

The Great Pain Masqueraders:

Thoracic Outlet Syndrome,  
Piriformis Syndrome,  
and Occipital Neuralgia

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# Disclosures

Dr. Michael Bottros has no financial disclosures.

# Learning Objectives

1. Describe the pathophysiology of thoracic outlet syndrome
2. Explain how to diagnose piriformis syndrome
3. Describe the treatment options for occipital neuralgia

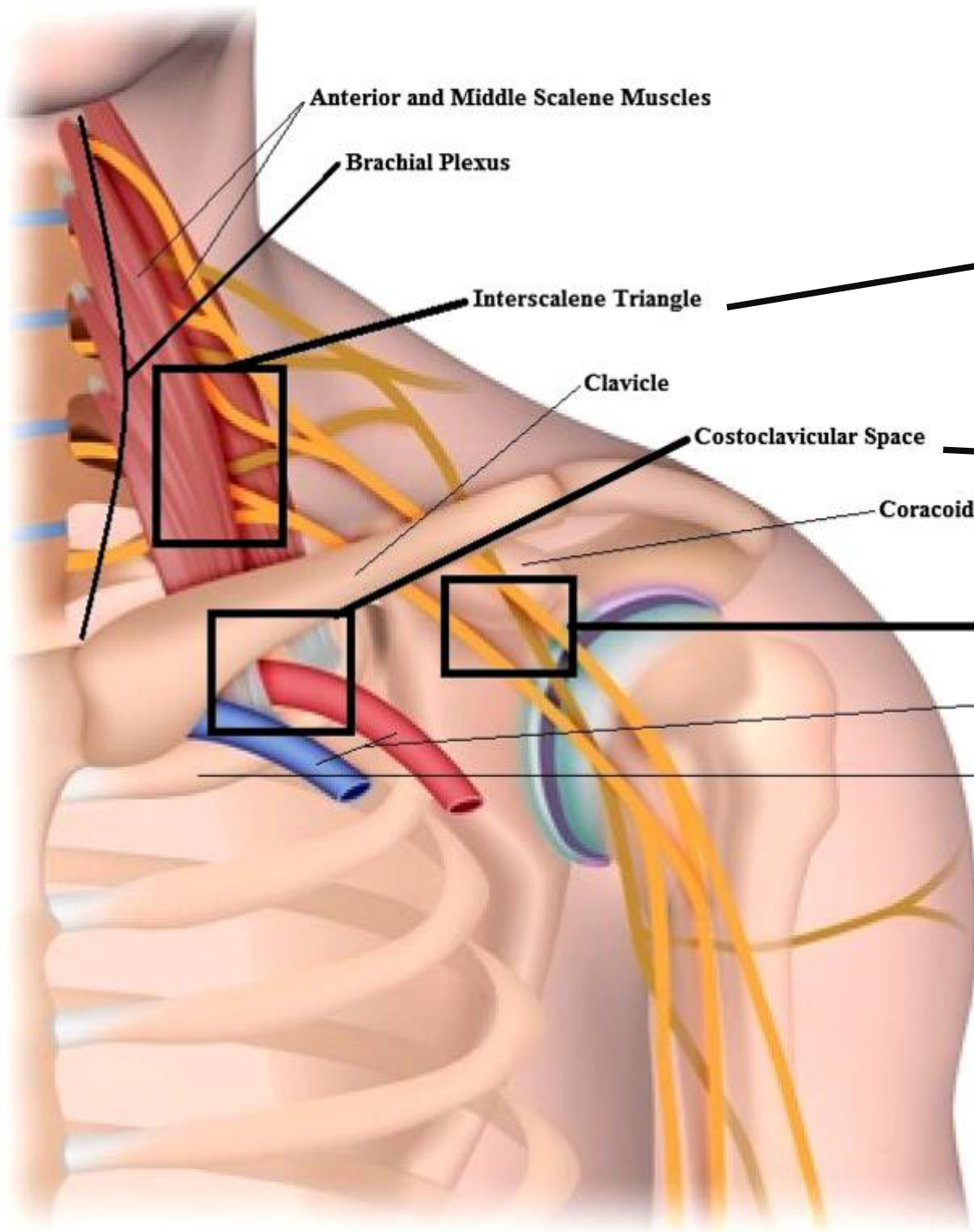


# Thoracic Outlet Syndrome

- A group of heterogenous upper extremity disorders.
- Caused by compression of the neurovascular structures between the first rib and the clavicle.







### Compartment

### Borders

### Contents

Interscalene triangle

Anterior: anterior scalene muscle  
Posterior: middle scalene muscle  
Inferior: first rib

Brachial plexus  
Subclavian artery

Costoclavicular space

Anterior: subclavius muscle  
Inferoposterior: first rib and anterior scalene muscle  
Superior: clavicle

Brachial plexus  
Subclavian artery  
Subclavian vein

Subcoracoid space

Anterior: pectoralis minor muscle  
Posterior: ribs 2–4  
Superior: coracoid

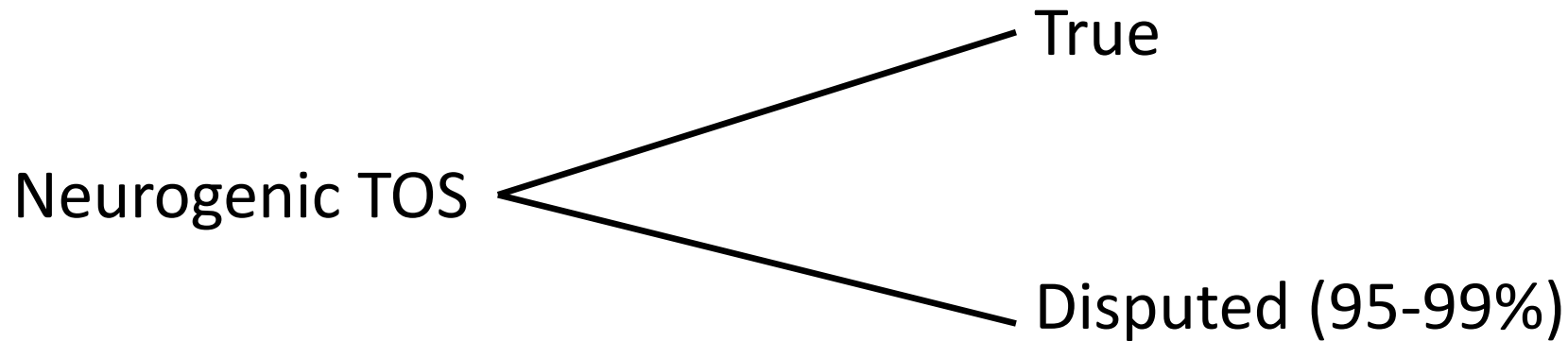
Brachial plexus  
Axillary artery  
Axillary vein

# Thoracic Outlet Syndrome

Three distinct types:

- Neurogenic – 95%
- Venous – 3-5%
- Arterial – 1-2%

# Epidemiology



- The symptoms of true and disputed are largely the same, though objective findings from motor nerve conduction studies and needle electromyography are notably absent in the disputed variety.
- Both true and disputed nTOS are more common in women.
- Teenaged to 60-year-old females are most frequently affected by true nTOS.



# Challenges

- Accurate diagnosis can be a substantial challenge due to:
  - a lack of healthcare provider awareness
  - clinical features that overlap or mimic more common conditions
  - an absence of clearly defined objective criteria



# Differential Diagnosis

## ***Neurological:***

**Cervical Radiculopathy**, Ulnar Neuropathy, Carpal Tunnel Syndrome, **Brachial Plexitis**, Multiple Sclerosis

## ***Vascular:***

Atherosclerosis, Vasculitis, **Raynaud's Syndrome**, Vasoplastic Disorders, Acute Coronary Syndrome

## ***Musculoskeletal:***

**Rotator Cuff Syndrome**, Adhesive Capsulitis, Impact Syndrome

## ***Other:***

Pancoast Tumor, **Complex Regional Pain Syndrome**, Trigger Points, Fibromyalgia



# Etiology

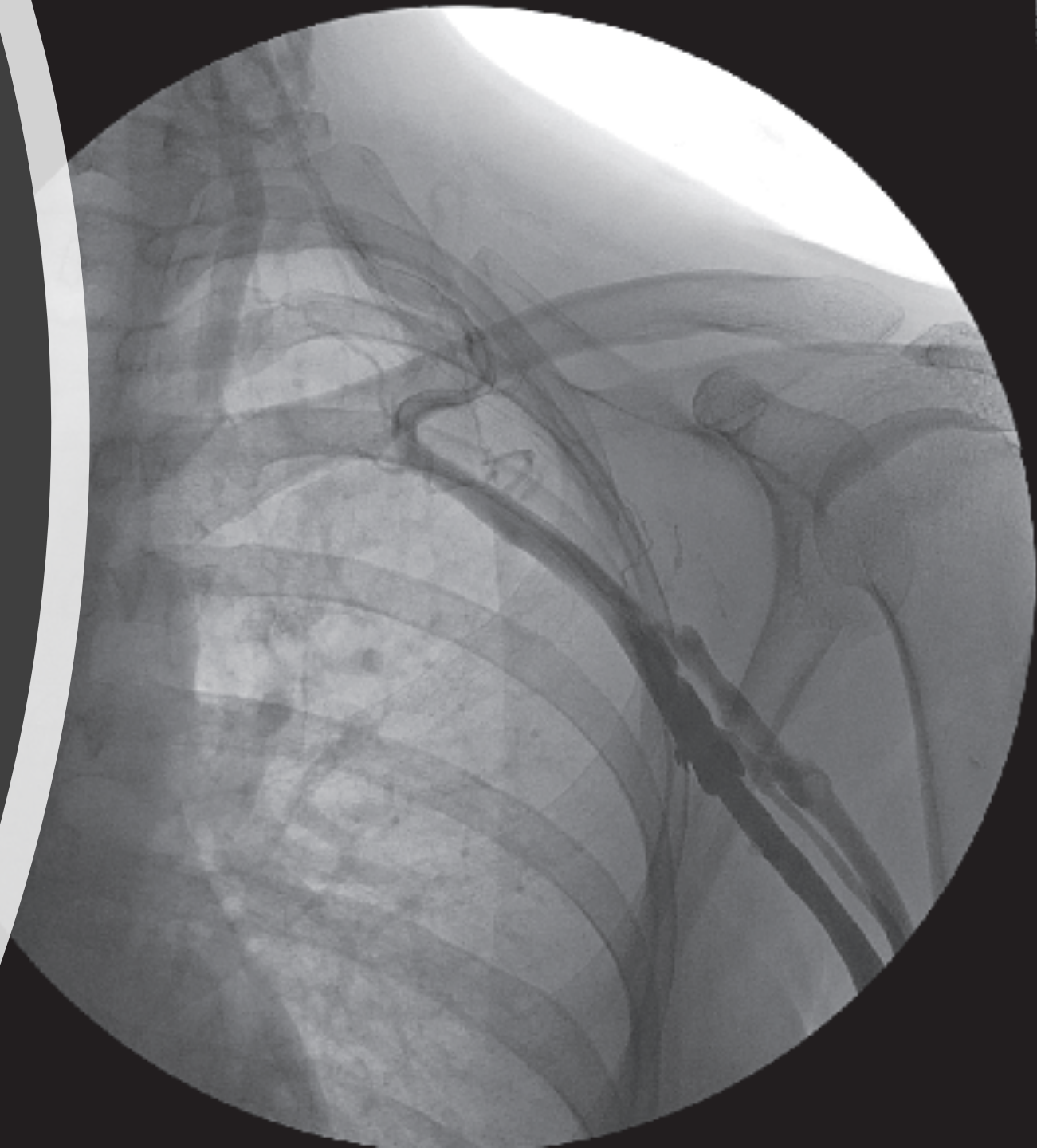
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- Neurogenic:
  - May be caused by a combination of **congenital variations** in anatomy—such as anomalous scalene musculature, aberrant fascial bands, or cervical ribs.
  - Most frequently occurs in relatively young and otherwise healthy individuals, particularly in those engaged in heavy lifting or repetitive overhead use of the upper extremities.



# Etiology

- Venous:
  - Subclavian vein compression between the clavicle and first rib within the costoclavicular space → abrupt presentation of axillary–subclavian vein effort thrombosis (Paget-von Schroetter syndrome).
  - Activities that involve arm elevation or heavy exertion can result in chronic injury and progressive fibrous stenosis, collateral vein expansion, and eventual thrombotic occlusion.





# Etiology

- Arterial:
  - Caused by subclavian artery compression within the scalene triangle, which leads to the development of poststenotic subclavian aneurysms.
  - Usually found in association with an anomalous cervical rib.

Tex Heart Inst J. 2012; 39(6): 842–843





## Clinical Presentation

- Neurogenic TOS presents as pain/numbness in the following regions:
  - upper extremity paresthesia (98%)
  - neck pain (88%)
  - trapezius pain (92%)
  - shoulder and/or arm pain (88%)
  - supraclavicular pain (76%)
  - chest pain (72%)
  - occipital headache (76%)
  - paresthesias in all five fingers (58%)
  - the fourth and fifth fingers only (26%)
  - or the first, second, and third fingers.
- Symptoms are typically dynamic, with marked positional exacerbation during arm elevation.



# Diagnosis

- Physical Examination
  - Adson Test
    - Affected arm is abducted 30° at the shoulder while maximally extended. While extending the neck and turning head towards ipsilateral shoulder, patient inhales deeply.
    - Positive if there is a decrease or absence of ipsilateral radial pulse.



# Diagnosis

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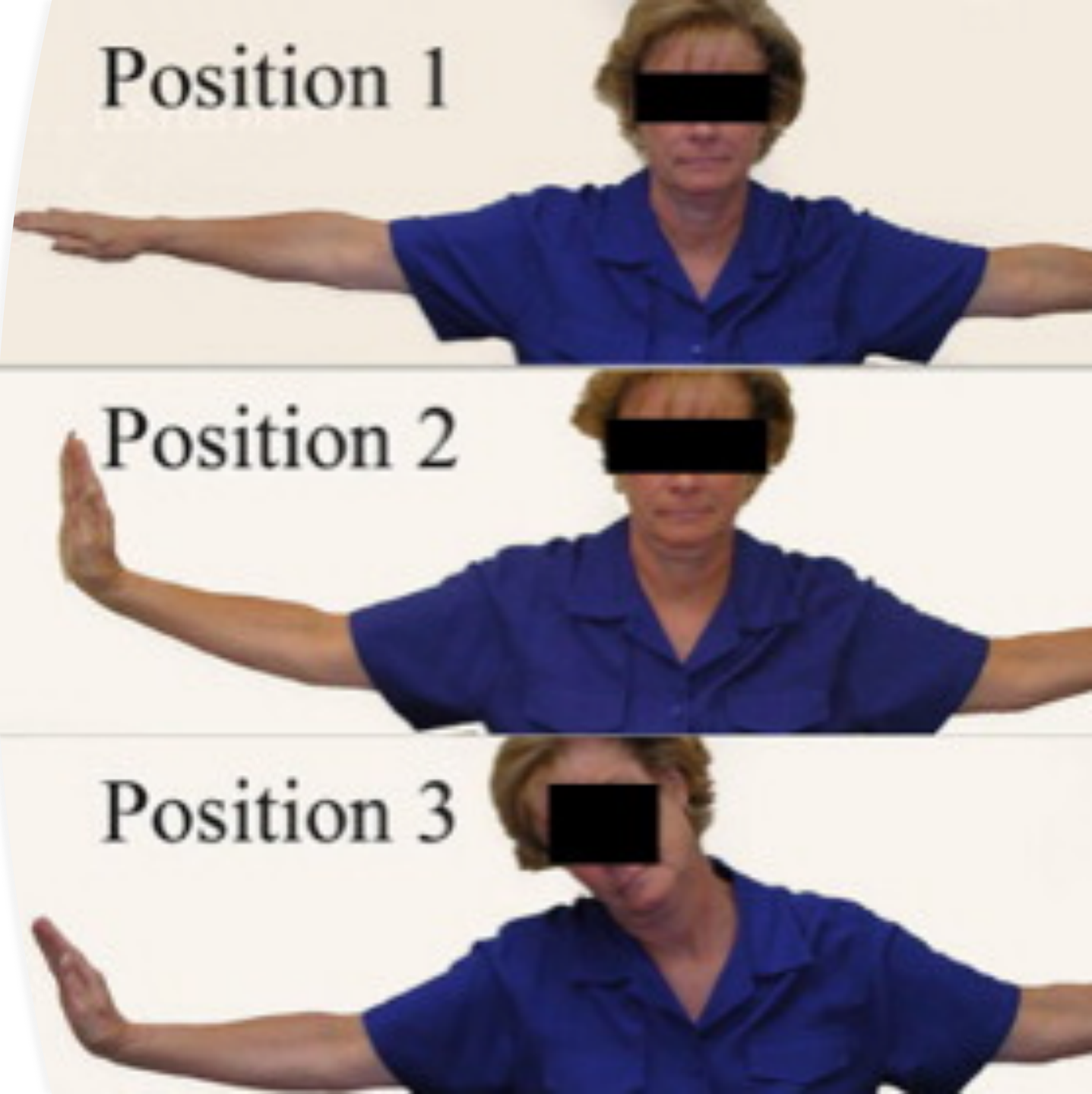
- Physical Examination
  - **Elevated Arm Stress Test (EAST) or ROOS**
    - Arms are placed in the surrender position with shoulders abducted to 90° and in external rotation, with elbows flexed to 90°. Patient slowly opens and closes hand for 3 min.
    - Positive if it precipitates pain, paresthesias, heaviness or weakness.

Image courtesy of: quora.com

# Diagnosis

- Physical Examination
    - Upper Limb Tension Test (ULTT) or ELVEY
- Position 1: arms abducted to 90° with elbows flexed.
- Position 2: active dorsiflexion of both wrists.
- Position 3: head is tilted ear to shoulder, in both directions.
- Positive if Positions 1 and 2 elicit symptoms on the ipsilateral side, while position 3 years elicits symptoms on the contralateral side.

Image courtesy of: [www.jvascsurg.org](http://www.jvascsurg.org)





# Diagnosis

- Electrodiagnostic Testing
  - A majority of patients will have normal or negative results.
  - Sensory response may be normal in the median distribution but diminished or absent in medial antebrachial cutaneous and ulnar sensory responses. Additionally, diminished or absent median and ulnar motor response may be seen.

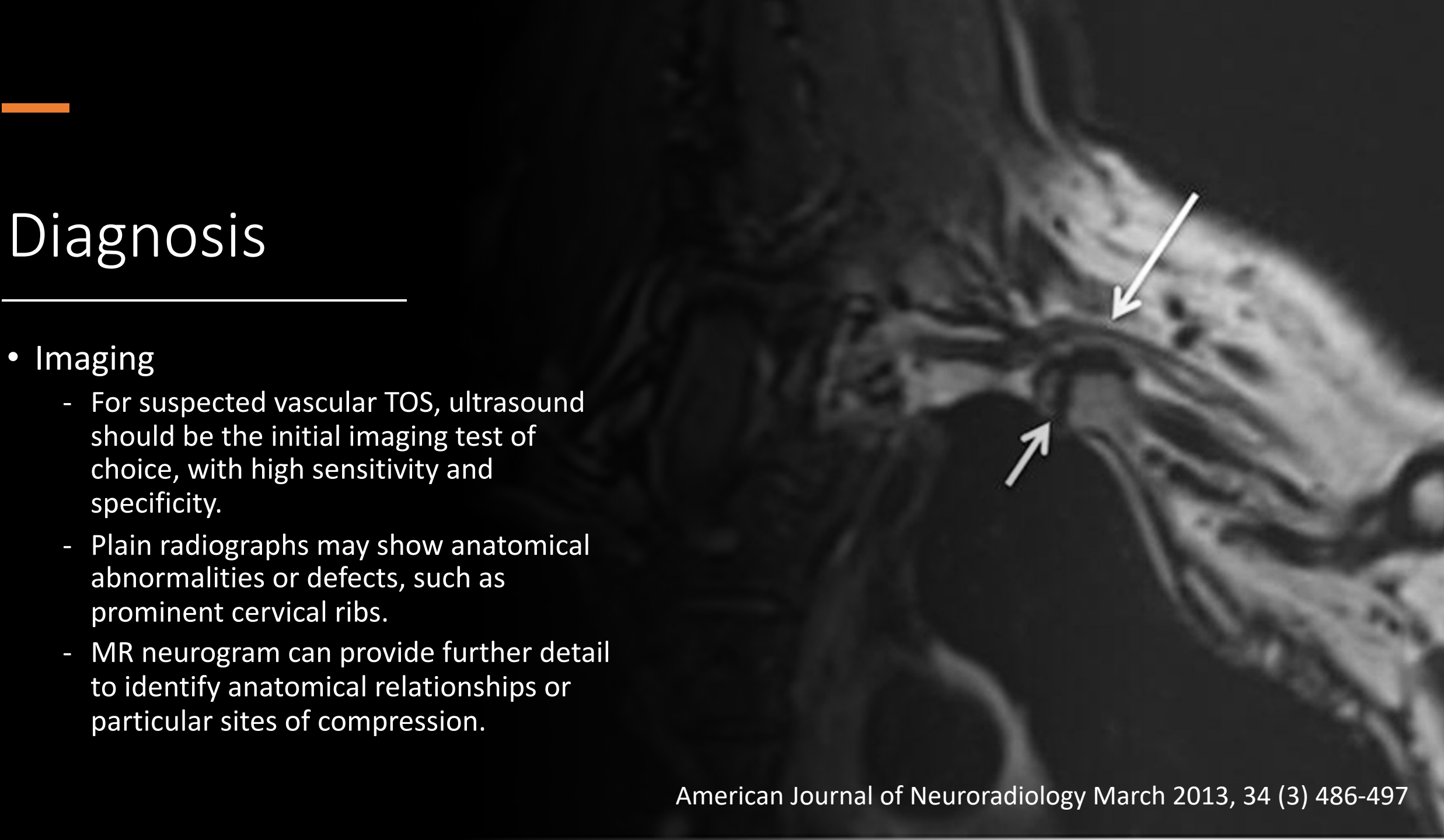


# Diagnosis

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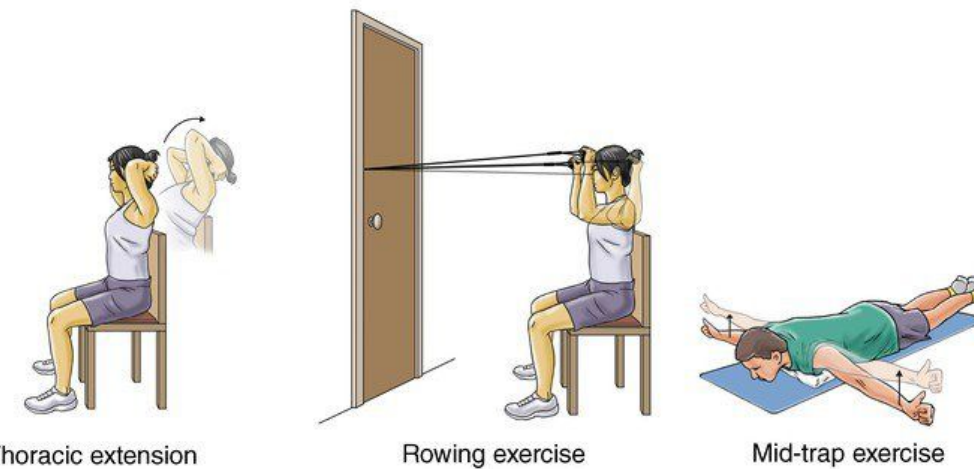
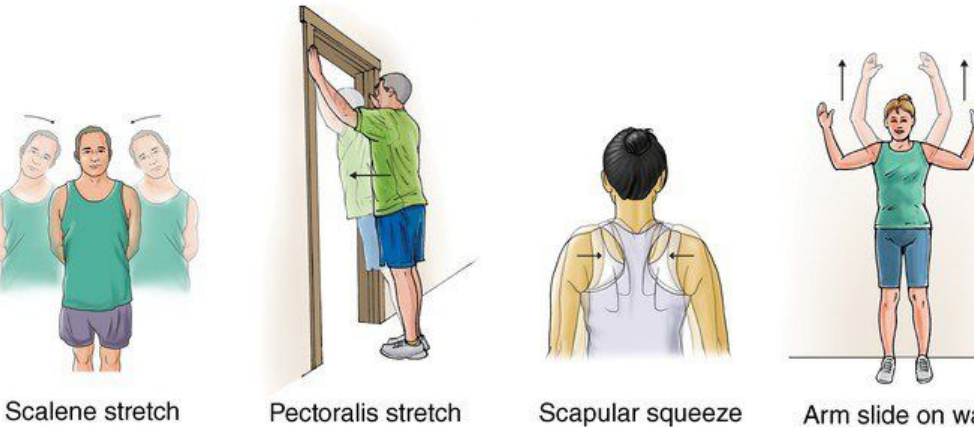
- Imaging

- For suspected vascular TOS, ultrasound should be the initial imaging test of choice, with high sensitivity and specificity.
- Plain radiographs may show anatomical abnormalities or defects, such as prominent cervical ribs.
- MR neurogram can provide further detail to identify anatomical relationships or particular sites of compression.





## Thoracic Outlet Syndrome Rehabilitation Exercises

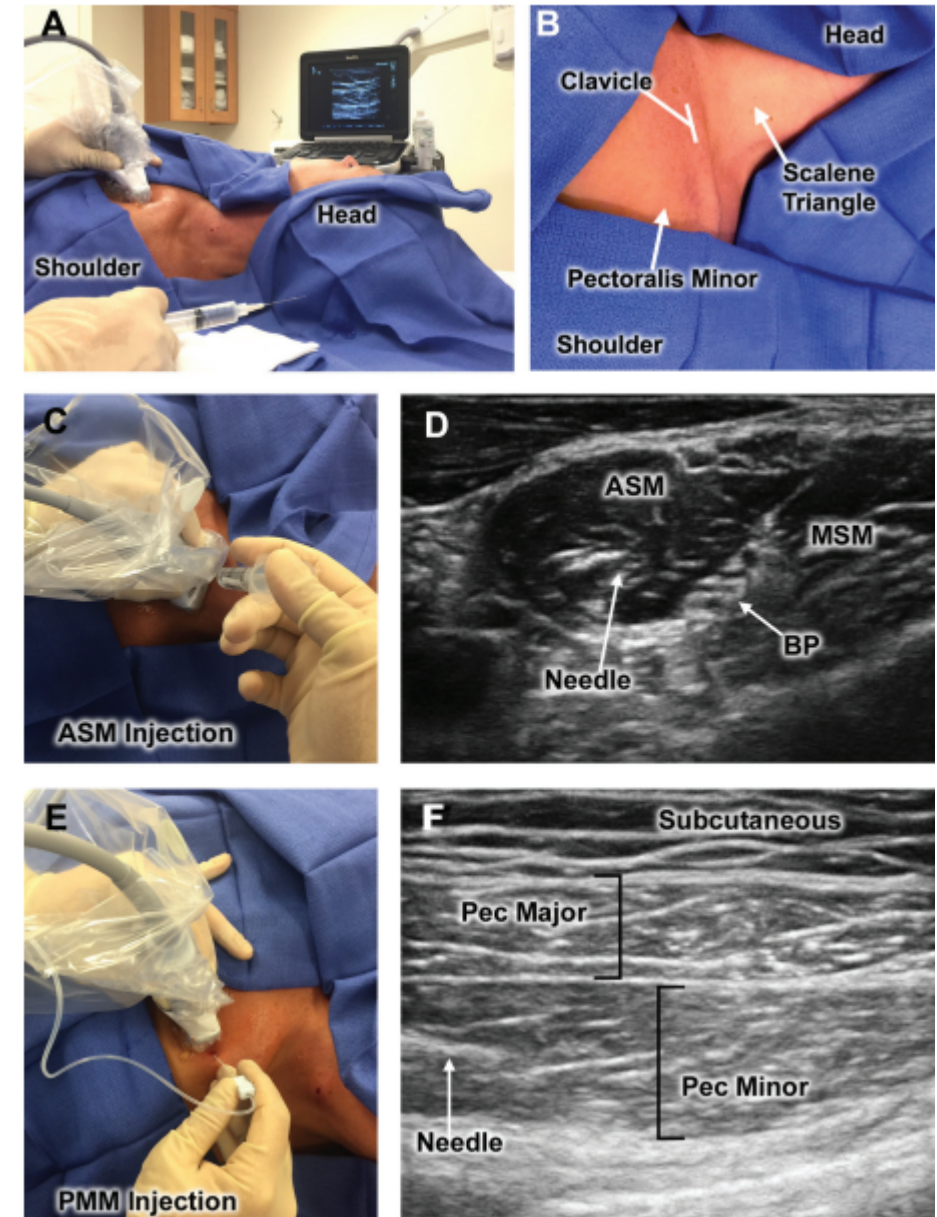


## Conservative Management

- TOS-focused physical therapy (active stretching, targeted muscle strengthening, etc.) for at least 4-6 months.
- Pharmacologic interventions often provide symptomatic relief, and primarily include
  - Anti-inflammatory (NSAIDs and/or acetaminophen)
  - Muscle relaxants
  - Anticonvulsants
  - Antidepressants

# Conservative Management

- Injection of local anesthetic, steroids, or botulinum toxin type A into the anterior scalene and/or pectoralis muscle have demonstrated varying levels of success in observational studies.





# Surgical Intervention

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- Surgical candidates should have failed conservative management.
- The surgery of choice is a first rib resection aimed at brachial plexus decompression, typically performed by vascular surgeons.
- In neurogenic TOS, the first rib is removed in addition to a scalenectomy +/- pectoralis minor tenotomy.



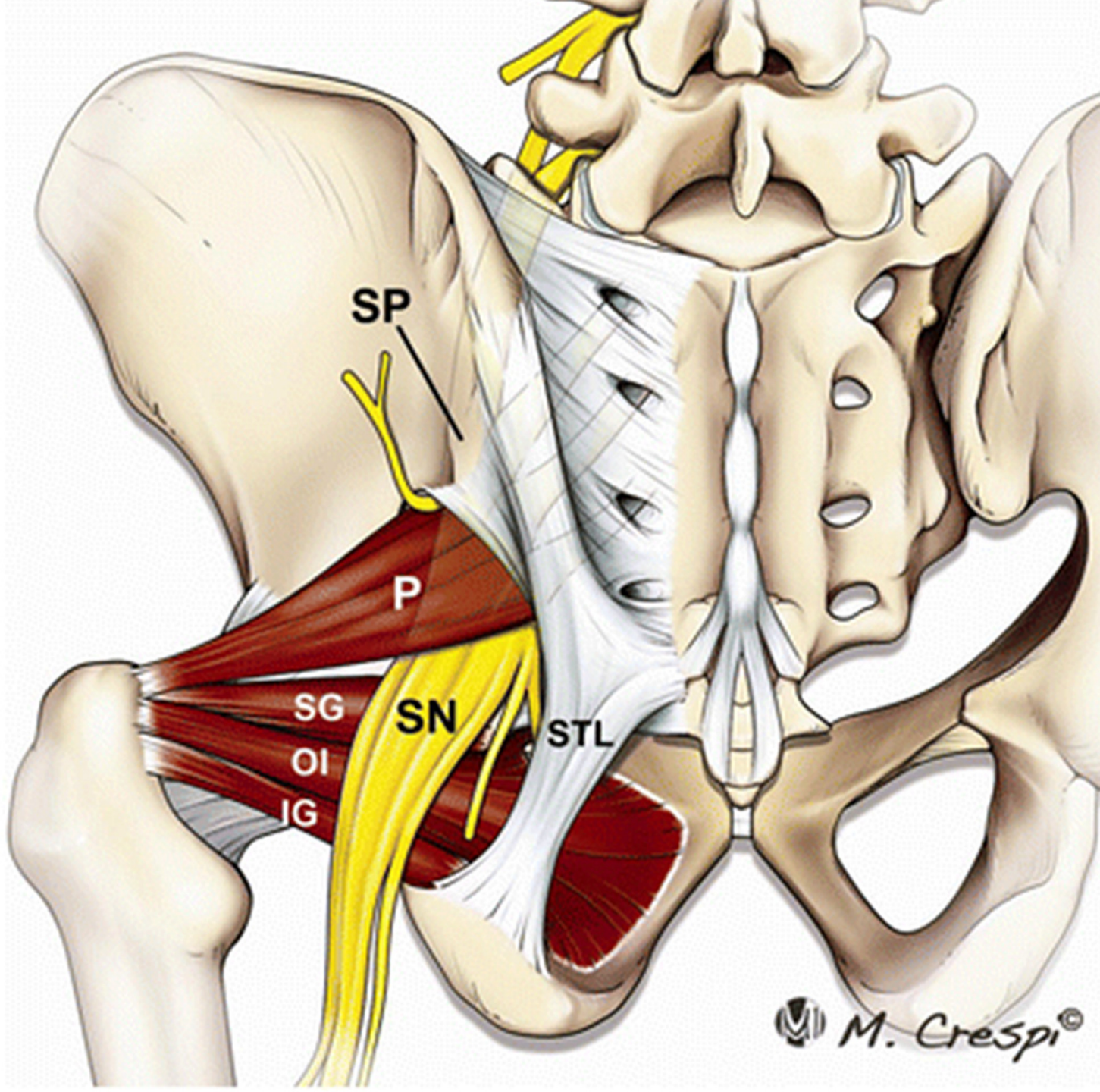
# Piriformis Syndrome

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- A form of nondiscogenic sciatica
- Caused by compression of the sciatic nerve by the piriformis muscle.







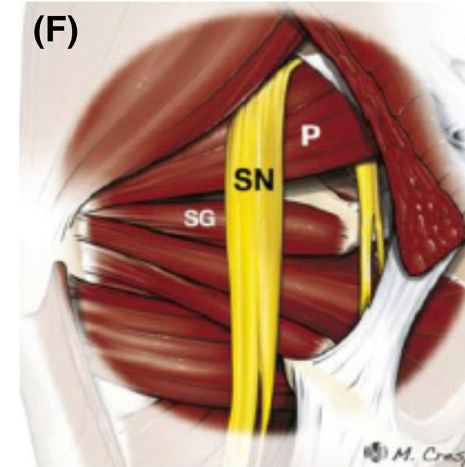
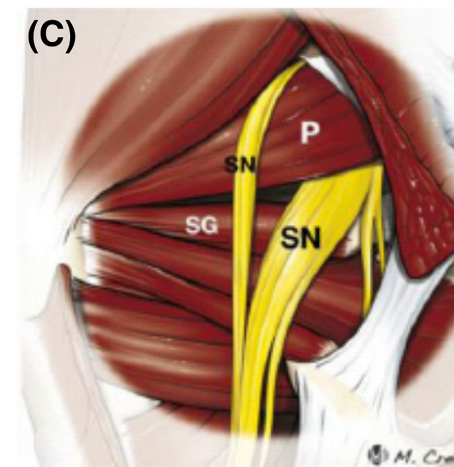
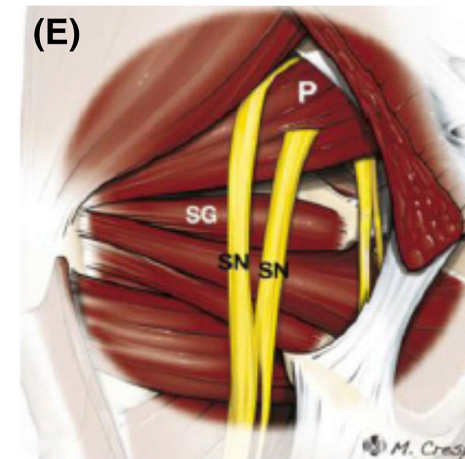
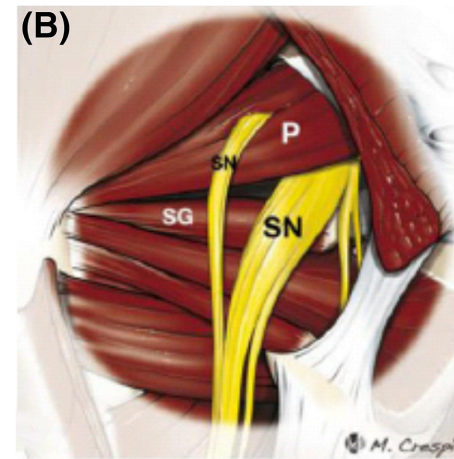
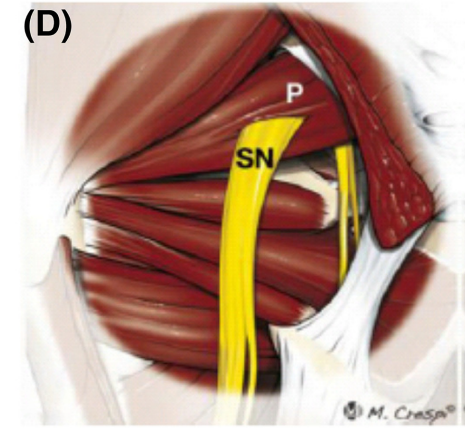
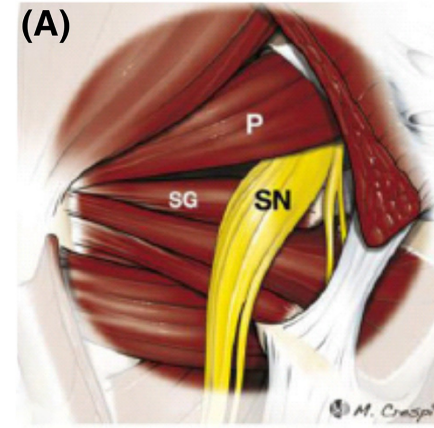
# Normal Anatomy of the Subgluteal Space

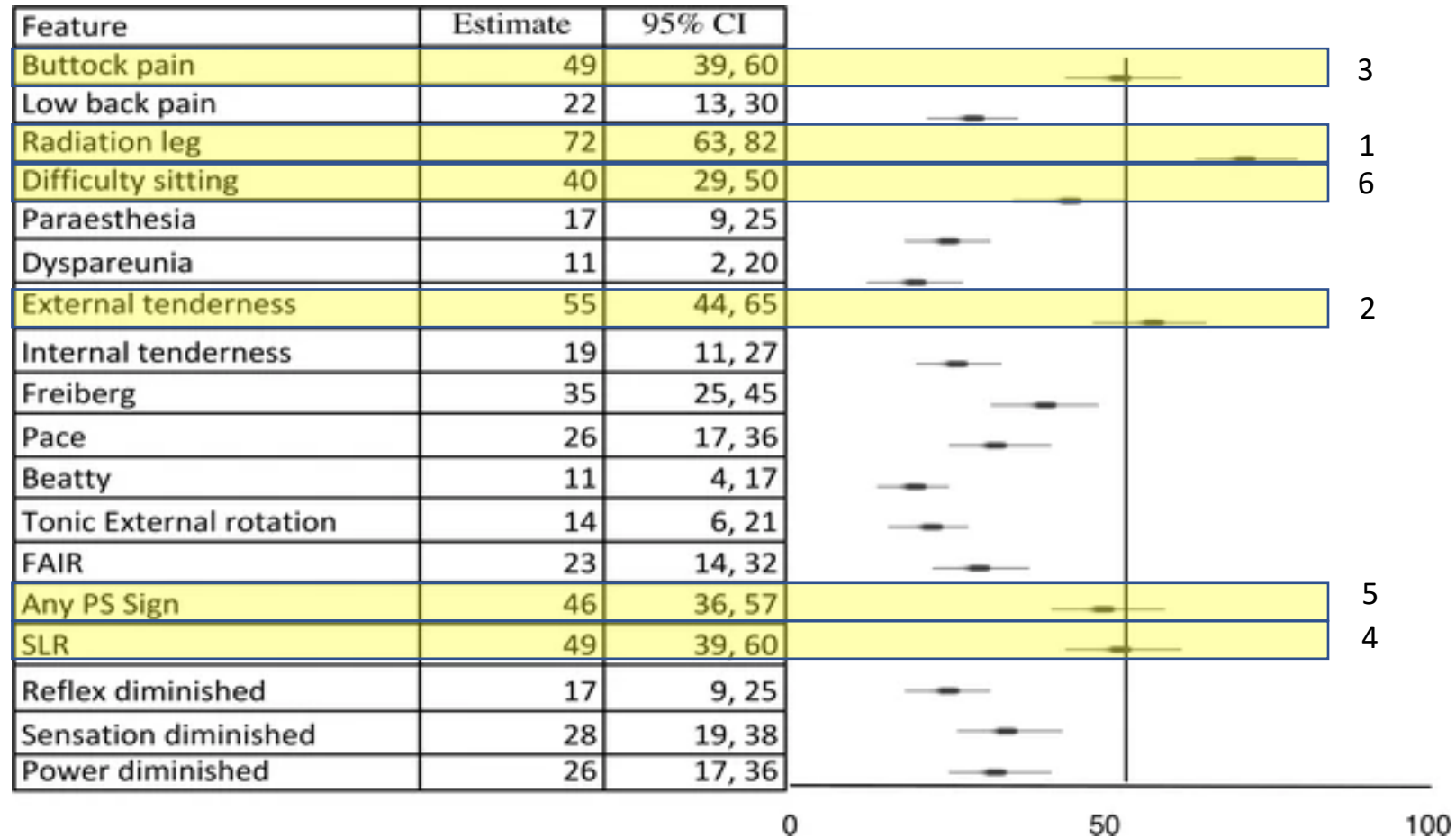
Skeletal Radiol. 2015;44(7):919-934.



# Anatomical Variation

- (A) Traditional anatomy: an undivided nerve emerges below the piriformis muscle.
- (B) A divided nerve passes through and below the piriformis muscle.
- (C) A divided nerve passes above and below the piriformis muscle.
- (D) An undivided nerve passes through the piriformis muscle.
- (E) A divided nerve passes through and above the piriformis muscle.
- (F) An undivided nerve emerges above the piriformis muscle.





## Clinical Presentation





# Diagnosis

## Physical Examination

- Tenderness to deep palpation of the piriformis muscle was present in 92% of cases.
- External tenderness to palpation over the greater sciatic notch.
- Often, sonopalpation reveals that the piriformis muscle is not the sole pain generator and the external rotators or gluteal muscles are also involved.

# Diagnosis

- Physical Examination

- A. Patient actively abducts and externally rotates the hip while the examiner resists these movements.
- B. Side-lying patient holds their flexed hip in abduction against gravity.
- C. FAIR: the patient's hip is placed in flexion, adduction, and internal rotation.
- D. The practitioner resists hip abduction with the patient in a seated position.



(A) Active piriformis Test

(B) Beatty Test

(C) FAIR Test

(D) PaceTest

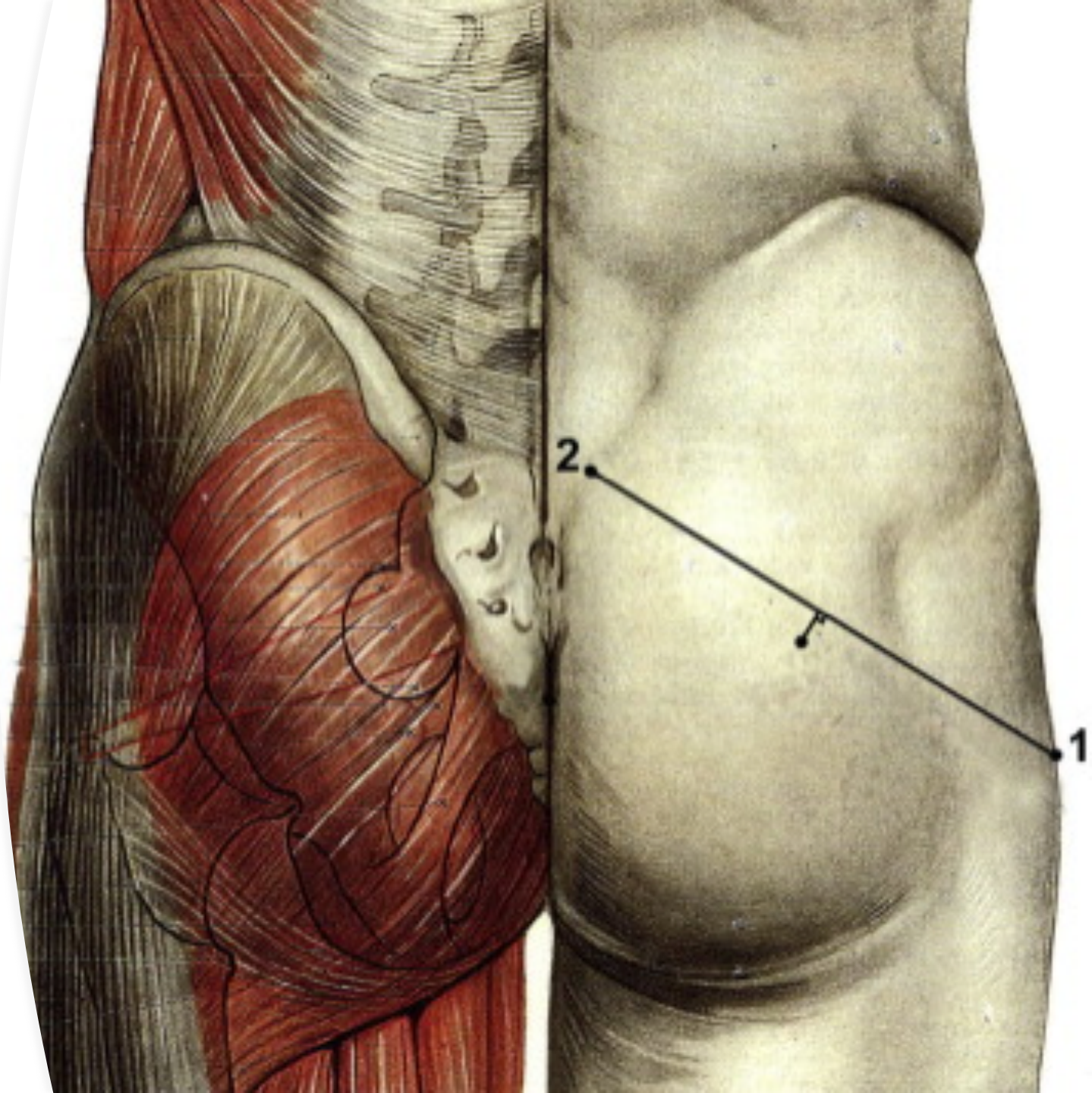




# Diagnosis

- Electrodiagnostic Testing

- Often normal.
- Most useful to exclude other conditions such as lumbosacral radiculopathy.
- May show conduction slowing or decreased amplitude of sensory nerve action potentials and compound motor action potentials.
- Degree of slowing has been shown to correlate with the duration of symptoms.

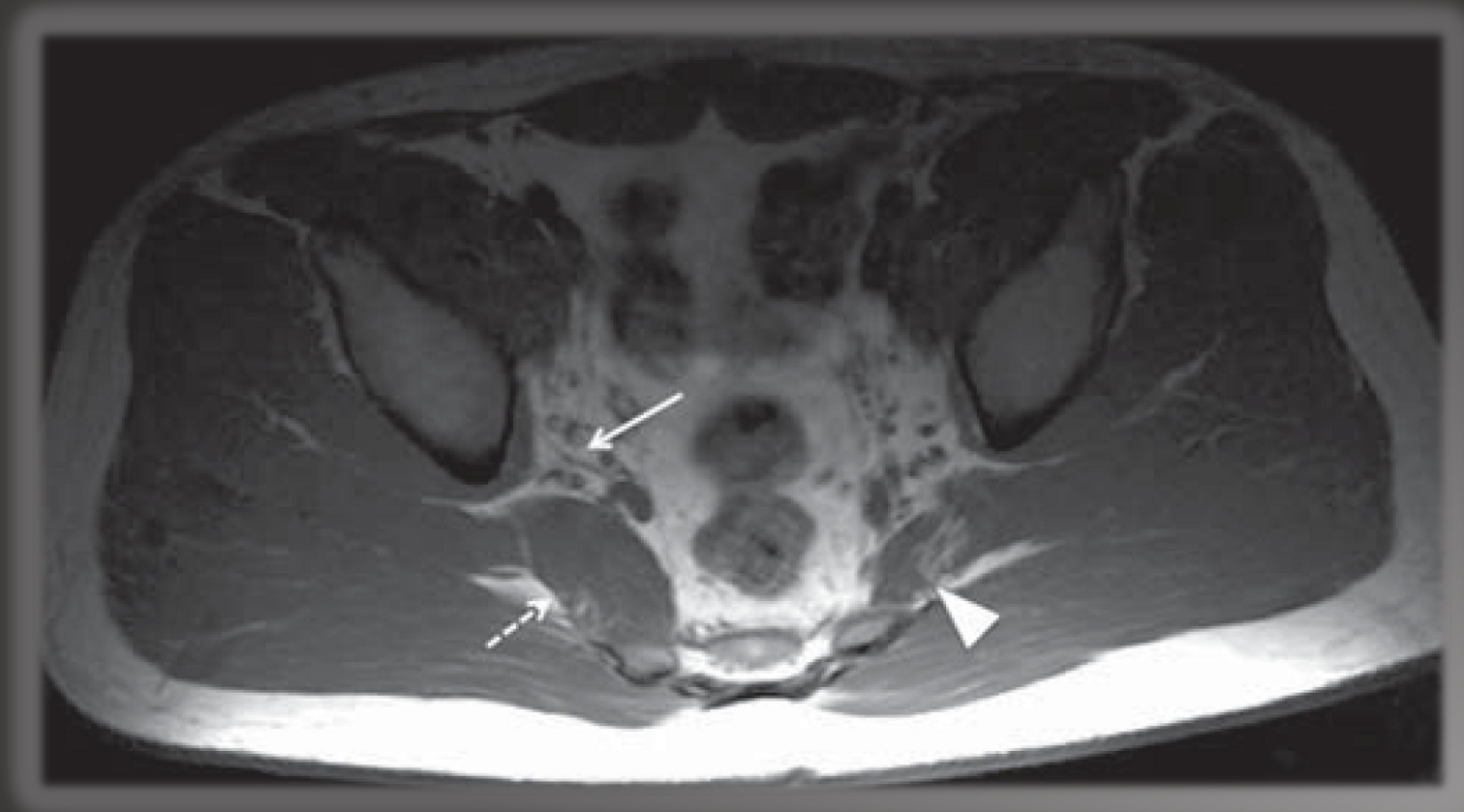




# Diagnosis

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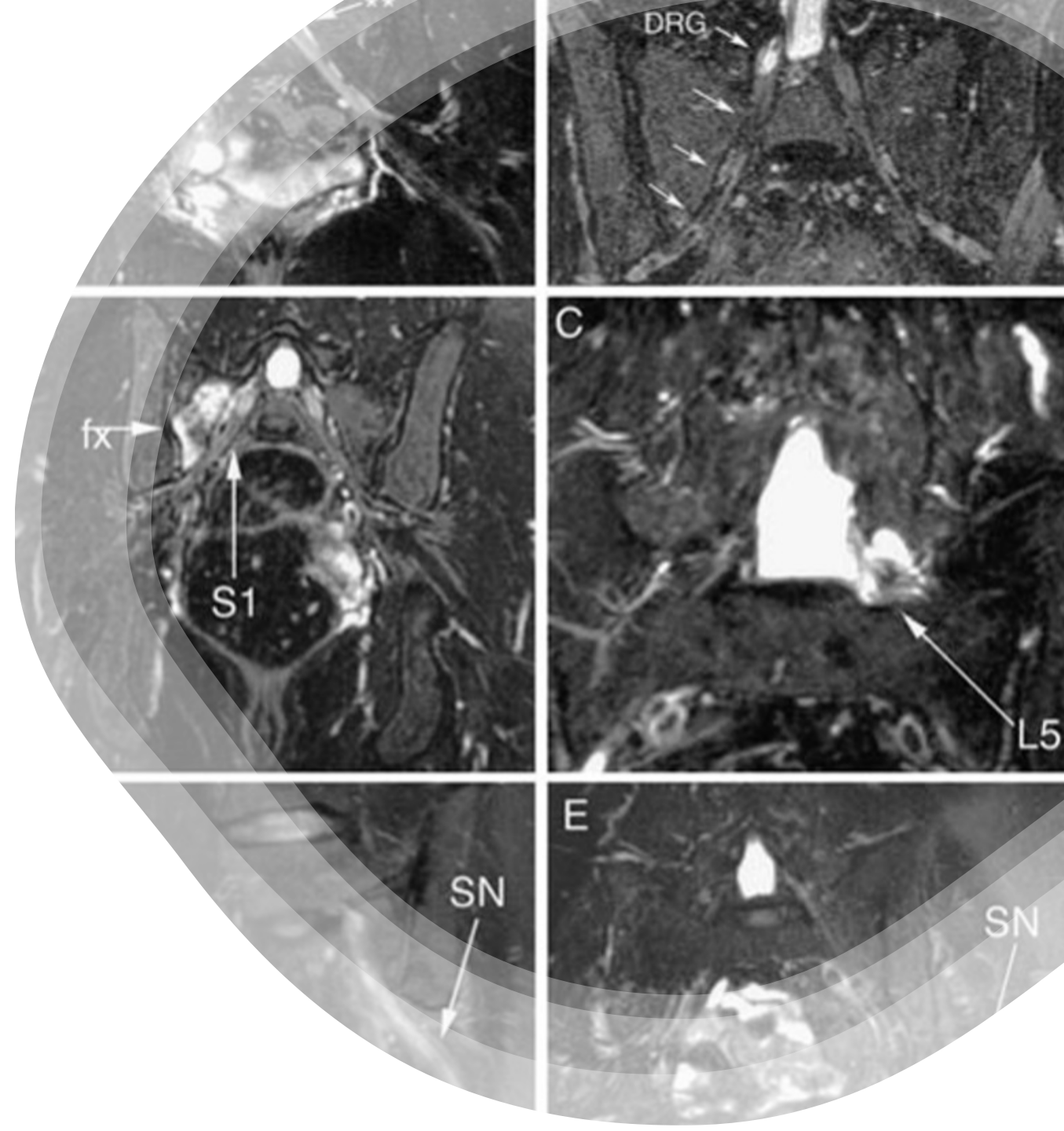
- MRI is preferred.
- Spine MRI important to exclude radiculopathy or spinal stenosis.
- Pelvic MRI can identify enlarged piriformis (not pathognomic).



# Diagnosis

- Imaging

- MR neurography improves visualization of peripheral nerves by suppressing the signal from surrounding tissue.
- 14 pts with unexplained sciatica and unremarkable MRI of the lumbar spine. 12 pts (86%) had increased STIR sequence signal in the ipsilateral sciatic nerve. In 8 pts, the abnormal signal was seen at or just inferior to the level of the sciatic notch and piriformis muscle.
- 239 pts with sciatica and in whom a diagnosis could not be established or who failed lumbar spine surgery; edema or hyperintensity in the ipsilateral sciatic nerve relative to the contralateral side was observed in 94% of patients, and of these patients, 88% had reproduction of their symptoms with the FAIR position.



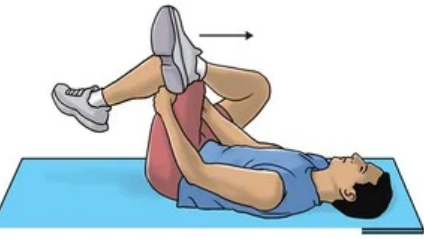
An anatomical illustration of a human back and pelvis, viewed from the back. The piriformis muscles are highlighted in a reddish-brown color, showing their origin from the greater trochanter of the femur and their course towards the greater sciatic foramen. The rest of the body is shown in a semi-transparent blue color.

# Treatment

- Physical Therapy
- Oral medications
- Injections
- Surgical release



## Piriformis Syndrome Rehabilitation Exercises



Gluteal stretch



Resisted hip abduction



Standing hamstring stretch



Plank



Prone hip extension with bent leg



Side plank



Clam exercise

## Physical Therapy

- Rest, ice, and heat may help relieve symptoms.
- Program of exercises and stretches to help reduce sciatic nerve compression.

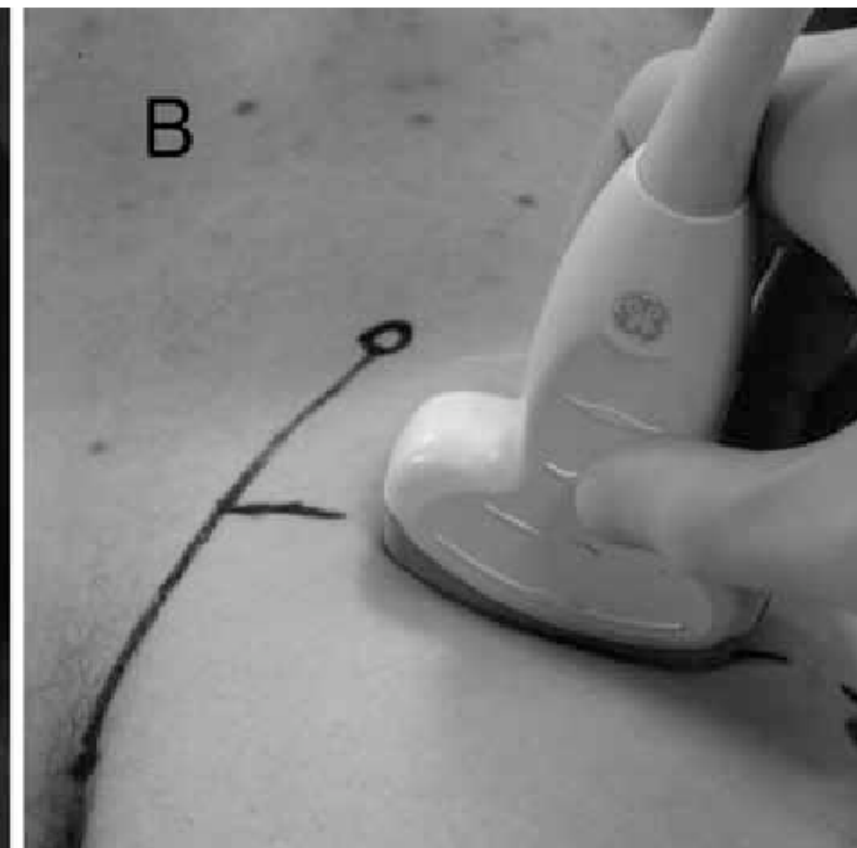


# Pharmacologic Management

- NSAIDs
- Acetaminophen
- Muscle relaxants
- Limited role for opioids
  - Lack of evidence for benefit and risk of side effects and dependence.

# Injections

J Ultrasound Med. 2008;27(8):1157-1163.  
Ann Phys Rehabil Med. 2013;56(5):371-383.



- Diagnostic and therapeutic (local anesthetic +/- steroid).
- Accuracy for anatomic landmark and fluoroscopic-guided injections ~30%. Ultrasound guided injections ~ 95%.
- Botulinum Toxin A shown to provide “good to very good” pain relief in treatment-resistant pts.



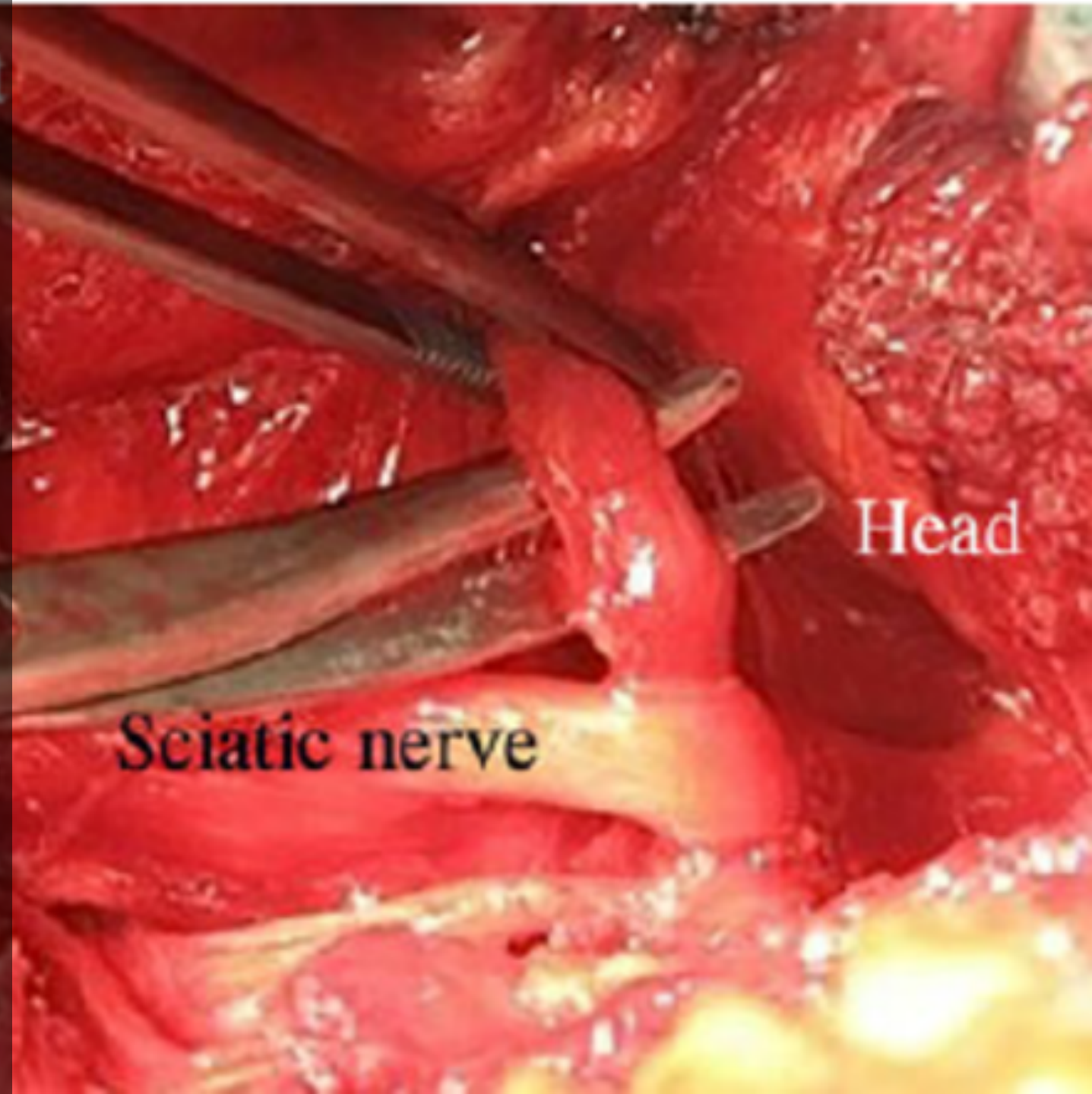


# Piriformis Surgical Release

- Often involves tenotomy of the piriformis muscle tendon and sciatic nerve decompression.
- No large, prospective, randomized, controlled trials performed.
- Should be considered last line only in cases refractory to treatment.

Right

Left



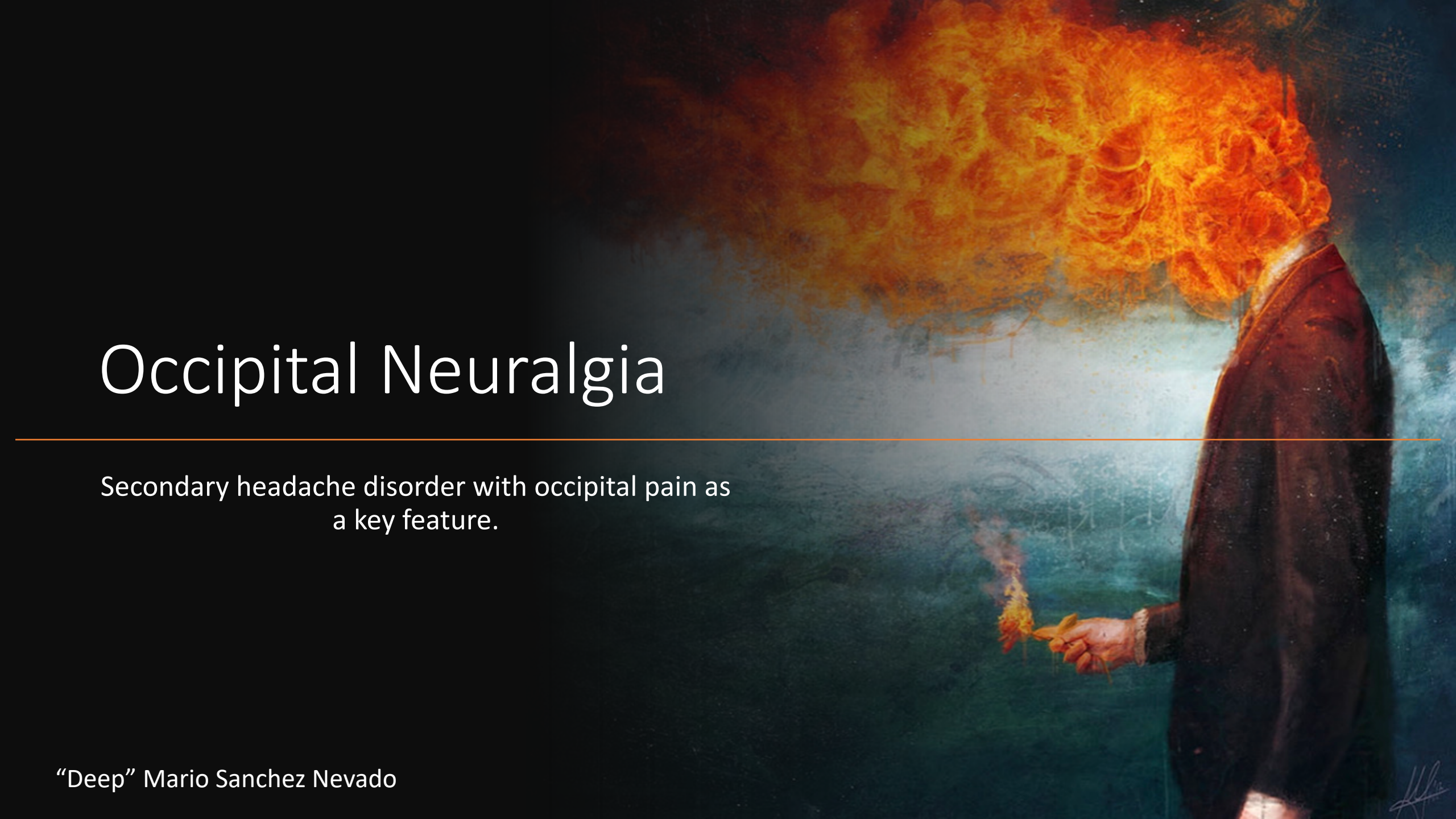


# Occipital Neuralgia

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Secondary headache disorder with occipital pain as a key feature.

“Deep” Mario Sanchez Nevado





# Epidemiology



- Dutch study evaluating facial pain in the general population, the incidence of ON was reported as 1.8%.
- CGH seems to be much more common, with a prevalence 2.2–4.1%

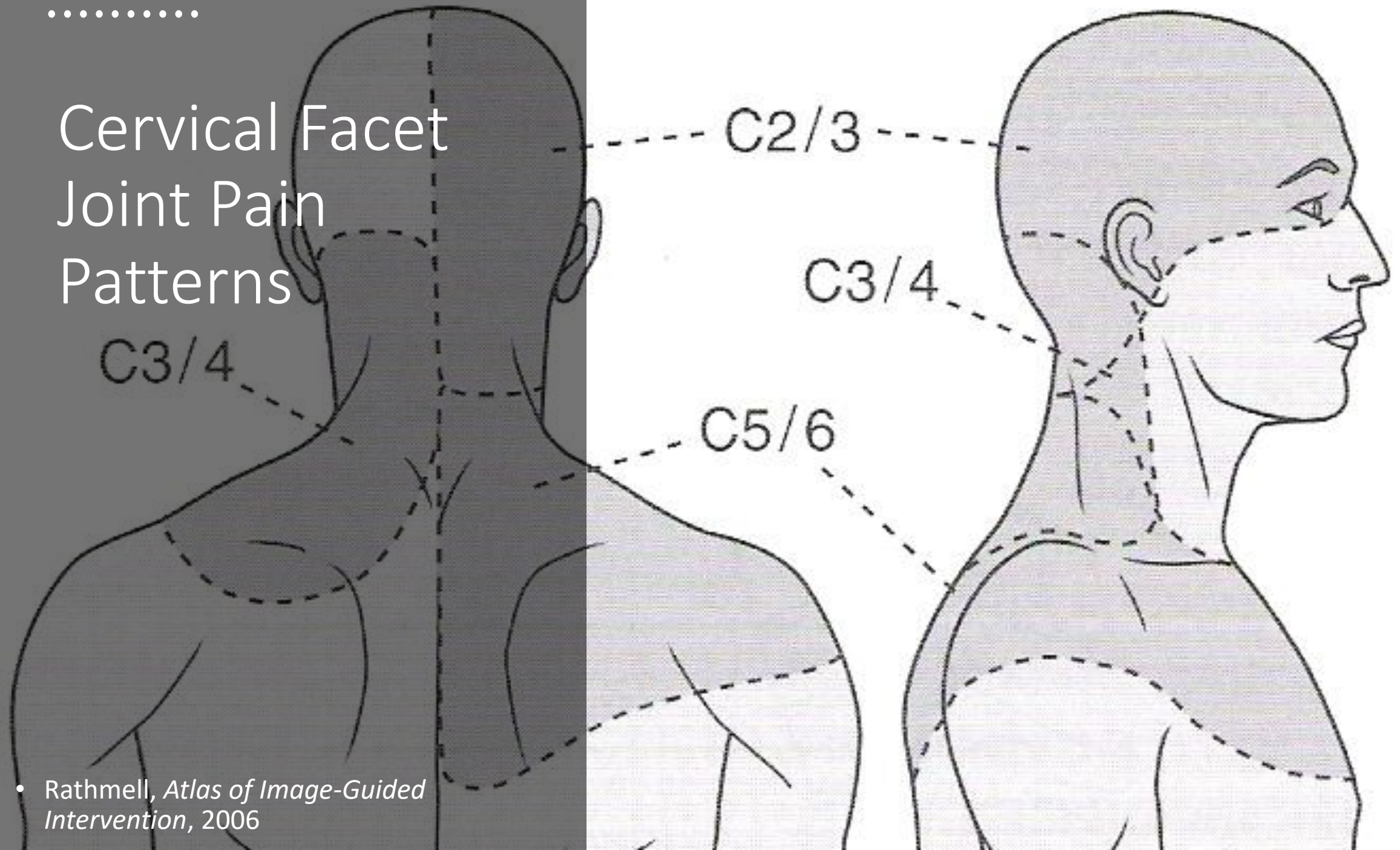
# Challenges & Differential Diagnosis

- Latency between symptom onset and diagnosis is  $\sim 27.7 \pm 56.1$  months.
- Cluster headaches
- Migraine
- Temporal arteritis (involving occipital artery)





# Cervical Facet Joint Pain Patterns



- Rathmell, *Atlas of Image-Guided Intervention*, 2006



# ICHD-3 diagnostic criteria for occipital neuralgia

Cephalalgia. 2018 Jan;38(1):1–211

A. Unilateral or bilateral pain in the distribution(s) of the greater, lesser and/or third occipital nerves and fulfilling criteria B-D

B. Pain has at least two of the following three characteristics:

1. recurring in paroxysmal attacks lasting from a few seconds to minutes

2. severe in intensity

3. shooting, stabbing, or sharp in quality

C. Pain is associated with both of the following:

1. dysesthesia and/or allodynia apparent during innocuous stimulation of the scalp and/or hair

2. either or both of the following:

- (a) tenderness over the affected nerve branches

- (b) trigger points at the emergence of the greater occipital nerve or in the distribution of C2

D. Pain is eased temporarily by local anesthetic block of the affected nerve(s)

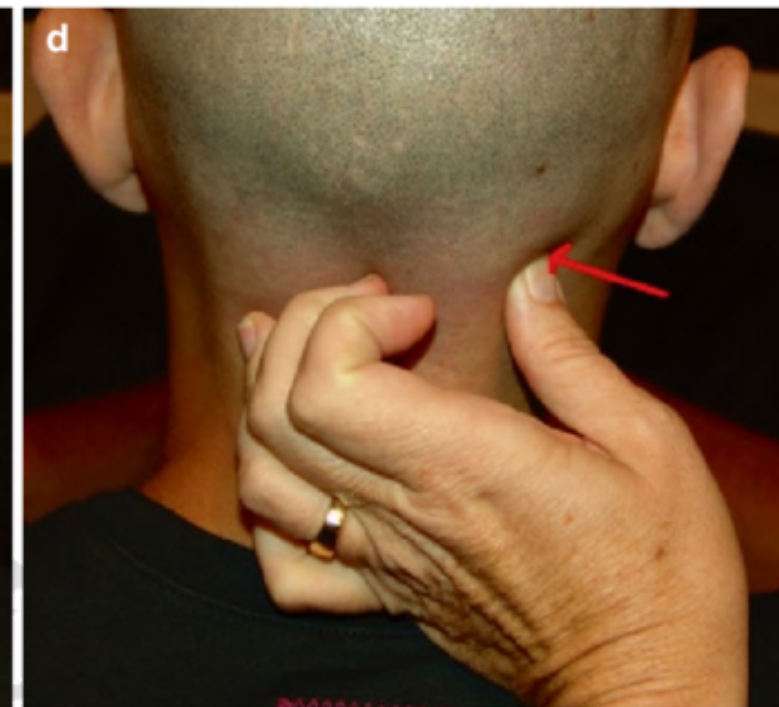
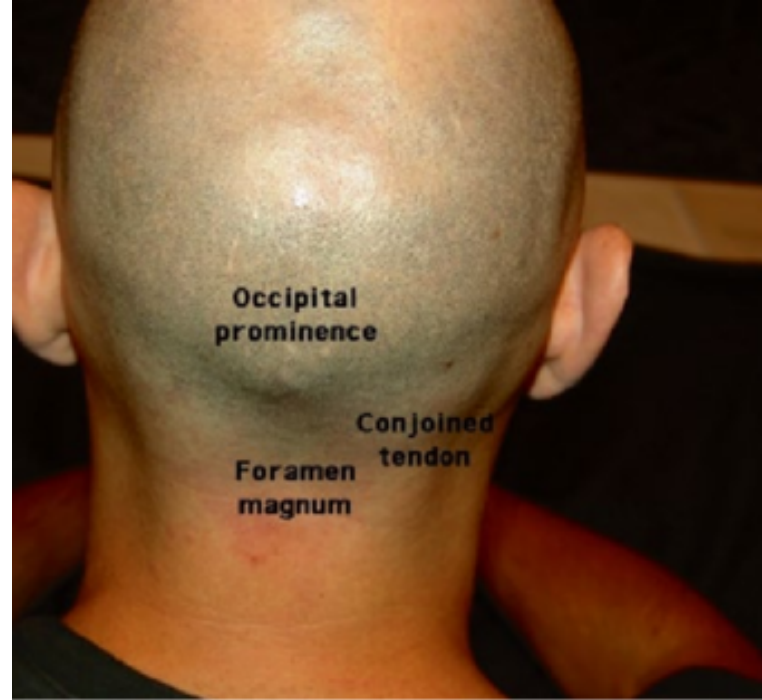
E. Not better accounted for by another ICHD-3 diagnosis

# ICHD-3 diagnostic criteria for cervicogenic headache

Cephalalgia. 2018 Jan;38(1):1–211

A. Any headache fulfilling criterion C
B. Clinical and/or imaging evidence of a disorder or lesion within the cervical spine or soft tissues of the neck, known to be able to cause headache
C. Evidence of causation demonstrated by at least two of the following:
1. headache has developed in temporal relation to the onset of the cervical disorder or appearance of the lesion
2. headache has significantly improved or resolved in parallel with improvement in or resolution of the cervical disorder or lesion
3. cervical range of motion is reduced and headache is made significantly worse by provocative maneuvers
4. headache is abolished following diagnostic blockade of a cervical structure or its nerve supply
D. Not better accounted for by another ICHD-3 diagnosis

# Physical Examination



Trescot, Andrea & Rawner, Esther & Irwin, David. (2016). Greater Occipital Nerve Entrapment.

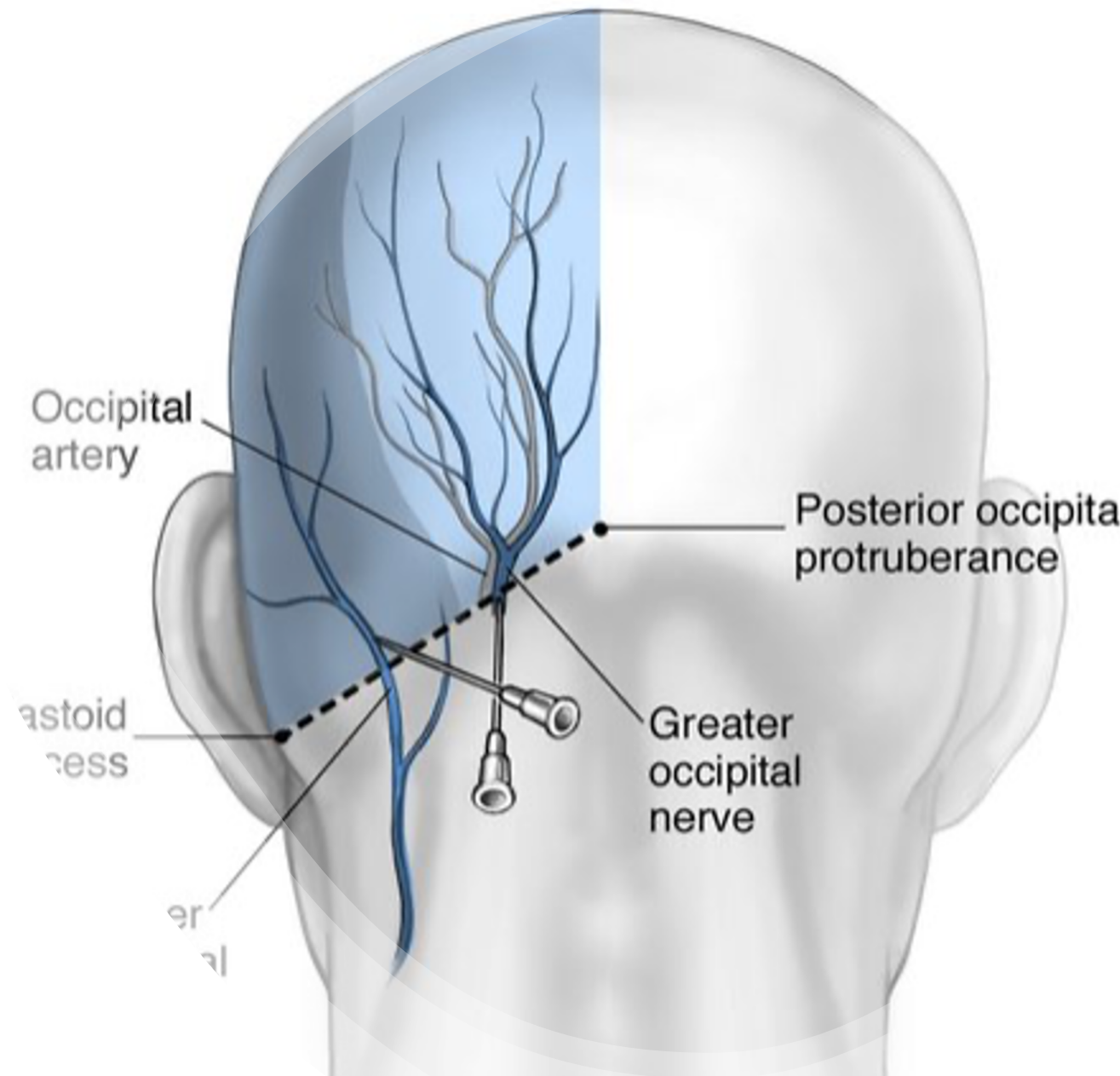


# Pharmacologic Management

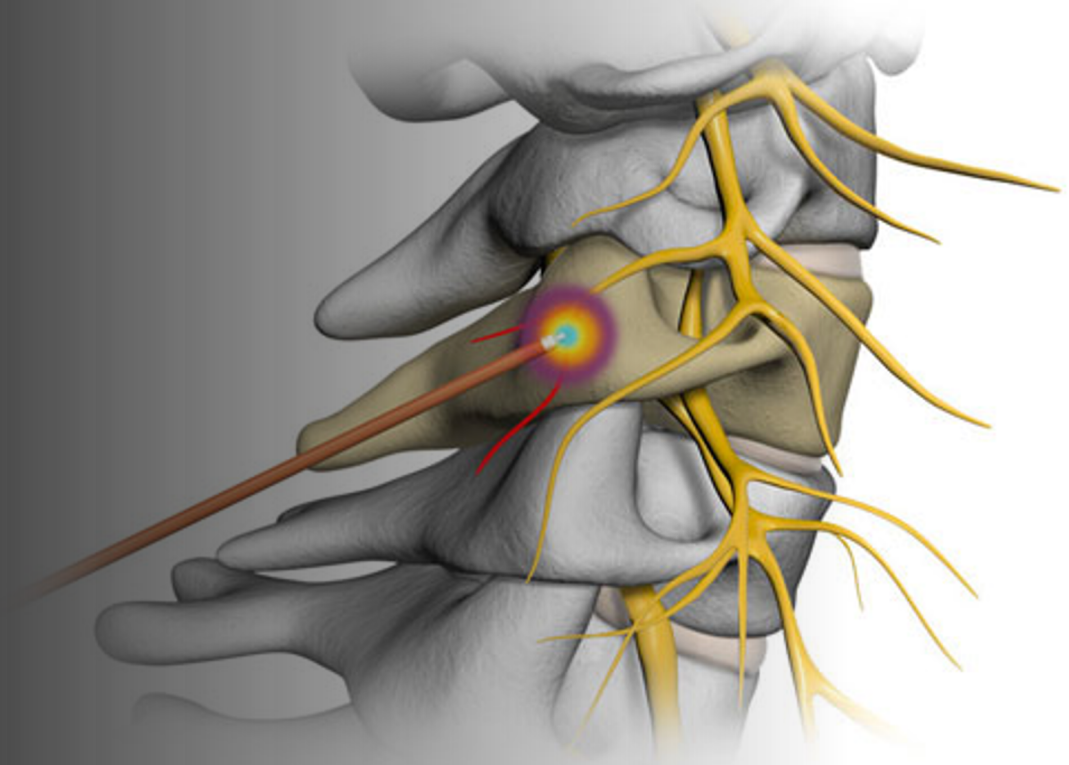
- NSAIDs
- Tricyclic antidepressants
  - Amitriptyline
- Muscle relaxants
  - Baclofen
- Anticonvulsants
  - Gabapentin
  - Carbamazepine
- Limited role for opioids
  - Lack of evidence for benefit and risk of side effects and dependence.

# Injections

- Local anesthetic
- Steroid
- Botulinum toxin A:
  - 2 small case series suggested improvement in sharp lancinating pain; less for the dull aching pain.



# Cervical Radiofrequency Ablation

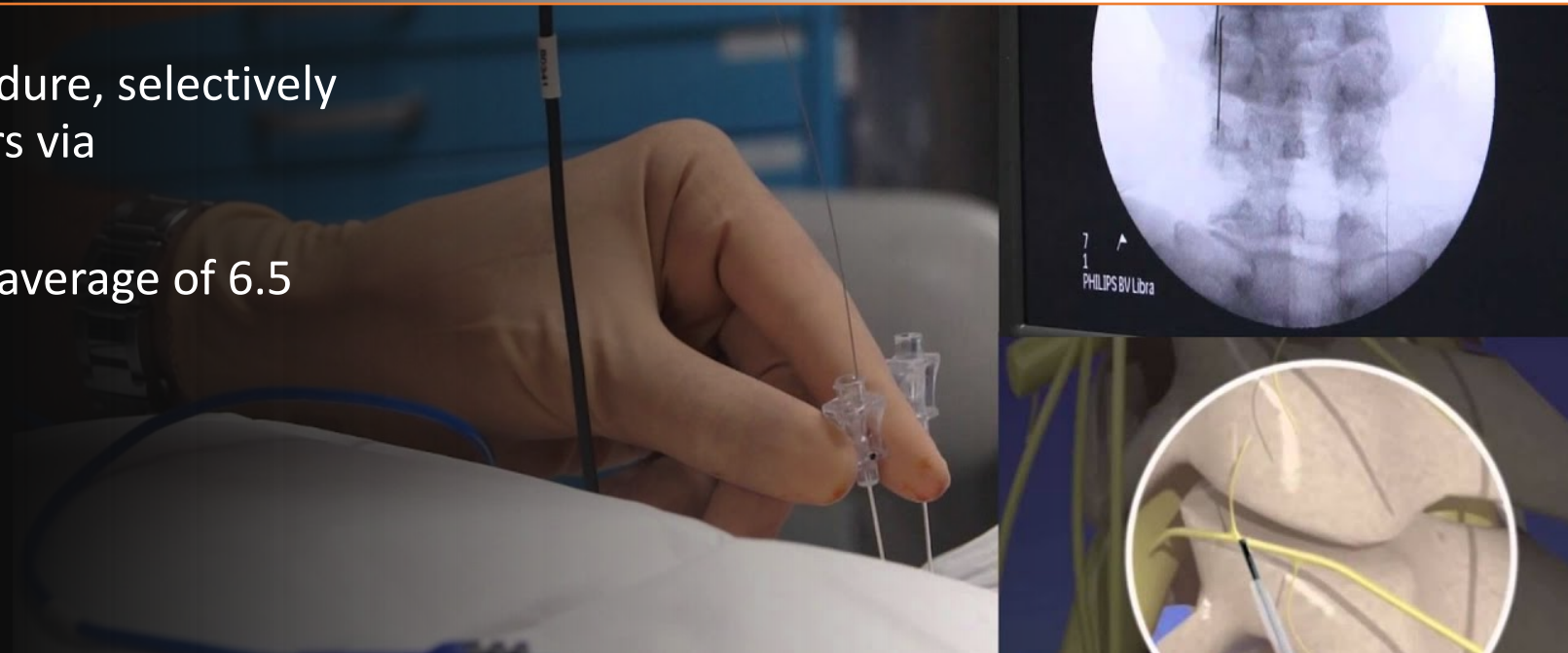


Minimally invasive lesioning procedure, selectively destroying A-delta and C pain fibers via thermocoagulation.

Mean 76.3% pain relief, lasting an average of 6.5 months.

Headache. 2014;54(3):500–10.

Ochsner J. 2018 Fall. 18(3):209-14.







# Occipital Nerve Stimulation

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62.5–100% improvement in  
symptomatology post-  
procedure.

J Headache Pain. 2013;14:67.





## Conclusion

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- Raising awareness of these three conditions can allow for faster patient relief and recovery.
- Recognition of these syndromes may prevent unnecessary surgery in pursuit of other diagnoses.

“Deliberation” Mario Sanchez Nevado

