Imaging Pearls

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- No disclosures

Objectives

- Make an informed choice of the correct imaging test based on patient age and clinical scenario
- Understand the strengths and limitations of commonly prescribed imaging tests, focusing on plain films, US, CT and MRI
- Become aware of the tools that interventional radiology can bring in order to treat commonly seen emergency and family practice conditions

Review cases, each with at least 3 pearls of wisdom

Case Study

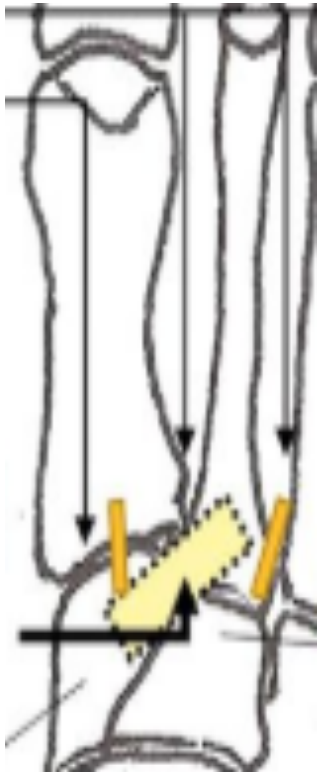
- 69 year old female
- Missed a step going down stairs
- X-rays normal
- Has difficulty weight bearing

Lisfranc Fracture-Injury

- Jacques Lisfranc: surgeon in Napoleon's Army
- Forefoot amputation through tarso-metatarsal joint

Lisfranc Ligament

- Interosseous ligament from medial cuneiform to base of 2nd metatarsal on plantar surface
- Lisfranc ligament critical to stabilizing the second metatarsal and maintenance of the midfoot arch



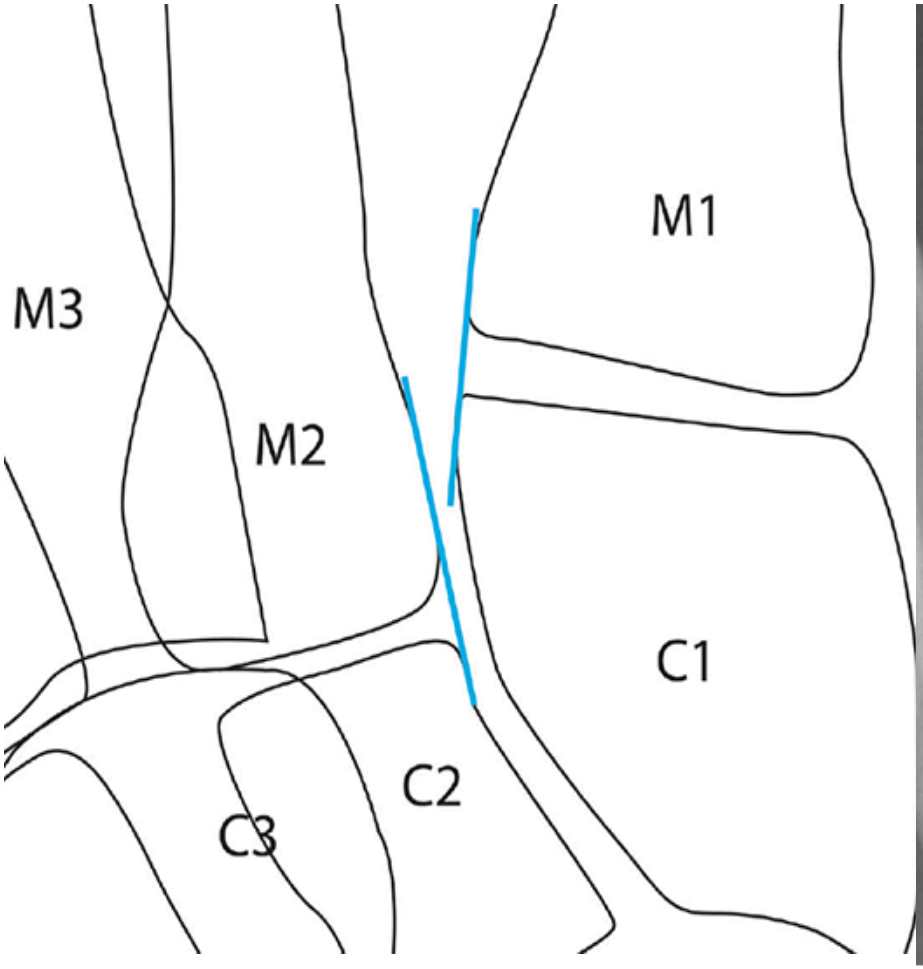
Lisfranc Ligament

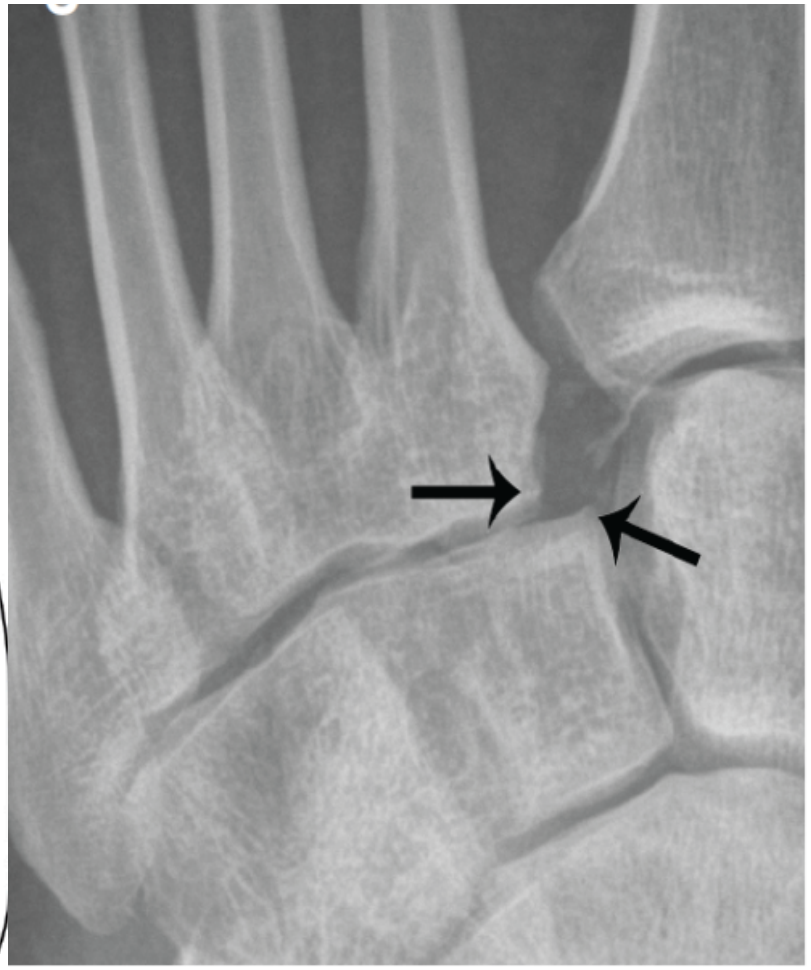
Current Problems in Diagnostic Radiology, Lisfranc Injury: Imaging Findings for this Important but Often-Missed Diagnosis, Curr Probl Diagn Radiol 2018;37:115-126.

Lisfranc Fracture-Injury: X-rays

- The medial margin of 2nd MT should always align with intermediate cuneiform
- The lateral margin of 1st MT should align with lateral margin of medial cuneiform
- CT if in doubt

Medial margin 2nd MT should align with intermediate cuneiform
Lateral margin 1st MT should align with medial cuneiform





Pearls

- Lisfranc injuries more common than previously believed
- Can occur even with minor trauma
- CT when in doubt
- Weight bearing views useful especially when no displacement

Case study

- 86 year old schizophrenic patient
- Fell a week ago
- Some pain on palpation

Cervical Spine

Cervical Spine Fractures

- Cervical spine injuries occur in 5-10% of polytrauma
- Of 10,000 spinal cord injuries, 55% involve cervical cord
- Cost of treating quadriplegic patients in US approaches $5.6 billion annually

Multidetector CT of Blunt Cervical Spine Trauma in Adults, Radiographics, November 2014

Odontoid fractures

- Odontoid fractures account for 10% to 15% of all cervical spine fractures.
  - Type II is the most common (over 50%)
- Most common C-spine fracture in patients over 65
- Etiology
  - high-energy trauma: MVA, diving; younger patient
  - lower energy impacts: falls from a standing position; elderly patient

Type II Odontoid Fractures of the Cervical Spine, Do Treatment Type and Medical Comorbidities Affect Mortality in Elderly Patients?
Andrew J. Schoenfeld, MD,[*] Christopher M. Bono, MD,[†] William M. Reichmann, MA,[‡] Natalie Warholic, MA,[§] Kirkham B. Wood, MD,[¶] Elena Losina, PhD,[‖] Jeffrey N. Katz, MD, MSc,[**] and Mitchel B. Harris, MD, FACS[††]

Odontoid fracture classification

Type I :
Fracture of the upper part of the odontoid peg ; it's rare and potentially unstable

Type II :
Fracture at the base of the odontoid ; unstable, and has a high risk of non-union

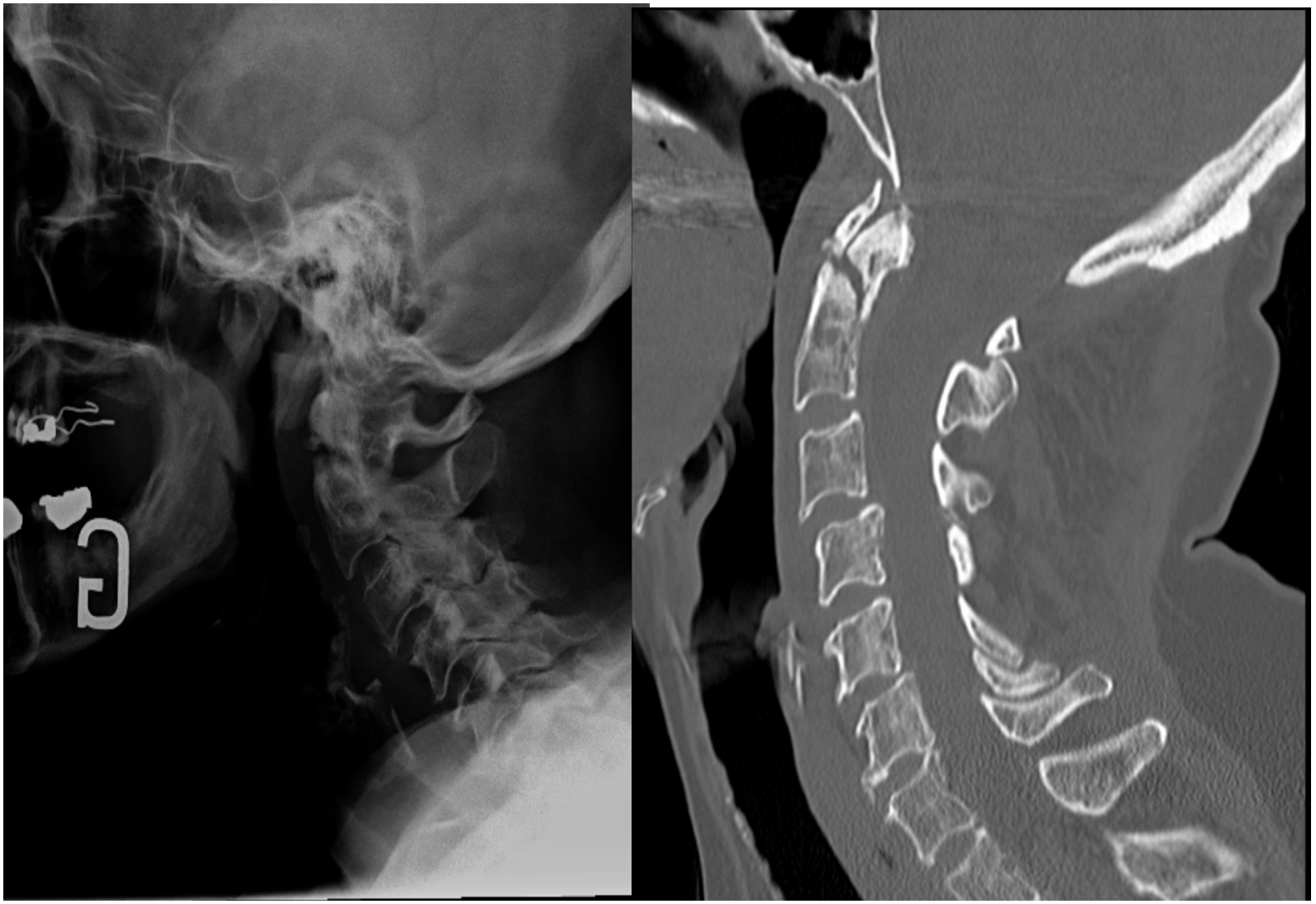
Type III :
Through the odontoid and into the lateral masses of C2 ; best prognosis for healing

M. Niknejad
Radiopaedia.org

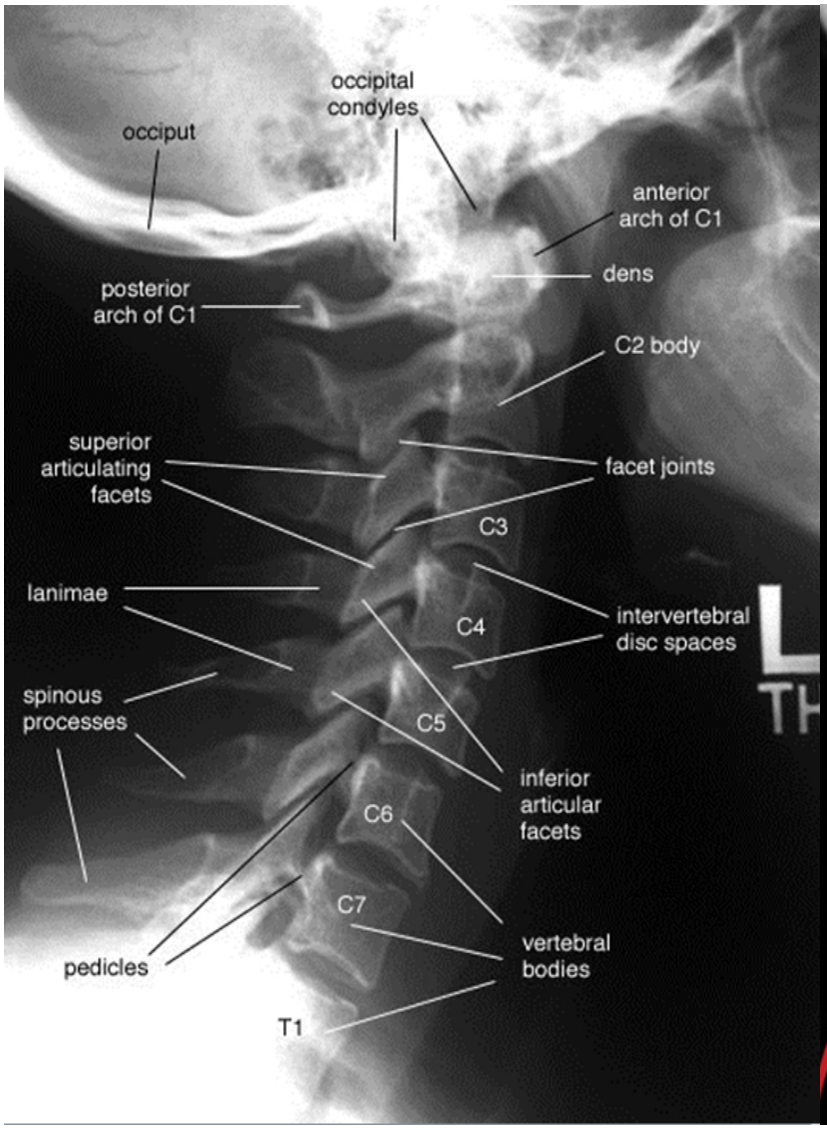
Odontoid fractures

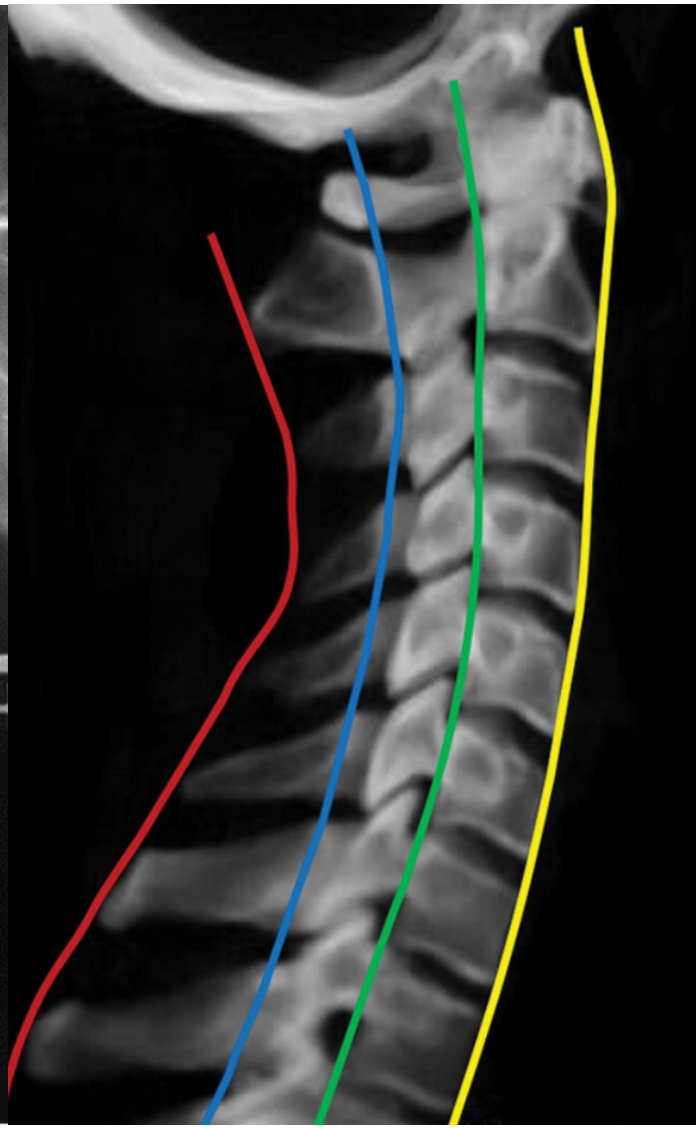
- Mechanism of injury
  - Most common : hyperextension of the cervical spine
    - energy mechanism and resulting force are high
    - bone density is compromised secondary to osteopenia/osteoporosis
  - Can also occur with hyperflexion of the cervical spine
  - As the number of elderly patients continues to rise, the prevalence of such fractures expected to increase

Cervical Spine



Cervical Spine Fractures





Cervical Spine Fractures

Systematic approach: ABCS

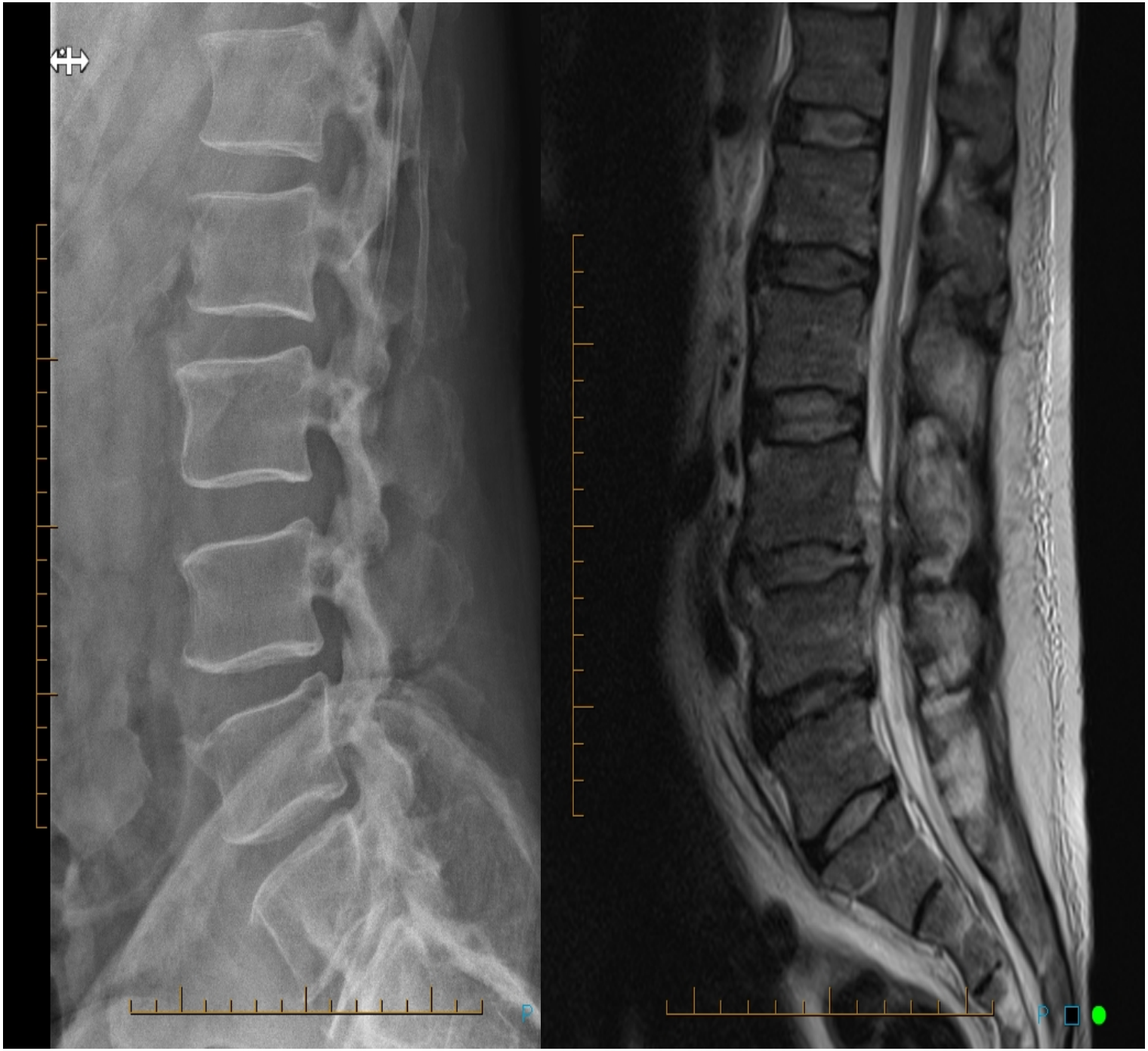
- Alignment
  - All 7 vertebrae
- Bones
  - Fractures
  - Anterior and posterior columns
- Cartilage
  - Intervertebral discs
- Soft tissues
  - Prevertebral space

Imaging Pearls

- Odontoid fractures are the most common isolated spine fracture in the elderly, and the majority of these are type II fractures.
- CT of head and spine in elderly patients after fall
- Patients who sustain these injuries experience high mortality, and their management, whether operative or nonoperative, remains controversial.

Case Study

- 65 year old male
- Cirrhotic
- Low grade fever with no clear source
- Nonspecific abdominal and back pain



Spondylodiscitis

- Primary infection of the intervertebral disc (discitis), with secondary infections of the vertebrae (spondylitis), starting at the endplates.
- May involve the vertebral bodies, the intervertebral disc, the paravertebral structures and the spinal canal
- The incidence has risen in recent years due to an increase in the at risk population and improved diagnostic accuracy with advanced imaging.

Spondylodiscitis

- Incidence
  - 2.2 to 5.8 per 100,000 per year over the period 1995–2008
  - Age-standardized incidence in Germany has been estimated at 30 per 250,000 per year on the basis of data from the Federal Statistical Office (2015)

- Early diagnosis and treatment essential but often delayed because of nonspecific SSx, no fever

- MRI the gold standard for the radiological demonstration of this condition
  - 92% sensitivity and 96% specificity.
  - Visualization of the extent of the infection and of abscess formation (if present)

Spondylodiscitis: Diagnosis and Treatment Options: A Systematic Review
Herren et al, Dtsch Arztebl Int. 2017 Dec; 114(51-52): 875–882.

Spondylodiscitis

- Cause
  - *Staphylococcus aureus (50%), Escherichia coli* (11%–25%)
  - *Mycobacterium tuberculosis*
- Treatment
  - Antibiotic therapy mainstay
    - Age >75 years and *Staphylococcus aureus* infection are risk factors for antibiotic failure.
  - Surgical : Neurologic deficits, an intra-spinal empyema, failure of conservative treatment, spinal instability

Imaging Pearls

- Spondylodiscitis incidence increasing
- Difficult clinical diagnosis which needs high index of suspicion
- Higher incidence in elderly and immunocompromised (poor, drug addicts, cirrhotics)
- MR imaging of choice

Take Home Message

- MR best imaging tool for the evaluation of the spinal cord

Case Study

- 76 year old male
- Painful shoulder movement on abduction
- No acute trauma
- Next imaging?

Case Study

- 45 year old male
- Remote trauma
- Persistent shoulder pain
- Next imaging?

Shoulder Pain

- Shoulder pain has a self-reported prevalence in the general population of between 16% and 26%
- Third most common MSK symptom for which patients seek medical attention, after low back pain and knee pain
- Common causes of shoulder pain
  - Rotator cuff disease (defined as tendinosis and/or tear)
  - Instability
  - Osteoarthritis

Radiology. 2013 May; 267(2): 589–595. PMCID: PMC3632808
Published online 2013 May. doi: 10.1148/radiol.13121947 PMID: 23401583

Imaging Algorithms for Evaluating Suspected Rotator Cuff Disease: Society of Radiologists in Ultrasound Consensus Conference Statement

Instability vs Impingement

Shoulder joint is the most unstable articulation in the entire human body

- Advantage: broad range of motion
- Introduces vulnerability to injury

Shoulder Instability: inability to maintain the humeral head in glenoid fossa

- Labral abnormalities, gleno-humeral ligament abnormalities
- Best imaged with CT or MR arthrograms

Imaging the Glenoid Labrum and Labral Tears
De Coninck et al, RadioGraphics 2016; 36:1628–1647

Instability vs Impingement

- Shoulder impingement:
  - Inflammation of tendons of the rotator cuff muscles as they pass through the subacromial space

Rotator Cuff Tears

- Rotator cuff disease is the most common cause of shoulder pain,
  - 65%–70%
- The prevalence of rotator cuff disease increases with age
  - By the age of 70 years, more than 50% of the population will have a full or partial-thickness rotator cuff tear,
  - Not always symptomatic

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Imaging Algorithms for Evaluating Suspected Rotator Cuff Disease: Society of Radiologists in Ultrasound Consensus Conference Statement

Levon N. Nazarian, MD,[✉] Jon A. Jacobson, MD, Carol B. Benson, MD, Laura W. Bancroft, MD, Asheesh Bedi, MD, John M. McShane, MD, Theodore T. Miller, MD, Laurence Parker, PhD, Jay Smith, MD, Lynne S. Steinbach, MD, Sharlene A. Teefey, MD, Ralf G. Thiele, MD, Michael J. Tuite, MD, James N. Wise, MD, and Ken Yamaguchi, MD

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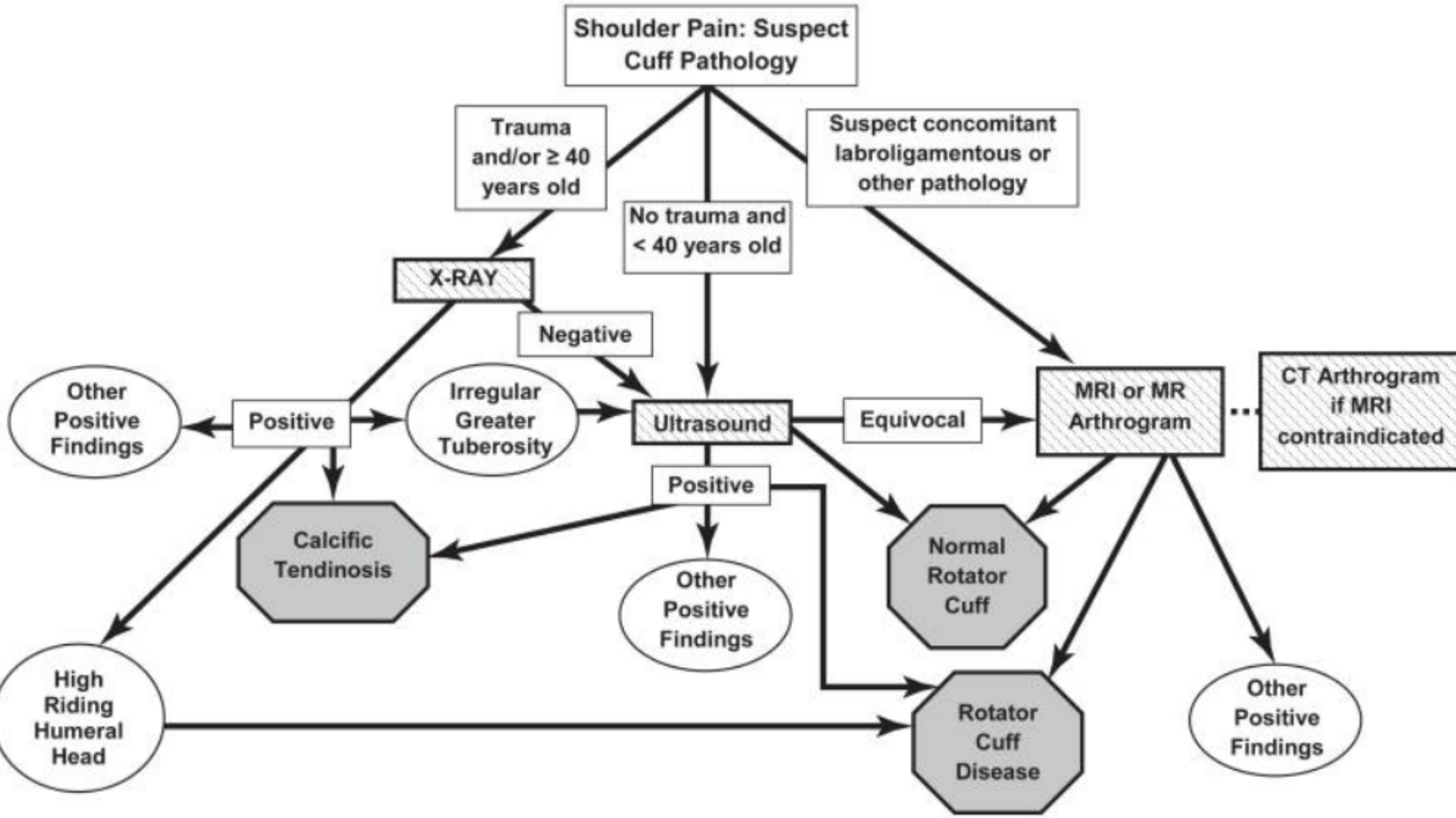
Rotator Cuff Disease Algorithm



Imaging Pearls

- Age is an important factor when deciding initial imaging for shoulder pain
- Early diagnosis of RTC will affect treatment options
- Consider US for diagnosis as well as treatment

Case Study

- 38 year old, newly married woman with severe progressive meno-metrorrhagia
- SSX
  - Anemia
  - Nocturia
  - Dyspareunia
- Lifestyle limiting symptoms

Case Study

- 40 year old female dysmenorrhea and menorrhagia
  - Symptomatic for years and worsening in the last several months
  - Anemic
  - Many days off of work due to pain & bleeding

Abnormal Uterine Bleeding

- Broad term that describes irregularities in the menstrual cycle involving frequency, regularity, duration, and volume of flow outside of pregnancy. Up to one-third of women will experience abnormal uterine bleeding in their life, with irregularities most commonly occurring at menarche and perimenopause.

- A normal menstrual cycle has a frequency of 24 to 38 days, lasts 7 to 9 days, with 5 to 80 milliliters of blood loss.

- Any deviation is considered abnormal

Can we achieve international agreement on terminologies and definitions used to describe abnormalities of menstrual bleeding?
Fraser IS, Critchley HO, Munro MG, Broder M.; Hum. Reprod. 2007 Mar;22(3):635-43

Abnormal Uterine Bleeding

- PALM-COEIN
  - Polyp, adenomyosis, leiomyoma,malignancy
  - Coagulopathy, ovulatory dysfunction, endometrial disorders, iatrogenic, not otherwise classified
- Acute versus chronic

Abnormal Uterine Bleeding

- Imaging
  - US: trans-vaginal & trans-abdominal
  - Hysterosonography
  - MRI

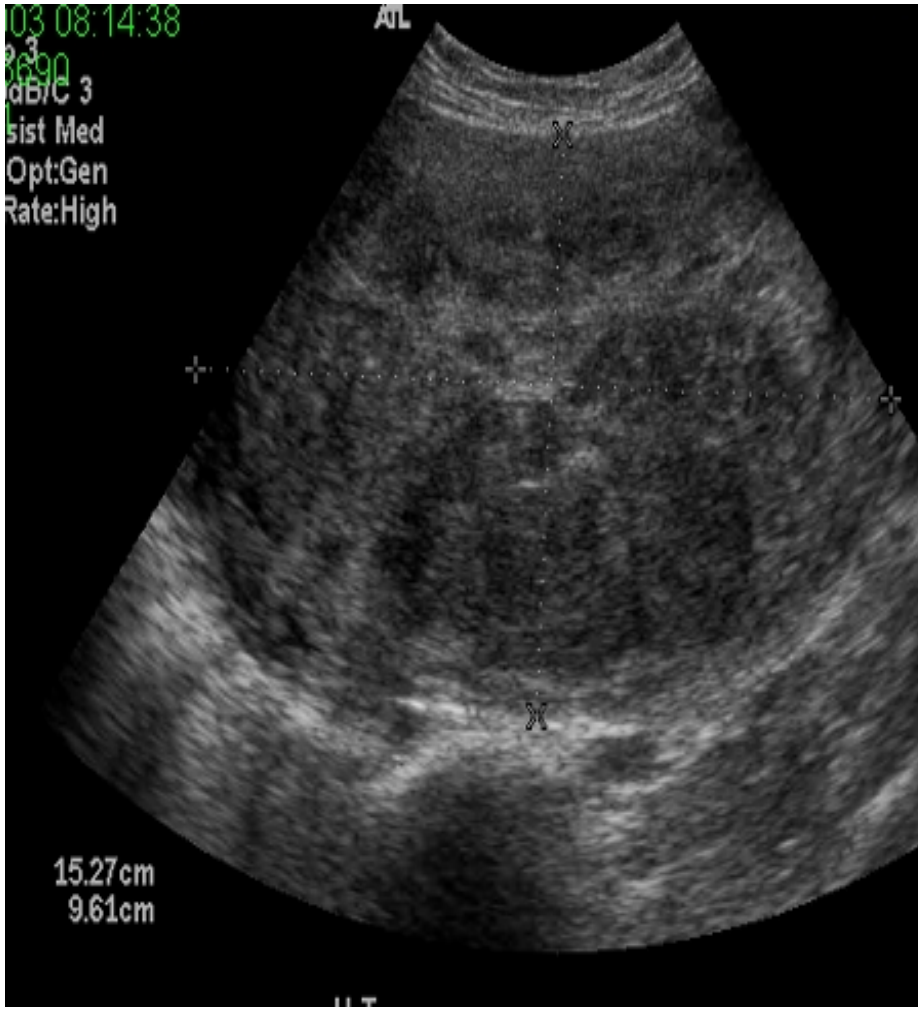
Role of MRI

- Confirm diagnosis
  - Fibroids versus adenomyosis
- Evaluate for necrosis
- Baseline for size

Case Study

- 38 year old, newly married woman with severe progressive meno-metrorrhagia
- SSX
  - Anemia
  - Nocturia
  - Dyspareunia
- Lifestyle limiting symptoms

Fibroids



Uterine fibroids

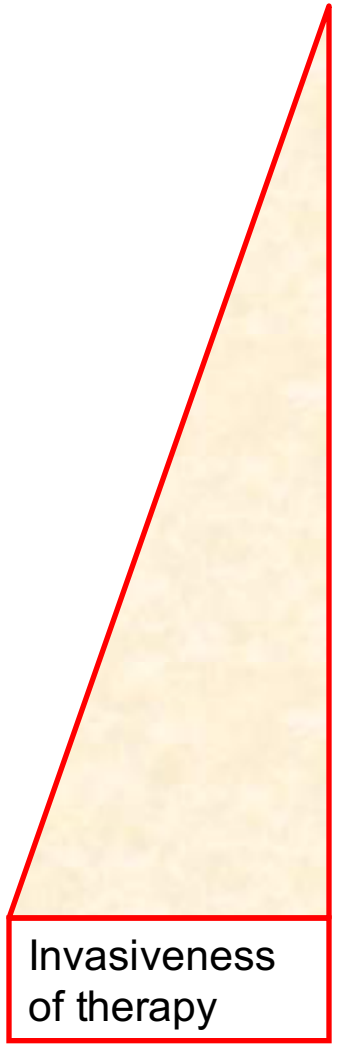
- Prevalence of clinically significant leiomyomas peaks in peri-menopausal years
- Estimate: 20-50% of women with fibroids will experience symptoms
  - Many women with fibroids are unaware
- ~60% of symptomatic women with fibroids will have multiple symptoms
- Symptoms correlate with number, size and location of fibroids

Fibroid symptoms

- Asymptomatic
- Abnormal uterine bleeding
  - Menorrhagia
  - Anemia
- Pelvic mass / pain
- Pelvic pressure
  - Urinary frequency
  - Urinary incontinence
  - Difficulty in urination
  - Hydronephrosis
  - Constipation
  - Tenesmus
  - Rectal pressure
- Dyspareunia
- Reproductive dysfunction
  - Infertility
- Pregnancy related
  - Myoma growth
  - Red degeneration and pain
  - Spontaneous miscarriage
  - Obstetric complications
- Malignancy
- Rare associations
  - Ascites
  - Polycythemia
  - Familial syndromes with renal cell carcinoma
  - Benign metastasizing uterine myoma
  - Intravenous leiomyomatosis

Fibroid Treatment Options

- Watchful waiting
- Medical Therapy (Ulipristal, GnRH-a)
- Endometrial ablation
- Uterine Artery Embolization
- Myomectomy
- Hysterectomy



Uterine Artery Embolization

- Uterine Artery Embolization (UAE) vs Uterine Fibroid Embolization (UFE)
  - Terms often used as synonyms
- UAE Mechanism:
  - Devascularize fibroids
  - Results in fibroid infarction
  - Symptomatic improvement

Uterine Artery Embolization

Indications

- Fibroids and adenomyosis
- PPH – post-partum hemorrhage
- Post-op hemorrhage
- Ectopic pregnancy hemorrhage

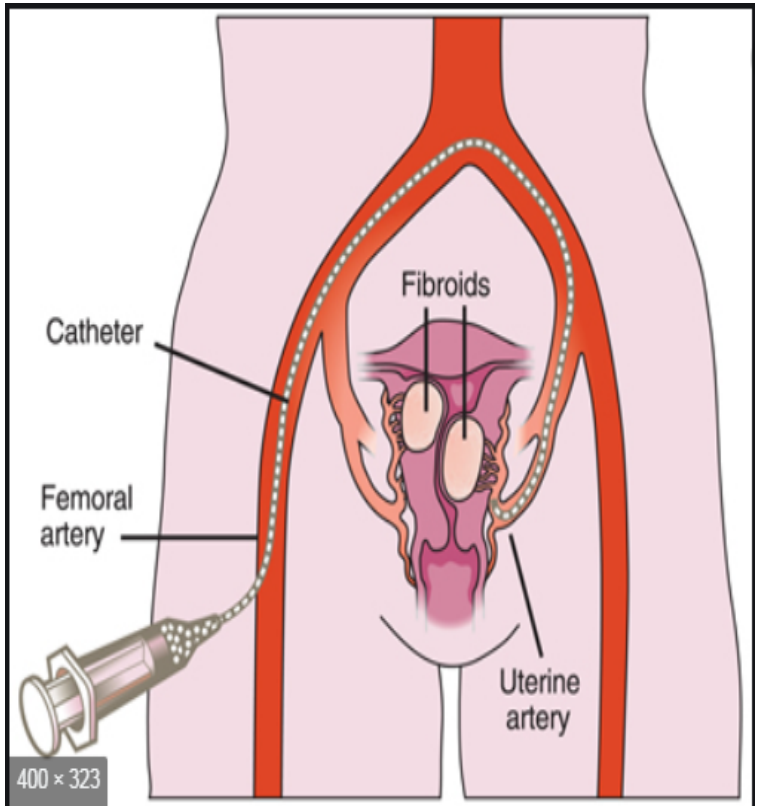
Success rates

- Fibroids:
  - 90-95% for bleeding
  - 85-90% for urinary/bulk symptoms
  - 75-80% for dyspareunia
- Adenomyosis:
  - 75-90% for bleeding and pain symptoms

UAE procedure

In the room:

- 2mm right femoral incision
- 90min procedure
- Intra-procedural conscious sedation (fentanyl for pain, midazolam for anxiety)



- Post-procedure pain controlled by regional nerve block, typical maximal pain score is 4-6/10

Superior Hypogastric Nerve Block as Post–Uterine Artery Embolization Analgesia: A Randomized and Double-Blind Clinical Trial

Joongchul Yoon, MD • David Valenti, MD • Karl Muchantef, MD • Tatiana Cabrera, MD • Fadi Toowi, MD • Carlos Torres, MD • Ali Bessissow, MD • Pouya Bandegi, MSc • Louis-Martin Boucher, MD, PhD

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Supported by a Resident Research Grant from the Society of Interventional Radiology.

Conflicts of interest are listed at the end of this article.

Radiology 2018; 00: 1–7 • https://doi.org/10.1148/radiol.2018172716 • Content code

Case Study

- 40 year old female dysmenorrhea and menorrhagia
  - Symptomatic for years and worsening in the last several months
  - Anemic
  - Many days off of work due to pain & bleeding

Adenomyosis

UAE risks:

- Ovarian damage/failure/menopause
  - <45 <1%, >47 ~2-3-%
- Endometritis
  - <5%
- Fibroid passage/sloughing, 5-10%
  - Up to 25% with larger sub-mucosal fibroids
- Clinical failure of procedure
  - 5% failure rate for bleeding
  - 10-15% for bulk symptoms

Role of MRI

- Confirm diagnosis (fibroids versus adenomyosis)
- Evaluate for necrosis
- Baseline for size
- Post MR: confirm shrinkage, necrosis and typical post MR behaviour

Imaging Pearls

- Many women continue to have hysterectomies when embolization would effectively treat their symptoms, with much lower procedural risk
- UAE has a very high success rate
- Fast recovery time, back to work in 10 days

Objectives

- Make an informed choice of the correct imaging test based on patient age and clinical scenario
- Understand the strengths and limitations of commonly prescribed imaging tests, focusing on plain films, US, CT and MRI
- Become aware of the tools that interventional radiology can bring in order to treat commonly seen emergency and family practice conditions

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