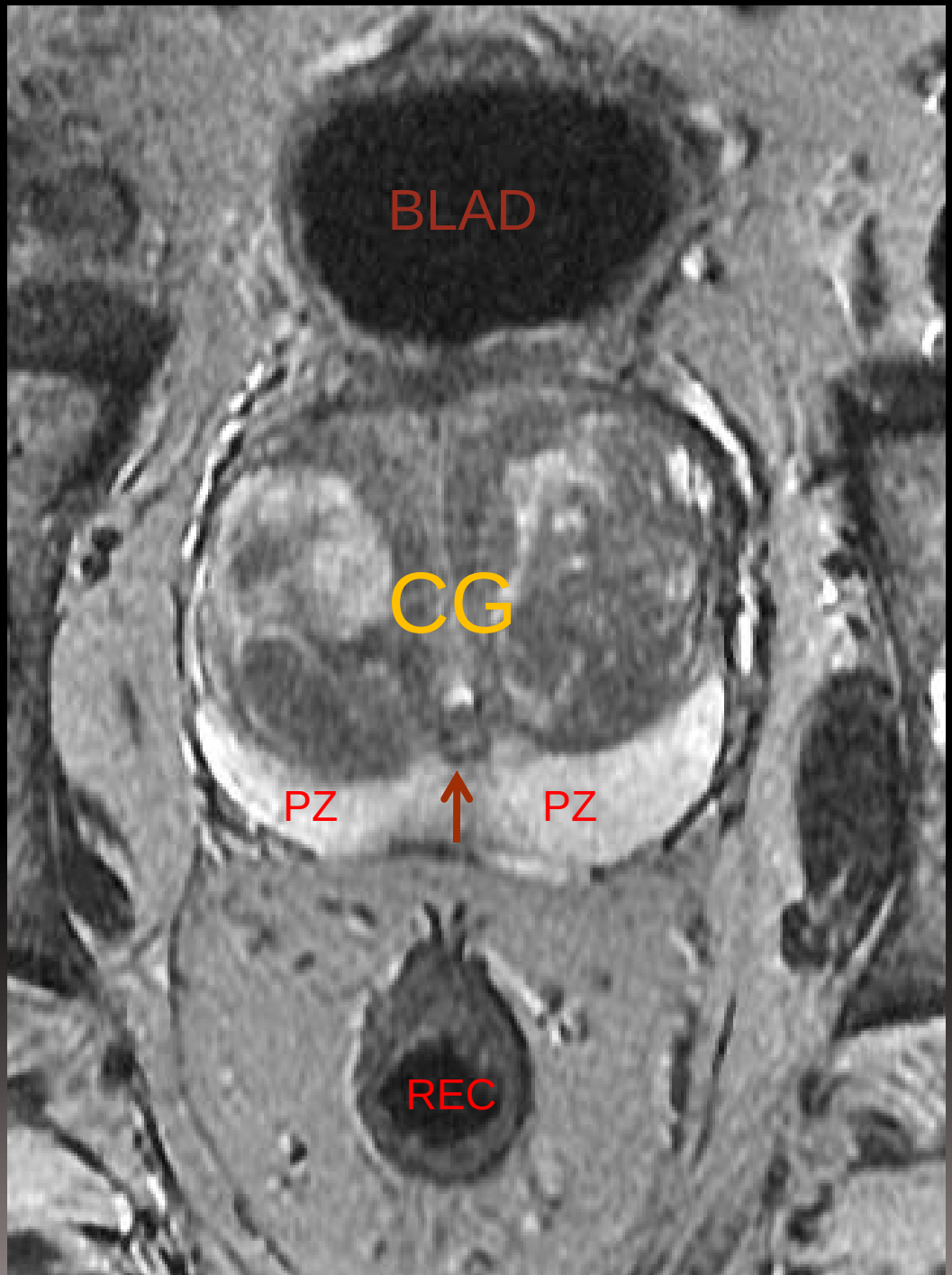
Results: The mean prostate volume defined by MRI (44.3 cm^3 [range, 8.8–182.8 cm^3]) was 35% smaller than that defined by CT (68.5 cm^3 [range, 15.2–241.3 cm^3]). The areas of nonagreement were observed predominantly in the most superior and inferior portions of the prostate. The incidence of seminal vesicle invasion (SVI) identified by MRI was 63% (n = 182 of 290). The median length of SVI was 2.6 cm (range, 1.1–4.7 cm; 62% of the median SV length). The low-risk patients (59%, n = 171 of 290) calculated by applying the Roach and Diaz formula had a SVI rate of 57% (n = 97 of 171), the high-risk patients (41%, n = 119 of 290) of 71% (n = 85 of 119).

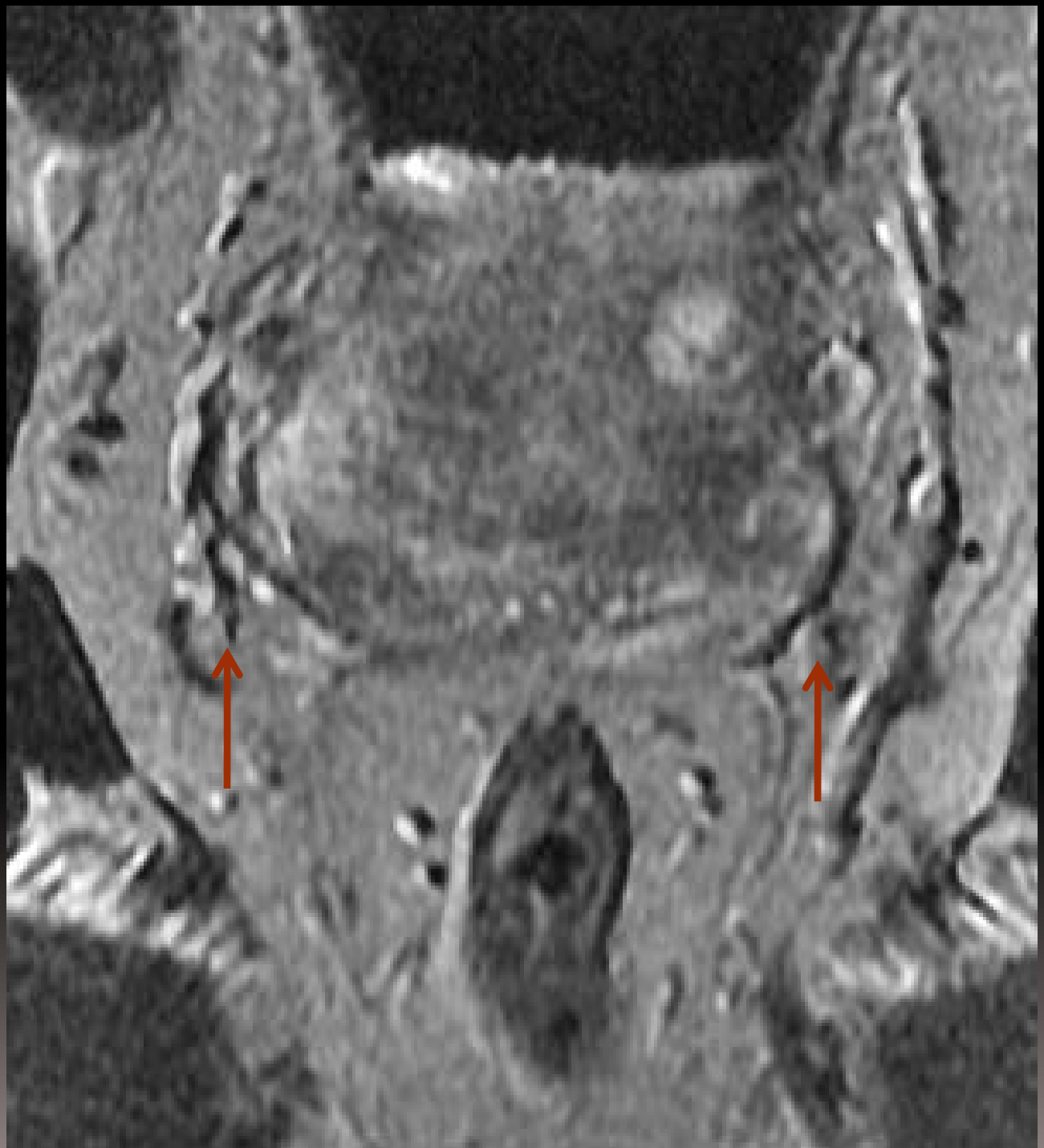
Conclusions: Compared with MRI, CT scans overestimate prostate volume by 35%. CT–MRI image fusion-based treatment planning allows more accurate prediction of the correct staging and more precise target volume identification in prostate cancer patients.

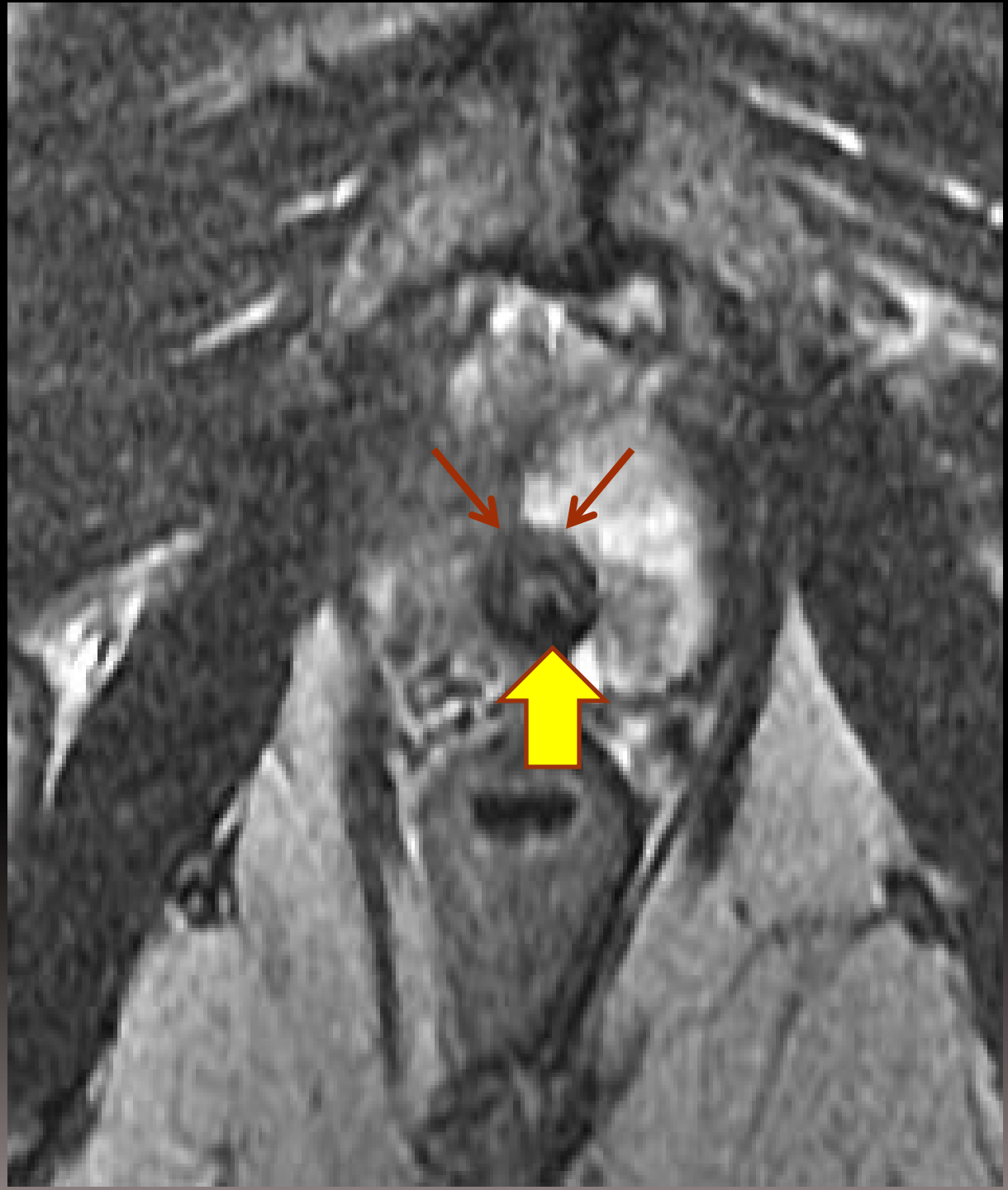
Key Words: Prostate cancer · MRI · Definition of prostate CTV · IMRT

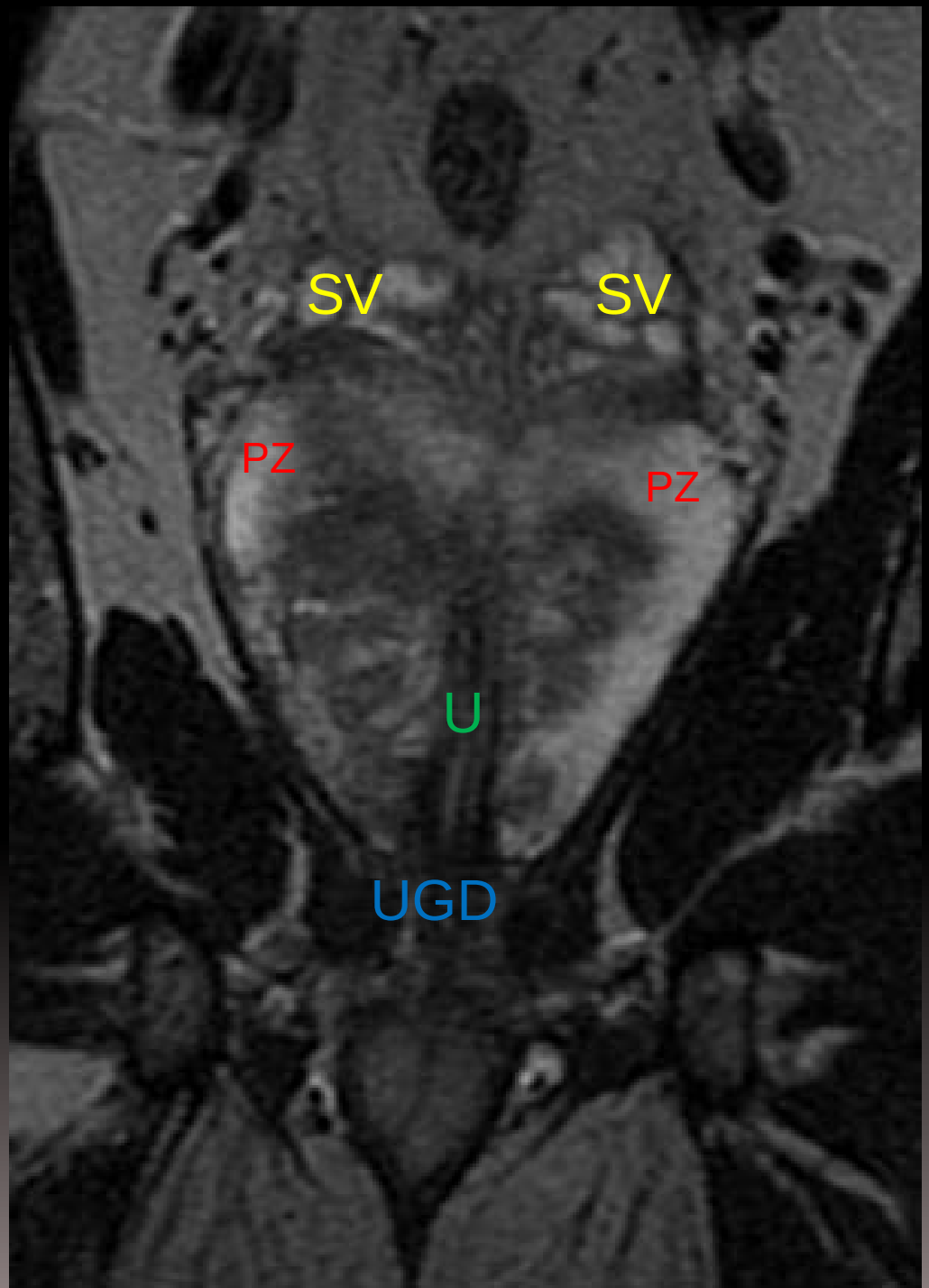
Defining CTV with MRI vs. CT

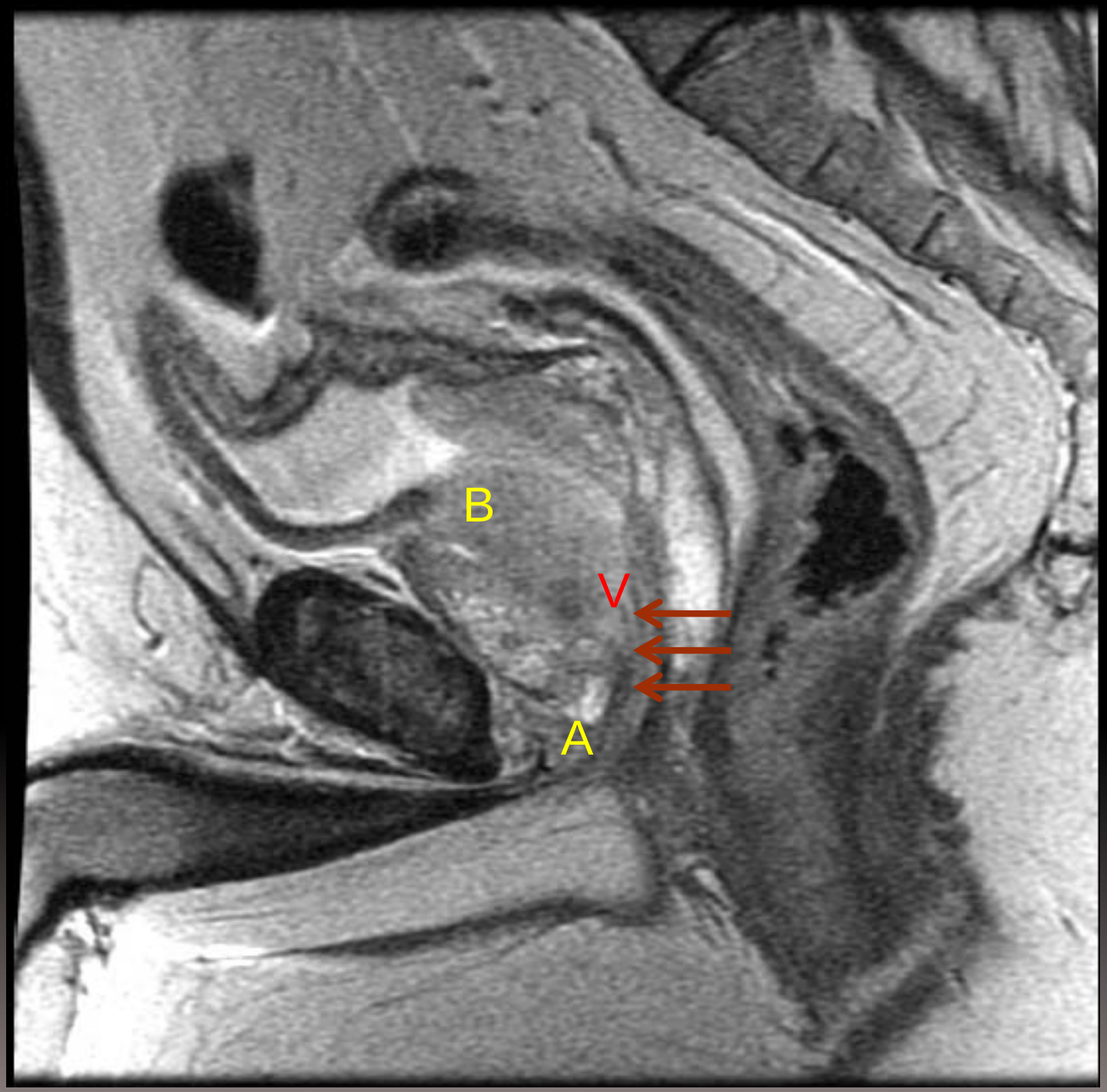
- 294 patients with prostate cancer underwent MRI and CT prior to IMRT
- 3D images were used to calculate volume on MRI and CT
- Mean prostate volume was 35% smaller than mean CT volume
- MRI also more correctly identified SV invasion when compared with Roach-Diaz model
  - Limiting SV radiation reduces irradiated rectal volumes


BLAD
CG
PZ
PZ
REC






SV
SV
PZ
PZ
U
UGD


B
V
A

Recurrent tumor localization

- Evaluate patients with biochemical failure
- Biopsy proven recurrence rate after radical prostatectomy: 32-54%
- Digital rectal examination and TRUS are often inadequate in detecting recurrent disease

Endorectal and Dynamic Contrast-Enhanced MRI for Detection of Local Recurrence After Radical Prostatectomy

Emanuele Casciani[1]
Elisabetta Polettini[1]
Enrico Carmenini[2]
Irene Floriani[3]
Gabriele Masselli[1]
Luca Bertini[1]
Gian Franco Gualdi[1]

OBJECTIVE. The objective of our study was to evaluate the sensitivity and specificity of endorectal MRI combined with dynamic contrast-enhanced MRI to detect local recurrence after radical prostatectomy.

MATERIALS AND METHODS. A total of 51 patients who had undergone radical prostatectomy for prostatic adenocarcinoma 10 months to 6 years before underwent a combined endorectal coil MRI and dynamic gadolinium-enhanced MRI before endorectal sonographically guided biopsy of the prostatic fossa. The MRI combined with MR dynamic imaging results were correlated with the presence of recurrence defined as a positive biopsy result or reduction in prostate-specific antigen level after radiation therapy.

RESULTS. Overall data of 46 (25 recurred, 21 nonrecurred) out of 51 evaluated patients were analyzed. All recurrences showed signal enhancement after gadolinium administration and, in particular, 22 of 24 patients (91%) showed rapid and early signal enhancement. The overall sensitivity and specificity of MR dynamic imaging was higher compared with MRI alone (88%, [95% CI] 69–98% and 100%, 84–100% compared with 48%, 28–69% and 52%, 30–74%). MRI combined with dynamic imaging allowed better identification of recurrences compared with MRI alone (McNemar test: chi-square$_1$ = 16.67; $p = < 0.0001$).

CONCLUSION. MRI combined with dynamic contrast-enhanced MRI showed a higher sensitivity and specificity compared with MRI alone in detecting local recurrences after radical prostatectomy.

Keywords: contrast-enhanced MRI, MRI, prostate neoplasm, recurrence

In patients with prostate cancer, the site of disease recurrence after radical prostatectomy is a critical issue because it may greatly influence the subsequent therapeutic strategy and patient management. Local recurrence of prostate cancer after radical tomy is a fundamental issue for therapy and follow-up of these patients.

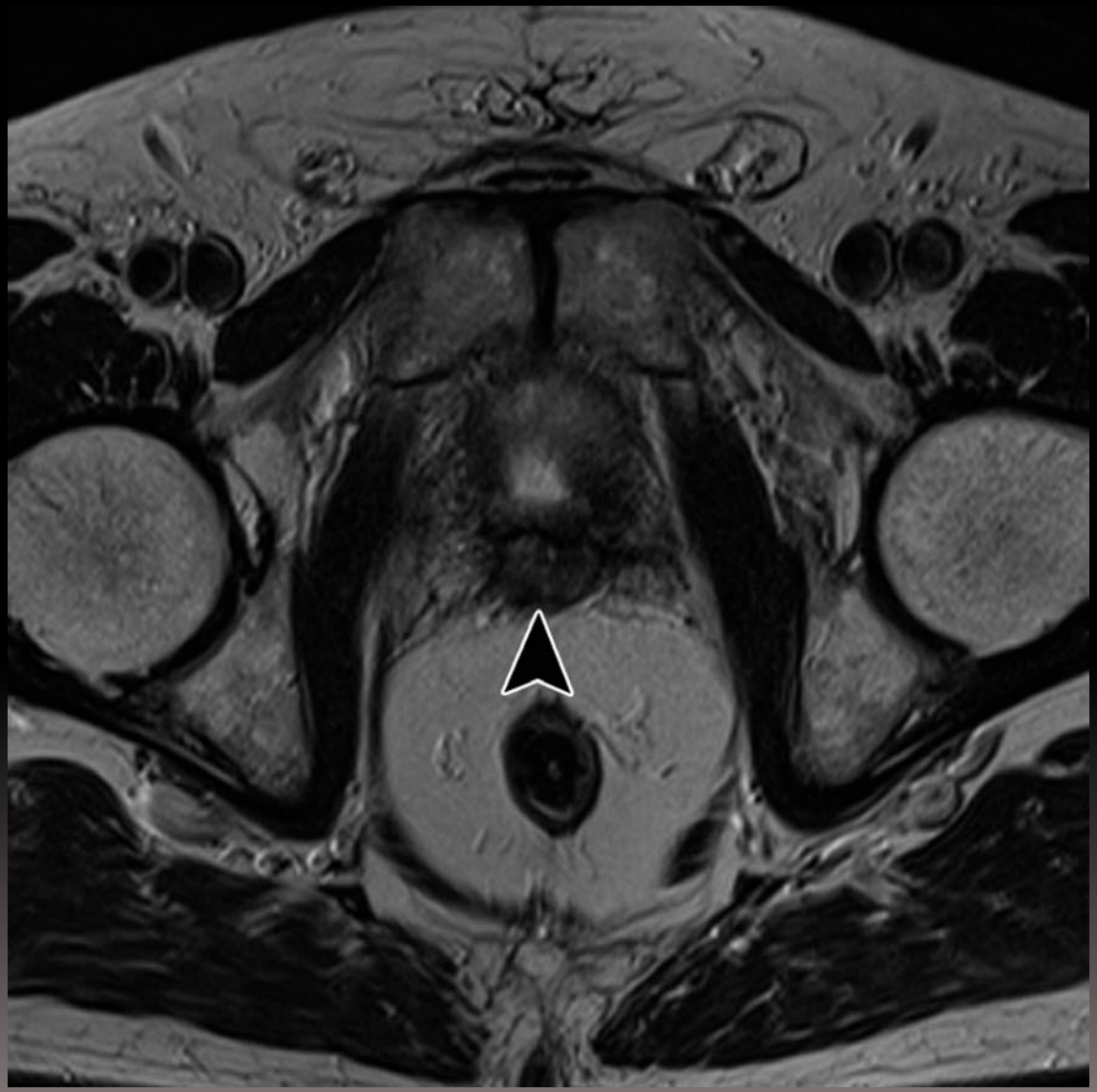
Digital rectal examination (DRE) has been shown to be inadequate in detecting local recurrences [5]. Although endorectal sonography (transrectal ultrasonography, TRUS) is better than DRE for detecting local recur-

Recurrent tumor localization

- 46 patients with biochemical failure underwent MRI followed by TRUS biopsy
  - 25 patients: recurrent tumor
  - 21 patients: no tumor
- DCE MRI for detection of recurrent tumor
  - sensitivity of 88% (22/25)
  - specificity of 100% (21/21)

Casciani E, Polettini E, Carmenini E, et al. Endorectal and dynamic contast-enhanced MRI for detection of local recurrence after radical prostatectomy. AJR 2008;190:1187-92.

Recurrent tumor localization



Sample Report

The following is a report on the examinations performed on the above captioned patient at the GALLOWAY office.

MRI PROSTATE WITH AND WITHOUT INTRAVENOUS CONTRAST

HISTORY: Elevated PSA.

PSA: 6.

COMPARISON: None.

TECHNIQUE: Magnetic resonance imaging of the prostate was performed on a 3 Tesla magnet with a surface phased array coil utilizing multiplanar T1, T2 weighted, diffusion weighted, and dynamic post contrast sequences. Postprocessing was performed with iCAD VividLook software.

CONTRAST: 20 cc IV Optimark.

FINDINGS:

Prostate size: 5.5 x 4.8 x 3.5 cm.
Prostate volume: 46 cc.

Central gland: Heterogenous with no discrete nodule. There is prominence of the median lobe.

Peripheral zone: There are 2 lesions which are low suspicion for malignancy and requires targetedrebiopsy including:

Left mid PZ: 19 x 12 x 9 mm lesion series 9 image 17 and series 5 image 9. This lesion is located 14 mm anterior to the posterior capsule. The midportion of this lesion is 15 mm from the midline. This lesion fills segment 4A. The lesion is low signal on T2, has a type II enhancement and no restricted diffusion.

Left apex: 8 x 8 x 7 mm lesion series 9 image 21 and series 10 image 10. This lesion abuts on the posterior capsule. The center of the lesion is 7 mm from the midline. This lesion straddles segments 5p and 6p. This lesion is low signal on T2, has a type II enhancement and mild restricted diffusion.

Capsule: Intact and smooth without bulging.

Neurovascular bundle: Intact with no evidence of invasion.
Seminal vesicles: Symmetric and within normal limits.

Bladder: Within normal limits.
Pelvic soft tissues: Within normal limits.
Lymph nodes: No adenopathy.
Bones : No aggressive bone lesions.

IMPRESSION:

Parkwood Professional Park · Suite 101 · 44 E. Jimmie Leeds Road · Galloway, NJ 08205 · (609) 677-XRAY (9729) · Fax: (609) 652-6512

Sample Report

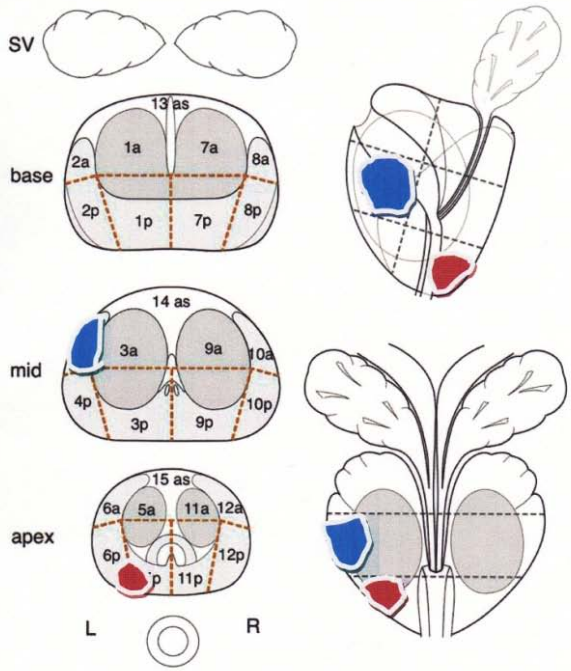
Atlantic Medical Imaging

❒ 44 E. Jimmie Leeds Road, Galloway, NJ 08205
❒ 30 E. Maryland Avenue, Somers Point, NJ 08244
❒ 3100 Hingston Avenue, Egg Harbor Township, NJ 08234
(609) 677-XRAY (9729)

MRI PROSTATE

Patient Name: [redacted] **MRN:** [redacted]
Date of Procedure: August 24, 2012

Twenty-seven Regions of Interest



Twelve posterior (p) and twelve anterior (a) glandular regions - mediolobar and lateral at base, mid and apex.
Three anterior stroma (as) central regions.

PI-RADS reporting:

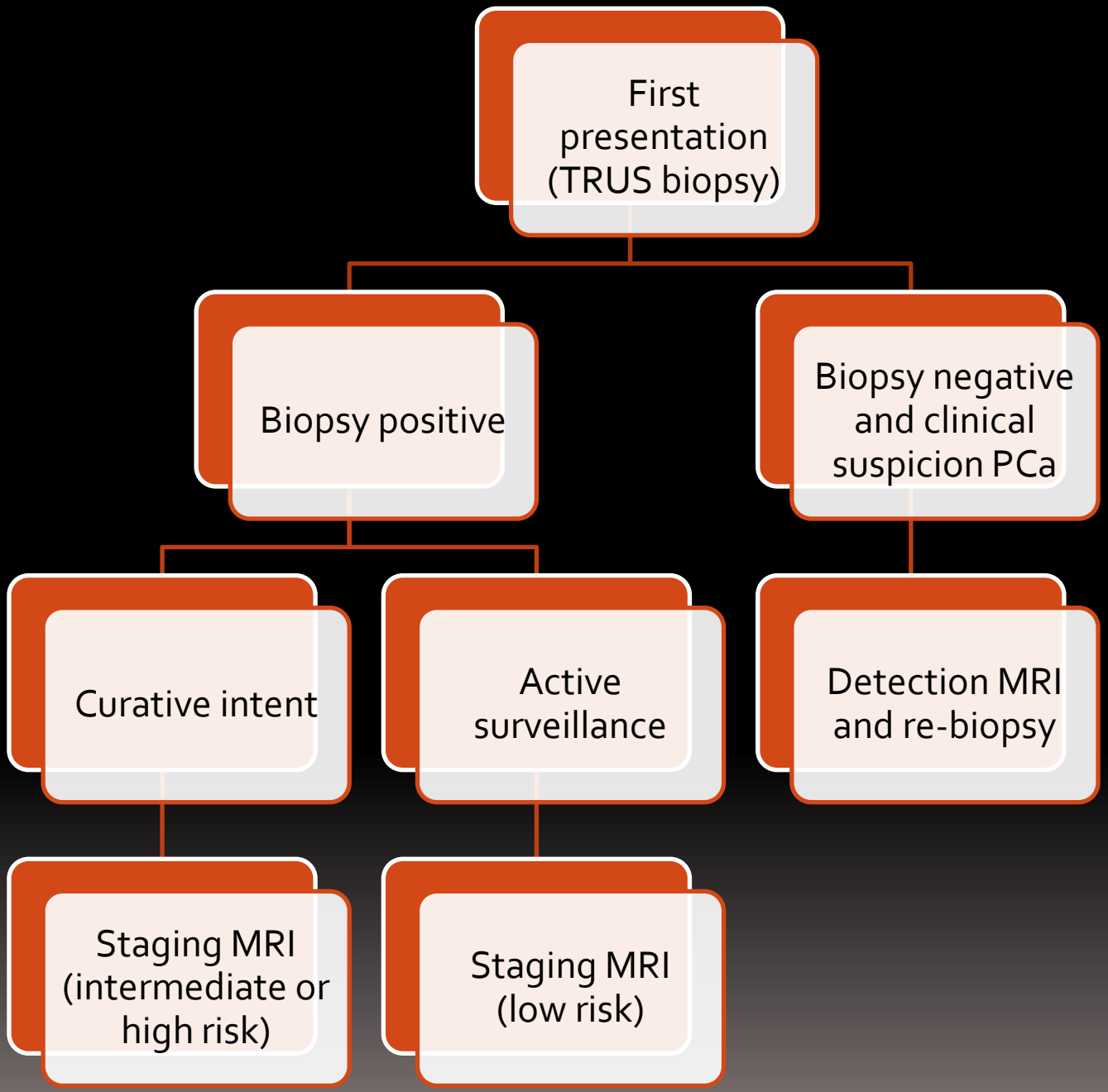
- 1: Benign features
- 2: Low suspicion
- 3: Intermediate suspicion
- 4: High suspicion
- 5: Consistent with cancer

Prostate MRI Summary

- MRI is the OPTIMAL modality for imaging the prostate
- Multi-parametric approach required to maximize sensitivity and specificity of exam
- Endorectal coil not required
- MRI before radiation therapy affords less collateral damage and better lesion targeting

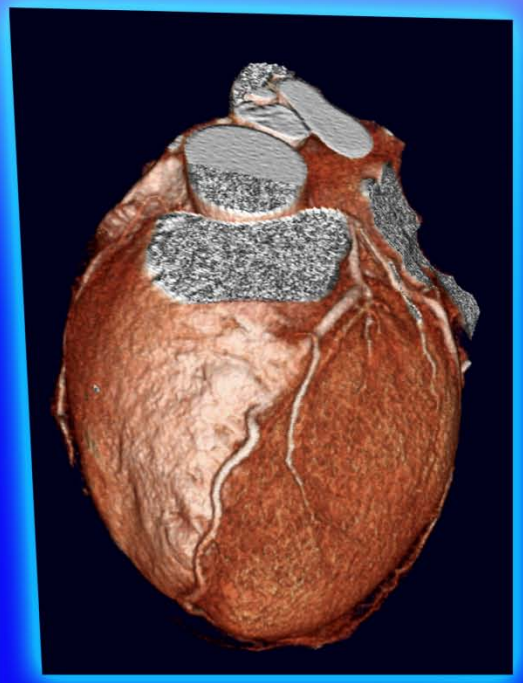
Prostate MRI Summary

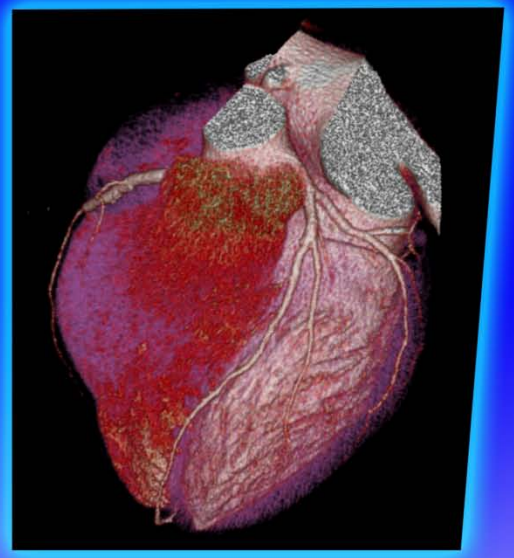
- TRUS negative biopsy : 50% will be recommended for targeted rebiopsy.
- Targeted rebiopsy: 30% positive.
- Active surveillance: MR outperforms standard nomograms for confirming insignificant disease.
- Pre-op ECE/NVB: 72% accuracy
- Suspected recurrent tumor: 88% sensitive.

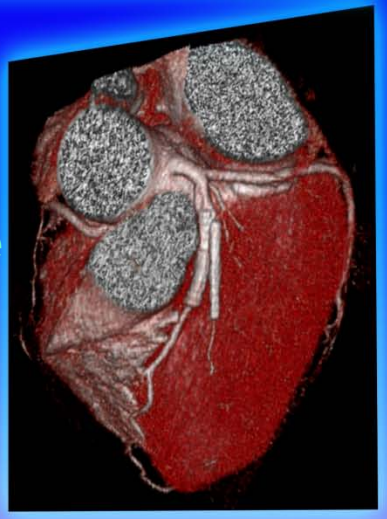

First presentation (TRUS biopsy)
Biopsy positive
Biopsy negative and clinical suspicion PCa
Curative intent
Active surveillance
Detection MRI and re-biopsy
Staging MRI (intermediate or high risk)
Staging MRI (low risk)

Thank you

Current Applications & Prospects of Coronary CT Angiography







Armin A. Zadeh MD PhD MPH
Associate Professor of Medicine
Associate Director, Cardiac CT
Division of Cardiology
Johns Hopkins University
Baltimore, MD

Disclosures

No financial conflicts of interest

Objectives

1. Provide an overview of the current clinical applications of coronary CTA
2. Discuss scan preparation and risks from CTA
3. Discuss reimbursement issues
4. Provide an outlook on emerging applications

Journal of the American College of Cardiology
© 2010 by the American College of Cardiology Foundation
Published by Elsevier Inc.

Vol. 56, No. xx, 2010
ISSN 0735-1097/$36.00
doi:10.1016/j.jacc.2010.07.005

APPROPRIATE USE CRITERIA

ACCF/SCCT/ACR/AHA/ASE/ASNC/SCAI/SCMR 2010 Appropriate Use Criteria for Cardiac Computed Tomography

A Report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, the Society of Cardiovascular Computed Tomography, the American College of Radiology, the American Heart Association, the American Society of Echocardiography, the American Society of Nuclear Cardiology, the Society for Cardiovascular Angiography and Interventions, and the Society for Cardiovascular Magnetic Resonance

Taylor AJ et al, J Am Coll Cardiol. 2010 23;56:1864-94

Summary for Appropriate Coronary CTA

Rule out CAD in symptomatic patients of low-intermediate pretest probability

Appropriateness Criteria – Use of CTA in Symptomatic Patients

Pretest Probability of CAD	Low	Intermediate	High
• ECG interpretable AND • Able to exercise	U (5)	A (7)	I (3)
• ECG uninterpretable OR • Unable to exercise	A (7)	A (8)	U (4)

Taylor AJ et al, J Am Coll Cardiol. 2010 23;56:1864-94

Assessment of Pre-Test Probability of CAD

Age	Sex	Typical/Definite Angina Pectoris	Atypical/Probable Angina Pectoris	Nonanginal Chest Pain	Asymptomatic
<39	Men	Intermediate	Intermediate	Low	Very low
	Women	Intermediate	Very low	Very low	Very low
40–49	Men	High	Intermediate	Intermediate	Low
	Women	Intermediate	Low	Very low	Very low
50–59	Men	High	Intermediate	Intermediate	Low
	Women	Intermediate	Intermediate	Low	Very low
>60	Men	High	Intermediate	Intermediate	Low
	Women	High	Intermediate	Intermediate	Low

Women <50 are of low pretest probability unless they have typical angina

Only men <40 with nonanginal pain are of low pretest probability

Taylor AJ et al, J Am Coll Cardiol. 2010 23;56:1864-94

Appropriateness Criteria – Use of CTA in Symptomatic Patients

Sequential Testing After Stress Imaging Procedures			
• Discordant ECG exercise and imaging results	A (8)		
Test Result/Ischemia	**Equivocal**	**Mild**	**Moderate or Severe**
• Prior stress imaging procedure	A (8)	U (6)	I (2)

Taylor AJ et al, J Am Coll Cardiol. 2010 23;56:1864-94

CT vs. SPECT for Diagnosis of CAD

CORE320, patients without history of CAD, n=232

	CTA	SPECT	p-value
AUC	**0.92** (0.88-0.95)	**0.67** (0.61-0.73)	<0.001
Sensitivity	**0.91** (0.84-0.96)	**0.56** (0.46-0.65)	<0.001
Specificity	**0.80** (0.72-0.87)	**0.69** (0.60-0.77)	0.08
PPV	**0.81** (0.73-0.88)	**0.62** (0.52-0.72)	<0.001
NPV	**0.91** (0.84-0.96)	**0.63** (0.54-0.71)	<0.001

Arbab-Zadeh A et al. Circulation CV Imaging 2015, in press

Outcome after CTA

Meta-Analysis from 32 studies, 41,960 patients

34%

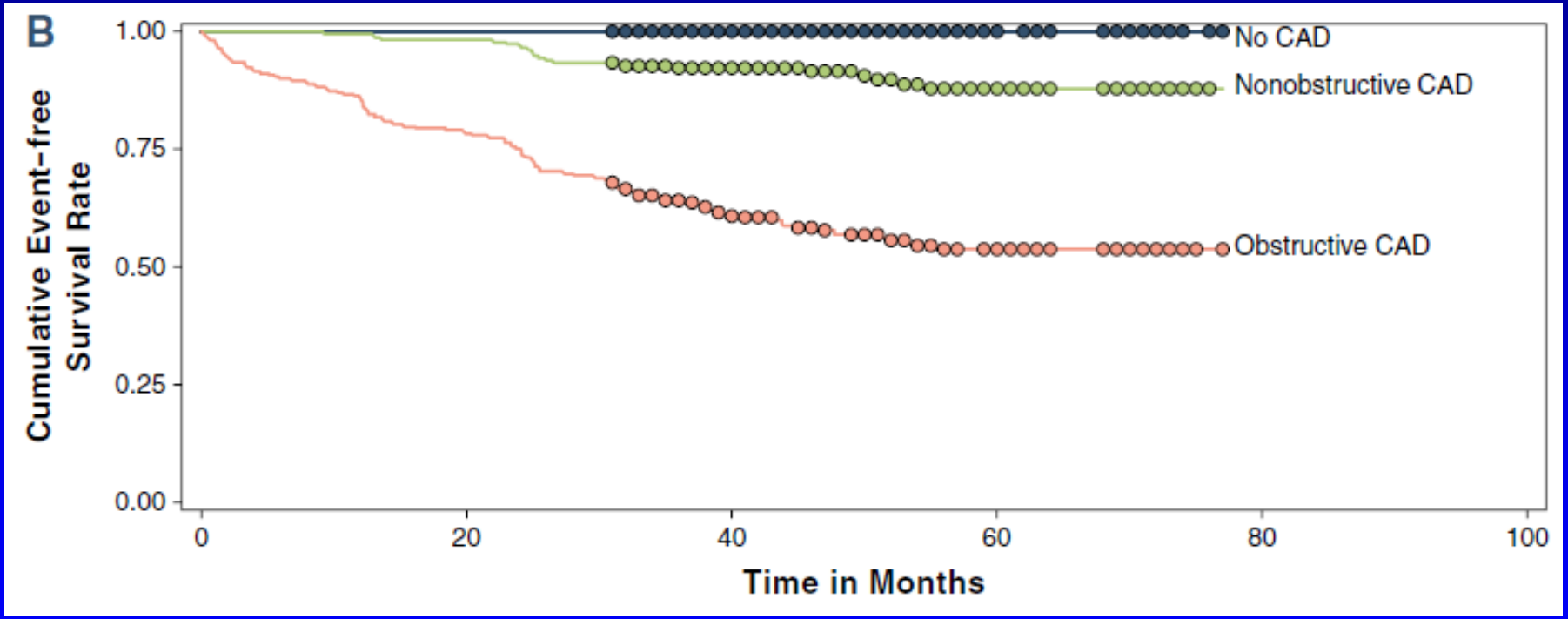
Cardiac Death or MI	No CAD	Non-Obstructive CAD	Odds ratio (95% CI)
Chow[36]	1 / 591	10 / 866	6.89 (0.88-53.99)
Øvrehus[33]	0 / 516	3 / 327	11.14 (0.57-216.37)
Gaemperli[10]	0 / 43	1 / 82	1.60 (0.06-40.14)
Min[11]	0 / 23	1 / 86	0.82 (0.03-20.91)
Dedic[57]	0 / 115	3 / 162	5.07 (0.26-99.09)
Cho[13]	1 / 1668	2 / 900	3.71 (0.34-41.00)
Aldrovandi[59]	0 / 219	4 / 282	7.09 (0.38-132.45)
Andreini[54]	0 / 503	23 / 241	108.30 (6.55-1791.09)
Pooled odds ratio	**2 / 3678**	**47 / 2946**	**6.41 (2.44-16.84)**

Annualized Rate **<0.03%** **0.80%**

Habib PI et al. Int J Cardiol 2013

MI & Cardiac Death 5 years after CTA

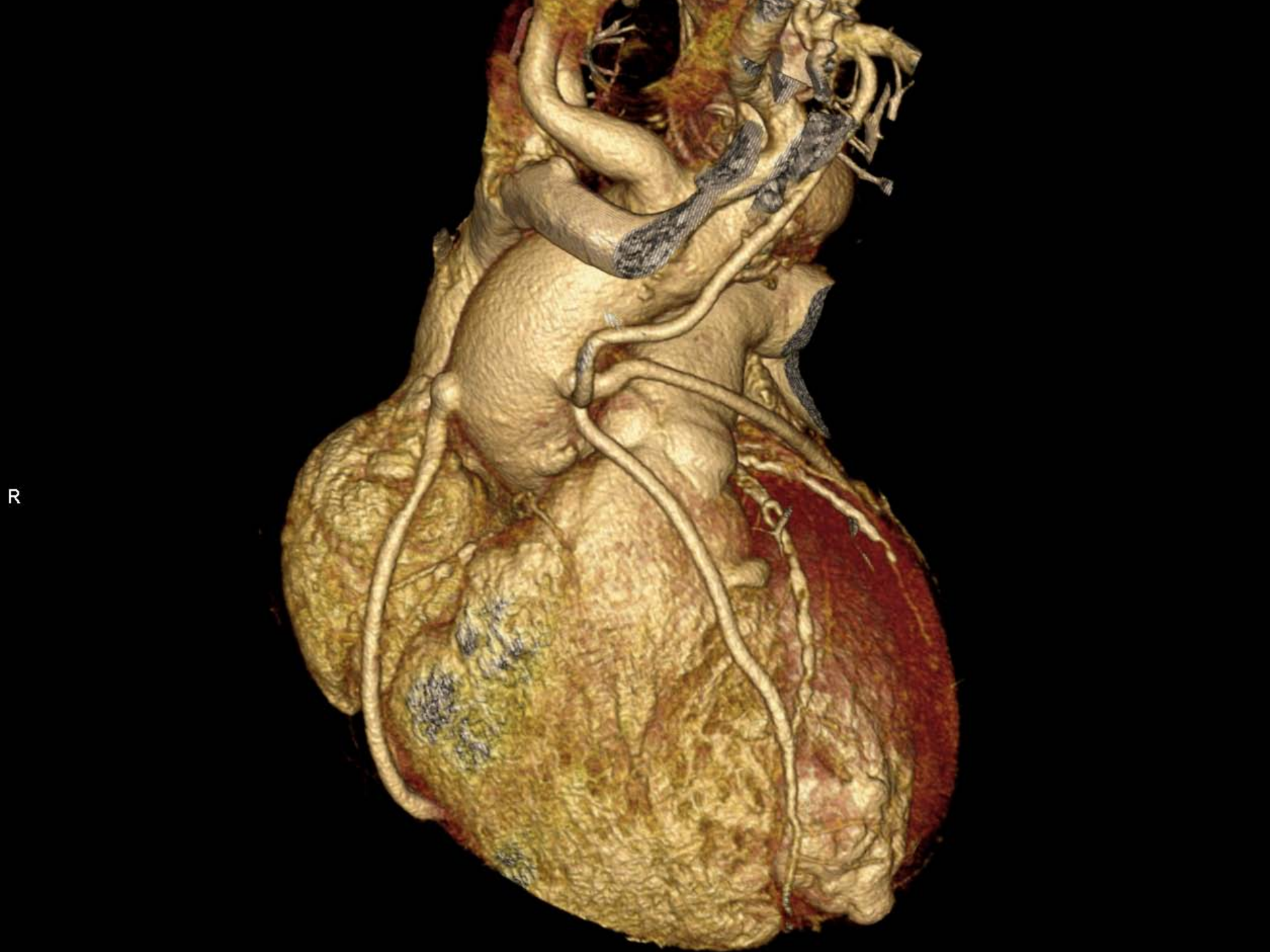
N=1,234



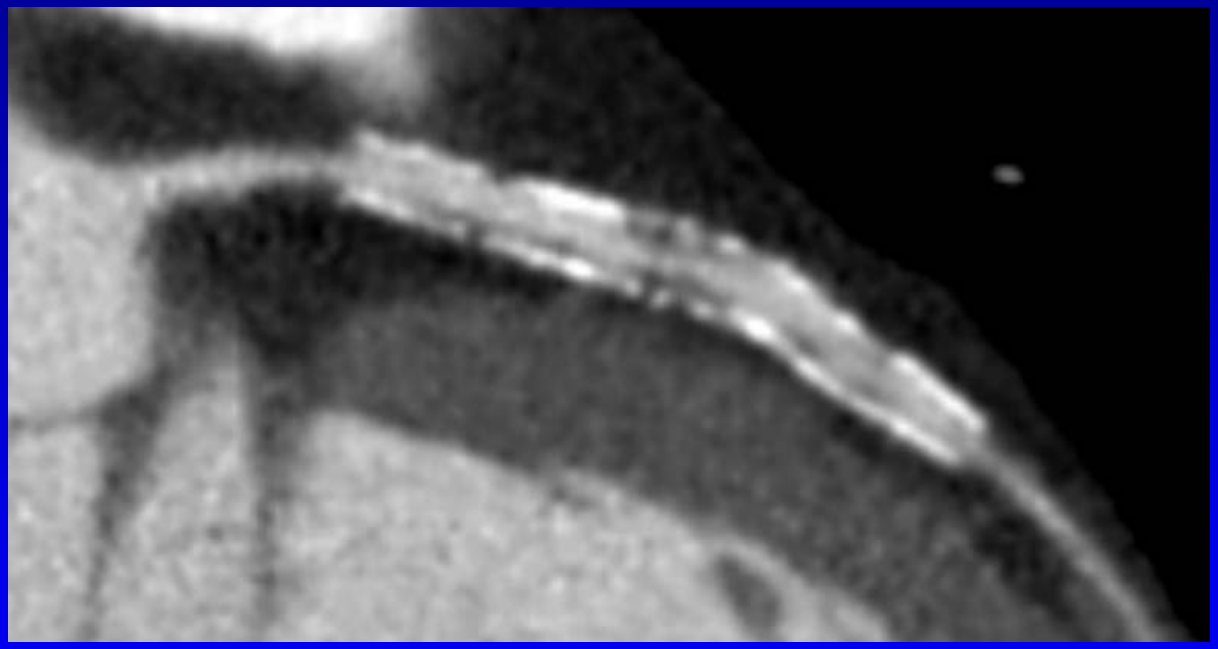
Andreini et al, *JACC IMG* 2012

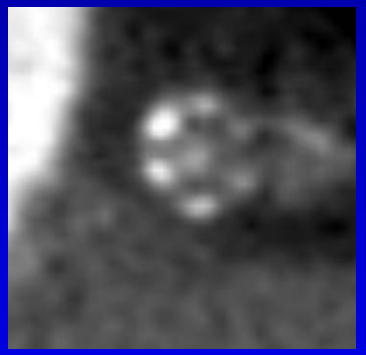
Current Reimbursement Policies

- Cardiac evaluation of a patient with chest pain syndrome as an alternative to cardiac catheterization (rule out CAD in new CHF)
- Assessment of coronary anatomy
- Uninterpretable or equivocal stress imaging test results
- In lieu of routine invasive coronary angiography prior to non-coronary cardiac or aortic surgery in patients at low risk of concomitant coronary disease


R

CTA For Stent Evaluation





Appropriateness Criteria – Use of CTA Post Revascularization

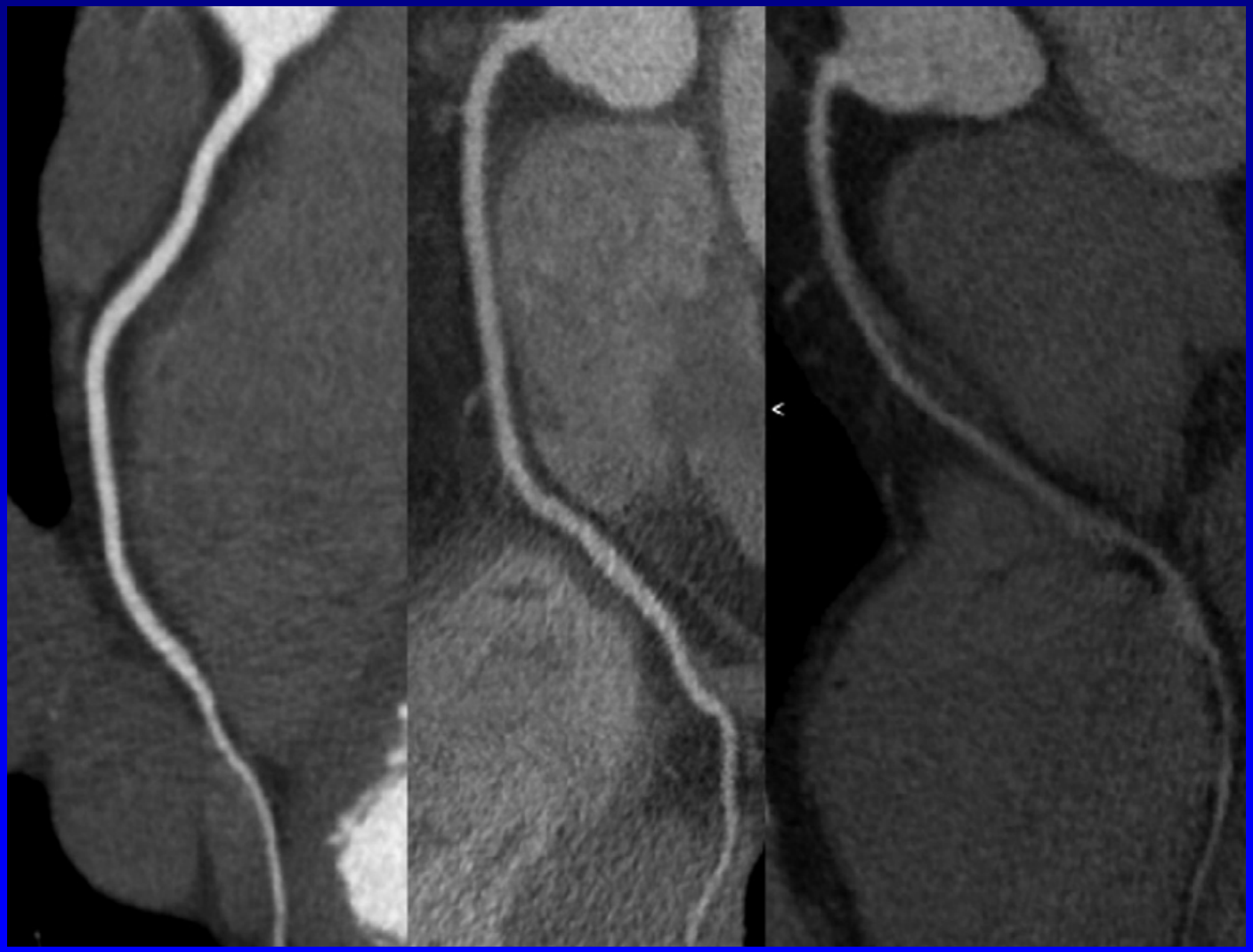
Symptomatic (Ischemic Equivalent)	
• Evaluation of graft patency after CABG	A (8)
• Prior coronary stent with stent diameter <3 mm or not known	I (3)
• Prior coronary stent with stent diameter ≥3 mm	U (6)

Taylor AJ et al, J Am Coll Cardiol. 2010 23;56:1864-94

Patient Preparation – Heart Rate Control

- If HR ≥ 65, oral beta blocker, e.g., metoprolol 25-150 mg
- If required, additional iv beta blocker, e.g., metoprolol 5-25 mg
- If required, additional ivabradine

Patient Preparation – HR Control



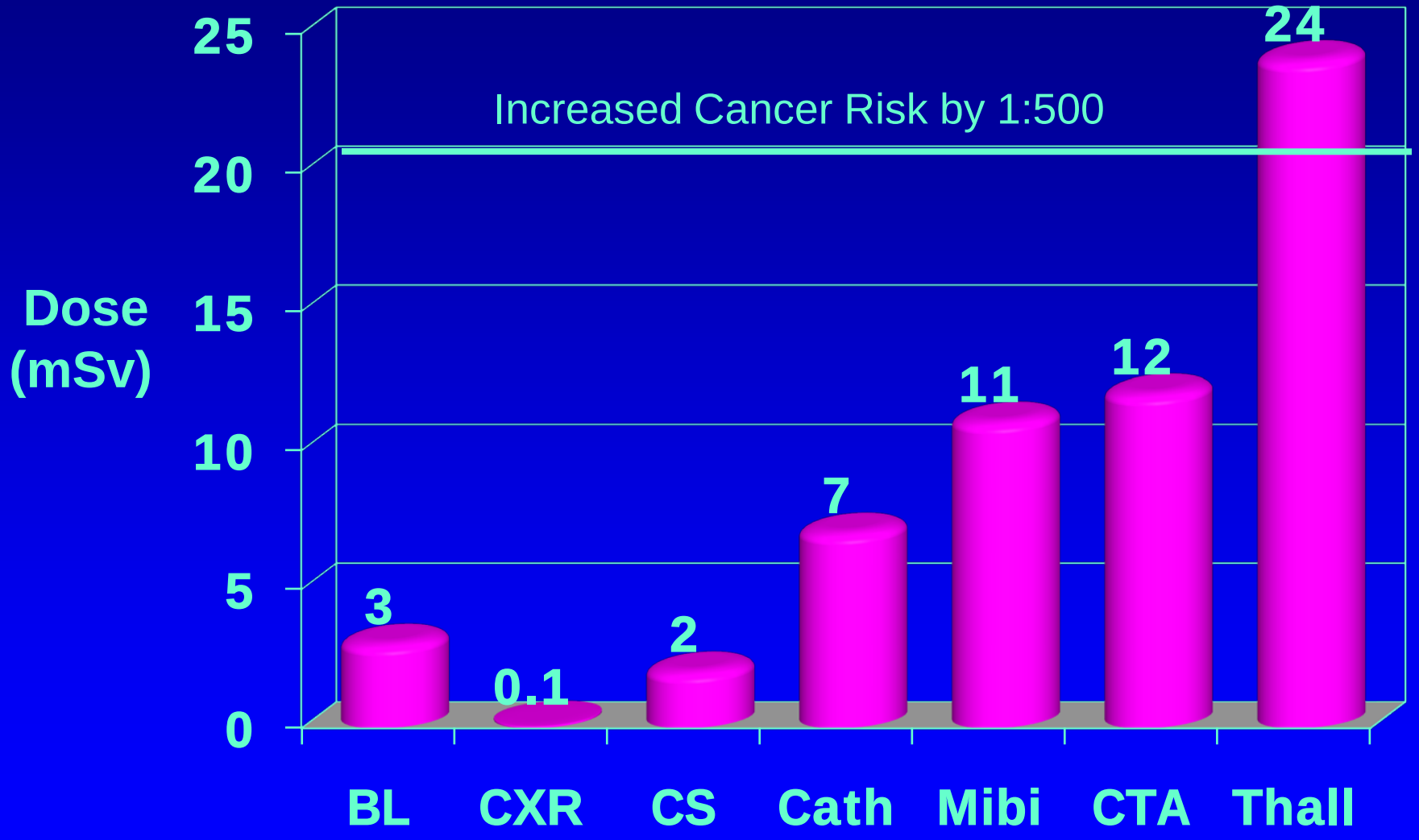
De Graaf FR, et al, Am J Cardiol 2010

Patient Preparation – Contrast

- Hold nephrotoxic drugs, e.g., NSAIDs
- Screening for CIN risk factors (DM, CRF, CHF, age >75*)
- Serum creatinine if indicated
- Hydration
- Premedication if indicated (e.g., prednisone, benadryl)
- NPO x 3 h
- No caffeine or nicotine x 12 h

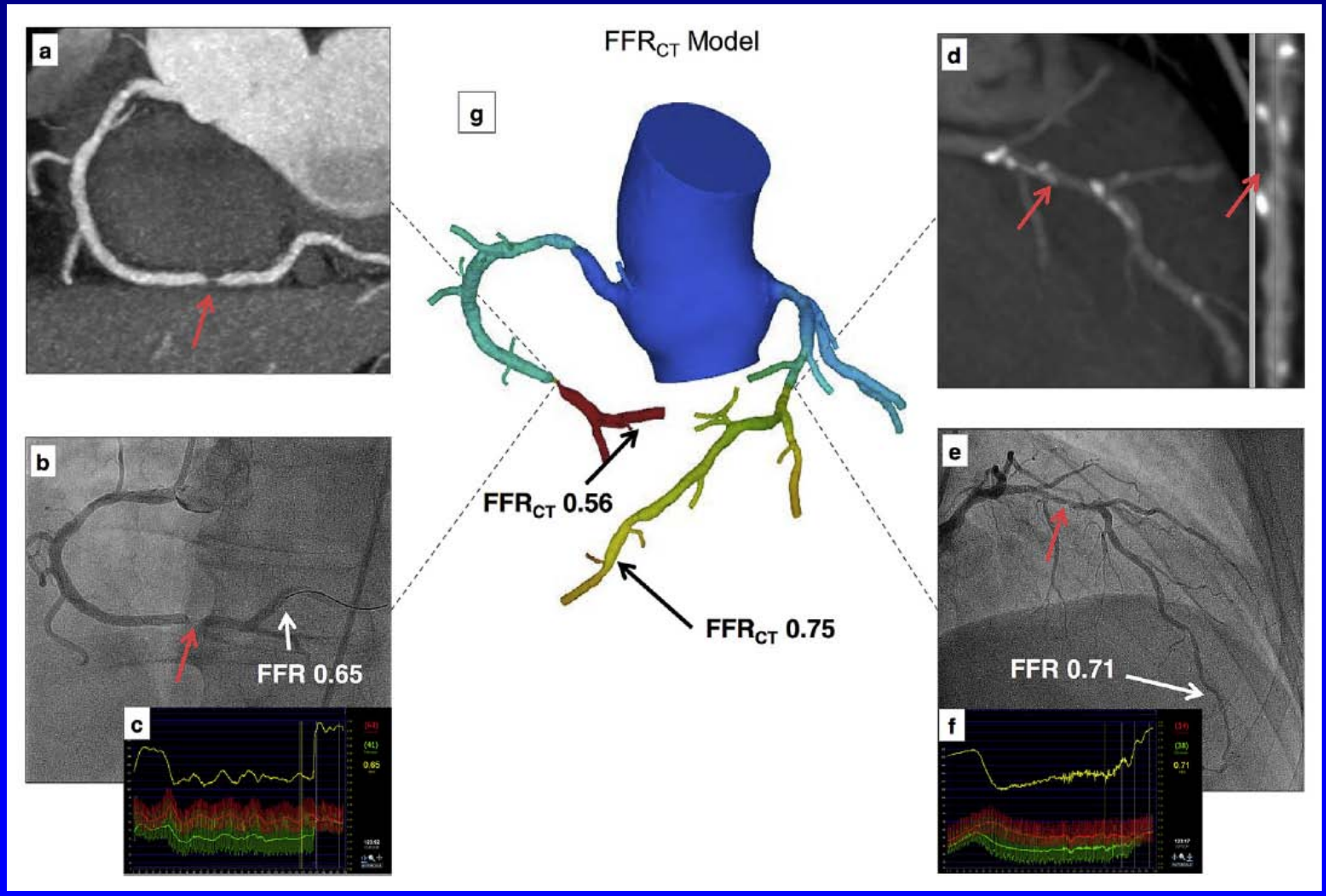
* Mehran R, et al, JACC 2004;44:1393

Radiation Doses From Cardiac Imaging



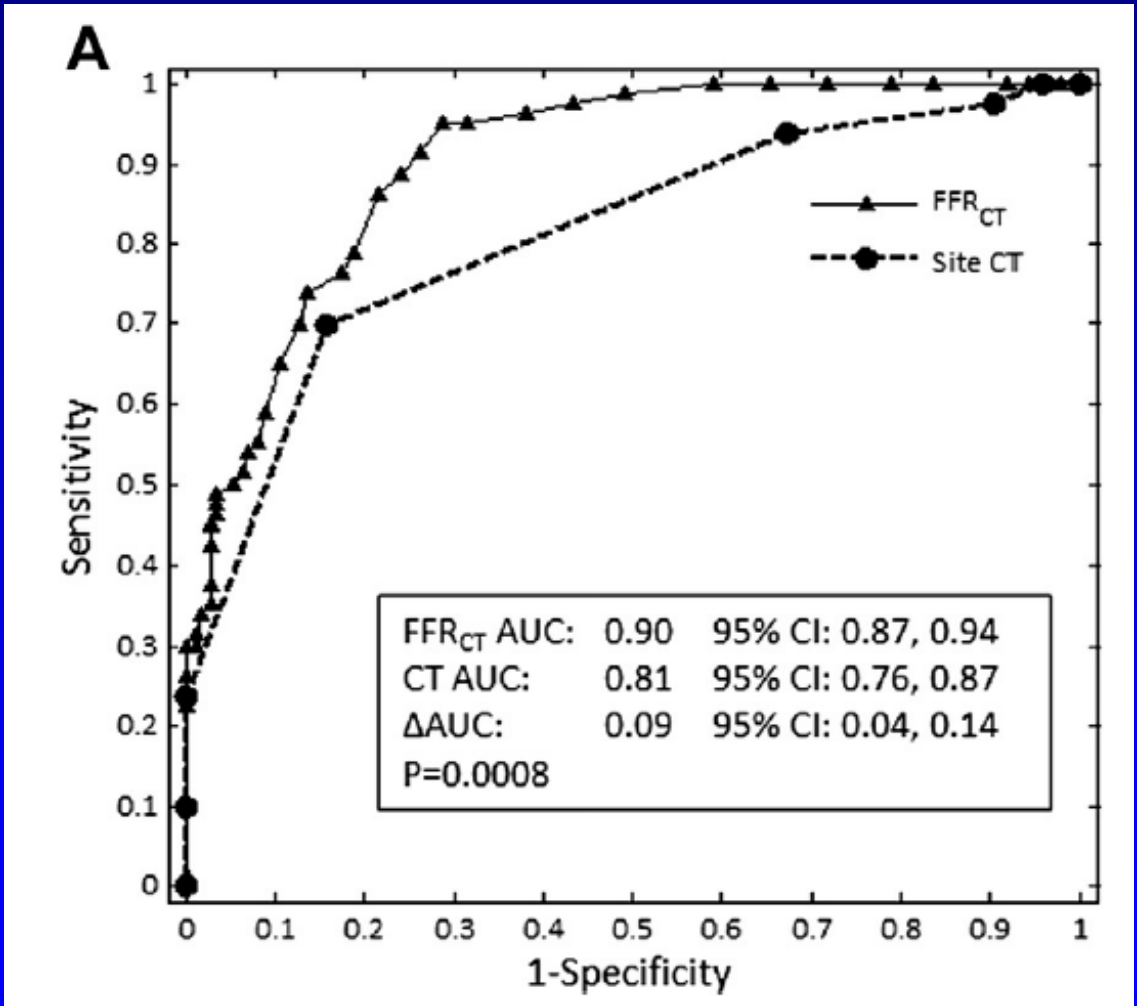
Sources: FDA, CCOHS 2005, Coles et al, J Am Coll Cardiol 2006, Picano, Am J Med 2003; Einstein et al. Circulation 2007

CT-FFR vs. FFR NXT Study



Norgaard et al. JACC 2014

CT-FFR vs. FFR NXT Study



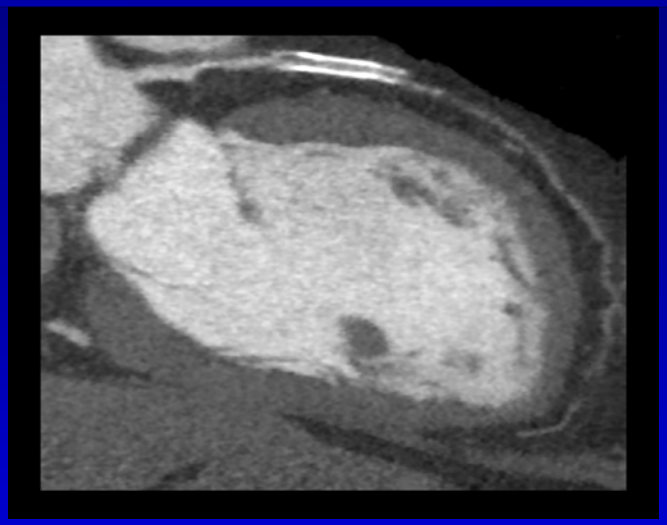
Norgaard et al. JACC 2014

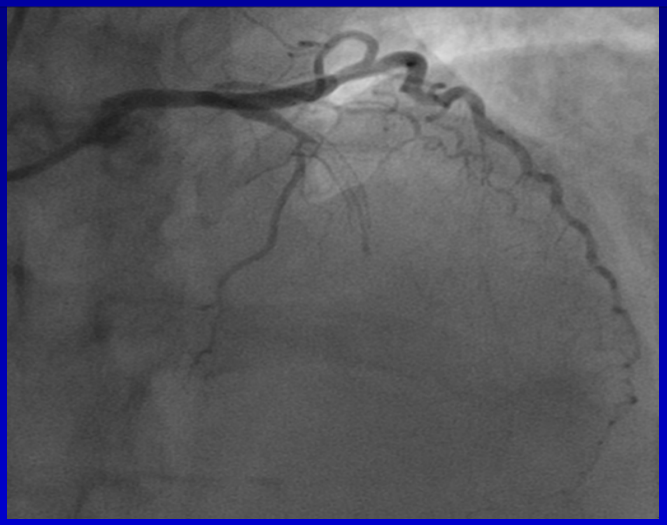
PLATFORM TRIAL

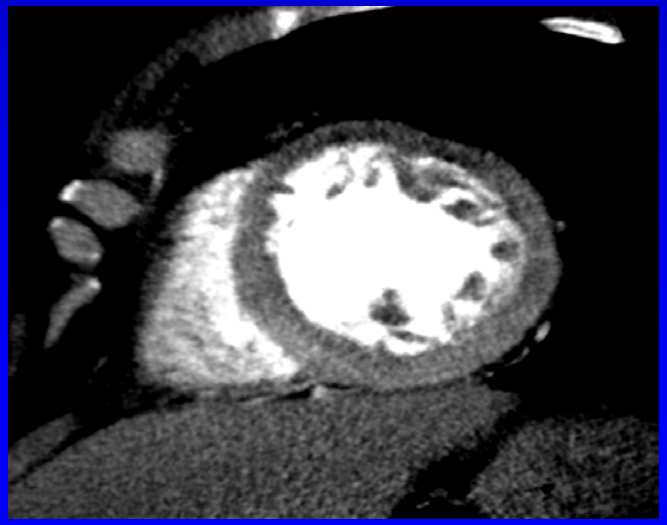
Planned invasive test (n = 380)		
Usual care strategy (n = 187)	FFR_{CT}-guided strategy (n = 193)	P-value
Rate of non-obstructive disease		
137 (73.3)	24 (12.4)	<0.0001

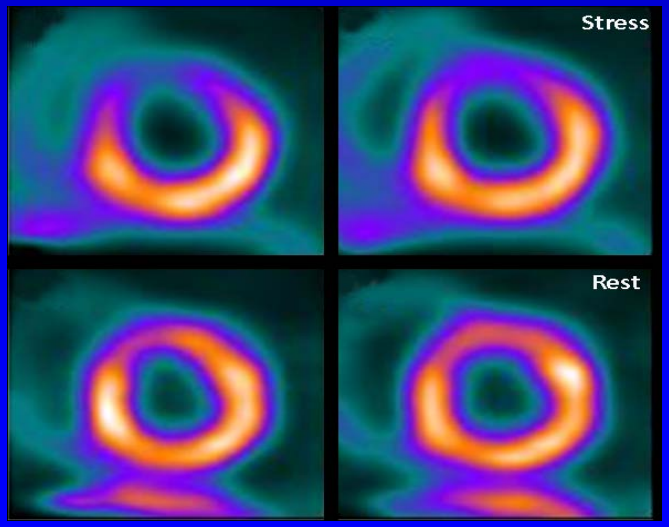
Douglas PM et al. Eur Heart J 2015

Combined CTA/CTP vs. QCA/SPECT – CORE320



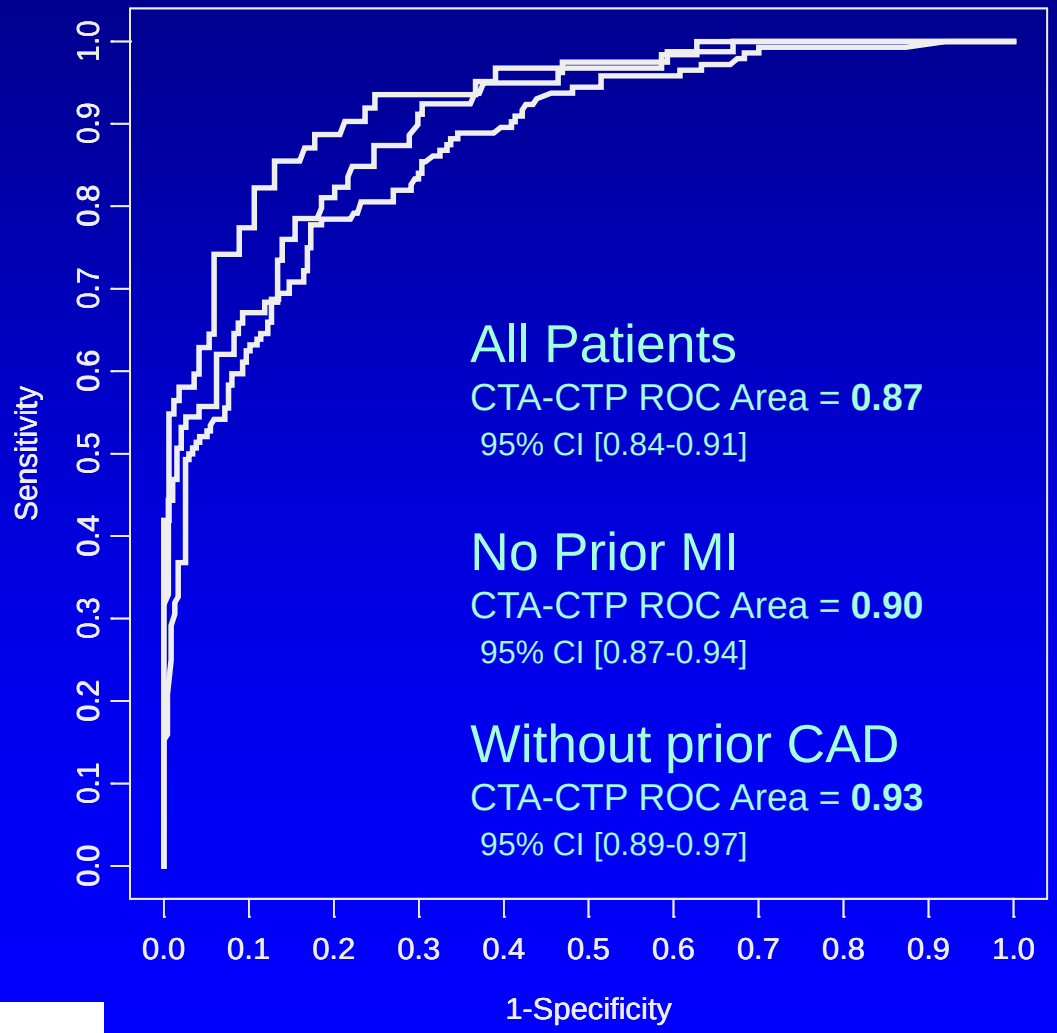






Rochitte et al. Eur Heart J 2014

CTA + CTP to predict flow limiting stenoses by QCA + SPECT



CORE 320

Rochitte et al, Eur Heart Journal 2014

Conclusions

- CTA is generally used to RULE OUT significant CAD in symptomatic patients of intermediate pretest probability, particularly, with equivocal stress test findings
- A normal CTA is associated with an exceptionally low rate of adverse events for at least 5 years
- Detecting non-obstructive CAD may help reducing events
- Novel adjunct technology allows hemodynamic assessment of CAD, which will further increase attractiveness of coronary CTA

Thank You

Imaging of Pedal Infection

David Levi, MD
Chief, Division of Musculoskeletal Radiology
Atlantic Medical Imaging

Overview

- Pedal Osteomyelitis and Soft Tissue Infection
  - Clinical background
  - Conventional Imaging Indications
  - Technique and Findings: Radiographs, CT, MRI, Nuclear Medicine

Pedal Osteomyelitis and Soft Tissue Infection

- Etiology- Contiguous spread and direct implantation are most common. Hematogenous spread is rare.
- Epidemiology- 200 mil diabetics. Most common cause of amputation. Lifetime risk of developing a pedal ulcer is 7-25% in diabetic. After amputation, 50% risk of serious complication in contralateral foot within 2 years.
- Immunopathy coupled with vascular disease, neuropathy and loss of plantar fat leads to wound infection eventually leading to osteomyelitis.

Foot Anatomy and Spread of Infection

- The foot has distinct myofascial compartments.
- However, in pedal osteomyelitis this anatomy is not reliable for predicting spread.
- Spread is most commonly in a centripetal pattern from the source (wound) but can spread along superficial fascial planes and tendon sheaths.
- Spread into deep fascial compartment is concerning as this can communicate to calf.

Foot anatomy and spread of infection

- Osteomyelitis almost always next to an ulcer
  - Exception is direct bone to bone spread of infection
- Most common locations
  - Forefoot: 1st and 5th met, distal 1st phalanx
  - Midfoot: uncommon
  - Hindfoot: calcaneus > lateral malleolus

Imaging Modalities

- Lack of uniform imaging algorithm based on many factors including access to imaging, reader expertise, access to white cell labeling, surgeon preference, imager preference and bias.
- Although not sensitive, initial imaging should always be radiographs of the foot, ankle or both. Radiographic evidence of osseous infection lags behind MRI/Nucs.
- MRI = gold standard
- All patients with contraindications to MRI should undergo nuclear imaging.

Imaging Modalities

- Three Phase Bone Scan is sensitive for osseous involvement but has low specificity in complicated settings such as neuropathic disease, trauma and post-operative settings.
- Labeled WBC scan lacks anatomic detail but in conjunction with bone scan with or without marrow imaging increases overall sensitivity.
- In most studies, MRI has as good if not better sensitivity and specificity with the addition of better soft tissue evaluation and no radiation. Limitations also include the presence of neuropathic disease and presence of hardware

Sample MRI Studies

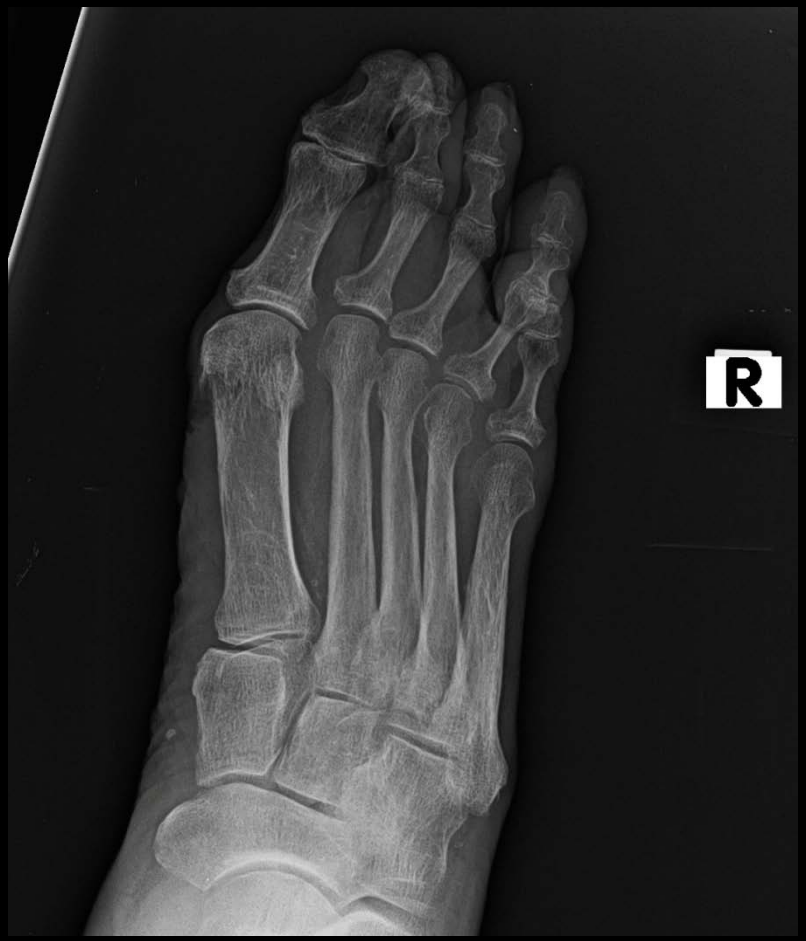
	Sens	Spec	Accuracy	#
Ledermann 2002	90	79	90	158
Wang 1990	99	81	94	50
Nigro 1992	100	95	98	44
Weinstein 1993	100	81	95	47

ACR Recommendation

- Meta-analysis from 2007 shows MRI to be overall superior.
  - Kapoor A, Page S, LaValley M, et al. Magnetic resonance imaging for diagnosing foot osteomyelitis. A Meta-analysis. Arch Intern Med 2007; 167:125-132.
- American College of Radiology appropriateness criteria and recommendations suggest that MRI be performed preferentially to nuclear imaging in patients who can undergo MRI
- Key is that MRI shows more soft tissue findings and margins of unaffected bone providing useful surgical information and a road map for bone amputation and soft tissue debridement

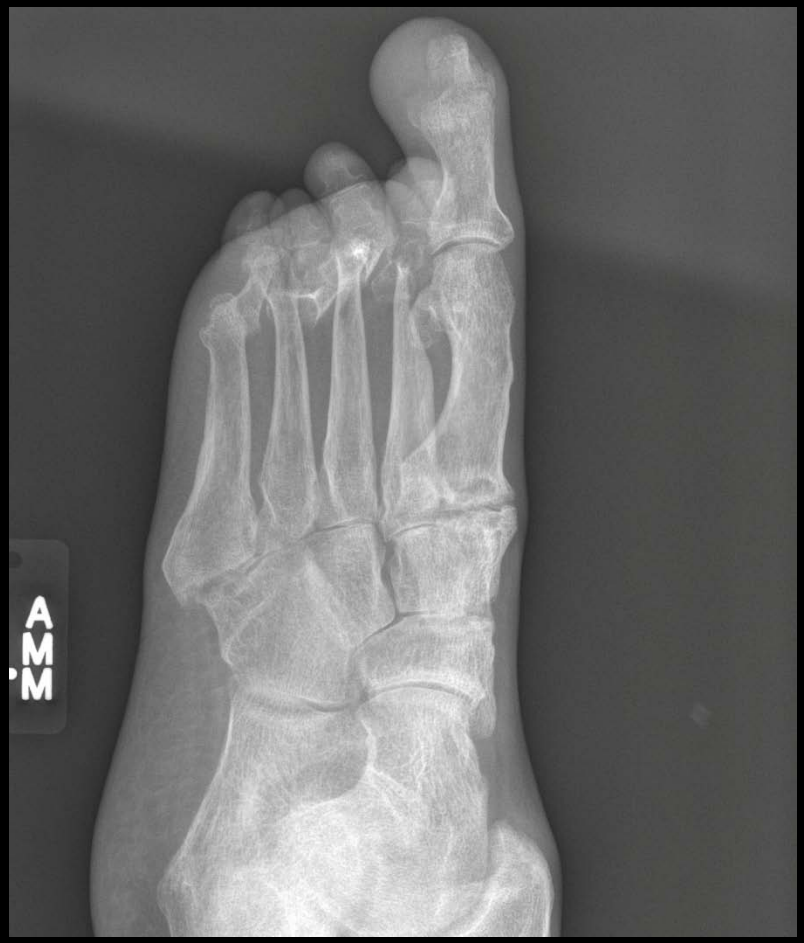
Radiographs

- Findings of osteomyelitis include periosteal reaction, soft tissue swelling, soft tissue gas, osseous erosion and frank osseous destruction
- Notoriously limited due to low sensitivity (usually don’t see findings for 2 weeks from initial infection)

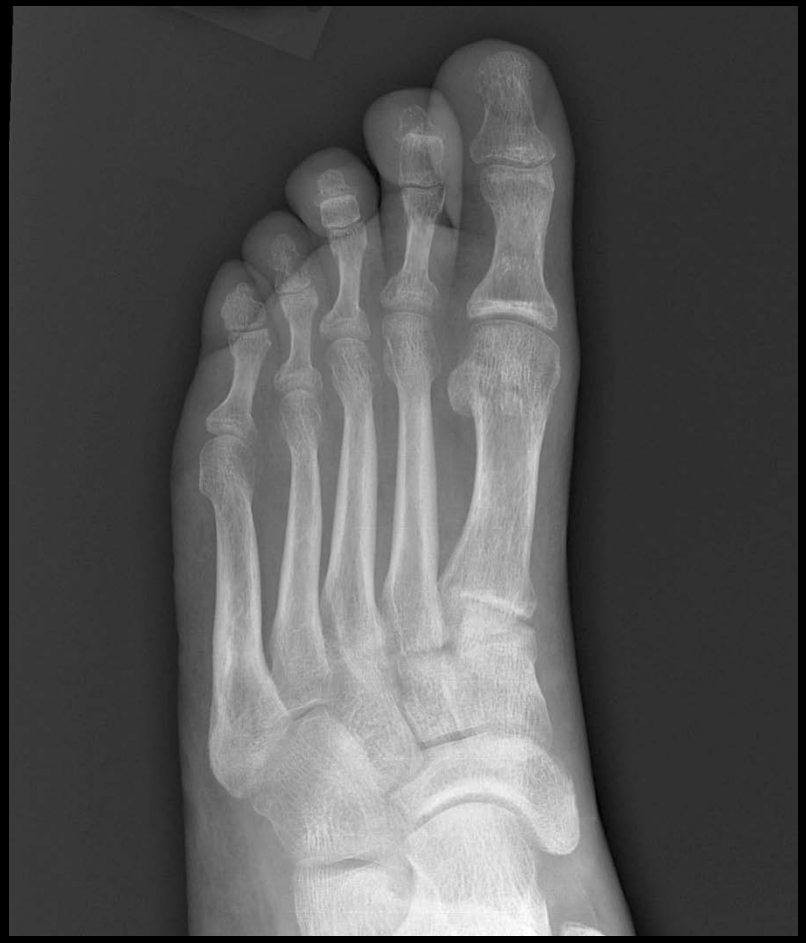


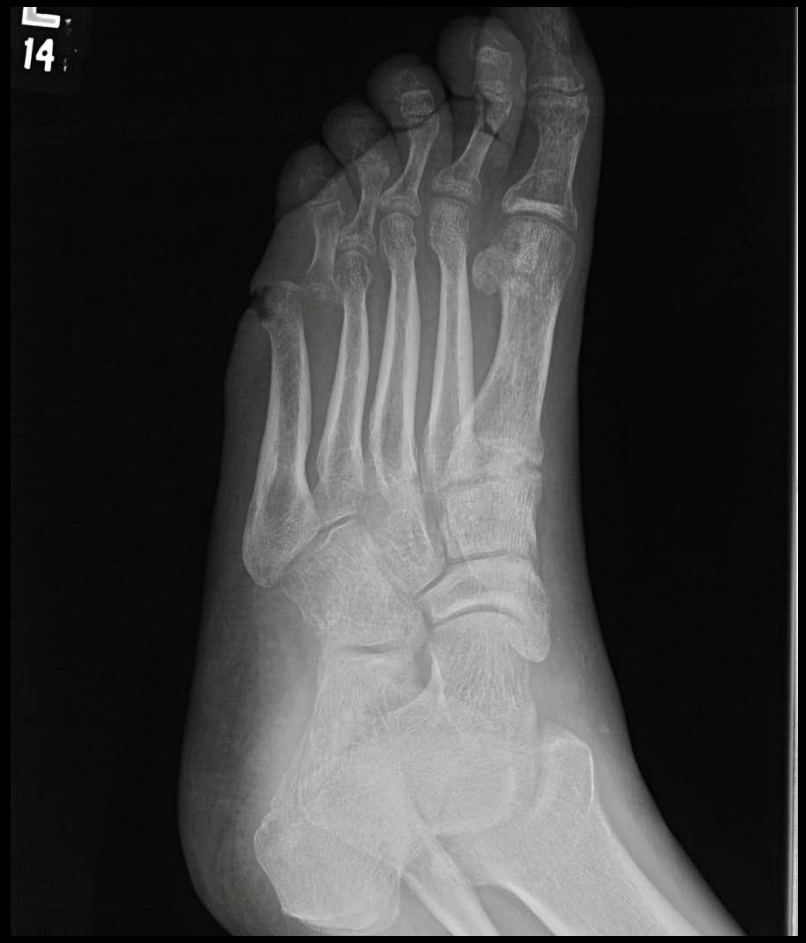
Radiographs

- This patient population tends to have “ugly feet”
- Often see complex picture of degenerative changes, post surgical changes with and without hardware, amputations, dislocations and neuropathic changes. This limits the specificity and sensitivity.



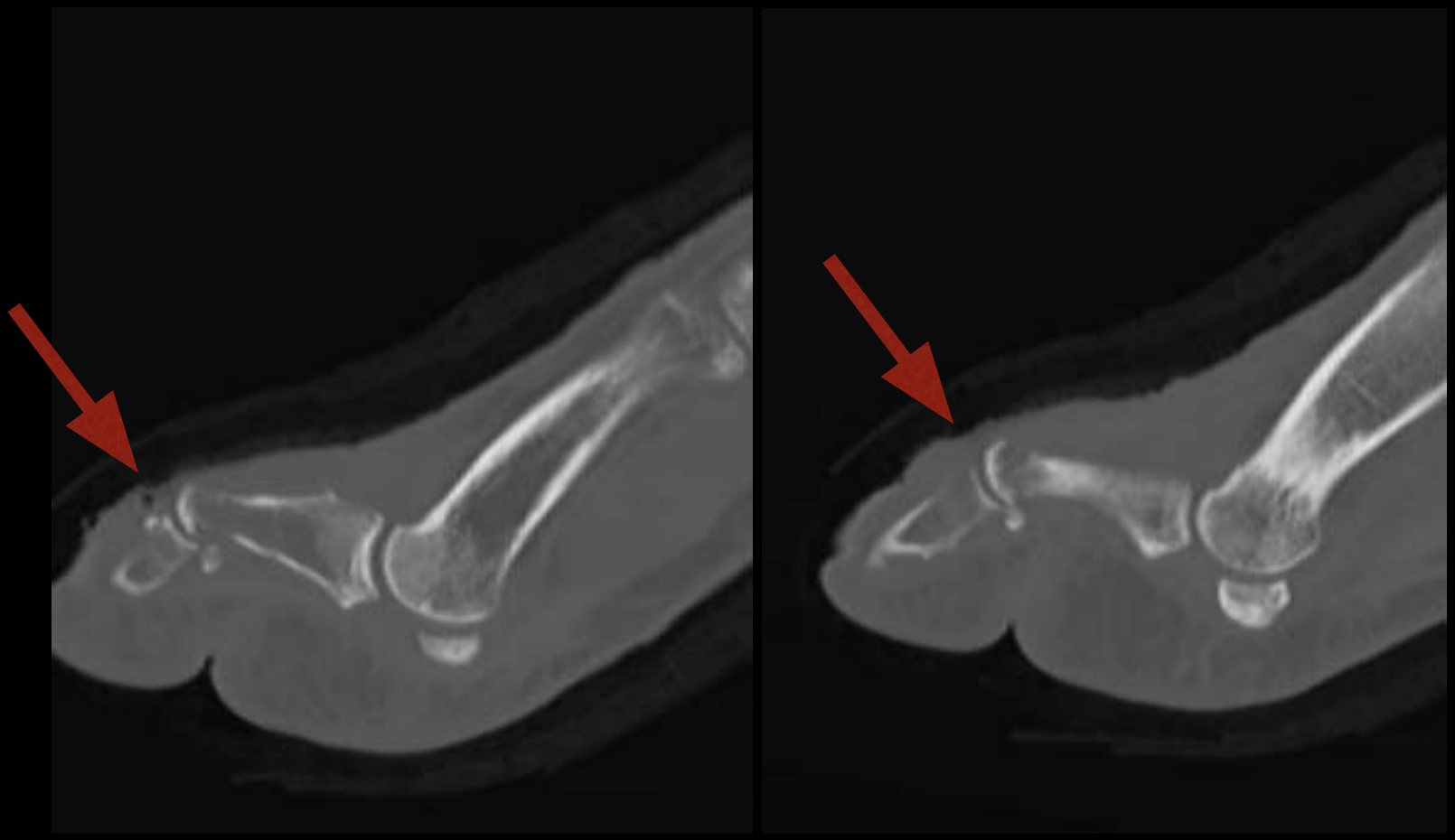
Radiographs





3 weeks later

CT of Osteomyelitis



MRI for Pedal Osteomyelitis

- Contrast Administration
  - Pros: Better evaluation of soft tissues including ulcers, abscesses, devitalized soft tissue, differentiate cellulitis from soft tissue swelling
  - Cons: NSF in renal patients, Allergy, Scan time
- There is some disagreement in the literature as to whether contrast is necessary for diagnosis of pedal osteomyelitis

AMI MRI Protocol

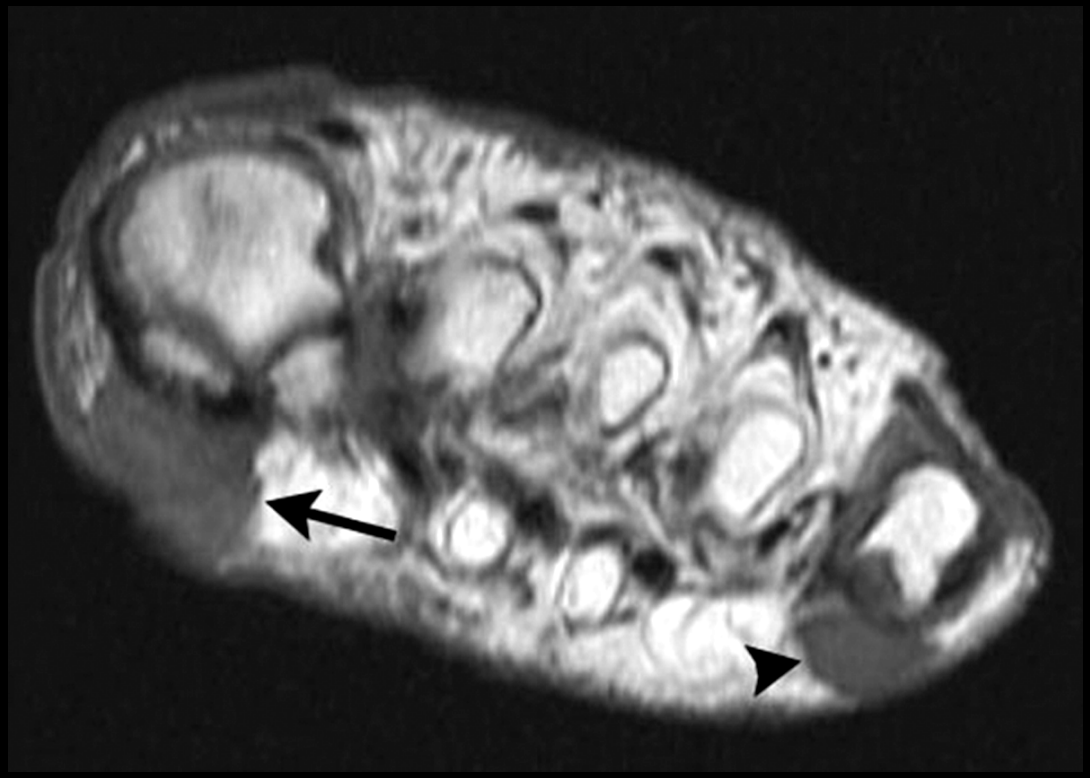
- Long axis STIR
- Short axis T1
- Sagittal T1 and STIR
- Pre and post Gad- Ax T1 FS

- May need metal artifact reduction techniques
- Imaging tips of toes is most challenging

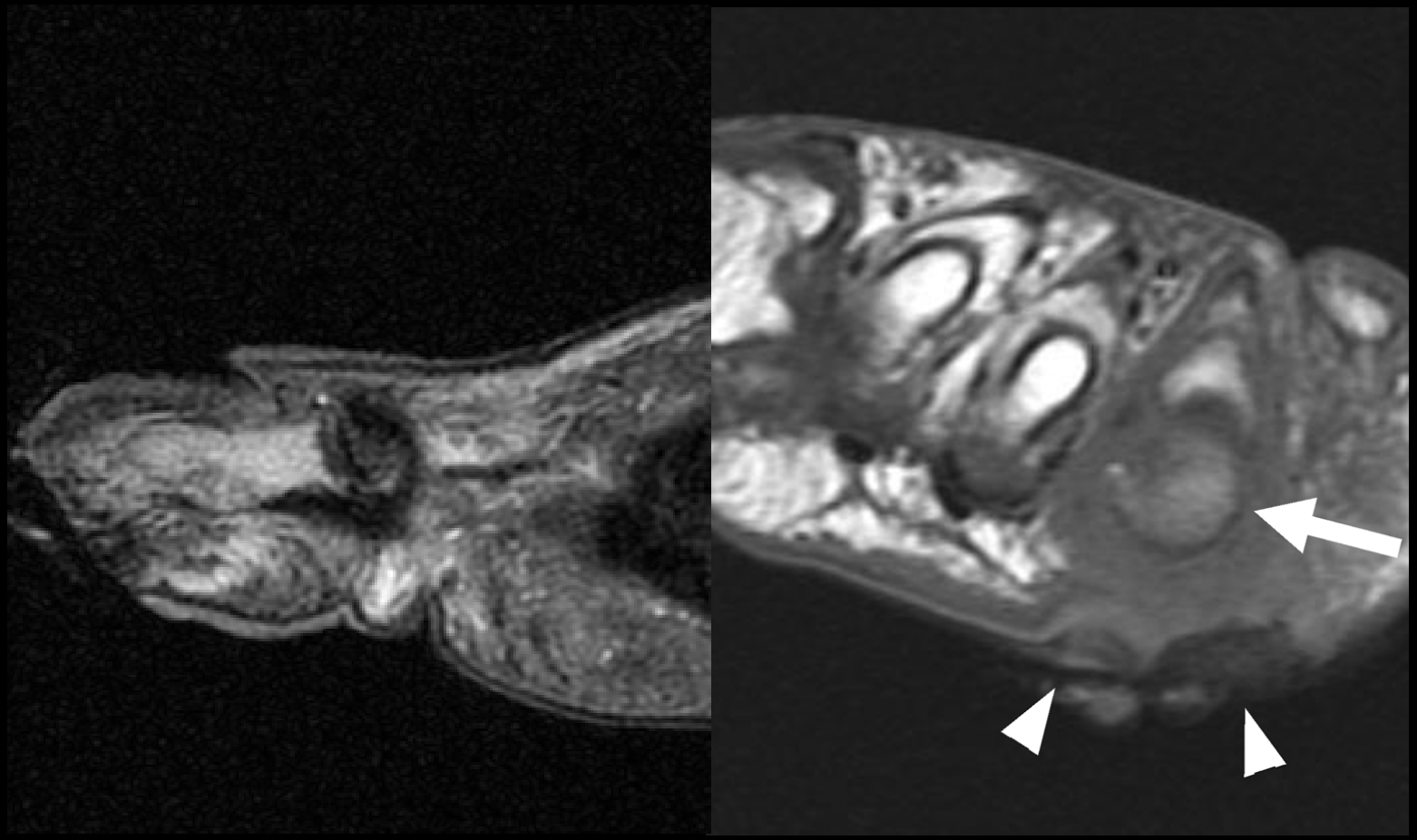
Foot MRI Soft Tissue Findings

- Callus, Ulcer and Adventitial Bursa
- Soft Tissue Edema and Cellulitis
- Muscle edema and infectious myositis
- Septic tenosynovitis
- Soft tissue abscess and devitalization

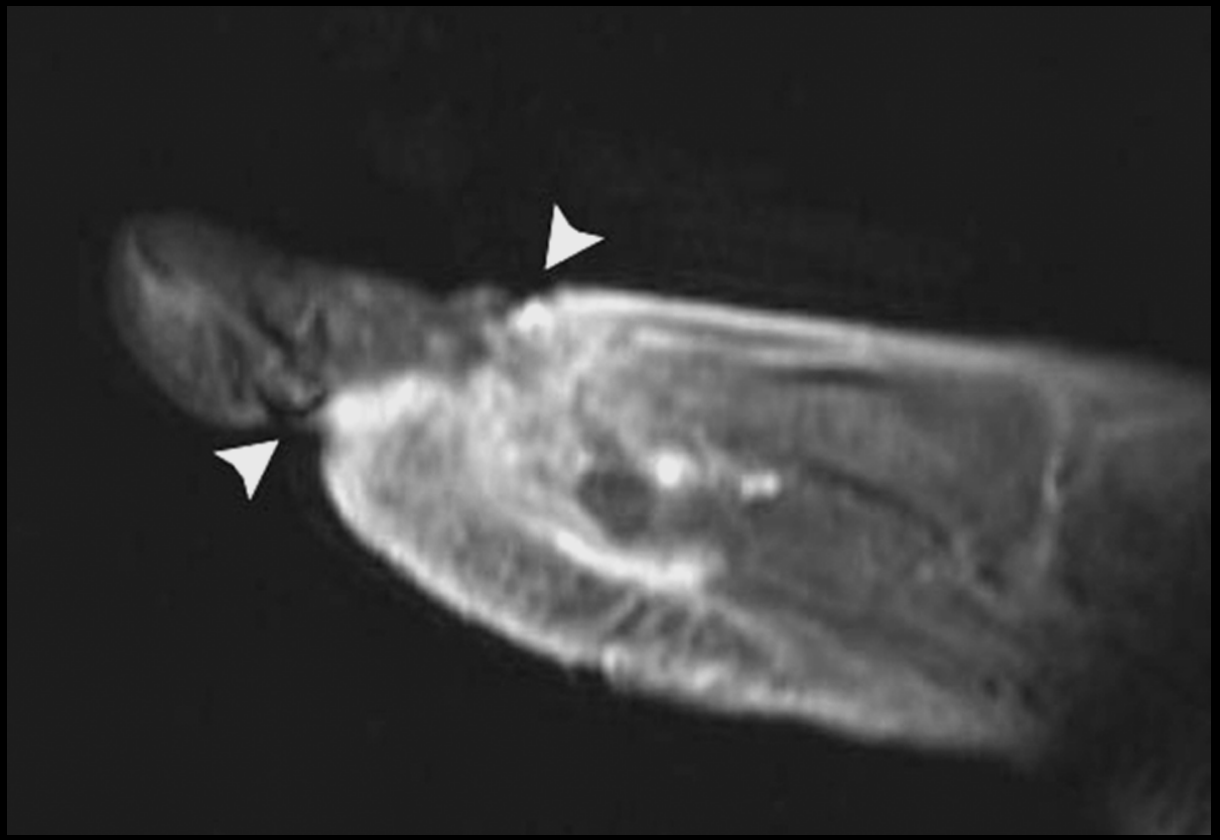
Soft Tissue Callus



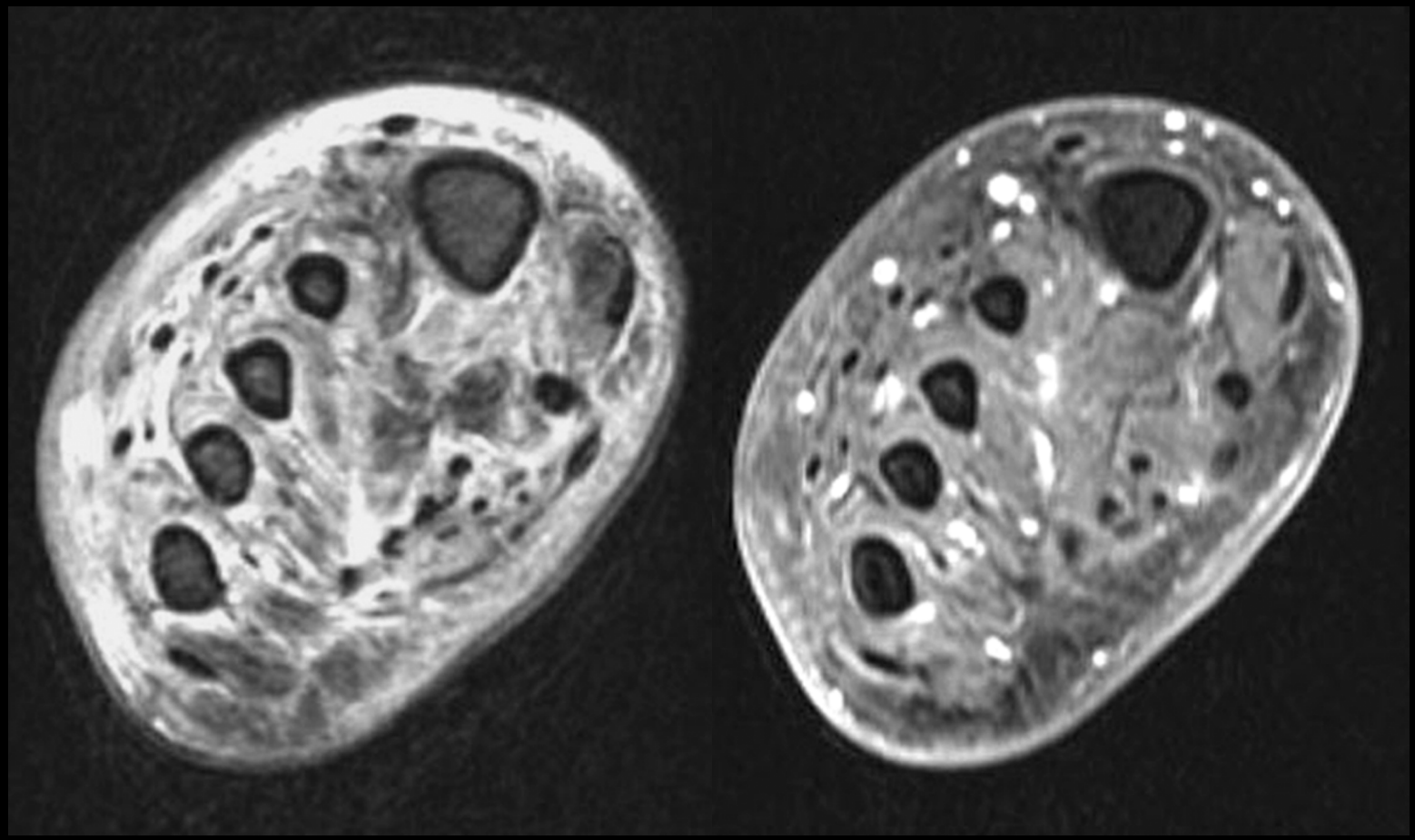
Soft Tissue Ulcer



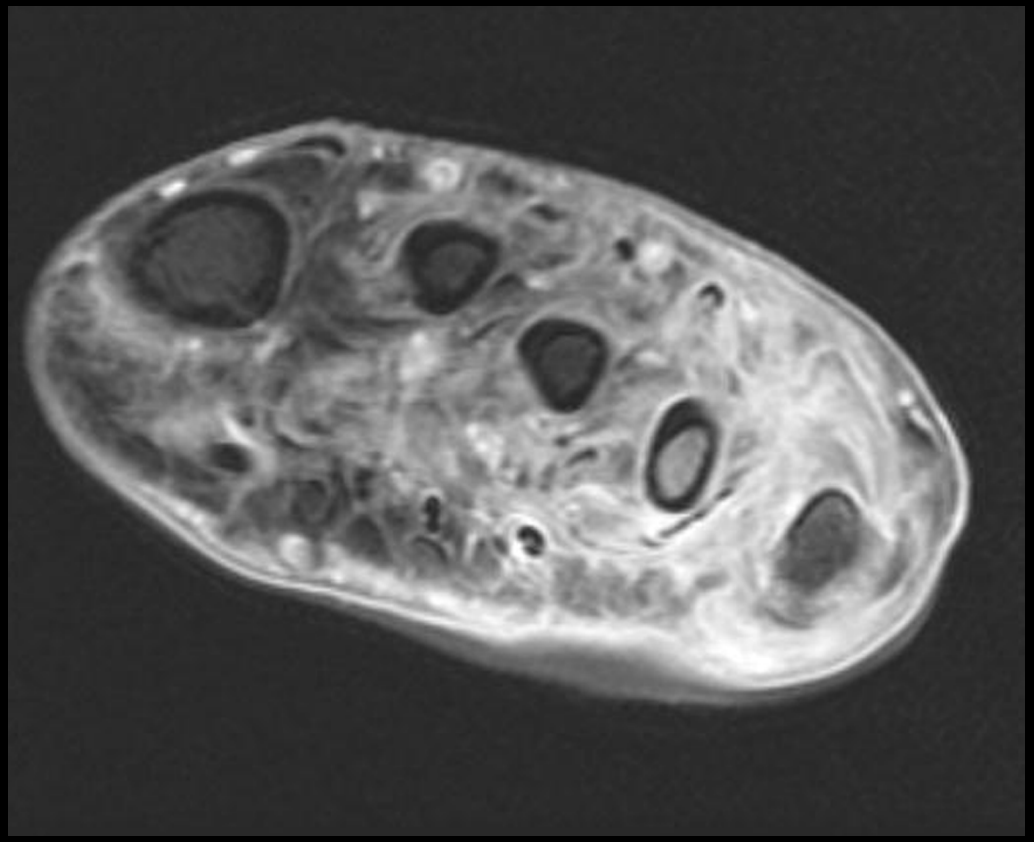
Devitalized Soft Tissue



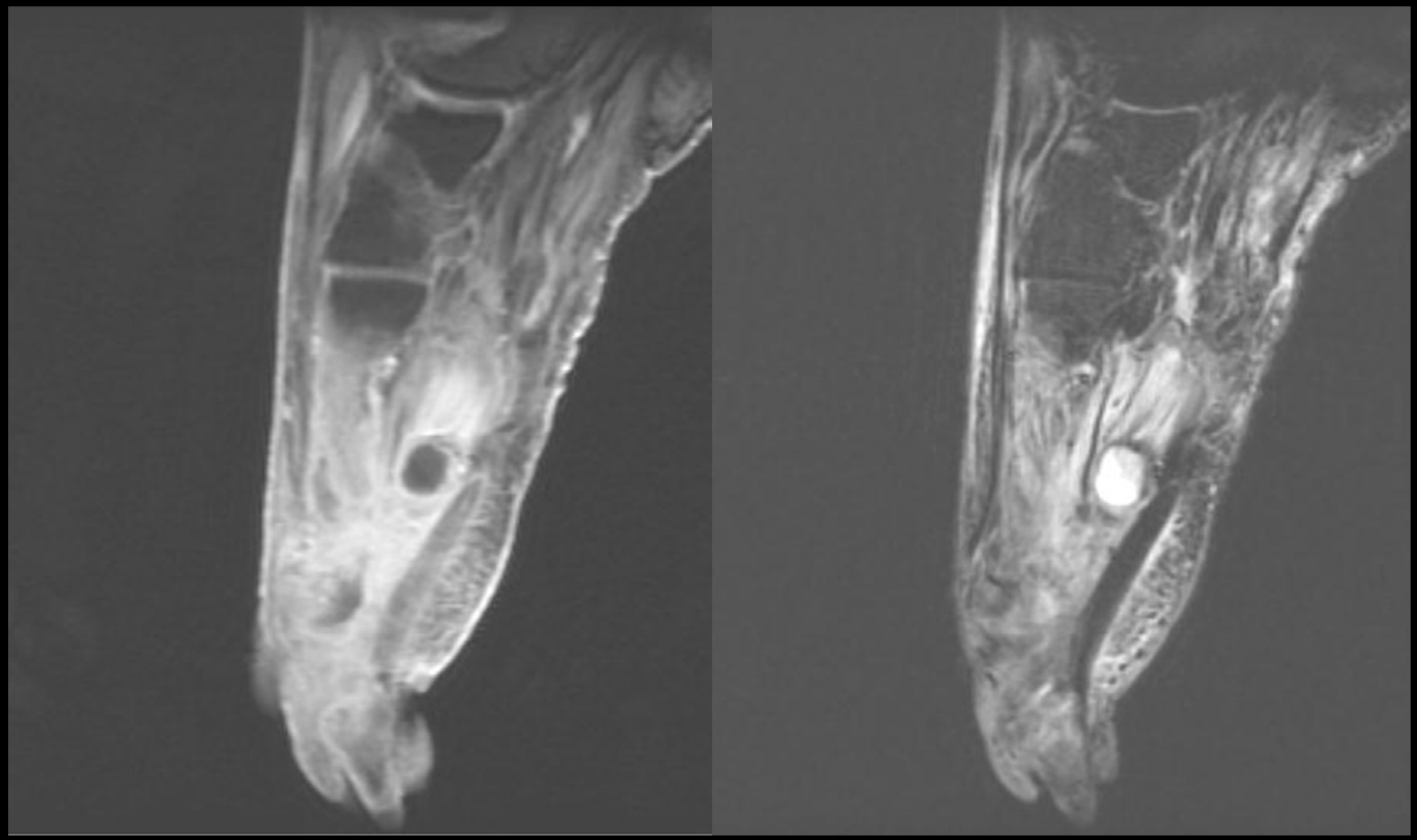
Diabetic Soft Tissue Edema



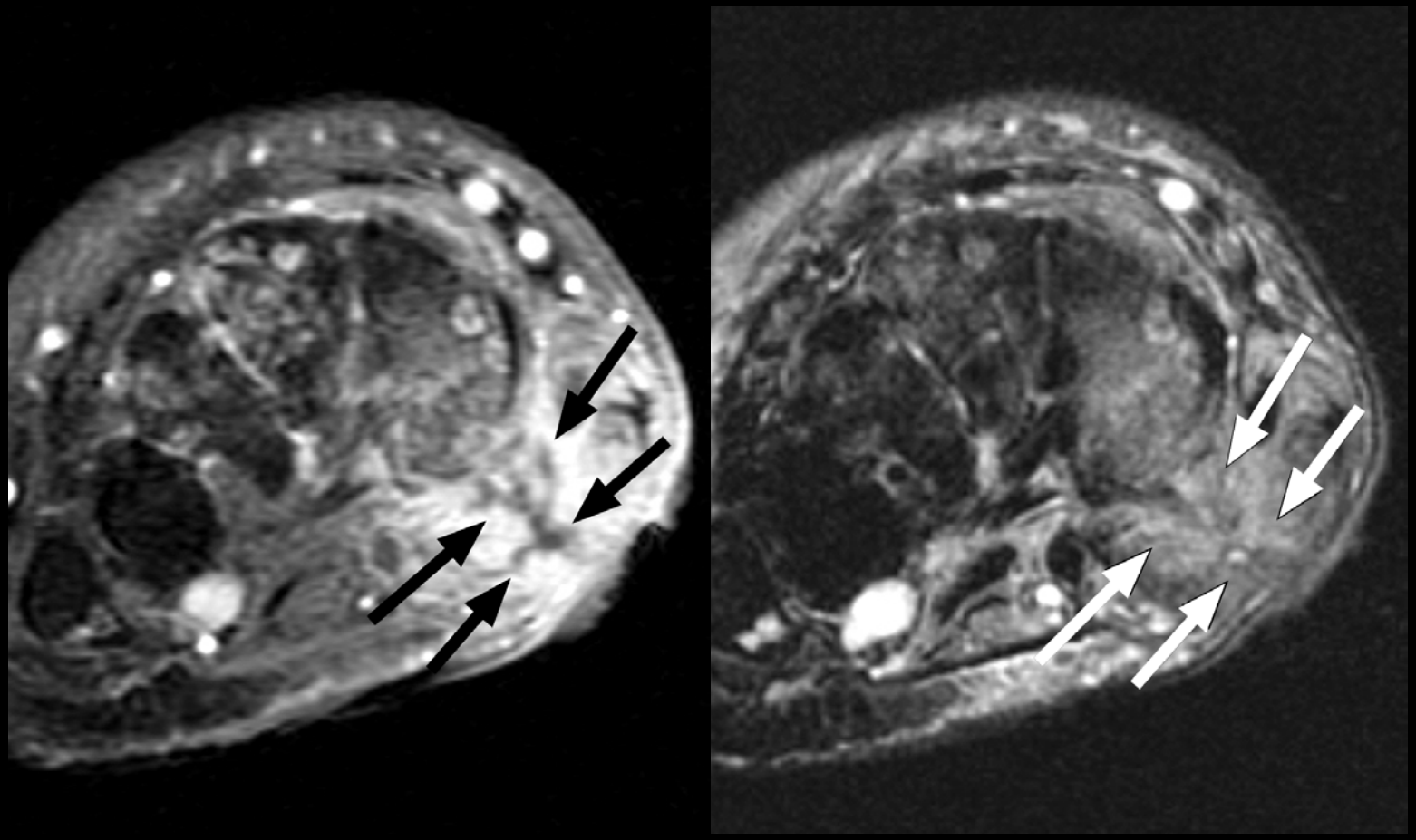
Infectious Cellulitis



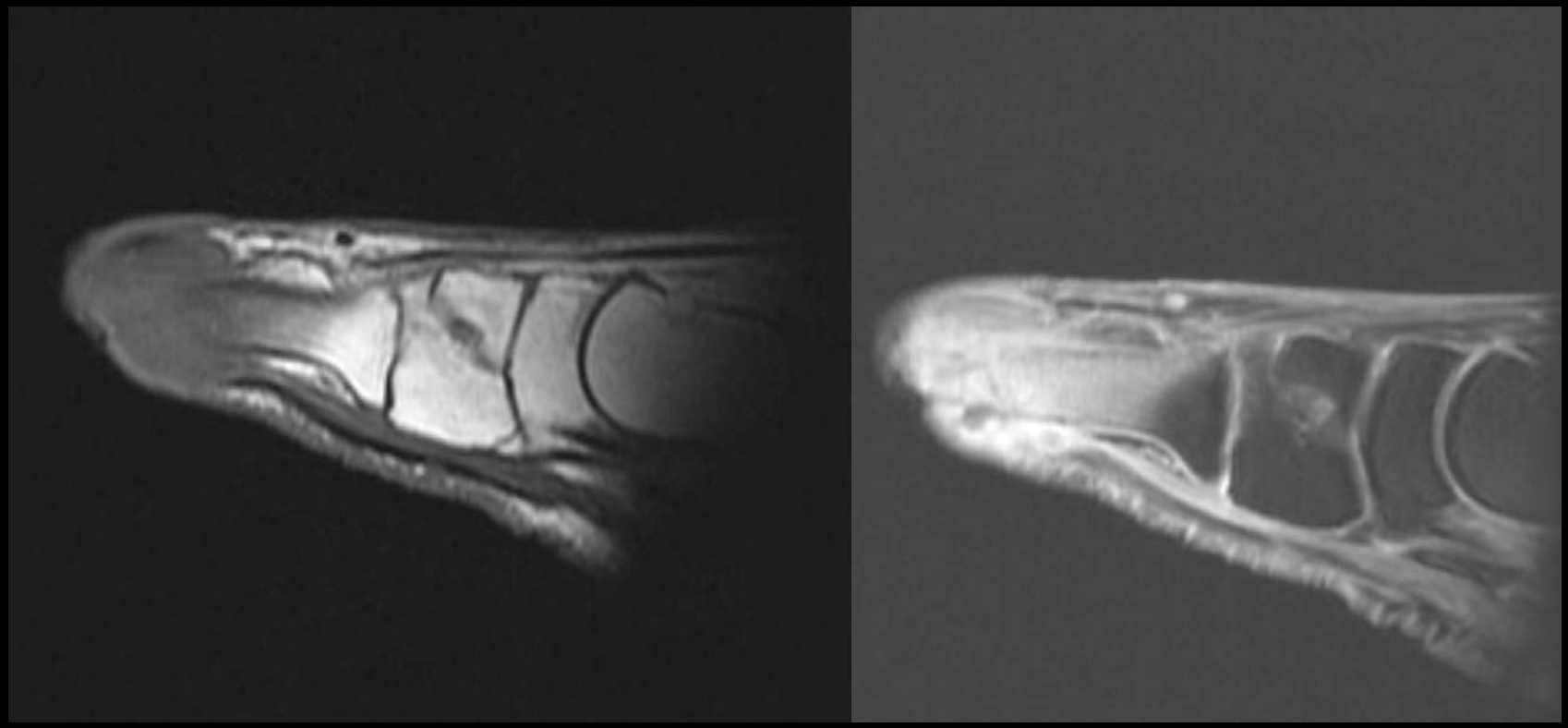
Myositis and Abscess



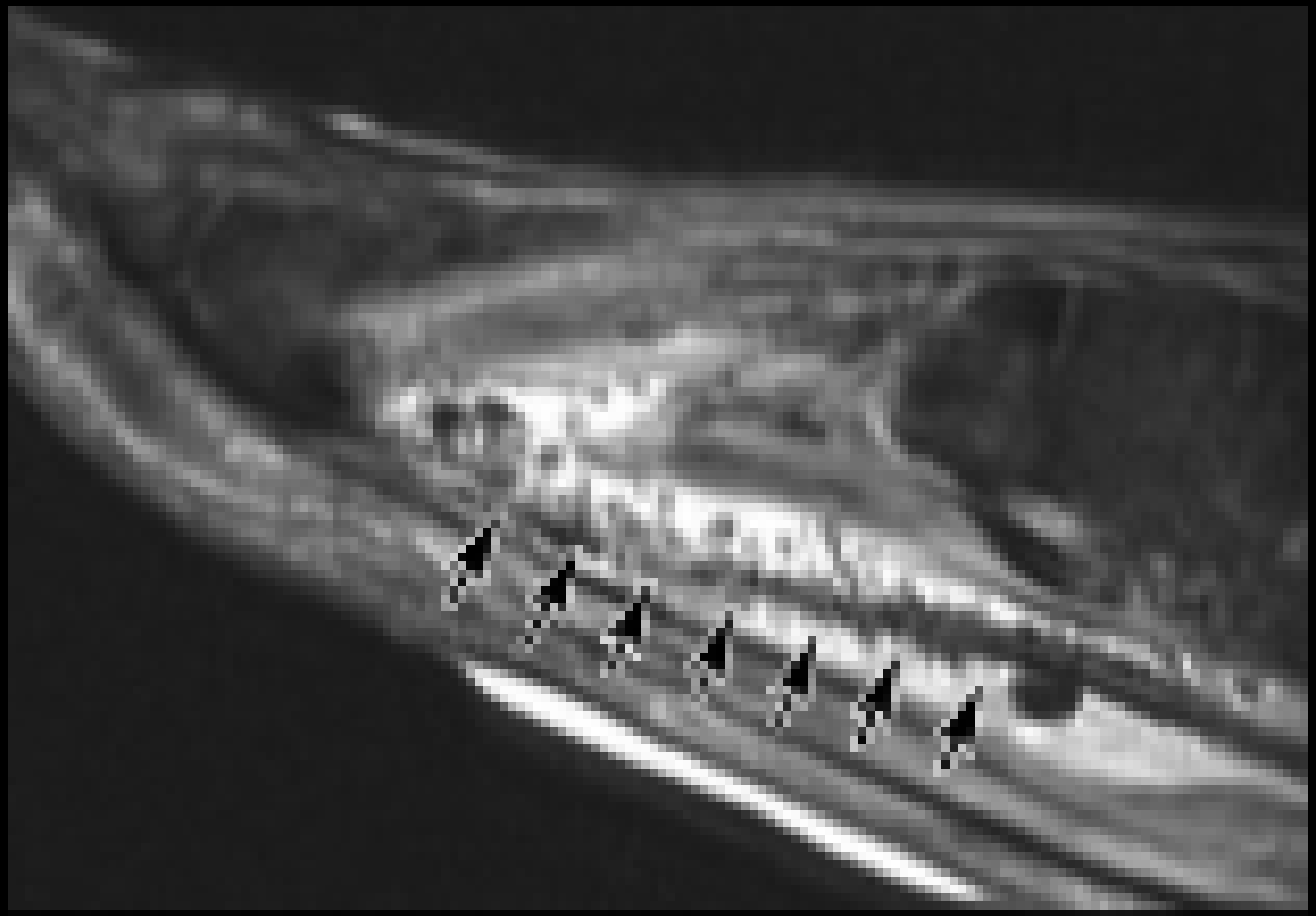
Ulcer with Sinus Tract



Post Operative Osteomyelitis



Infections Tenosynovitis with wet gangrene



Donovan and Schweitzer, Radiographics, 2010

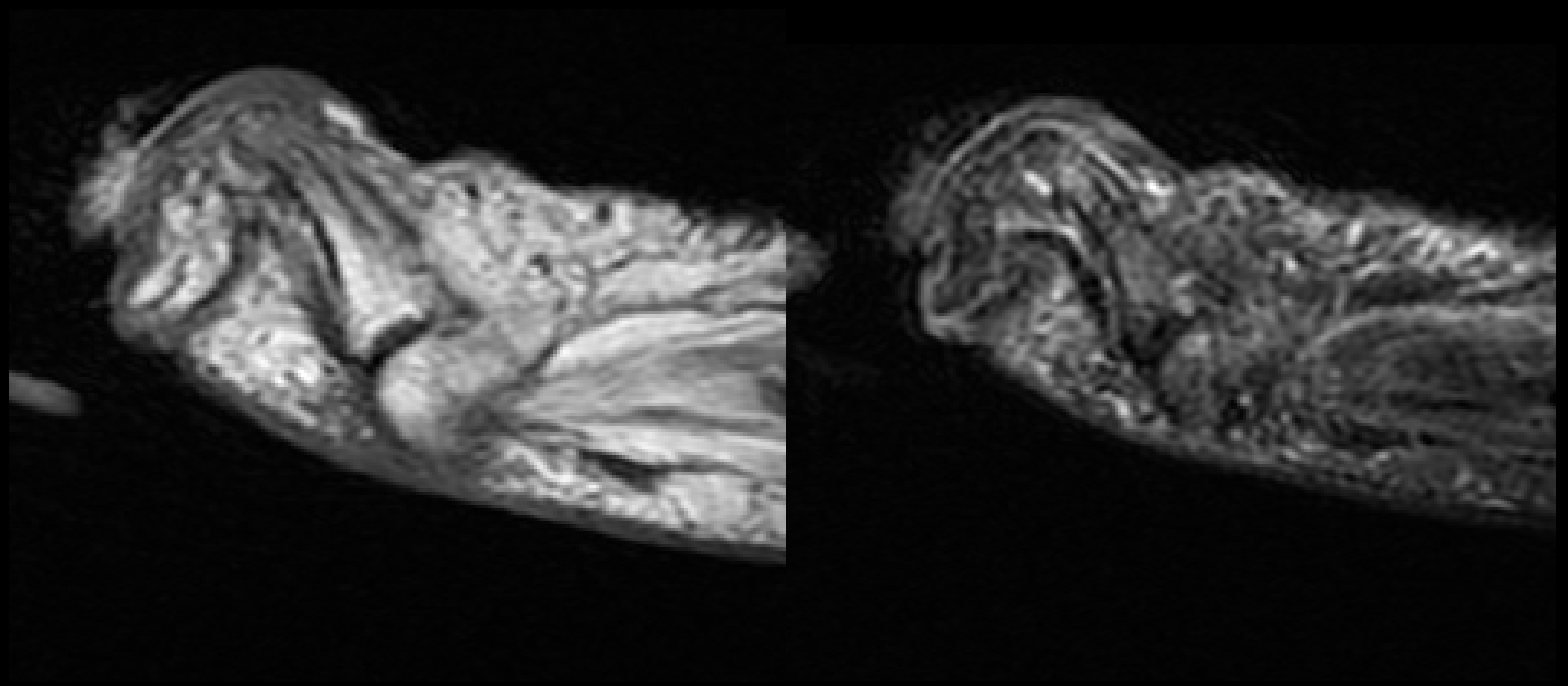
Foot MRI Bone Findings

- Osteomyelitis
  - Low signal on T1, High signal on T2/STIR, Enhancement
- Bone abscess
- Reactive osteitis vs early osteomyelitis
  - **If there is no signal abnormality on T1 weighted imaging but there is edema signal on T2 weighted imaging, the diagnosis is more likely reactive osteitis than osteomyelitis but must then use secondary signs to diagnosis possible early osteomyelitis.**

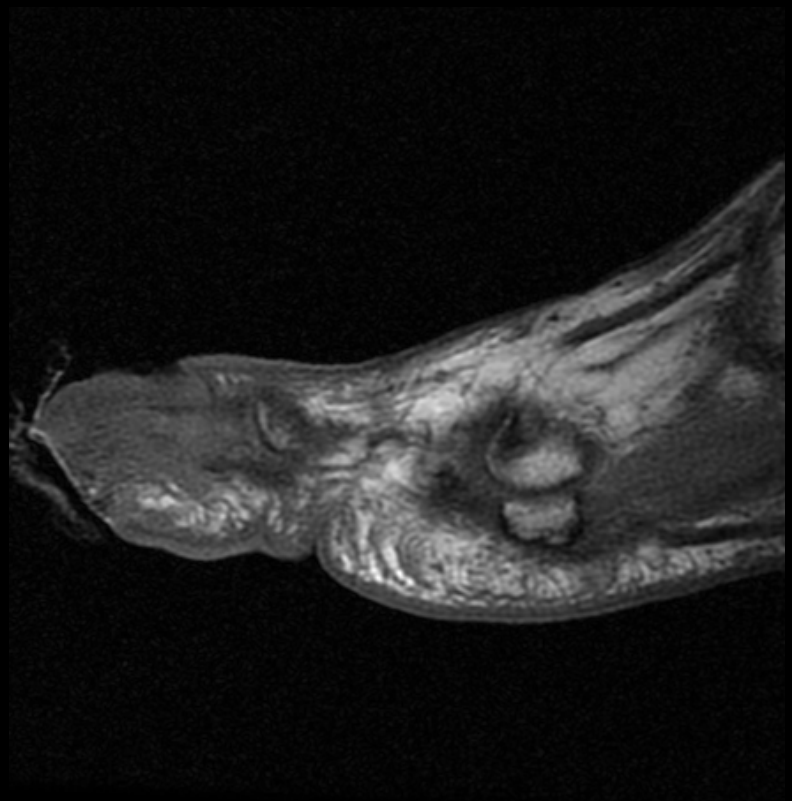
Foot MRI Bone Findings

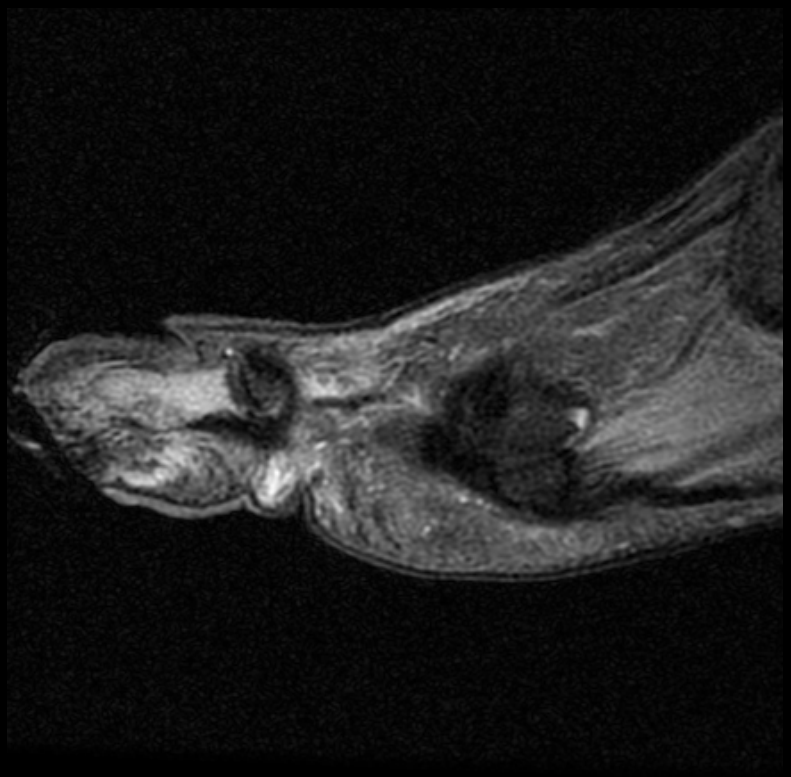
- **If there is no signal abnormality on T1 weighted imaging but there is edema signal on T2 weighted imaging, the diagnosis is more likely reactive osteitis than osteomyelitis but must then use secondary signs to diagnosis possible early osteomyelitis.**
  - **Adjacent ulcer and soft tissue changes, ability to probe to bone**
  - **Does contrast help in these cases?**
    - **May indicate adequate vascularity to treat with IV Abx…**

Osteomyelitis

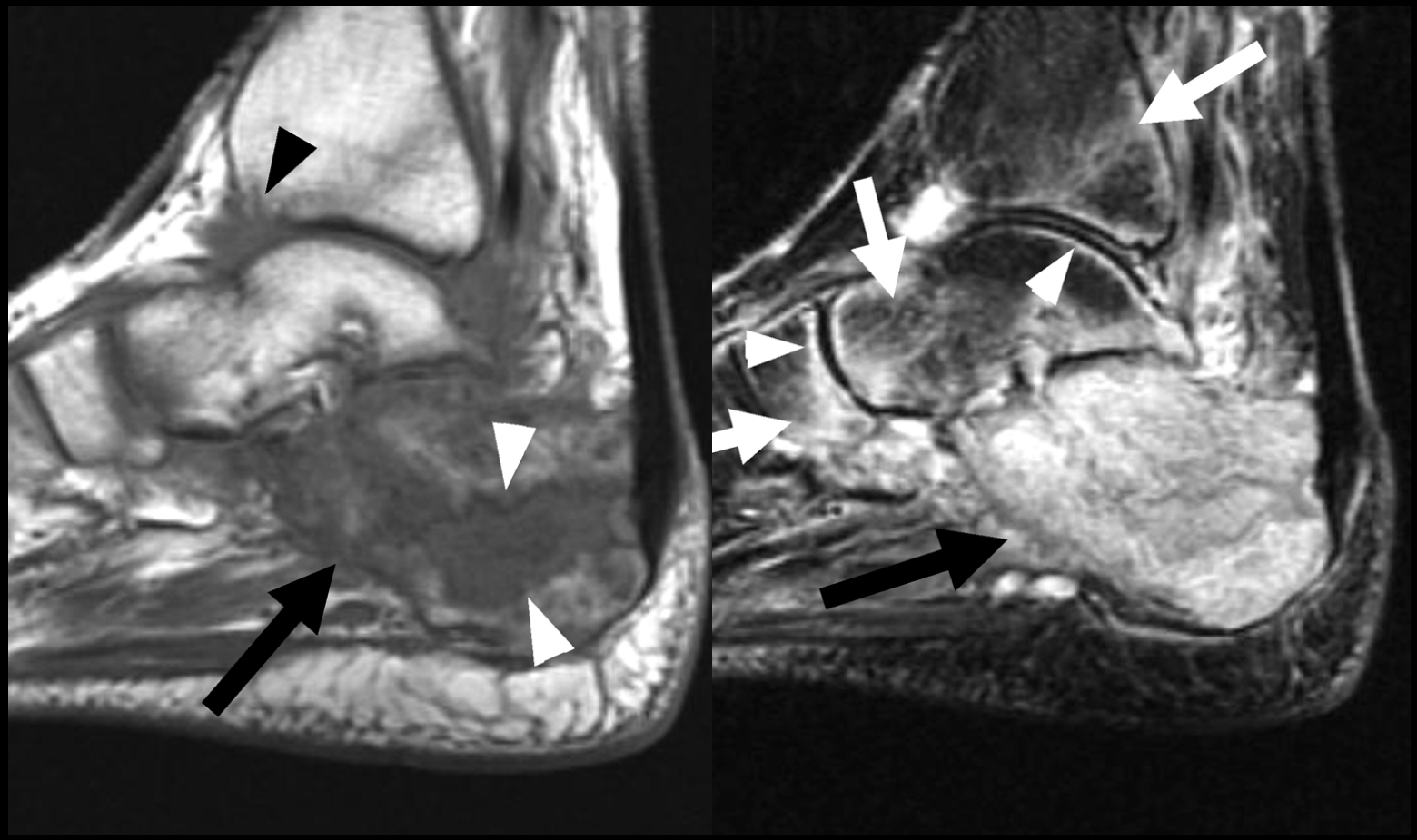


Osteomyelitis with Gadolinium

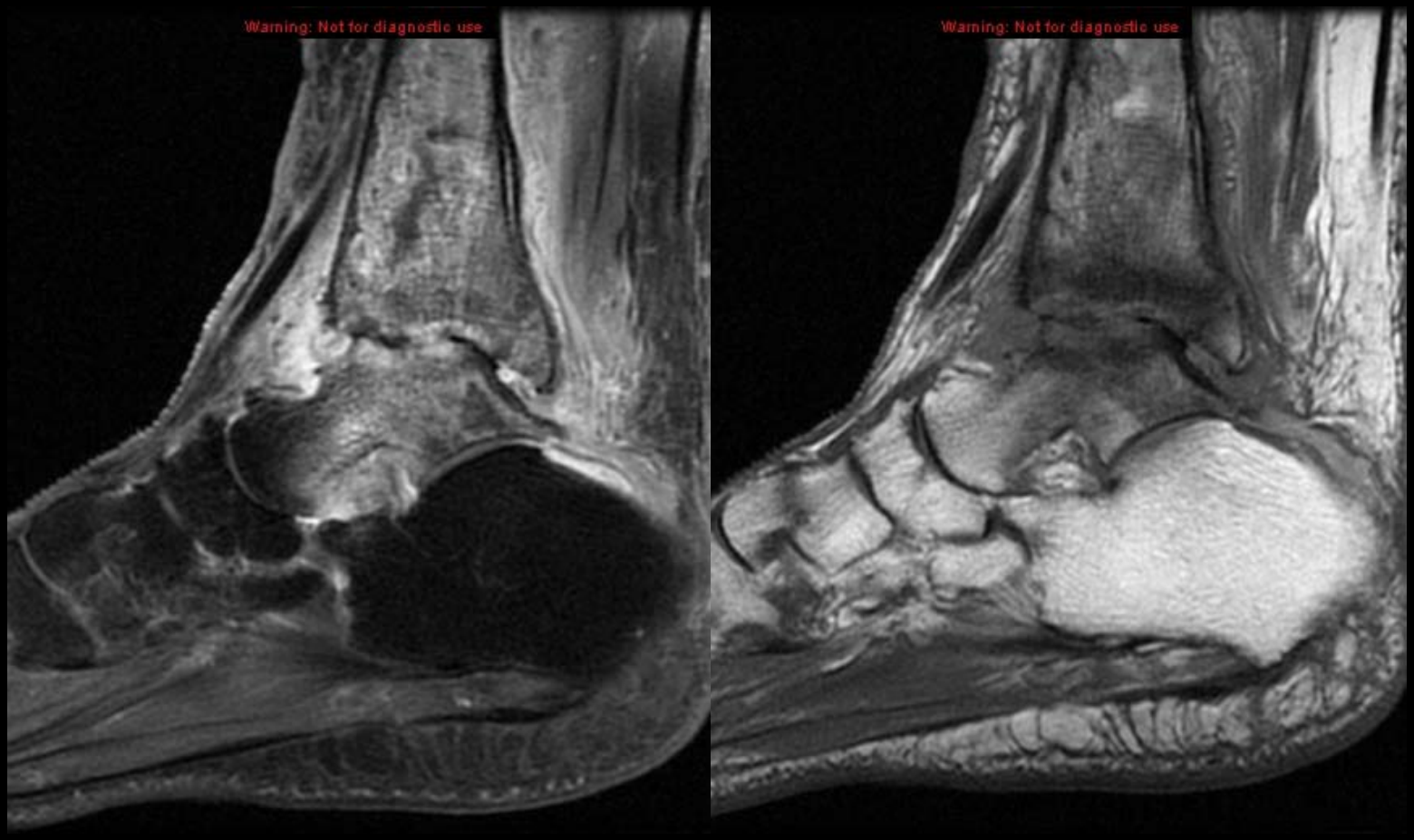




Osteomyelitis with Bone Abscess and Septic Arthritis



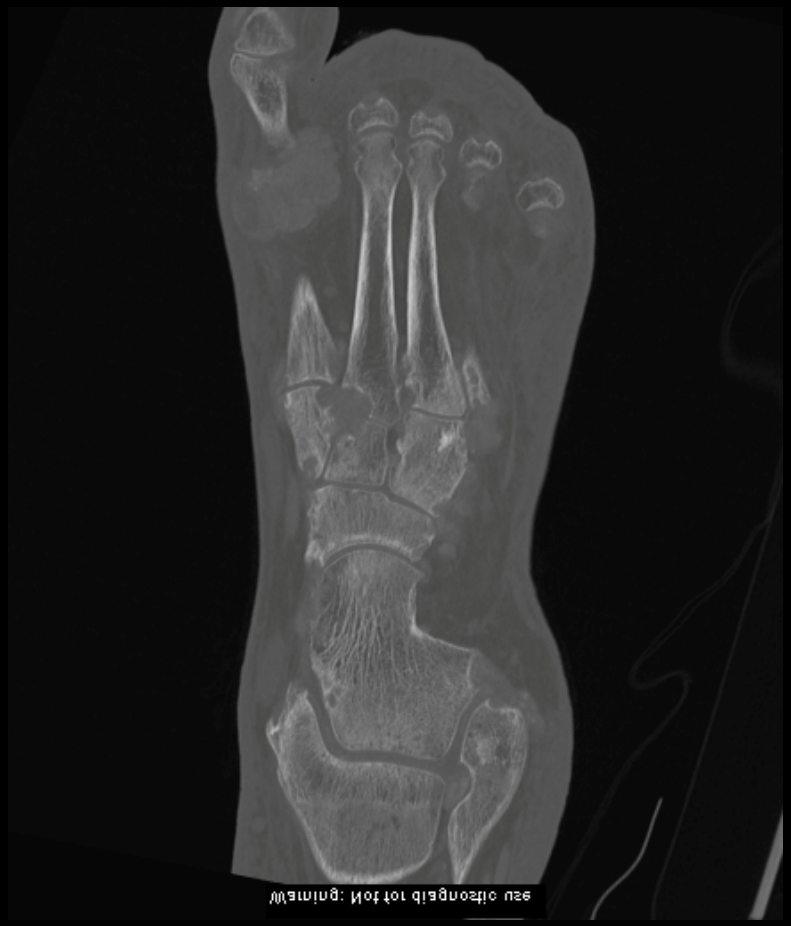
Osteomyelitis with Bone Abscess and Septic Arthritis

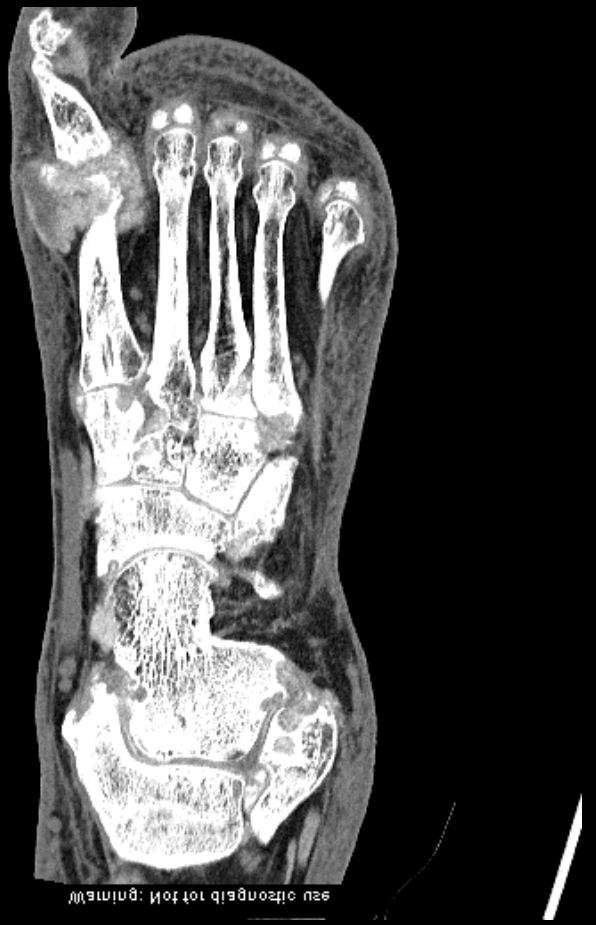


Complicating Conditions

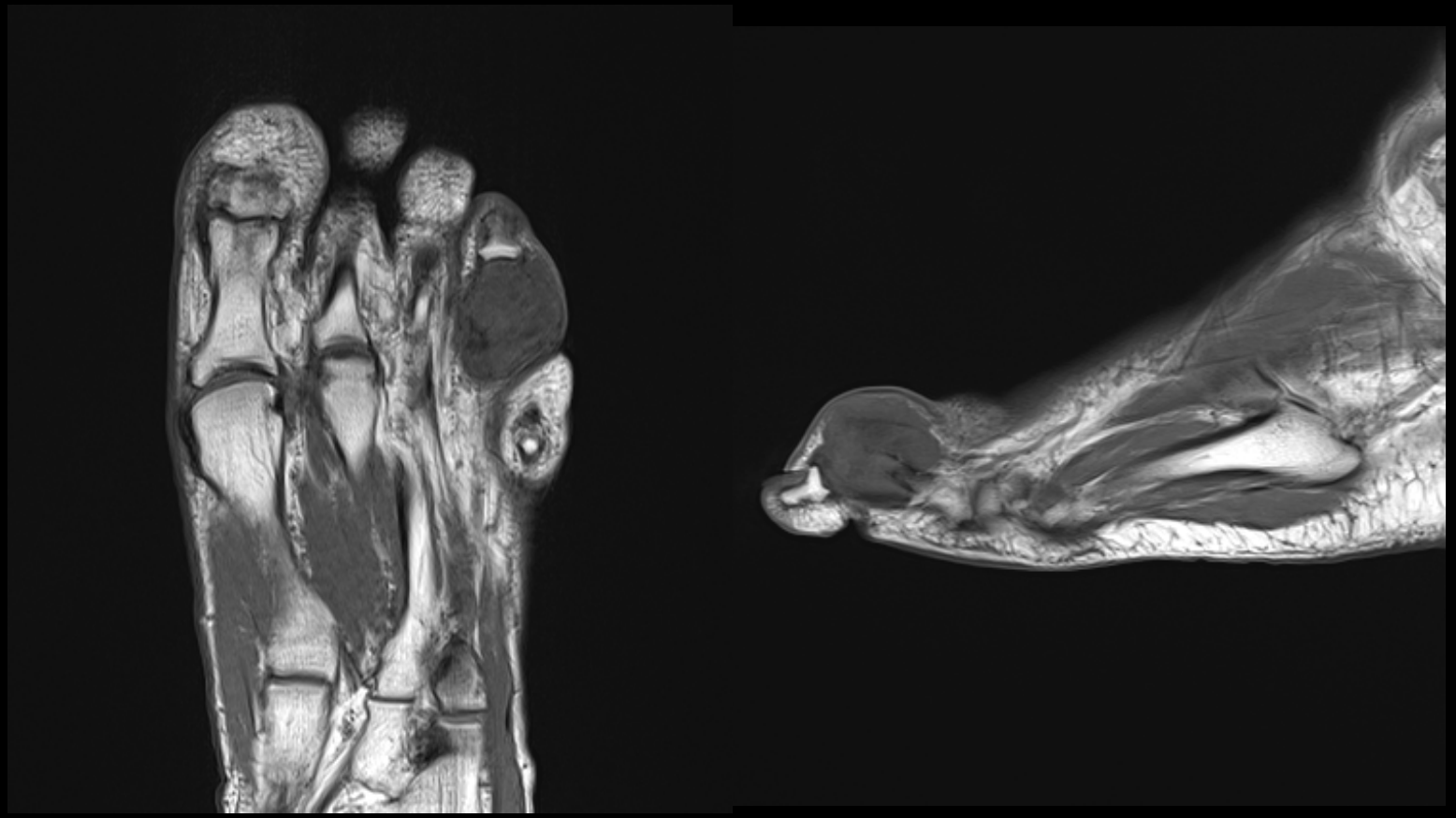
- Complicating because have similar imaging findings and are seen in similar patient populations
  - Charcot/ Neuropathic
  - Gout
  - Other Inflammatory Arthropathies

Gout

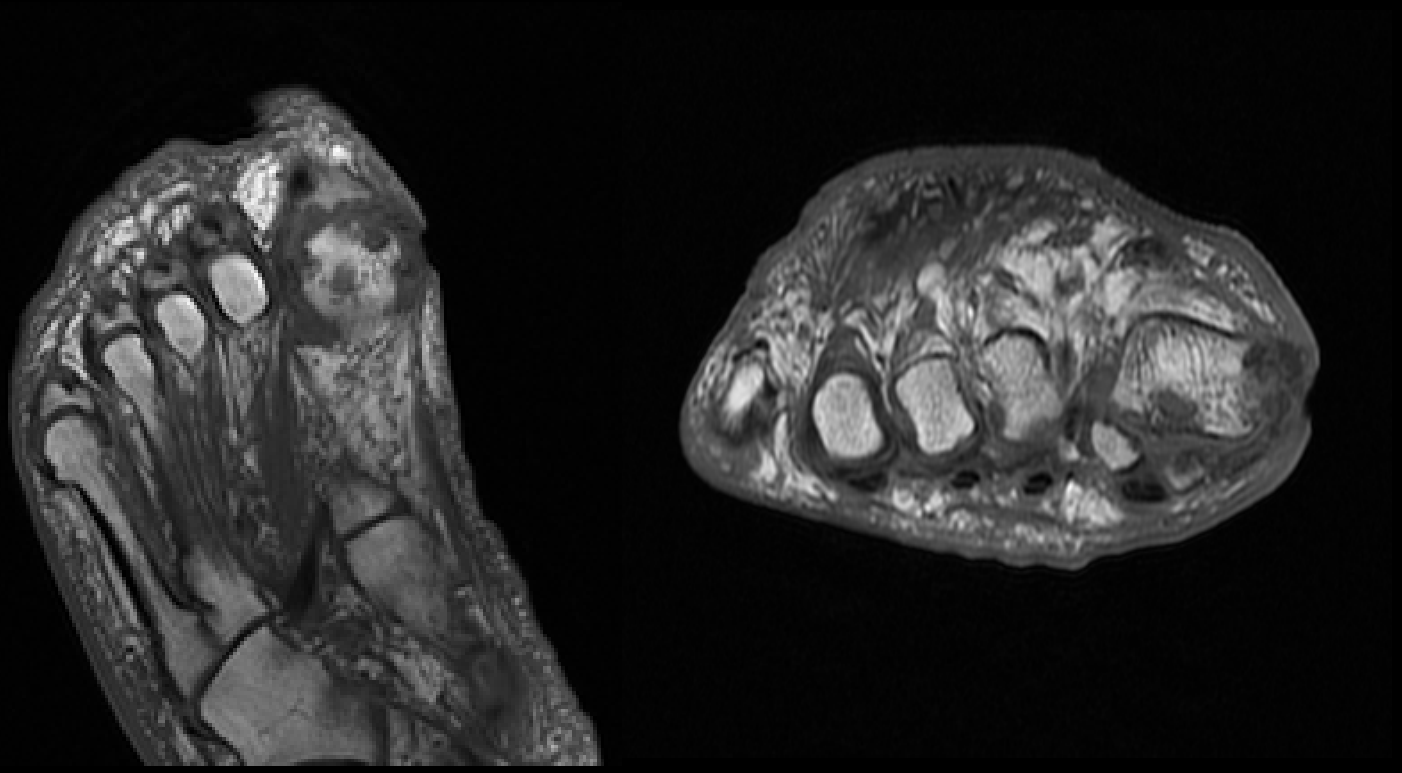

Warning: Not for diagnostic use


Warning: Not for diagnostic use

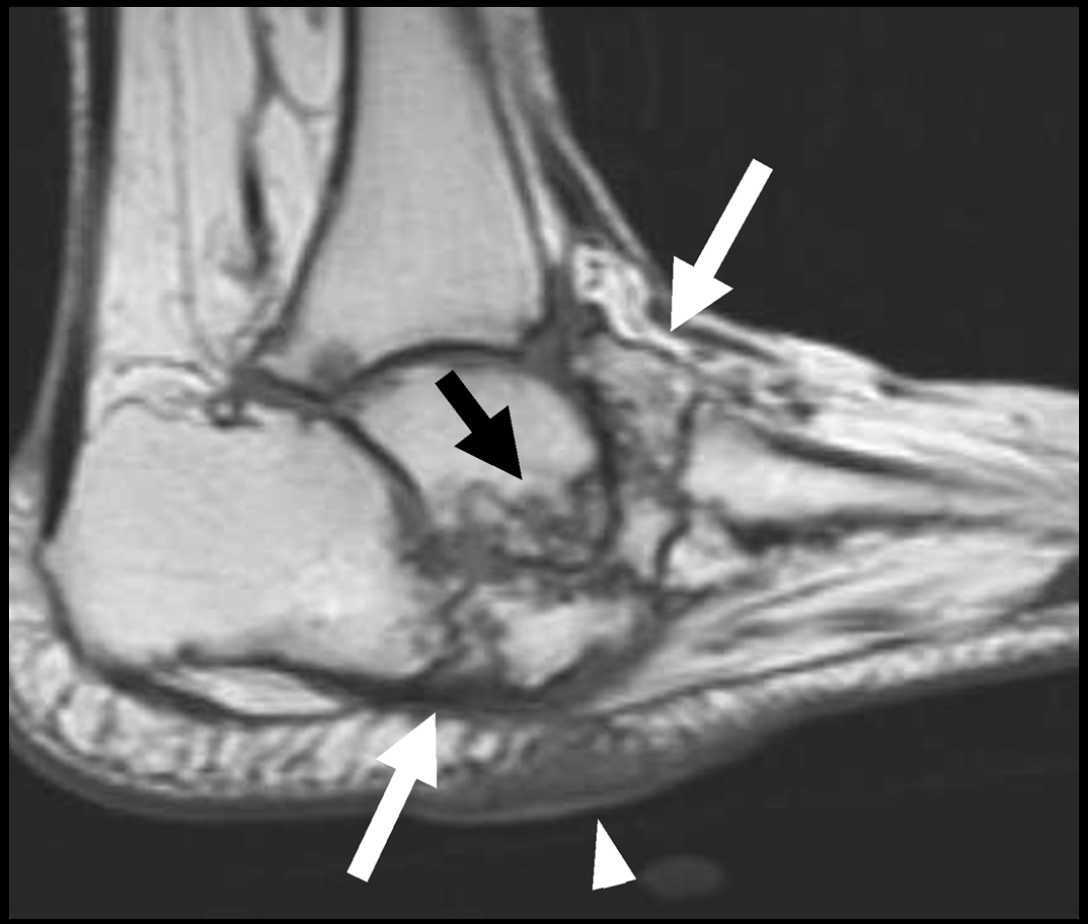
Gout



Gout

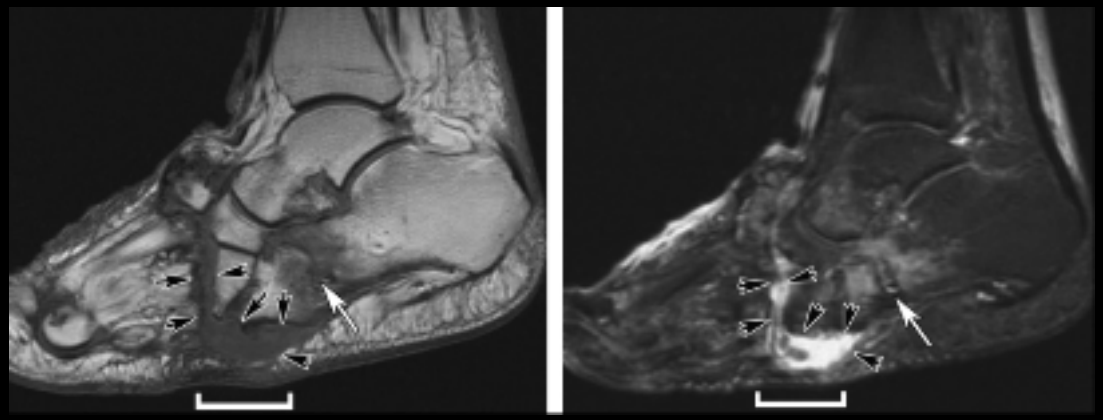


Neuropathic Joint

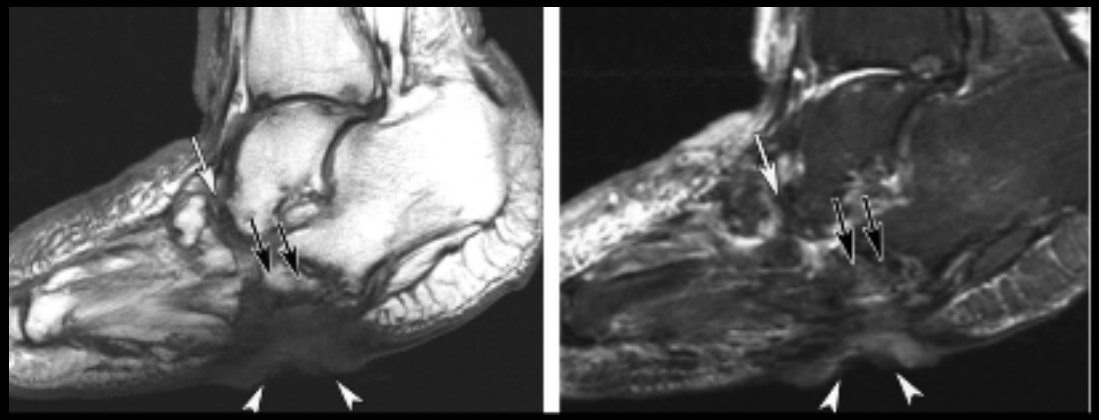


Charcot Arthropathy

No osteomyelitis



Osteomyelitis

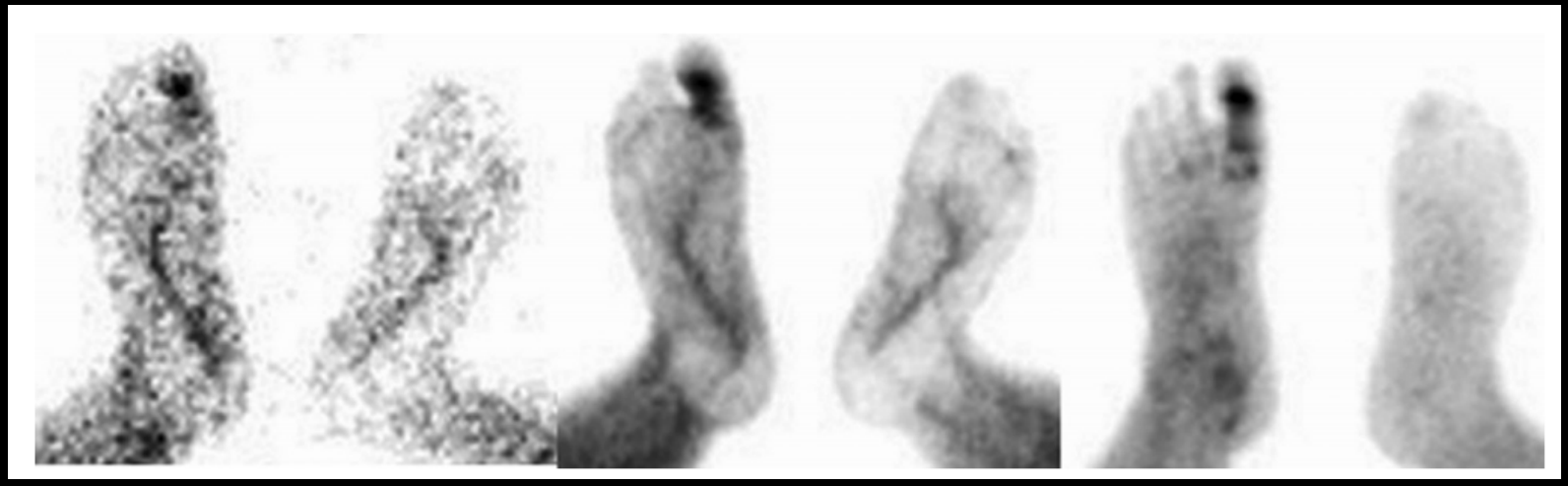


Donovan and Schweitzer, Radiographics, 2010

Nuclear medicine

- 3-phase bone scan (Tc-99m) historically has been nuclear medicine test of choice
  - Readily available
  - Positive on all 3 phases = diagnostic of osteomyelitis?
  - Sensitive but not specific
    - Mimics of osteomyelitis include neuropathic joint and pedal ulcer

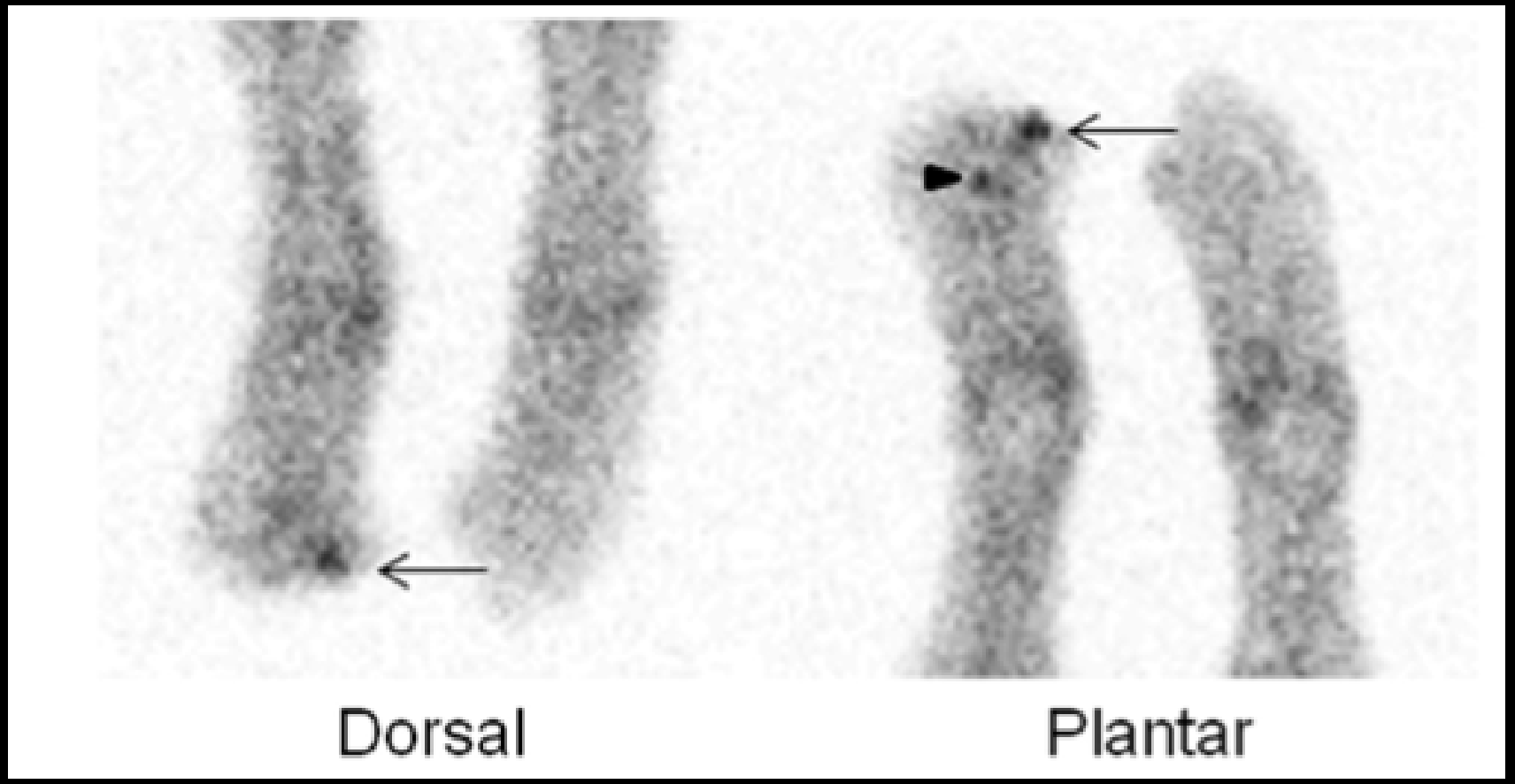
3 phase bone scan



Nuclear medicine

- WBC imaging is gold standard for nuclear medicine imaging of pedal osteomyelitis in diabetics
- In-111 WBC: sensitivity 72-100%; specificity 67-100%
- Tc-99m WBC: sensitivity 86-93%; specificity 80-98%
- Specificity increases with SPECT-CT

WBC imaging



WBC Imaging

Conclusion

- Radiographs = starting point, but often lags
- MRI = gold standard for diagnosis of pedal infection/osteomyelitis
  - ACR appropriateness criteria
  - Allows best evaluation of soft tissues, better resolution than Nucs
  - IV contrast preferred but not necessary
- Nuclear medicine = if contra-indication to MRI

References

1. Tins BJ, Cassar-Pullicino VN. MR imaging of spinal infection. Semin Musculoskelet Radiol 2004;8: 215–229.
2. Varma R, Lander P, Assaf A. Imaging of pyogenic infectious spondylodiskitis. Radiol Clin North Am 2001;39:203–213.
3. Moore SL, Rafii M. Imaging of musculoskeletal and spinal tuberculosis. Radiol Clin North Am 2001;39: 329–342.
4. Ledermann HP, Schweitzer ME, Morrison WB, Carrino JA. MR imaging findings in spinal infec- tions: rules or myths? Radiology 2003;228:506–514.
5. Palestro CJ, Love C. Nuclear medicine and diabetic foot infections. Semin Nucl Med 2009; 39:52-65.
6. Kapoor A, Page S, LaValley M, et al. Magnetic resonance imaging for diagnosing foot osteomyelitis. A Meta-analysis. Arch Intern Med 2007; 167:125-132.
7. Schweitzer ME, Daffner RH, Weissman BN, et al. ACR appropriateness criteria on suspected osteomyelitis in patients with diabetes mellitus. J Am Coll Radiol 2008; 5:881-6.
8. Pladkowski AJ, Hayter CL, Miller TT, Nguyen JT, Potter HG. Lamellated Hyperintense Synovitis: Potential MR Imaging Sign of an Infected Knee Arthroplasty.
9. Kowalski, TJ, Layton, KF, Berbari, EF, Steckelberg, JM, Huddleston PM, et al. Follow-up MRI Imaging in Patients with Pyogenic Spine Infections: Lack of Correlation with Clinical Features. Am J Neuroradiol, Apr 2007; 28:693-699.

Thank You

Radiation: Separating Fact from Fantasy

David Levi, MD
Chief, Division of Musculoskeletal Imaging
Atlantic Medical Imaging

Goals

- 1) Clarify what we know and (don't know) about radiation:
  - Dose
  - Linear no threshold model
  - Does radiation cause cancer?
- 2) Who is most at risk?
- 3) How do we minimize radiation?

Imaging benefits

- Imaging has become integral to the diagnostic algorithm
  - Decrease in false positive surgical diagnoses
    - 24-3% from 1996-2006 for appendicitis
  - Earlier cancer detection
  - Image-guided interventional diagnosis and therapies

Radiophobia

- CT use has increased 20x since early 1990s
- Some authors are predicting thousands of radiation induced cancers in the future

The New York Times

Radiation Overdoses Point Up Dangers of CT Scans

A week ago, Cedars-Sinai Medical Center in Los Angeles disclosed that it had mistakenly administered up to eight times the normal radiation dose to 206 possible stroke victims over an 18-month period during a procedure intended to get clearer images of the brain. State and federal health officials are investigating the cause.

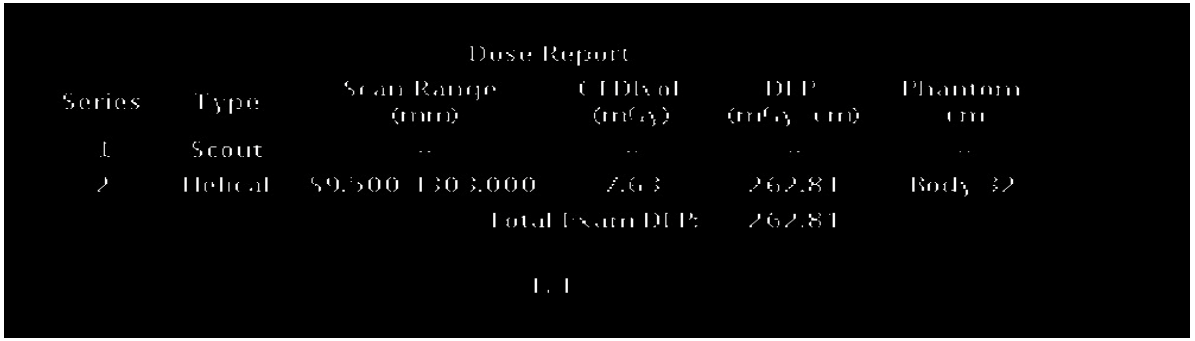
Hundreds of miles north at Mad River Community Hospital in Arcata, the other case — involving a 2 ½-year-old boy complaining of neck pain after falling off his bed — has led to the revocation of an X-ray technician's state license for subjecting the child to more than an hour of CT

Reducing CT radiation is **top priority** among hospitals' health technology initiatives

ECRI Institute
The Discipline of Science. The Integrity of Independence.

Dose

- Effective dose: mSv
  - Dose which if delivered uniformly to the whole body would produce same health consequences as those caused by a dose to one organ
  - What we use to "score" radiation dose
- Effective dose is what we calculate on every CT



Dose Report

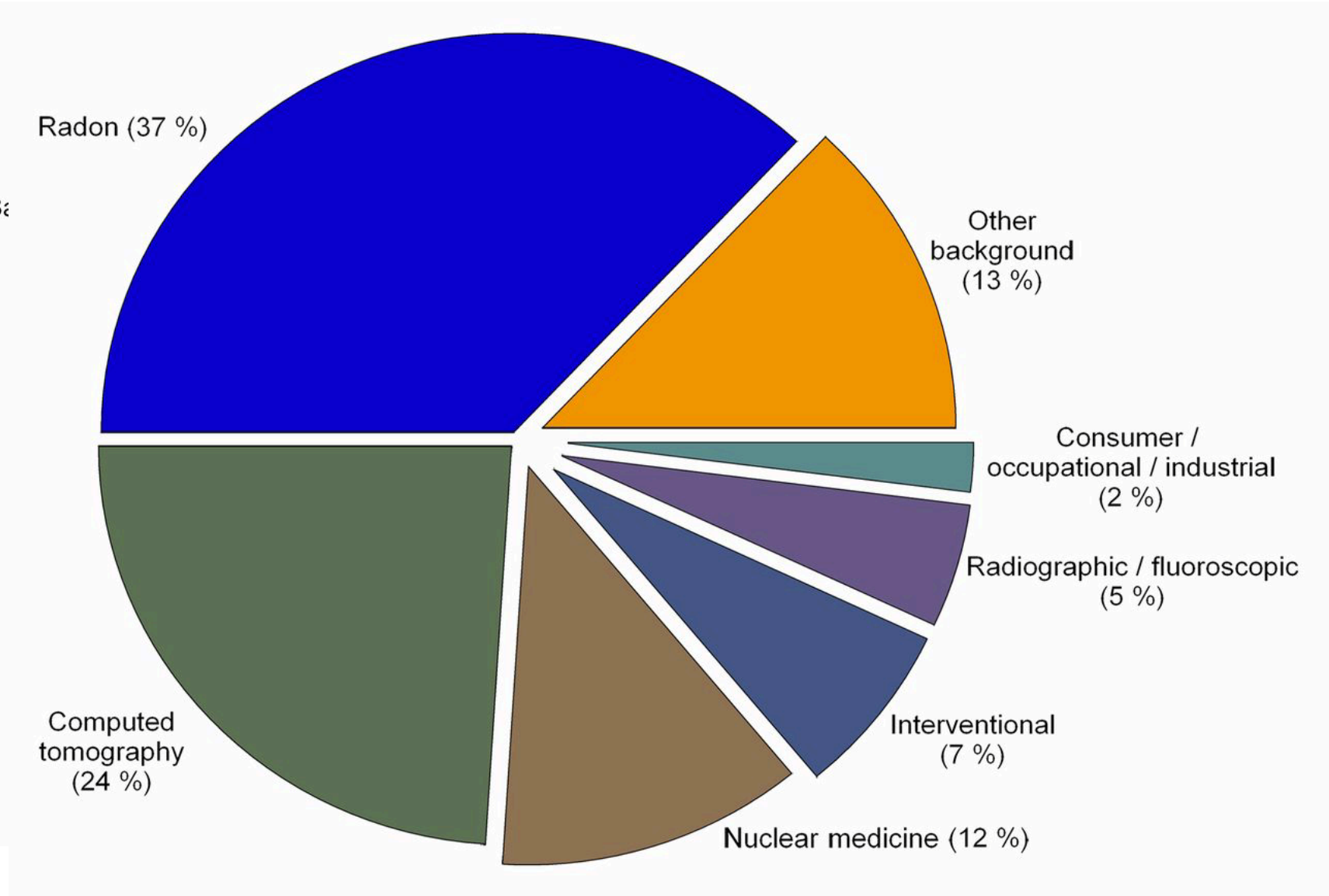
Series	Type	Scan Range (mm)	CTDIvol (mGy)	DLP (mGy · cm)	Phantom cm
1	Scout	--	--	--	--
2	Helical	59.500 - 130.000	7.63	262.81	Body 32

Total Exam DLP: 262.81

The problem with effective dose

- "Effective dose is intended for use as a protection quantity. The main uses of effective dose are the prospective dose assessment for planning and optimization in radiological protection….Effective dose is not recommended for epidemiological evaluations, nor should it be used for detailed specific retrospective investigations of individual exposure and risk."

Average effective dose per capita to the U.S. population from major sources of exposure.



Hendee W R , O'Connor M K Radiology 2012;264:312-321

Background radiation

Fact from fantasy

- Commonly cited number is fatal cancer risk of 1:2000 per 10 mSv.
  - Projected, theorized number
- No prospective epidemiologic studies demonstrating increased cancer risk for doses less than 100 mSv
- Putting data in perspective
  - Recent retrospective cohort study demonstrated EAR of 0.83 cases of leukemia per 10k children with multiple head CT
  - UNSCEAR report invalidating this study

EPI-CT

- Epidemiological study to quantify risks for pediatric CT and to optimize doses
- 1 million patients in 18 countries
- Data from 1985-2002 until now
- Comparing cancer rates in these patients vs. expected cancer rates in average population
- Results expected this year

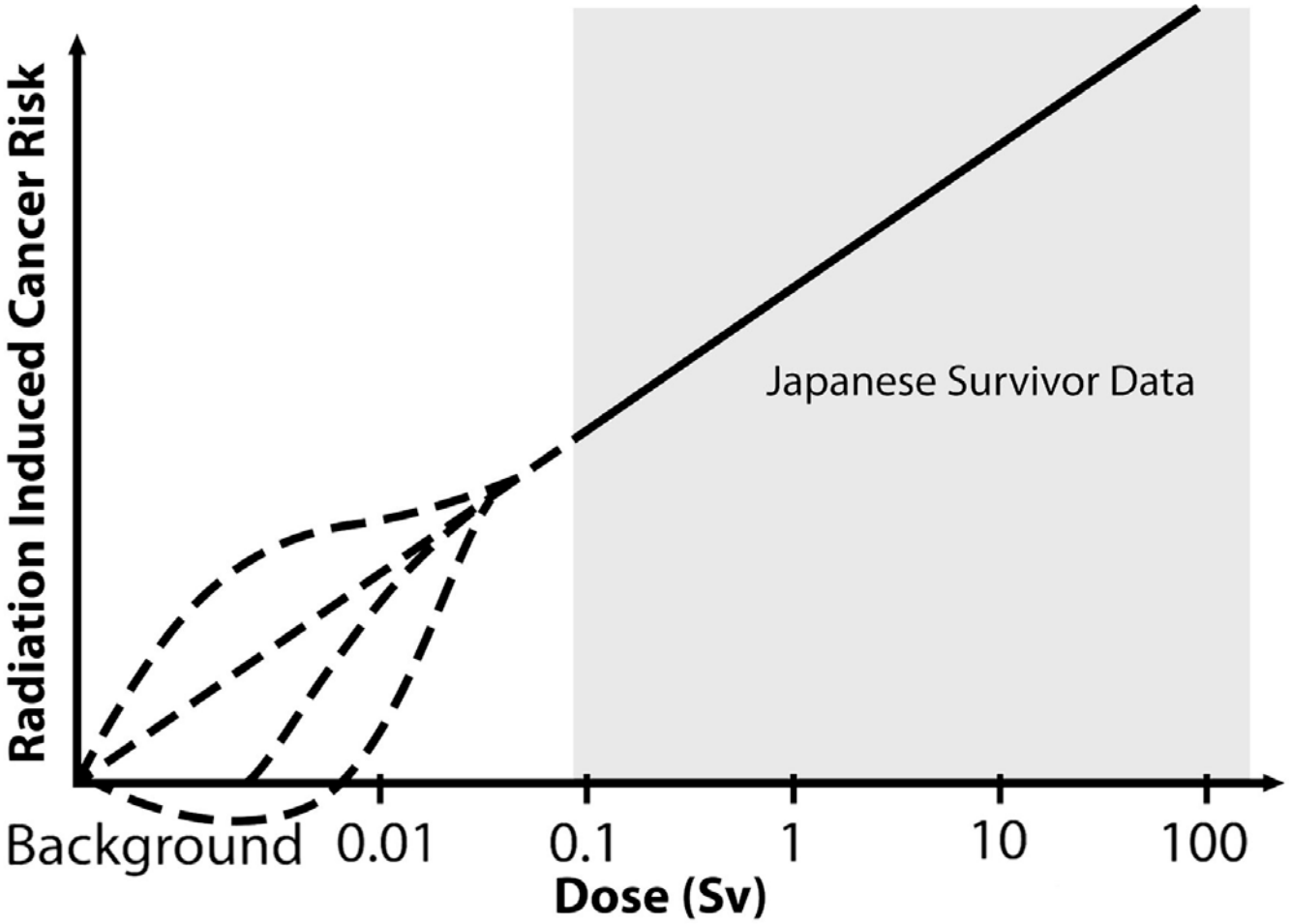
Quantifying risk: data sources

- Atomic bomb survivors
  - Hiroshima and Nagasaki
  - Greatest emphasis
- People exposed to medical radiation
- Workers in radiation and nuclear industries
- Survivors of environmental radiation exposure
  - Chernobyl
  - Three Mile Island

Hiroshima and Nagasaki

- Radiation from atomic bombs was different than radiation in medical imaging
  - Whole body radiation and radiation fallout
  - Different radiation particles
  - Difficult to extrapolate relevance to medical imaging
- At doses greater than 100 mSv, increased incidence of cancer
- At doses less than 100 mSv, no increased incidence of cancer

Graph shows models for extrapolating radiation-induced cancer risk to low doses (dashed line and curves).



Hendee W R , O'Connor M K Radiology 2012;264:312-321

Radiology

Benefit:Benefit

- Re-evaluation of atomic bomb survivor data shows radiation hormesis below 100 mSv
- Adaptive response to radiation
  - Mutation rate secondary to radiation vs background mutation rate
  - Multi-hit + evasion from immune detection and destruction
- Response to low dose radiation vs. response to high dose radiation

Other data sources

- Occupational exposure
  - 500k nuclear power plant workers = no increase in cancers
- Most population studies have revealed no or small demonstrable health effects of radiation exposure
- Chernobyl
  - Increased risk of thyroid cancer in persons exposed to downwind radiation in utero
  - Compare this with 15 million people who exhibited psychosomatic disorders from the radiation exposure
  - Workers cleaning up Chernobyl: no increased incidence of cancer
- Fukushima
  - >1000 evacuation related deaths

Statement from AAPM

- "Risks of medical imaging at patient doses below 50 mSv for single procedures or 100 mSv for multiple procedures over short time periods are too low to be detectable and may be nonexistent. Predictions of hypothetical cancer incidence and deaths in patient populations exposed to such low doses are highly speculative and should be discouraged."

Who is at risk?

- Study by Zondervan et al. compared risk of dying within 3 years after a CT in young (18-35 yo) patients vs. theoretical risk of dying from future cancer
  - CT abdomen: 35x more likely to die from condition than theoretical radiation induced cancer
  - CT chest: 70x more likely to die from condition than theoretical radiation induced cancer

Radiophobia

- Virtually all imaging procedures deliver doses way below 100 mSv
- Predictions of cancer incidence and death are at best controversial and at worst lack supportive evidence and are speculative
- Patients often delay or defer necessary imaging due to these fears

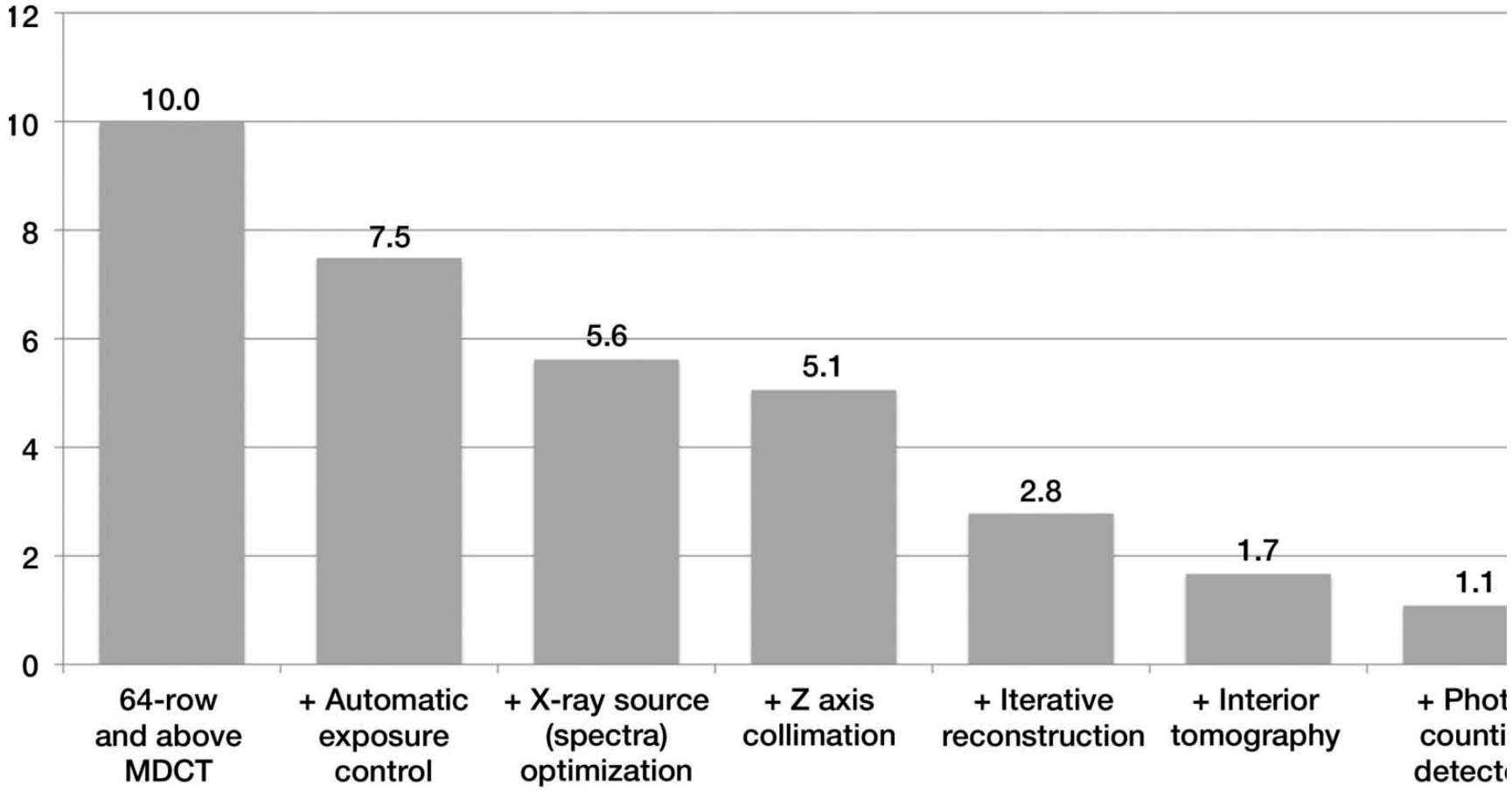
What we do know

- Age matters
- Weight matters
- Location matters

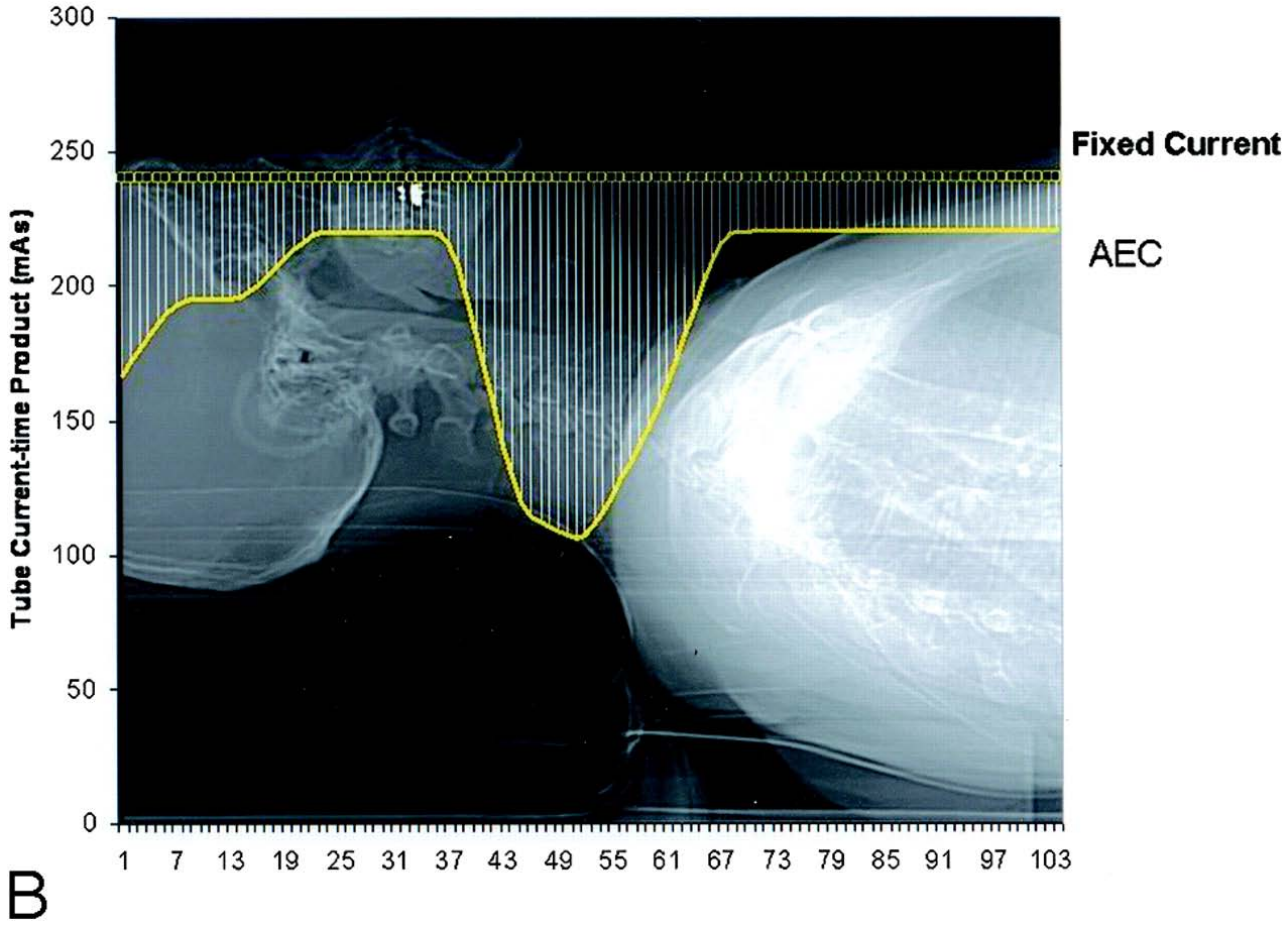
Common doses

- Background radiation = 3 mSv
- CT head = 2 mSv
- CT abd/pelvis = 8 mSv
- Nuclear stress test = 5 mSv
- Coronary CTA = 1 mSv
- Barium enema = 10-15 mSv

What we do know: dose reduction

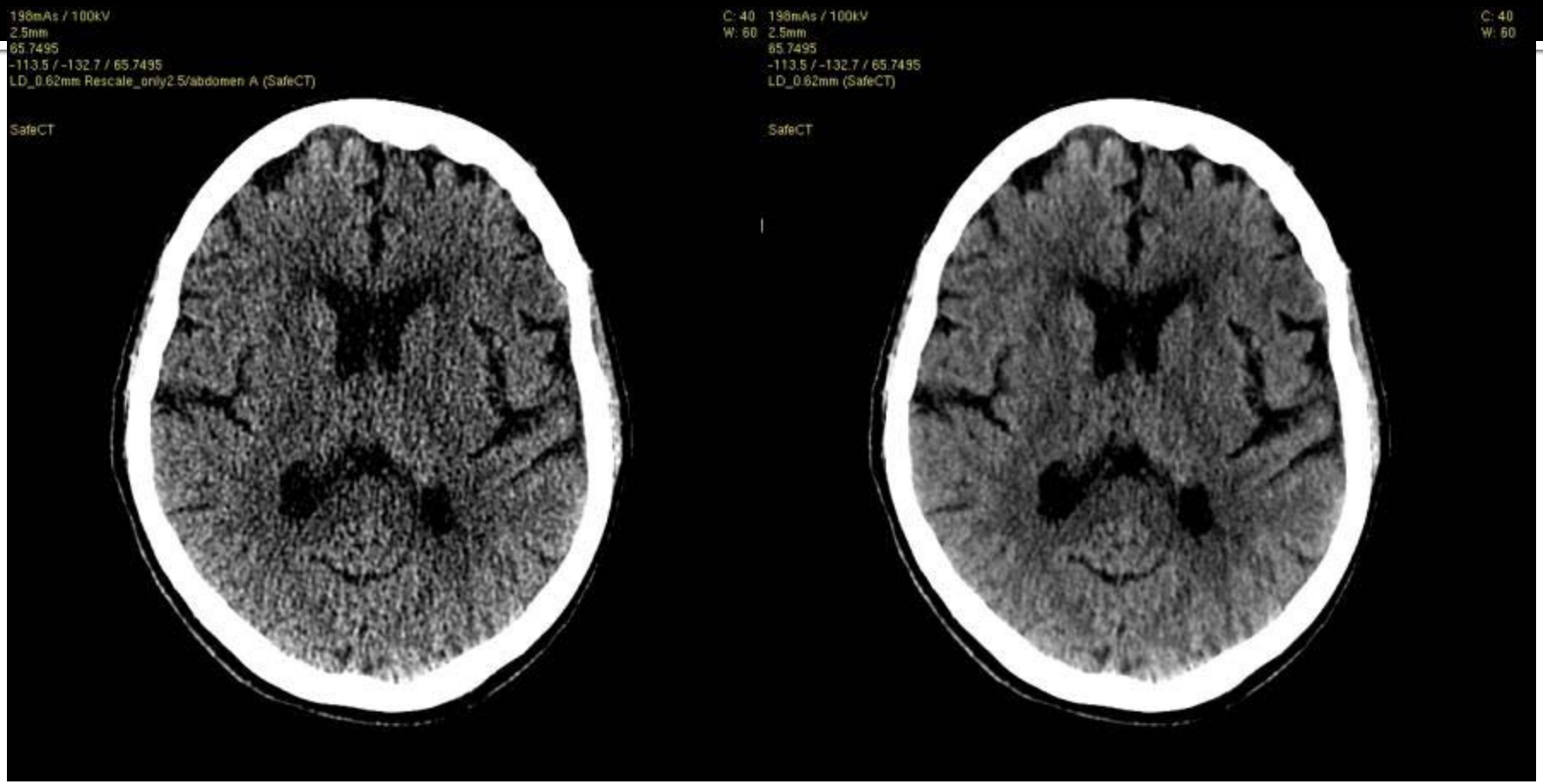


Radiation Exposure Reduction



Namasivayam S et al. AJNR Am J Neuroradiol 2006;27:2221-2225

Dose reduction software

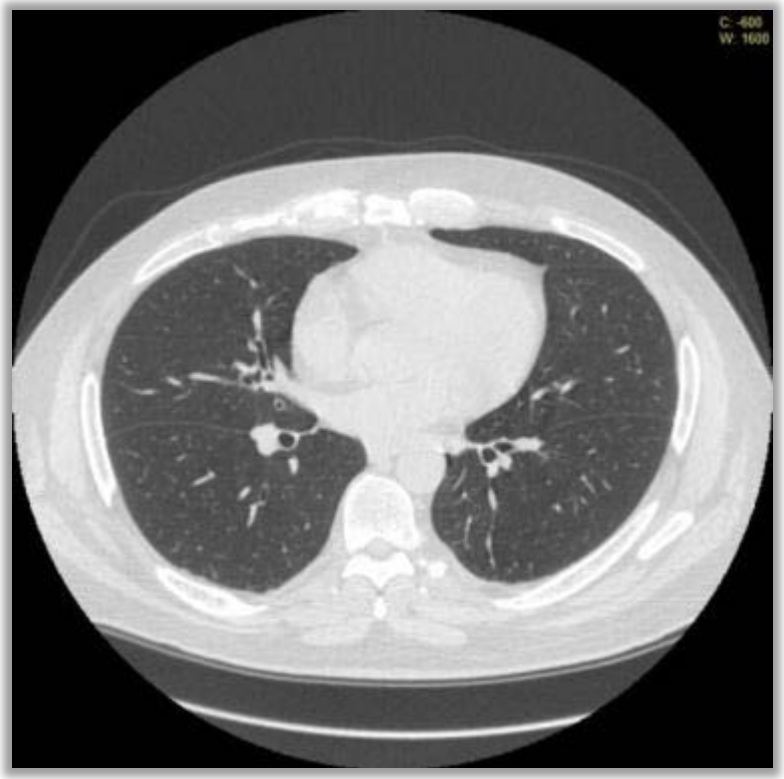


198mAs, 100kV,
2.5 mm slice thickness
Unprocessed

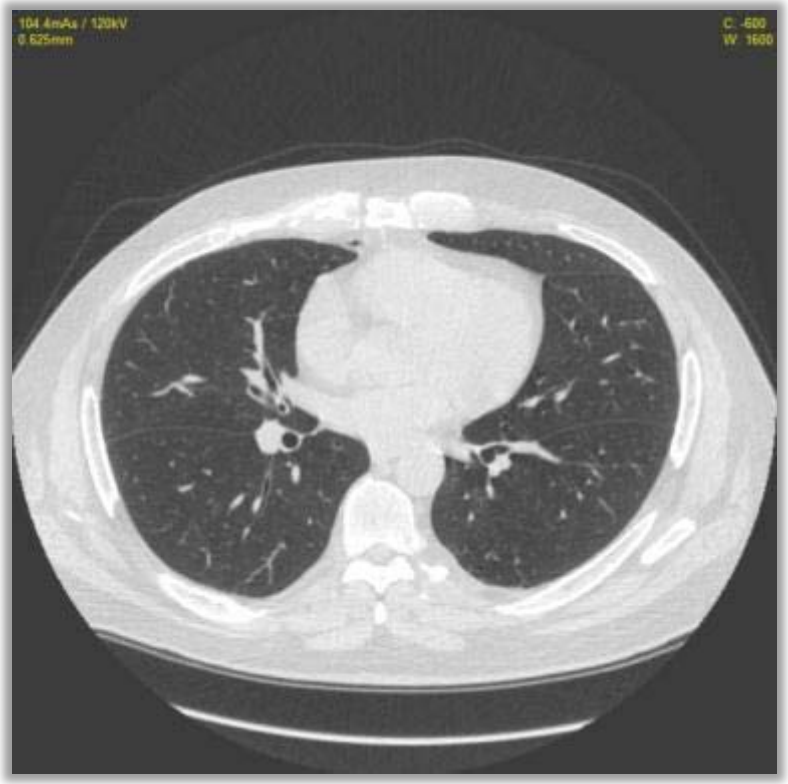
198mAs, 100kV,
2.5 mm slice thickness
Post-processed by SafeCT

316

Dose reduction software

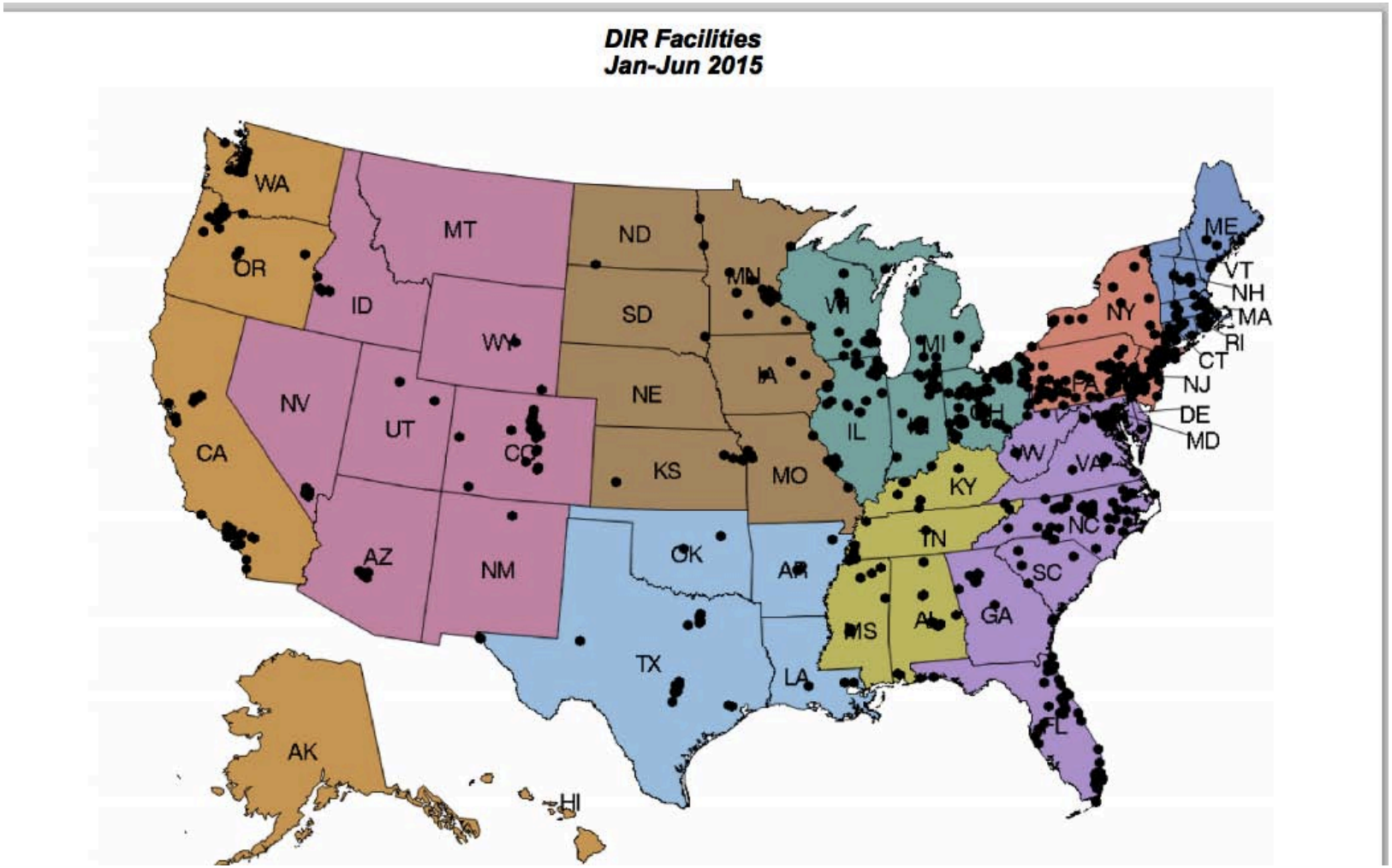


Full-dose CT at 200mAs

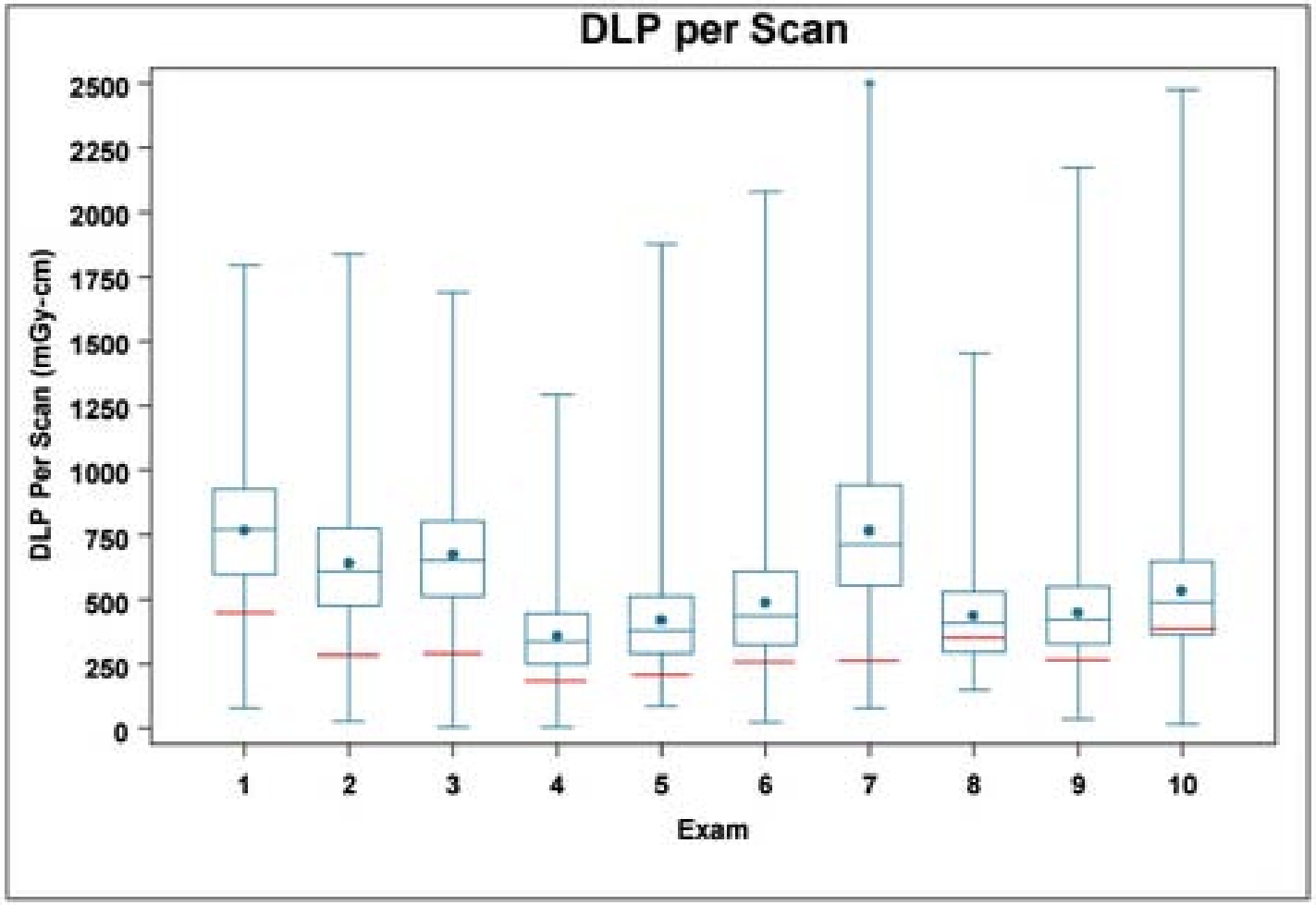


Half-dose SafeCT-processed image of the same patient (104mAs)

ACR dose registry



AMI vs. other imaging centers



Your patients

- If you believe that your patient needs a CT, then you should not hesitate to order it
- Council them on:
  - Dose: http://hps.org/physicians/documents/doses_from_medical_x-ray_procedures.pdf
  - Theoretical risks
  - Why the CT is necessary
- Appropriateness of imaging tests
  - http://www.acr.org/Quality-Safety/Appropriateness-Criteria
- Make sure your radiologists are doing everything possible to minimize your patient's dose

Benefit vs. risk

- While risk is theoretical, we must minimize dose as much as possible (ALARA)
  - Using best technology possible
  - Using best protocols
  - Considering if there is another test we can use
  - Dose minimization most important in children, but try to minimize dose to everyone
- We must focus on the benefits of imaging (AHARA), realizing that the theoretical risk is small

Thank you

Low Dose CT Lung Cancer Screening Update

David Kenny DO

Atlantic Medical Imaging

Cancer survival

Primary cancer	5 year % survival 1975-77	1999-2013
Lung	13	16
Colorectal	52	64
Breast	75	90
Pancreas	3	6

No significant improvement in mortality in the past 15 years

Sputum and serologic markers haven't yet shown to be of any benefit

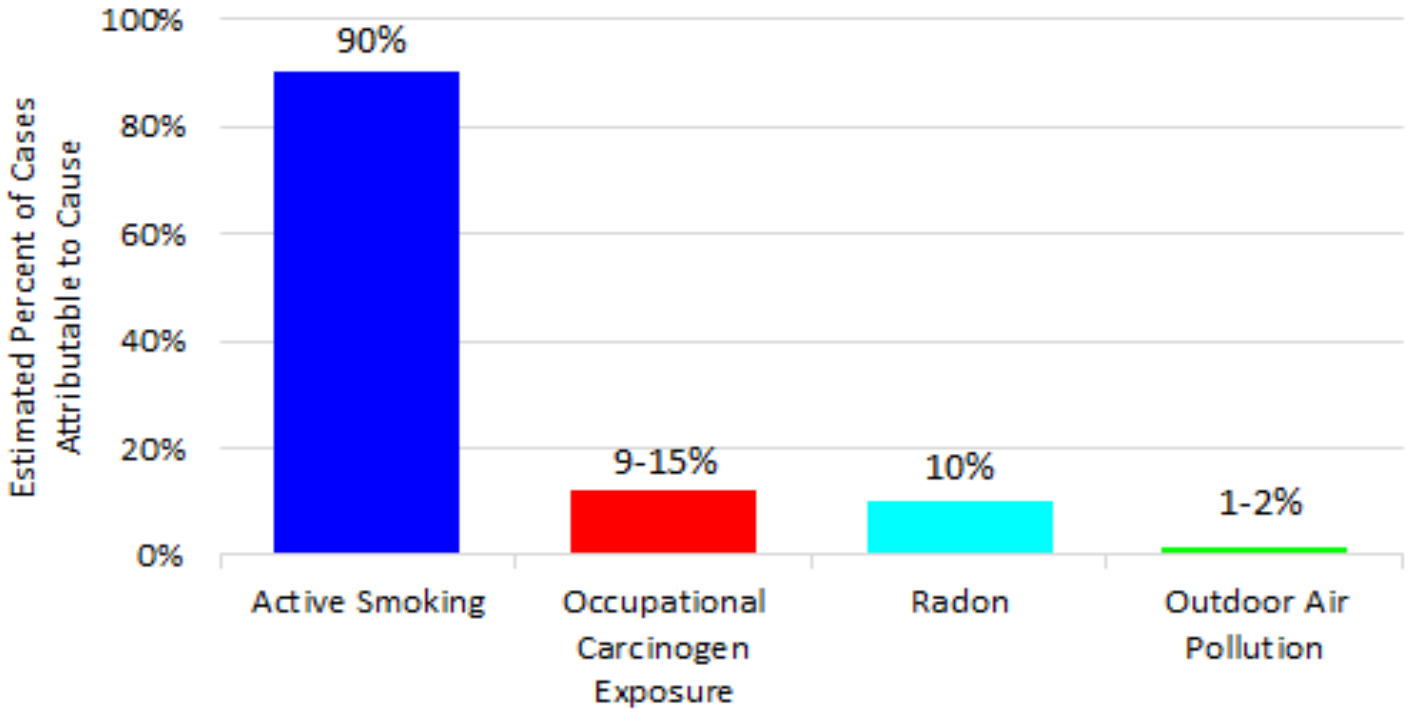
Estimated Cancer Deaths by Sex and Age (Years), 2014

	All ages	Younger than 45	45 and Older	Younger than 65	65 and Older
All sites, men	310,010	9,490	300,520	96,920	213,090
All sites, women	275,710	10,570	265,140	83,950	191,760
Colon & rectum, men	26,270	890	25,380	8,620	17,650
Colon & rectum, women	24,040	700	23,340	6,040	18,000
Lung & bronchus, men	86,930	930	86,000	25,860	61,070
Lung & bronchus, women	72,330	930	71,400	19,680	52,650
Breast, women	40,000	2,480	37,520	16,970	23,030
Prostate	29,480	*	29,450	2,940	26,540

*Estimate is fewer than 50 deaths.
Projected deaths are based on US mortality data from 1995-2010, National Center for Health Statistics, Centers for Disease Control and Prevention.
Note: Estimates should not be compared with those from previous years because of ongoing changes in the method for estimating cancer deaths.

American Cancer Society, Surveillance Research, 2014

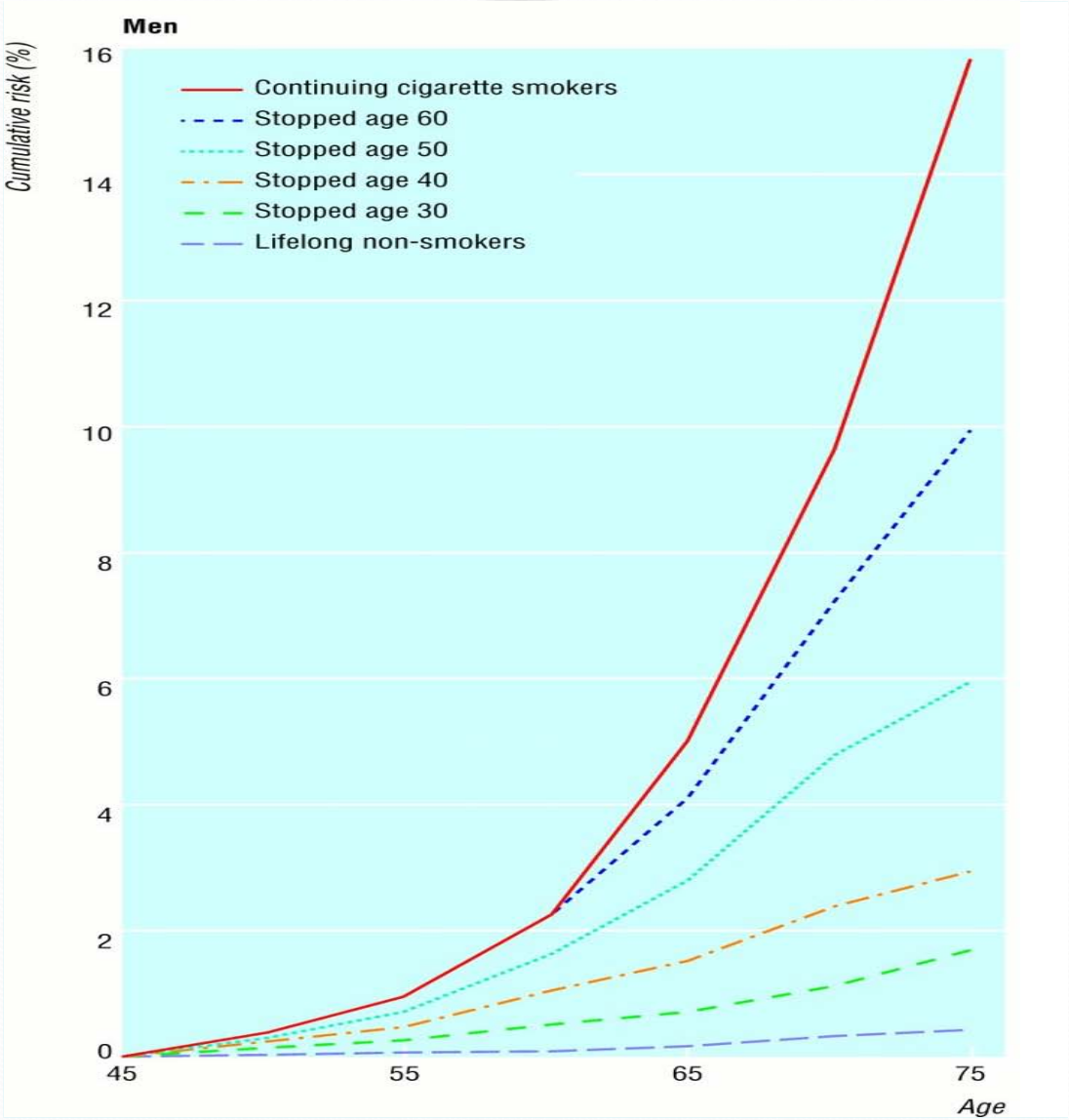
Estimated Attributable Portion of Lung Cancer Cases by Cause [12]



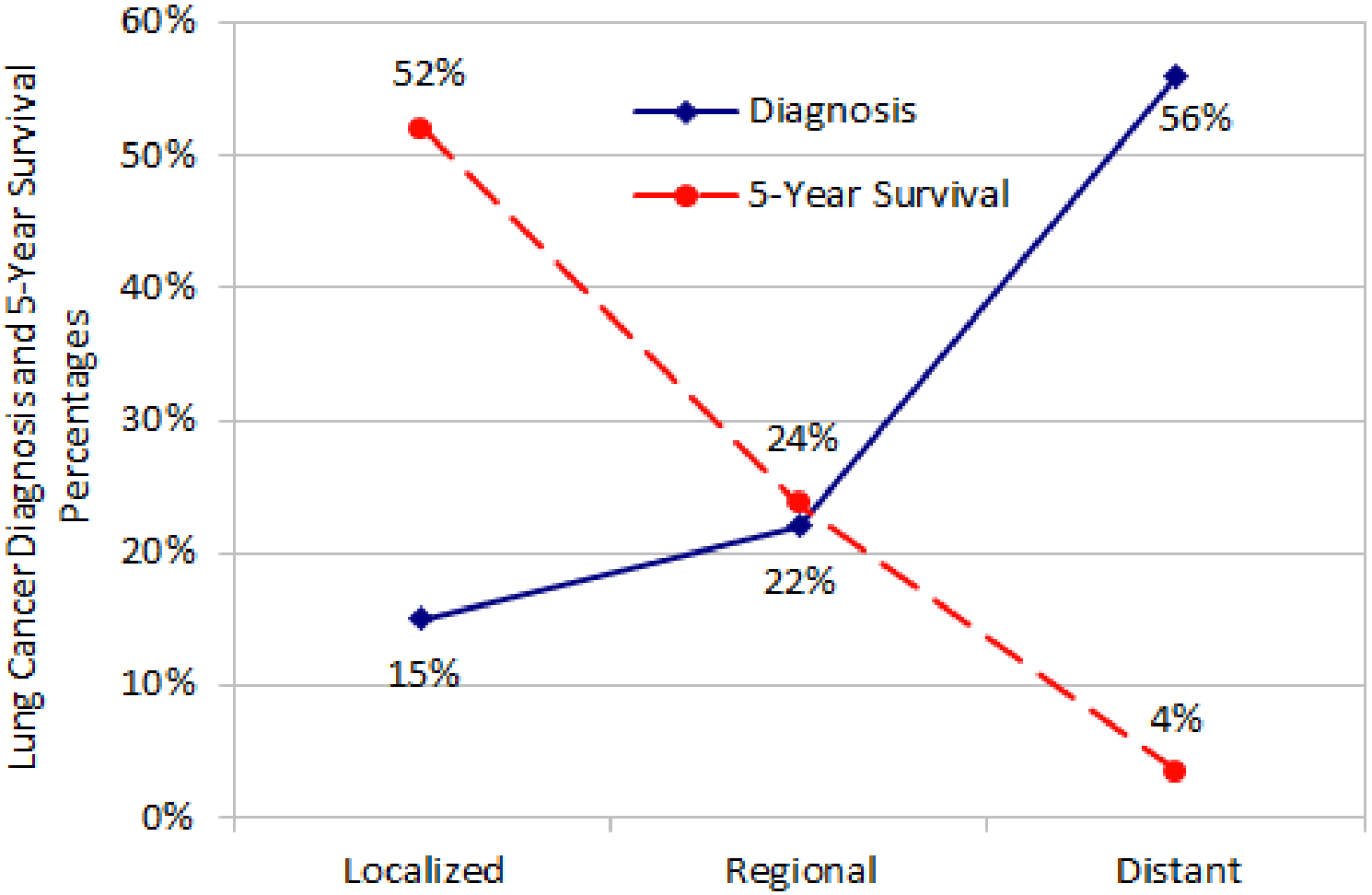
37% US adults are current or former smokers

Effects of stopping smoking at various ages on the cumulative risk (%) of death from lung cancer up to age 75, at death rates for men in UK in 1990. Nonsmoker rates were taken from US prospective study of mortality

* Importance of smoking cessation



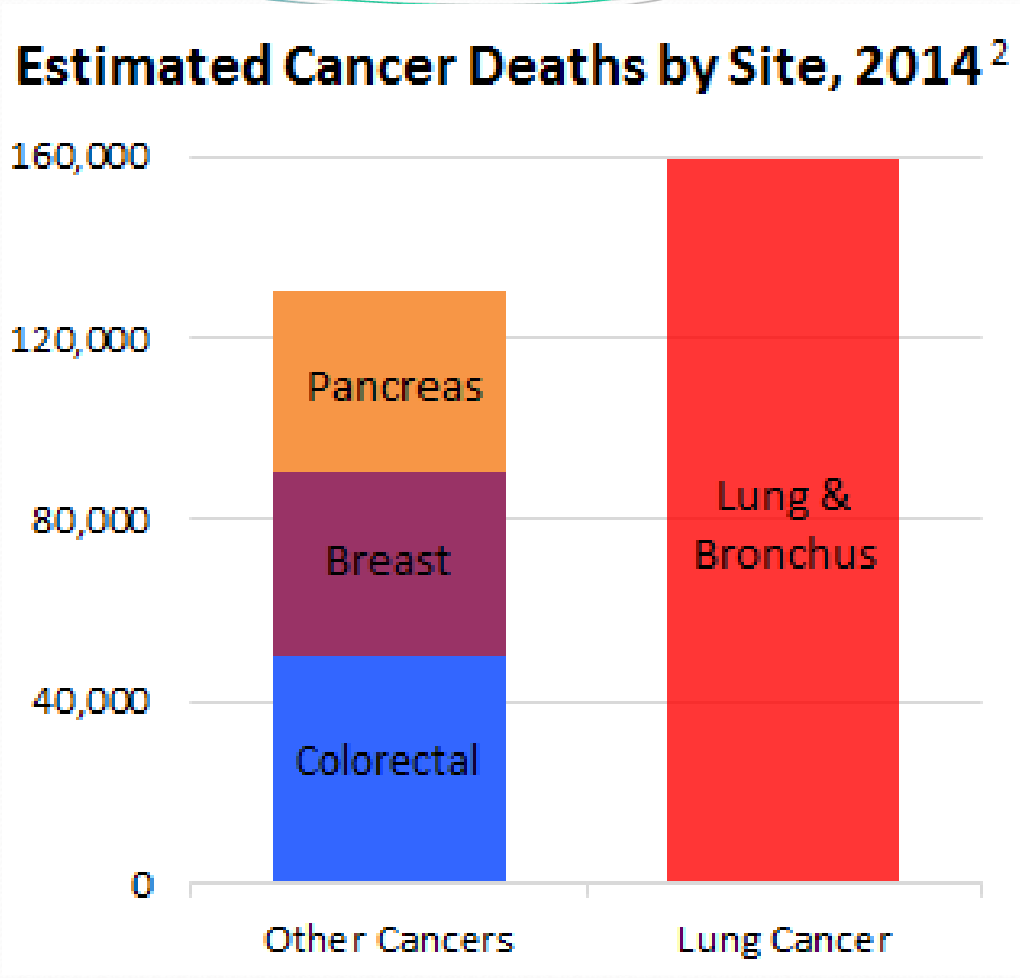
Lung Cancer Diagnosis and Survival By Stage, 2001-2007

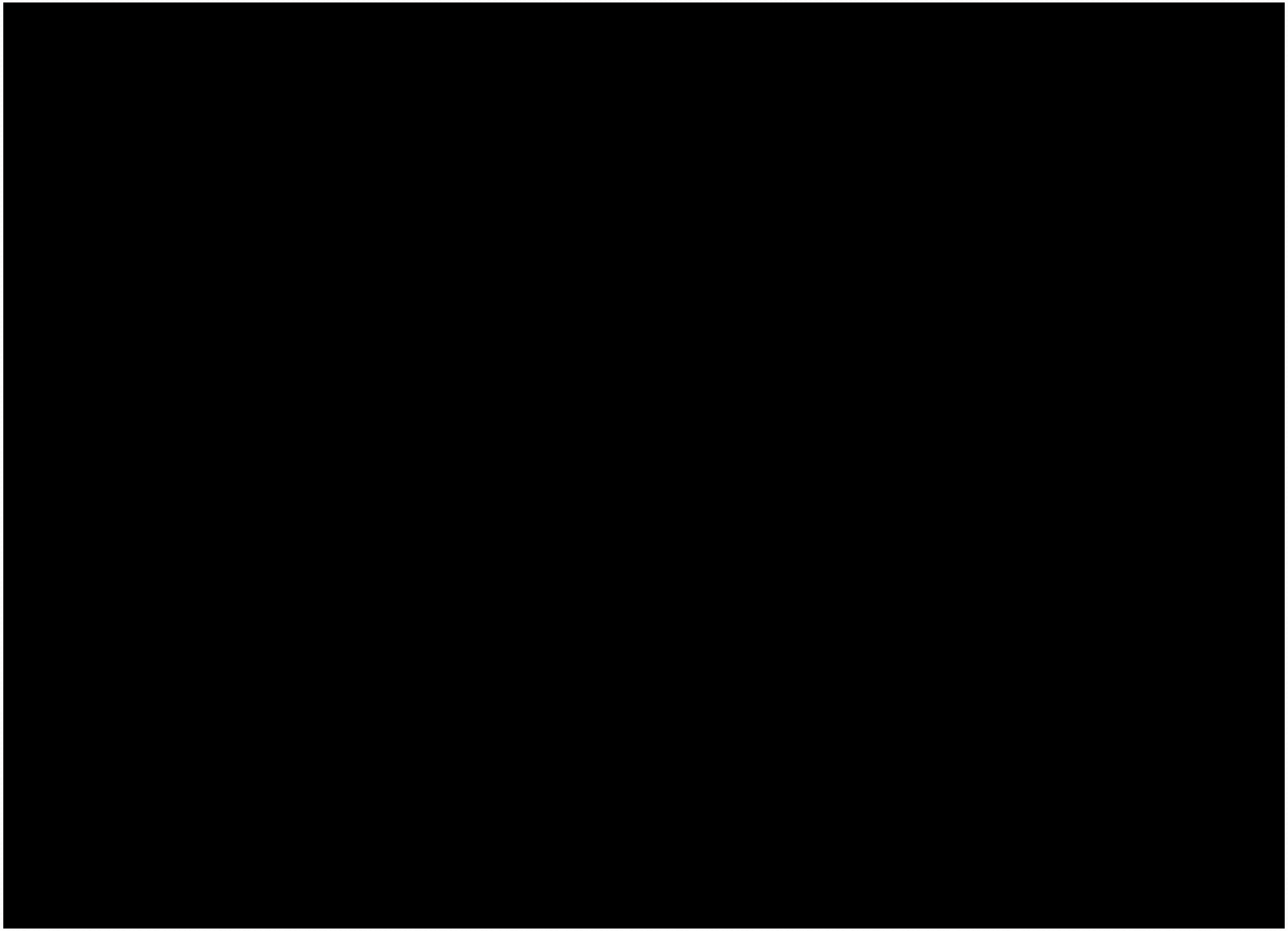


Source: SEER Cancer Statistics Review, 1975-2008

Leading cancer killer in both men and women since 1987

27% of all cancer deaths





The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening

The National Lung Screening Trial Research Team

N Engl J Med 2011; 365:395-409 | August 4, 2011 | DOI: 10.1056/NEJMoa1102873

Comments open through August 10, 2011

November 2010 initial findings from the NLST were released

Published online New England journal of Medicine June 2011 print August 2011

National Lung Screening Trial (NLST)

Divided more than 53,000 high risk smokers ages 55-74 into two groups

- CT
- CXR

Patients were imaged yearly for a total of 3 years and then followed for another 4 years

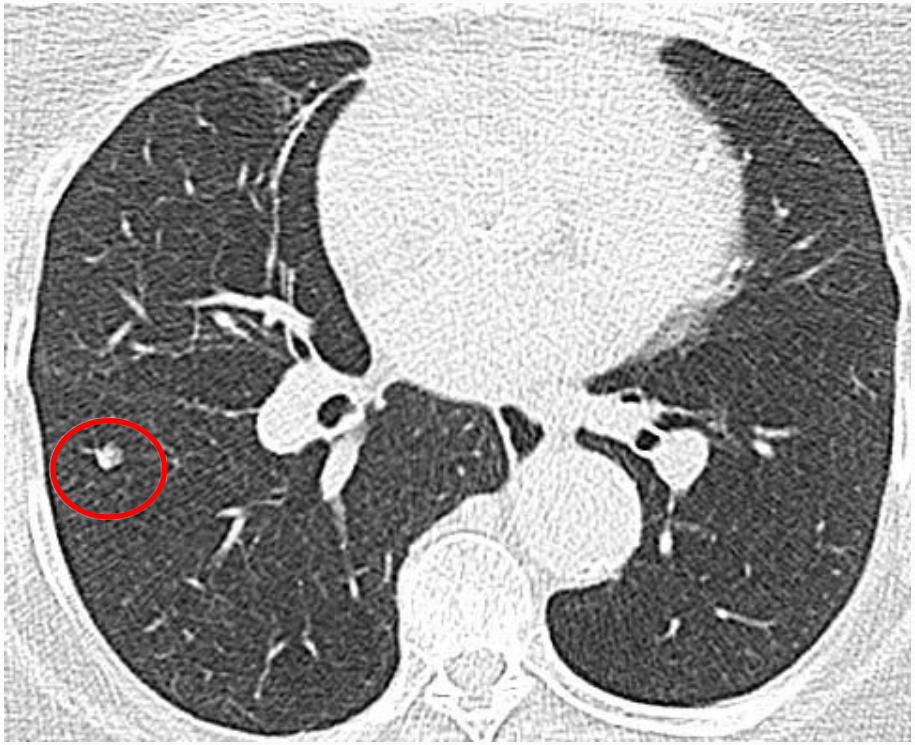
CT group showed 20% fewer deaths due to lung cancer compared with CXR

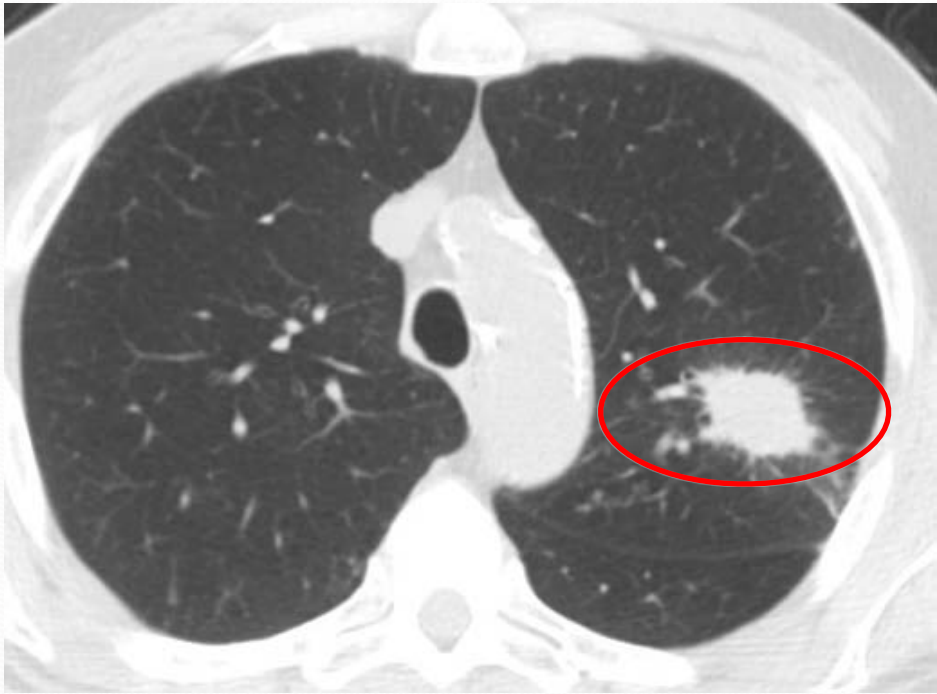
320 people needed to be screened with CT in order to save 1 life

Benefits of CT lung screening

- Detect more cancers at smaller size
- Detect earlier stage cancers
- Improved survival
- Detect other cancers and diseases
- Coronary artery disease
- Improved smoking cessation rates

Detect earlier stage cancers

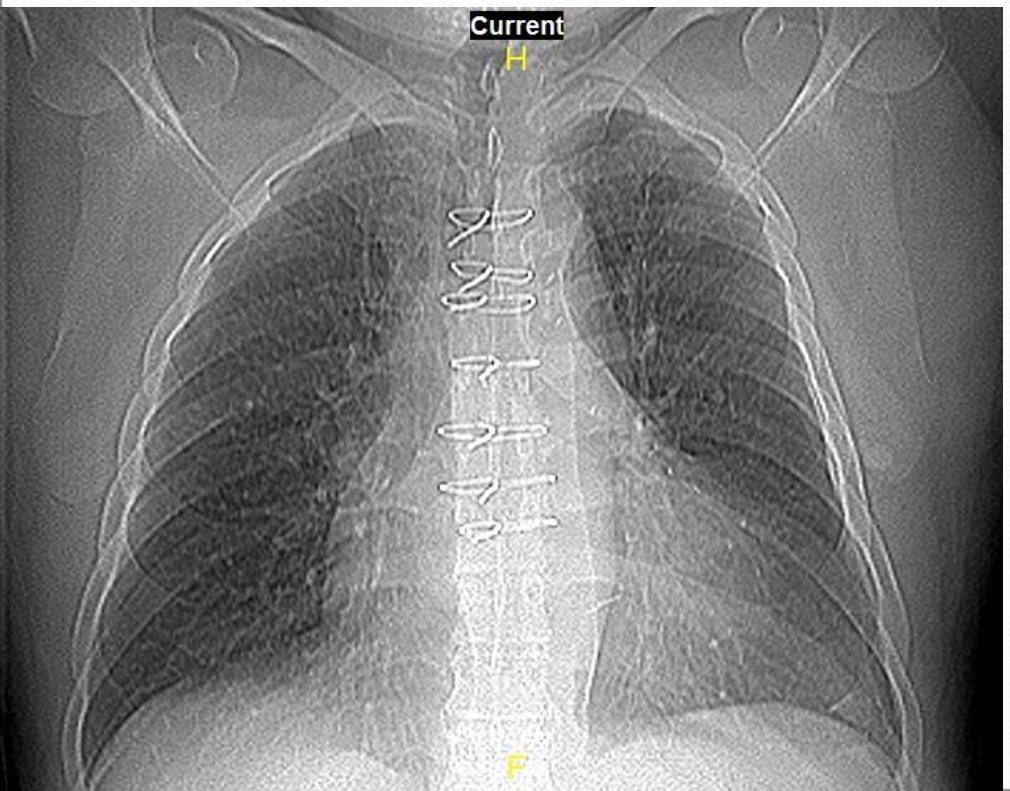


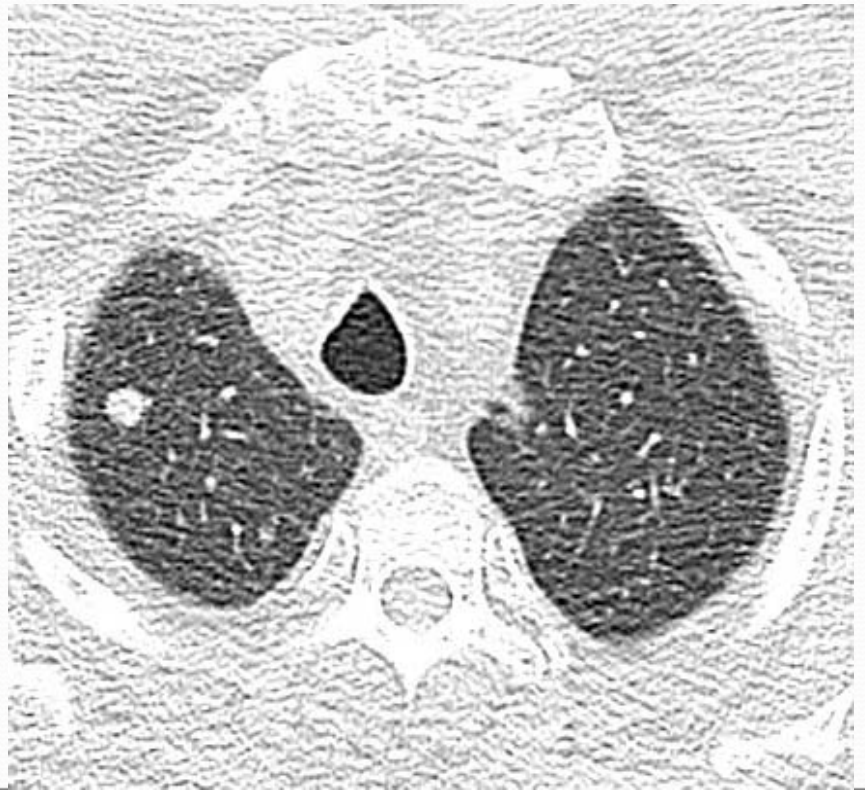


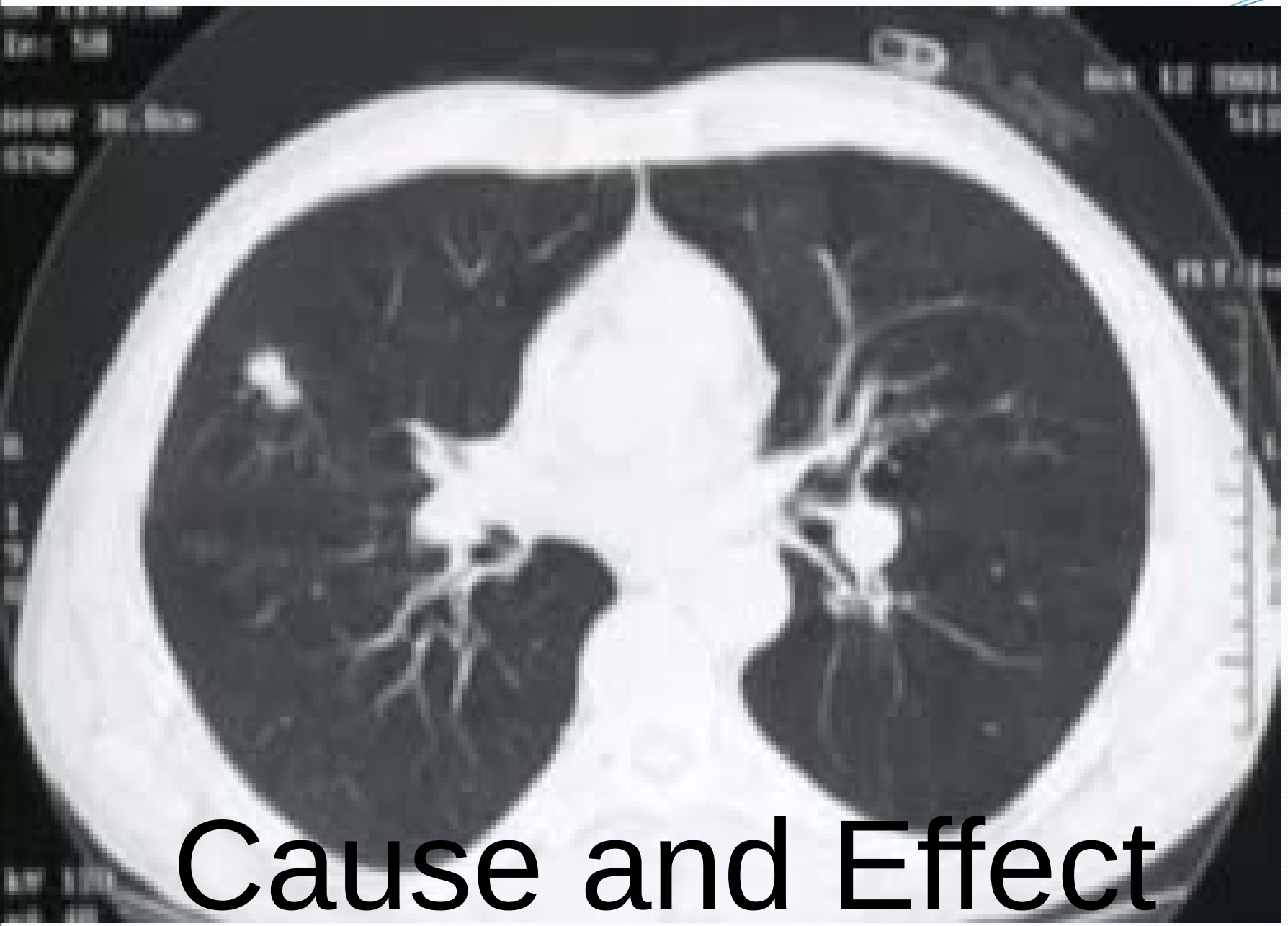
Do you see the cancer?

CT vs. X-ray

Screening trials demonstrate that 70-80% of lung cancers seen on CT are missed on X-ray







Cause and Effect

Using actuarial models, this study estimated the costs and benefits of annual lung cancer screening offered as a commercial insurance benefit in the high-risk US population ages 50–64. Assuming current commercial reimbursement rates for treatment, we found that screening would cost about $1 per insured member per month in 2012 dollars. The cost per life-year saved would be below $19,000, an amount that compares favorably with screening for cervical, breast, and colorectal cancers.

Type of cancer	Screen intervention	$/Year of life saved in 2012 dollars
Cervix	Pap	50,162-75,181
Colorectal	Colonoscopy	18,705-28,958
Breast	Mammography	31,309-51,274
Lung	LDCT Baseline	18,862
	Low estimate	11,708
	High estimate	26,016

Pyenson B S et al. Health Aff 2012;31:770-779

USPSTF

- Official recommendation December 2013 (category B)
  - High certainty of moderate net benefit
- Asymptomatic
  - 55- 80 high risk annual low dose CT screening
- 30 pack year (or quit within 15 years)

Health Imaging Magazine

February 19, 2013

- Can Imaging practices provide multidisciplinary lung cancer screening?
  - Hybrid multidisciplinary model
    - Multiple Institutions, private groups
  - How?
    - Lung cancer screening database
    - Nursing Coordinator
  - “Recognized by the Lung Cancer Alliance”
    - 1 of 75 practices

Medicare covering LCS

To qualify for the once-per-year benefit, patients must be 55 to 77 years old. Additionally, Medicare beneficiaries must:

- currently smoke tobacco products or have quit within the past 15 years,
- have smoked an average of one pack of cigarettes a day for 30 years, and
- have a physician or other health care professional's written order requesting the test.

Medicare coverage includes an office visit dedicated to patient counseling on tobacco-related issues and a conversation about the relative harms and benefits of lung cancer screening.

The pros and cons of lung cancer screening for patients in this age group have been hot discussion topics among physicians and other stakeholders since at least the summer of 2013.

Potential Harms

- False positives
- Cascade of testing and treatment
  - Potential morbidity
- Unnecessary procedures
- 8 of 250 will have a negative biopsy or surgery
- After 3 years the number of false positives 390 per 1000

Atlantic Medical Imaging is One of 75 Medical Centers Applauded by the Lung Cancer Alliance

Lung Cancer Alliance Congratulates 75 Medical Centers For Screening Program

Today, Lung Cancer Alliance (LCA) applauded over 75 medical centers nationwide that have announced they will begin lung screening for those at risk as part of their continuum of multi-disciplinary care for lung cancer. These sites have committed to provide clear information based on current evidence on who is a candidate for lung cancer screening, and to comply with comprehensive standards based on best practices developed by the National Comprehensive Cancer Network (NCCN) and the International Early Lung Cancer Action Program (I-ELCAP) for controlling screening quality,

Radiologist interprets study same day

- Discuss the findings with patient
- Smoking cessation

AMI patient tracking

- program similar to BIRADS

How does we do LC screening?

At scheduling detailed questions are asked and insurance information obtained

- Specified criteria
- Low dose CT procedure (ASIR/SafeCT)
- No oral or intravenous contrast needed

Patient is given information on lung smoking cessation programs and has the option of reviewing the scan with the radiologist

What should screened patients know?

What is a positive screen?

- Probability of false positive

What if I have a positive screen?

- Most likely follow up studies

Abnormalities unrelated to lung cancer

- Lung, esophageal, cardiac, mediastinal, renal, adrenal, lymphoid and vascular abnormalities

What if my screen is negative?

- Screening is a process not a test
- Radiation risk

Low dose CT at AMI

- Average radiation dose for protocol from NLST was approximately 2 m Sv (natural background 3.1 mSv/year, chest xray 0.1 mSv)

- Using ASIR or Safe CT
  - even lower, approx 1 mSv (or less) at AMI
  - 2 recent representative cases 0.6 mSv
    - Additional cancer risk 0.0028%
    - Baseline cancer risk 44.9 %
    - Comparable to 6 chest xrays

AMI Lung Cancer Screening database

- November 2011 to present
- 2000 screenings
- Initial criteria for screening by NCCN and ACR
- Current criteria set forth USPTF

AMI LCS database

- 1.1 % lung cancer
- 0.2 % other cancers
- 33 % normal
- 66 % had nodules

AMI LCS database

- STAGE 1A 40 % (6 pts)
- STAGE 2A 20 % (3 pts)
- STAGE 4 33 % (5 pts)

- NLST estimated 1 life saved for every 350 screened

Thank You

Appropriate Outpatient Imaging

How do I know I'm ordering the right study?
Can/should I order that STAT?

DAVID KENNY, DO
ATLANTIC MEDICAL IMAGING

ACR Appropriateness criteria

http://www.acr.org/Quality-Safety/Appropriateness-Criteria

- Evidence based guidelines
  - Most appropriate decision: enhancing quality
  - Developed by expert panels in 1994
  - ACR Select. licensed software product used to be incorporated into EHR and computerized order entry.

Abdominal Pain

Gastrointestinal		
Topic Name	**Narrative**	**Evidence Table**
Acute (Nonlocalized) Abdominal Pain and Fever or Suspected Abdominal Abscess	Narrative	Evidence Table
Acute Pancreatitis	Narrative	Evidence Table
Blunt Abdominal Trauma	Narrative	Evidence Table
Colorectal Cancer Screening	Narrative	Evidence Table
Crohn Disease	Narrative	Evidence Table
Dysphagia	Narrative	Evidence Table
Jaundice	Narrative	Evidence Table
Left Lower Quadrant Pain — Suspected Diverticulitis	Narrative	Evidence Table
Liver Lesion — Initial Characterization	Narrative	Evidence Table
Palpable Abdominal Mass	Narrative	Evidence Table
Pretreatment Staging of Colorectal Cancer	Narrative	Evidence Table
Right Lower Quadrant Pain — Suspected Appendicitis	Narrative	Evidence Table
Right Upper Quadrant Pain	Narrative	Evidence Table
Suspected Liver Metastases	Narrative	Evidence Table
Suspected Small-Bowel Obstruction	Narrative	Evidence Table

Acute (non-localized) abdominal pain and fever, (possible or suspected abscess) no recent operation

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis with contrast	8		☢☢☢☢
CT abdomen and pelvis without contrast	6		☢☢☢☢
US abdomen	6		O
X-ray abdomen	6	To evaluate for bowel perforation.	☢☢
MRI abdomen and pelvis without contrast	5		O
MRI abdomen and pelvis without and with contrast	5	See statement regarding contrast in text under "Anticipated Exceptions."	O
X-ray upper GI series with small bowel follow-through	4		☢☢☢
X-ray contrast enema	4		☢☢☢
CT abdomen and pelvis without and with contrast	3	May be helpful in select cases but should be used with caution because of increased radiation dose.	☢☢☢☢
Ga-67 scan abdomen	3		☢☢☢☢
Tc-99m WBC scan abdomen and pelvis	3		☢☢☢☢
In-111 WBC scan abdomen and pelvis	3		☢☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Clinical Decision Support Software

- Appropriate use, imaging and therapy
  - Declining reimbursement push for clinical decision support software
  - Telling you what to do? and how/when to do it.
    - Integrated workflow accepted by doctors
      - Meeting appropriateness guidelines, reducing unnecessary tests.....reducing HC cost
  - Cost.....MU-2
  - Already in place in many hospital systems

Radiology Benefits Management Firms
(EviCore, Medsolutions, AIM) and NCD/LCD (Medicare)

- Utilization management programs
  - Tools to appropriately manage radiology benefits
  - Use of evidence based criteria (based largely upon ACR appropriateness criteria)
  - Seen frequently as an obstacle but grew out of necessity to control cost and utilization

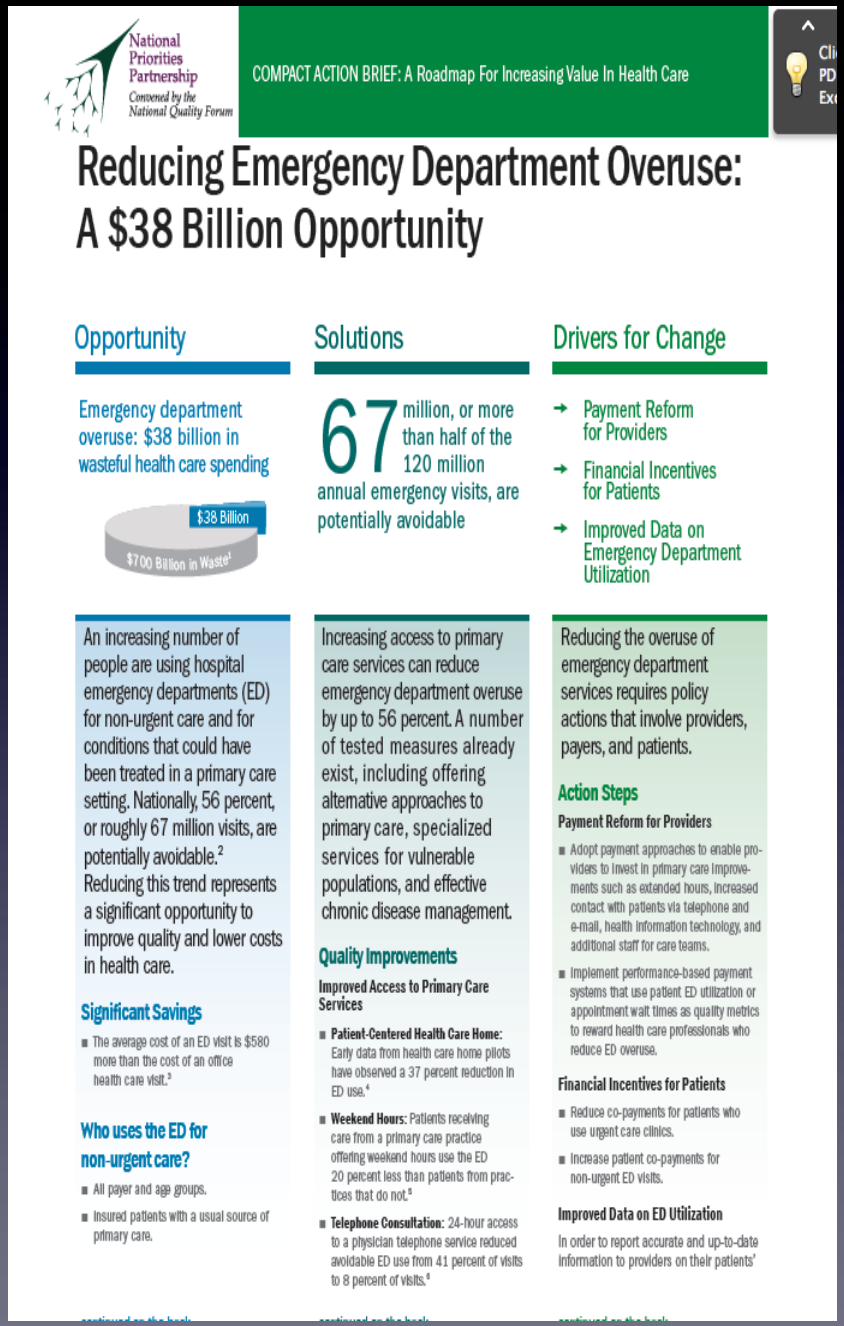
How do I order a study?

- In light of ICD-10 additional specific requirements
- Include brief but detailed clinical information, signs and symptoms
- Please DO NOT USE “Rule out” (unless signs and symptoms are included)
- If needed, specify a particular entity or condition that you would like us to comment on

"Give it to me straight, Doc. How long do I have to ignore your advice?"

Example: STAT outpatient study

- Can I even do that? Should I? Should I send the patient to the ER?
- What's the process?
- Is it even covered by insurance?
- Do I have to wait for pre-certification to be completed?



National Priorities Partnership
Convened by the National Quality Forum

COMPACT ACTION BRIEF: A Roadmap For Increasing Value In Health Care

Reducing Emergency Department Overuse: A $38 Billion Opportunity

Opportunity

Emergency department overuse: $38 billion in wasteful health care spending

Solutions

67 million, or more than half of the 120 million annual emergency visits, are potentially avoidable

Drivers for Change

- Payment Reform for Providers
- Financial Incentives for Patients
- Improved Data on Emergency Department Utilization

An increasing number of people are using hospital emergency departments (ED) for non-urgent care and for conditions that could have been treated in a primary care setting. Nationally, 56 percent, or roughly 67 million visits, are potentially avoidable.[2] Reducing this trend represents a significant opportunity to improve quality and lower costs in health care.

Significant Savings

- The average cost of an ED visit is $580 more than the cost of an office health care visit.[3]

Who uses the ED for non-urgent care?

- All payer and age groups.
- Insured patients with a usual source of primary care.

Increasing access to primary care services can reduce emergency department overuse by up to 56 percent. A number of tested measures already exist, including offering alternative approaches to primary care, specialized services for vulnerable populations, and effective chronic disease management.

Quality Improvements

Improved Access to Primary Care Services

- **Patient-Centered Health Care Home:** Early data from health care home pilots have observed a 37 percent reduction in ED use.[4]
- **Weekend Hours:** Patients receiving care from a primary care practice offering weekend hours use the ED 20 percent less than patients from practices that do not.[5]
- **Telephone Consultation:** 24-hour access to a physician telephone service reduced avoidable ED use from 41 percent of visits to 8 percent of visits.[6]

Reducing the overuse of emergency department services requires policy actions that involve providers, payers, and patients.

Action Steps

Payment Reform for Providers

- Adopt payment approaches to enable providers to invest in primary care improvements such as extended hours, increased contact with patients via telephone and e-mail, health information technology, and additional staff for care teams.
- Implement performance-based payment systems that use patient ED utilization or appointment wait times as quality metrics to reward health care professionals who reduce ED overuse.

Financial Incentives for Patients

- Reduce co-payments for patients who use urgent care clinics.
- Increase patient co-payments for non-urgent ED visits.

Improved Data on ED Utilization

In order to report accurate and up-to-date information to providers on their patients'

Primary Care treating more acute illnesses

Today only 42 percent of the 354 million annual visits for acute care - treatment for newly arising health problems - are made to patients' personal physicians.

The rest are made to emergency departments (28 percent), specialists (20 percent), or other outpatient departments (7 percent).

Need for improved access to primary care for emerging health problems.

- Cost for Emergency or even Urgent Care is astronomical

- For flank pain an ER visit can cost up to $5000

STAT-

- Horizon….precertification through Evicore

- Amerihealth…..Medsolutions

  - What do I need?

  - What are common pitfalls and denied indications?

  - How can RADCON help?

Private Insurance
Horizon, Amerihealth, Oxford, Aetna etc

- Use Precertification process through third party
  - Evicore, Medsolutions, AIM

Determine a need for a STAT study and send the patient with an order or prescription for the STAT study

Simultaneously the pre certification process is started with the above companies

- Either at your office or through a service such as RADCON the process must be initiated and will be finalized likely after the procedure has been done

In the background the normal precertification process is taking place (this can take up to 3 days if all is well)

74176 CT Abdomen and Pelvis without Contrast

Complaints associated with abdominal or pelvic pain [One of the following]:

Abdominal pain persisting and one of the following:

Tenderness

Evidence of inflammatory reaction (such as aural temperature >38.3°C or >100.9°F or elevated WBC >11,500/cu.mm) Muscular rigidity – guarding

Abdominal distention on exam

Obstructive uropathy or hydronephrosis (renal, ureteral, or bladder stone causing obstruction) [One of the following] :

Pain in flank, radiating toward the groin

Hematuria

70450 CT of the Head or Brain without Contrast

Head trauma[1,2] [One of the following]

A. Minor or mild acute closed head trauma without neurologic deficit adult
1. Glasgow Coma Scale ≥13

Mild or moderate acute closed head injury under age 2

Minor or acute closed head injury with focal neurologic deficit

Moderate or severe closed head trauma

Subacute or chronic closed head trauma with cognitive and/or neurologic deficit (See F next slide) (MRI without contrast is preferred)

Suspected carotid or vertebral dissection (CTA head and neck is preferred)

Penetrating injury, stable neurologically intact (CT is preferred)

"You have a lot of boring health issues, so I'm prescribing medical marijuana for myself."

70450 CT of the Head or Brain without Contrast

Focal neurologic finding

I. Headache

1. Vomiting
2. Memory loss
3. Seizure
4. Ataxia

B. Drug or alcohol intoxication and evaluation is suboptimal or inadequate

C. Skull fracture

II. Abrupt onset of a neurologic deficit – including stroke and TIA [One of the following][3,4]

A. Motor weakness affecting a limb, or one side of the face or body

B. Decreased sensation affecting a limb, or one side of the face or body

C. Acute ataxia (unsteady and clumsy motion of the limbs or trunk)

D. Mental confusion including memory loss and disorientation

E. Impaired vision, including amaurosis fugax, visual field loss and diplopia

F. Aphasia (loss or impairment of the ability to produce or comprehend language due to brain damage)

G. Dysarthria (speech disorder resulting from neurological injury)

H. DysphagiawithnoGIcause

I. Vertigo with either headache or nystagmus

J. Numbness, tingling, paresthesias

K. Decreased level of consciousness

L. Papilledema

M. Stiff neck

RADCON PRE-CERT SERVICES

- RADCON provides a much needed service for your diagnostic imaging pre-authorization requests. This program covers pre-authorization requests for computed tomography (CT), computed tomography angiography (CTA), magnetic resonance imaging (MRI), magnetic resonance angiography (MRA) and nuclear medicine studies.

- Our dedicated team of authorization specialists will work on the request, coordinate all requirements with the insurance companies, complete all follow-up and send results immediately back to you.

- Our goal is to provide high-quality insurance authorization services, while reducing the time consuming administrative work involved in obtaining insurance authorizations for your patients.

TO GET STARTED

- You will need to register for the pre-authorization service by faxing the completed designation form and business associate agreement to RADCON at (855) RADCON2 (723-2662).
- If you have additional questions, please contact one of our authorization specialists at (855) RADCON1 (723-2661).

Helpful links

- EviCore https://www.carecorenational.com/content/pdf/44/4AE31EEFA155483CBBBE46B949999C5E.pdf
- Amerihealth http://www.medsolutions.com/documents/guidelines/guideline_downloads/HEAD%20IMAGING%20GUIDELINES.pdf
- RADCON Precert service http://radconinc.net/pre-cert-services/?lang=en
- ACR Appropriateness criteria https://acsearch.acr.org/list

Thank You