The Institute
for Advanced Reconstruction

Recognizing & Referring Neuropathic Pain for Surgical Relief

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Disclosures

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Learning Objectives

1. Describe common causes of neuropathic pain

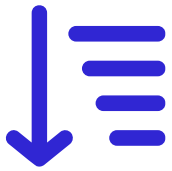
2. Summarize surgical treatment options available for peripheral neuropathic pain

Scope of Presentation

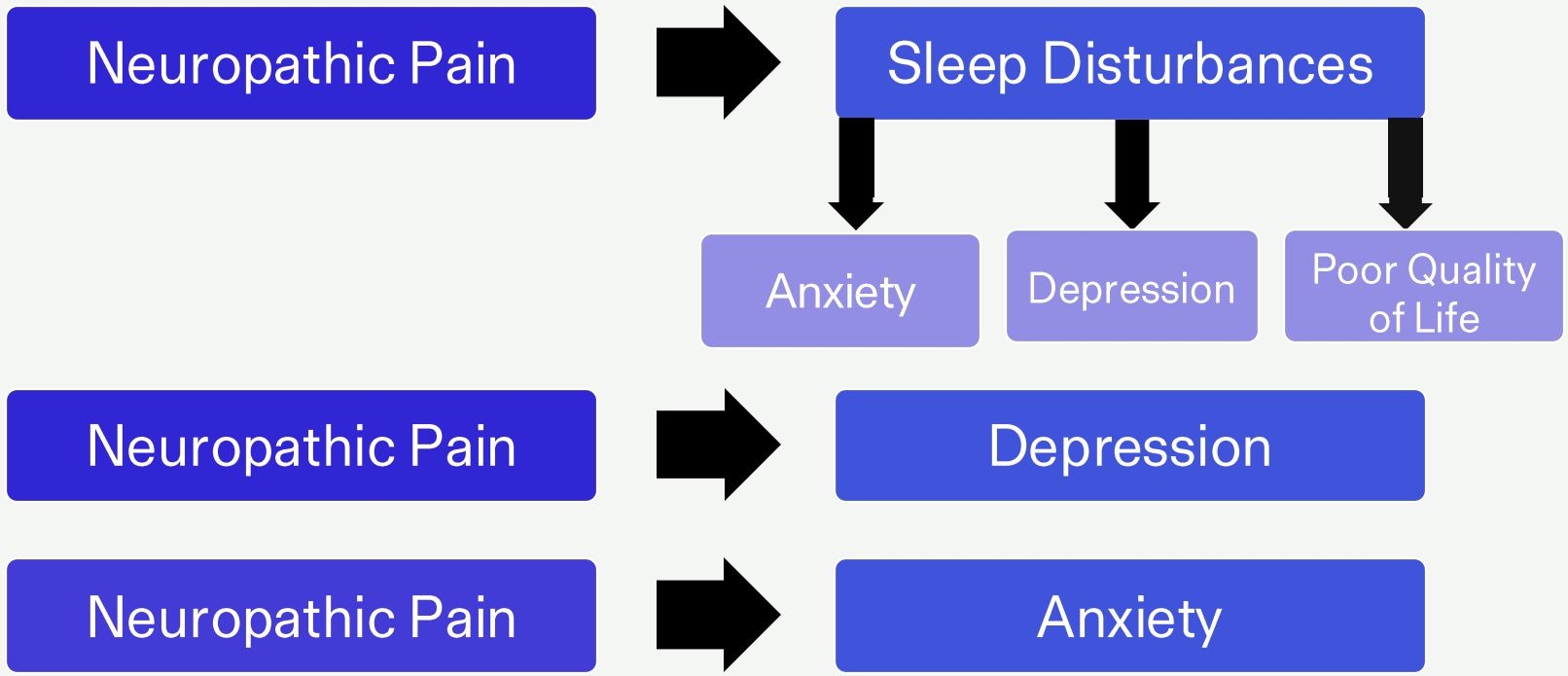
1. Overview of neuropathic pain
2. Occipital Neuralgia
3. Pelvic Pain
4. Sports Hernia
5. Joint Denervation
6. Neuropathy
7. Foot Drop

Goals of Peripheral Nerve Surgery

01	02	03	04
Return of function	Decrease disability score	Restore sensibility	Decrease pain

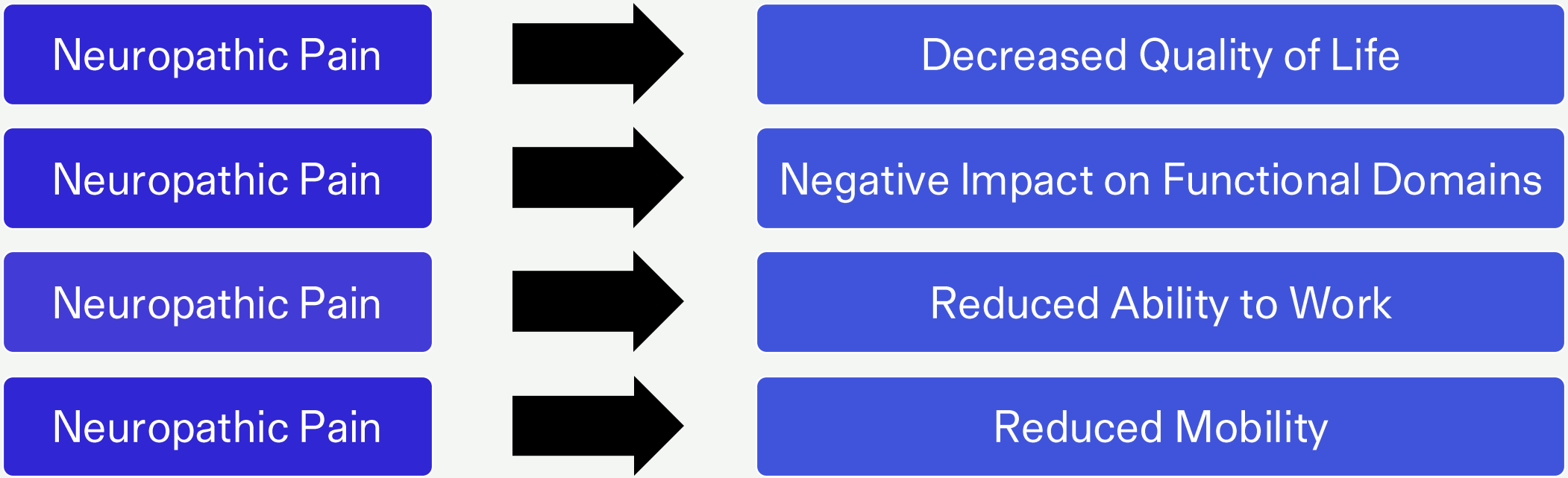


Neuropathic Pain and Comorbid Conditions



Comorbid conditions *exacerbate* pain and in turn, pain *exacerbates* the comorbid conditions.

Biopsychosocial Effects of Neuropathic Pain



Additional Considerations of Chronic Pain

National Economic Burden

Chronic pain contributes to an estimated **$725 billion** each year in direct medical costs, lost productivity, and disability programs (Merative MarketScan Database,2022)

Prescription opioid misuse in the United States costs an estimated **$1.5 trillion** a year (Joint Economic Committee, 2022)

Opioid Use, Misuse & Dependence

21-29% of patients prescribed opioids for chronic pain *misuse* them

~10% percent develop an *opioid use disorder*

4-6% who misuse prescription opioids *transition to heroin*

Occipital Neuralgia

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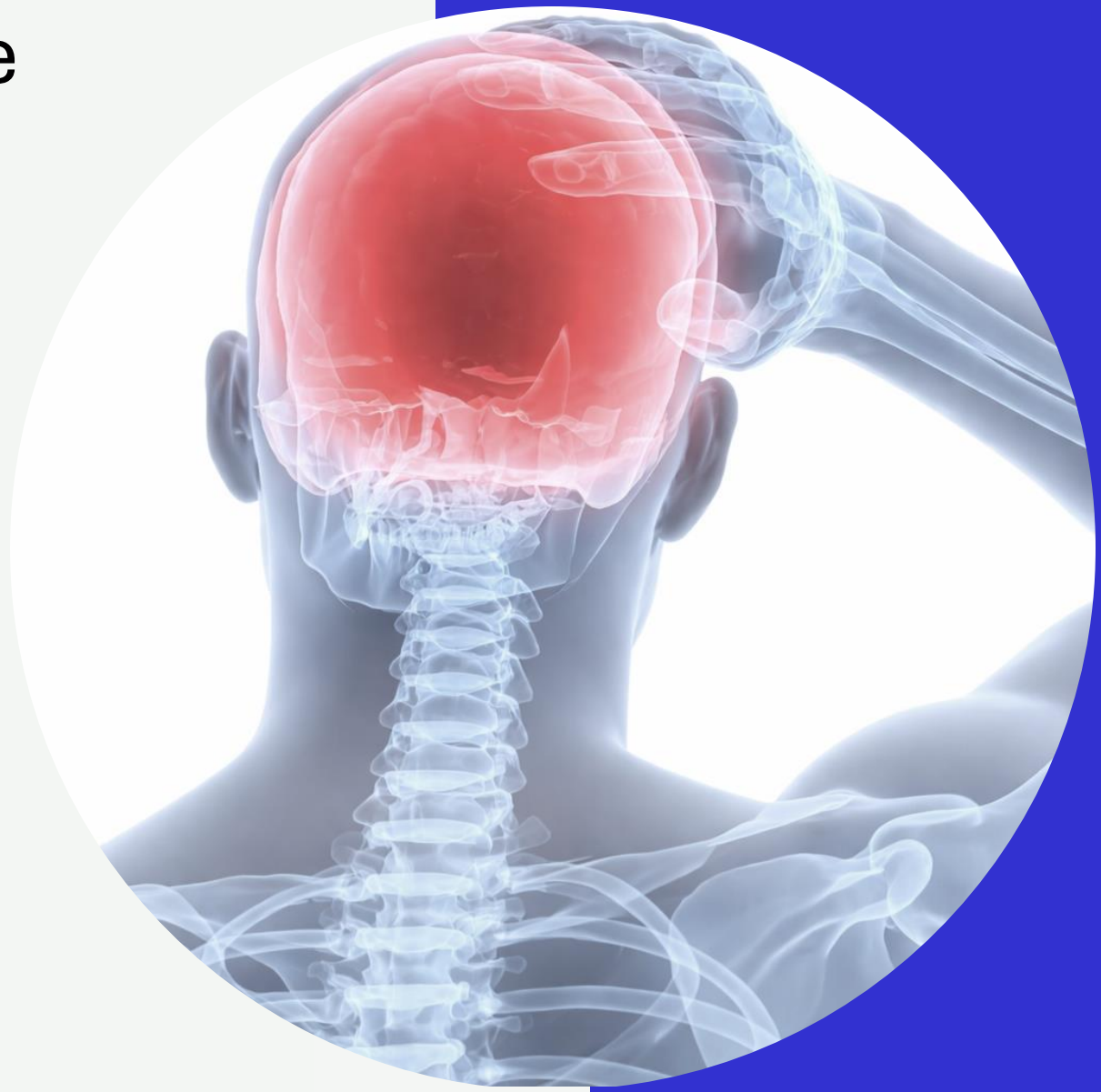
Post Traumatic Headache

A new headache occurring in close temporal relationship to a head and/or neck trauma.

International Headache Society



→ Acute vs. Chronic

→ Sub-categories

- → Mild-to-severe head injury
- → Whiplash
- → Other head and/or neck trauma
- → Intracranial hematoma
- → Post-craniotomy

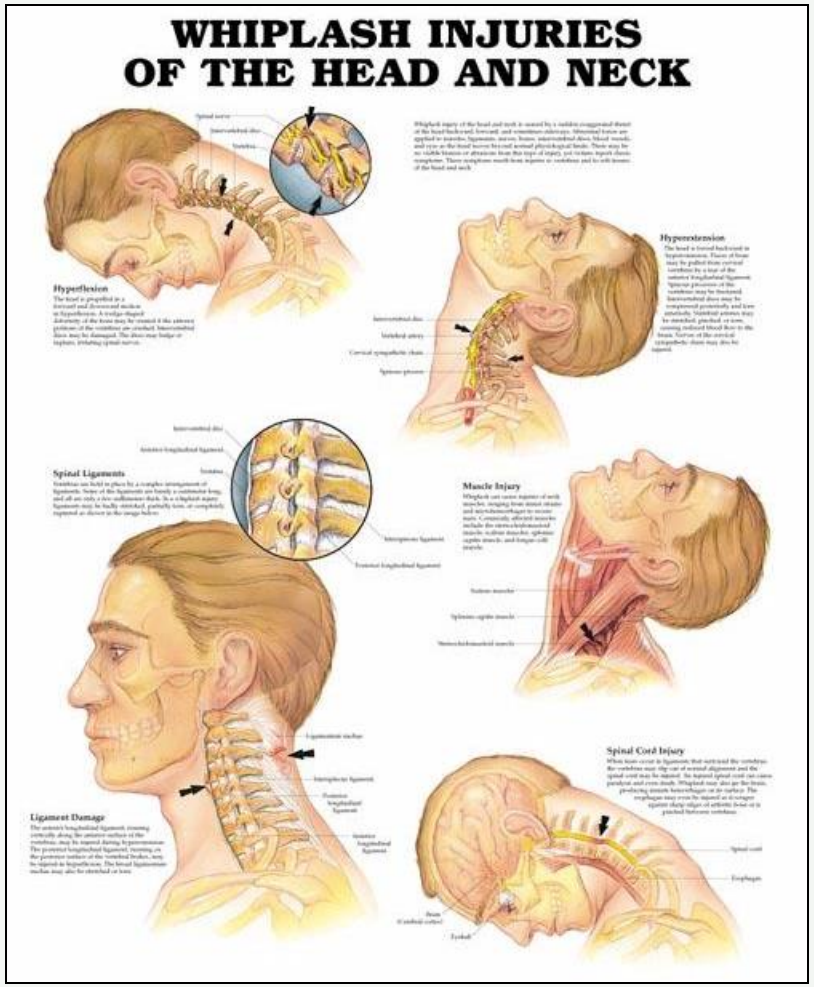
Post-Traumatic Headache

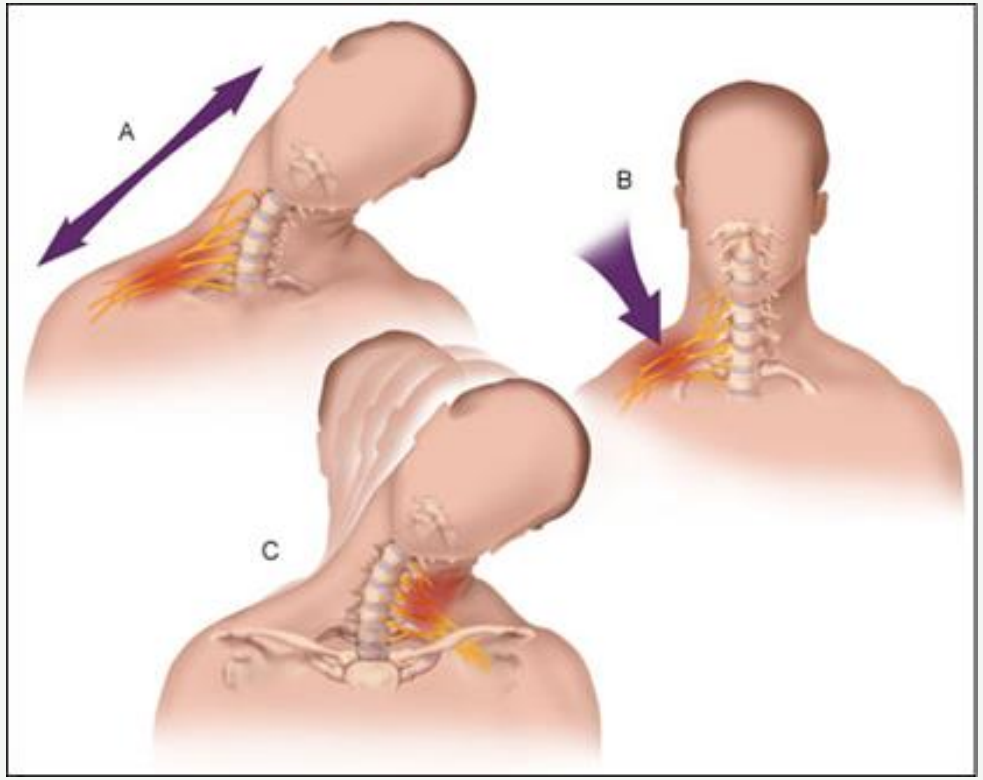
- A secondary headache diagnosis
- Primary headache diagnosis or a cranial/cervical neuralgia diagnosis can be applied

Primary Headache Diagnosis	Post-traumatic migraine
	Post-traumatic cluster
	Post-traumatic tension-type
Cranial/Cervical Neuralgia Diagnosis	**Post-traumatic occipital neuralgia**
	Post-traumatic trigeminal neuralgia
	Post-traumatic supraorbital neuralgia

Post-Traumatic Headache

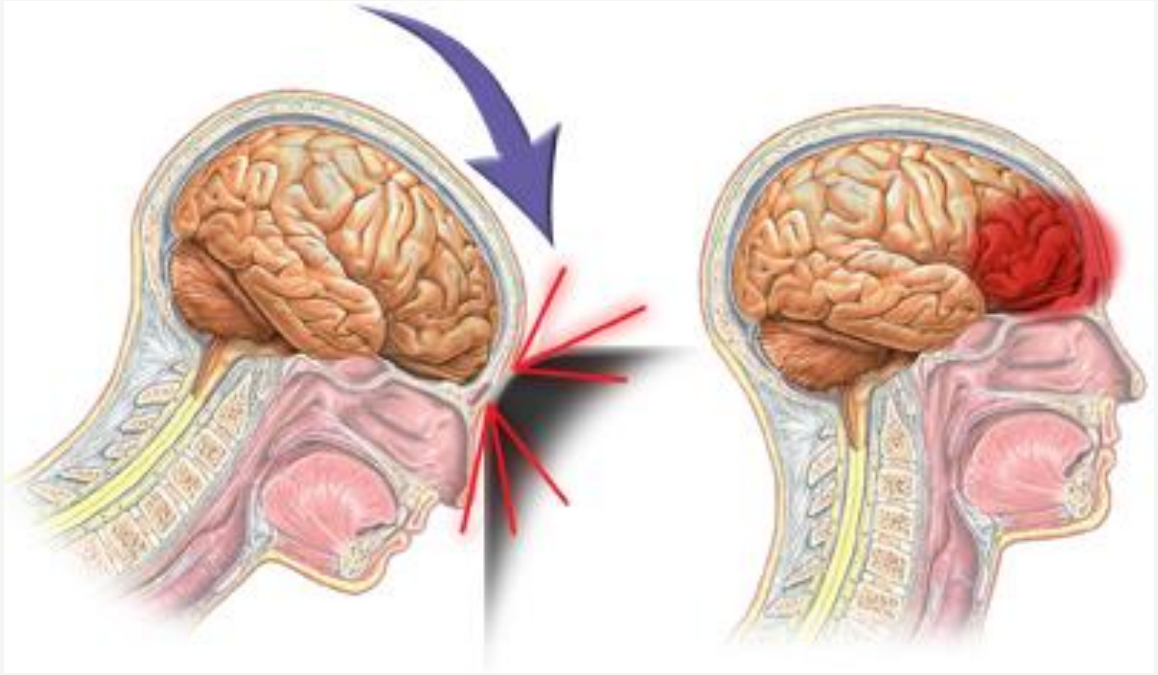
Mechanism of Injury

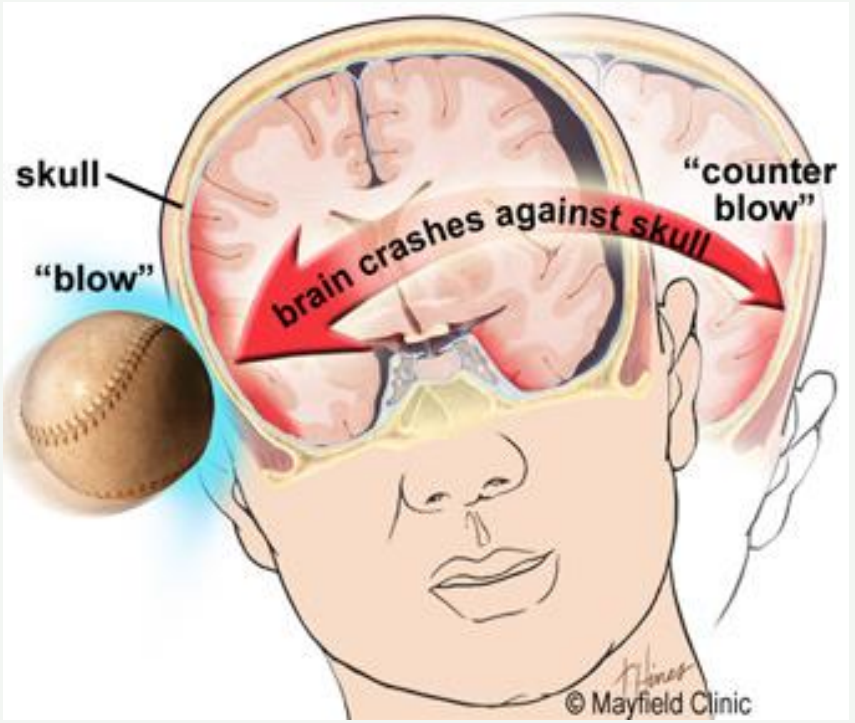




Post-Traumatic Headache

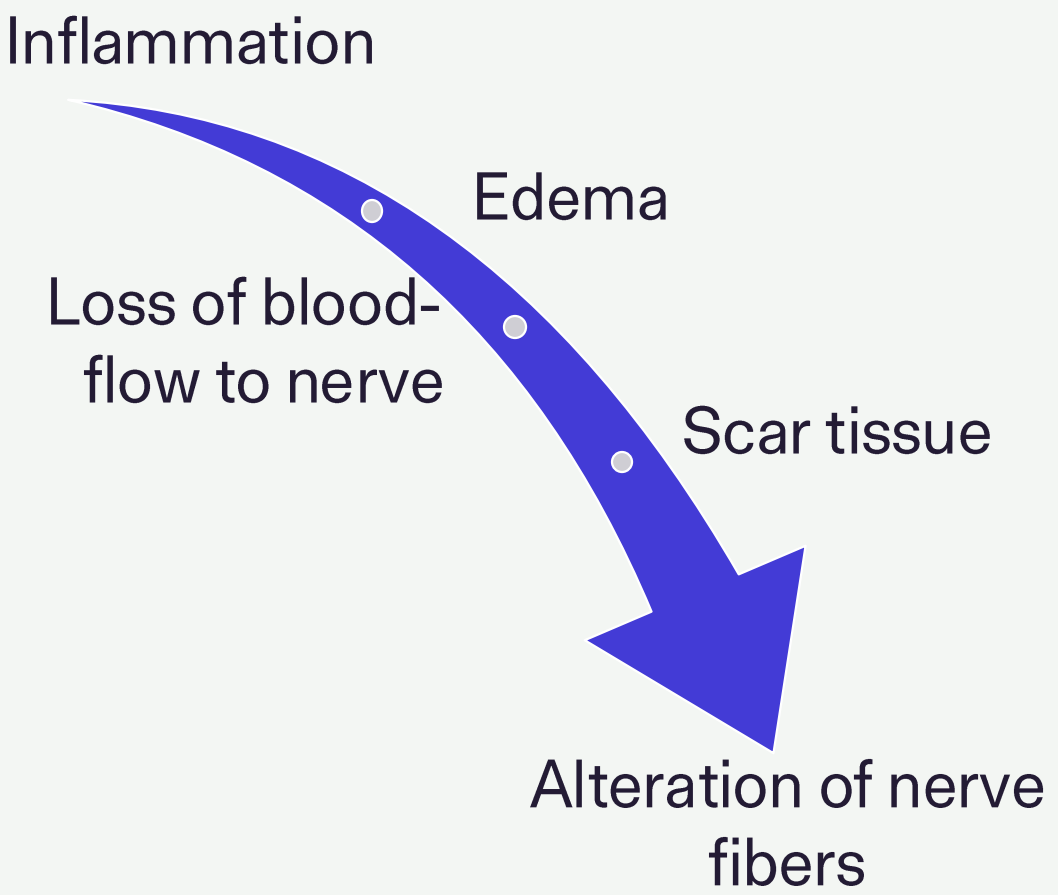
Mechanism of Injury





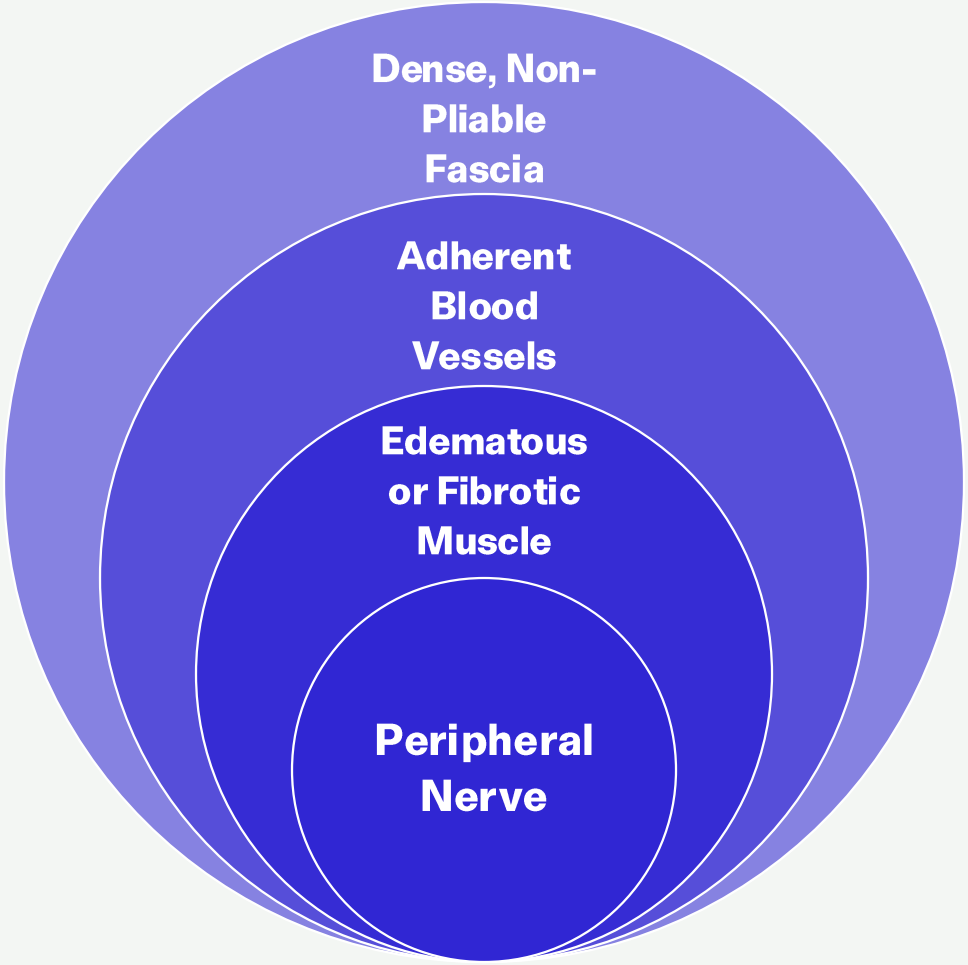
Head & Neck Trauma

Mechanism of Nerve Damage

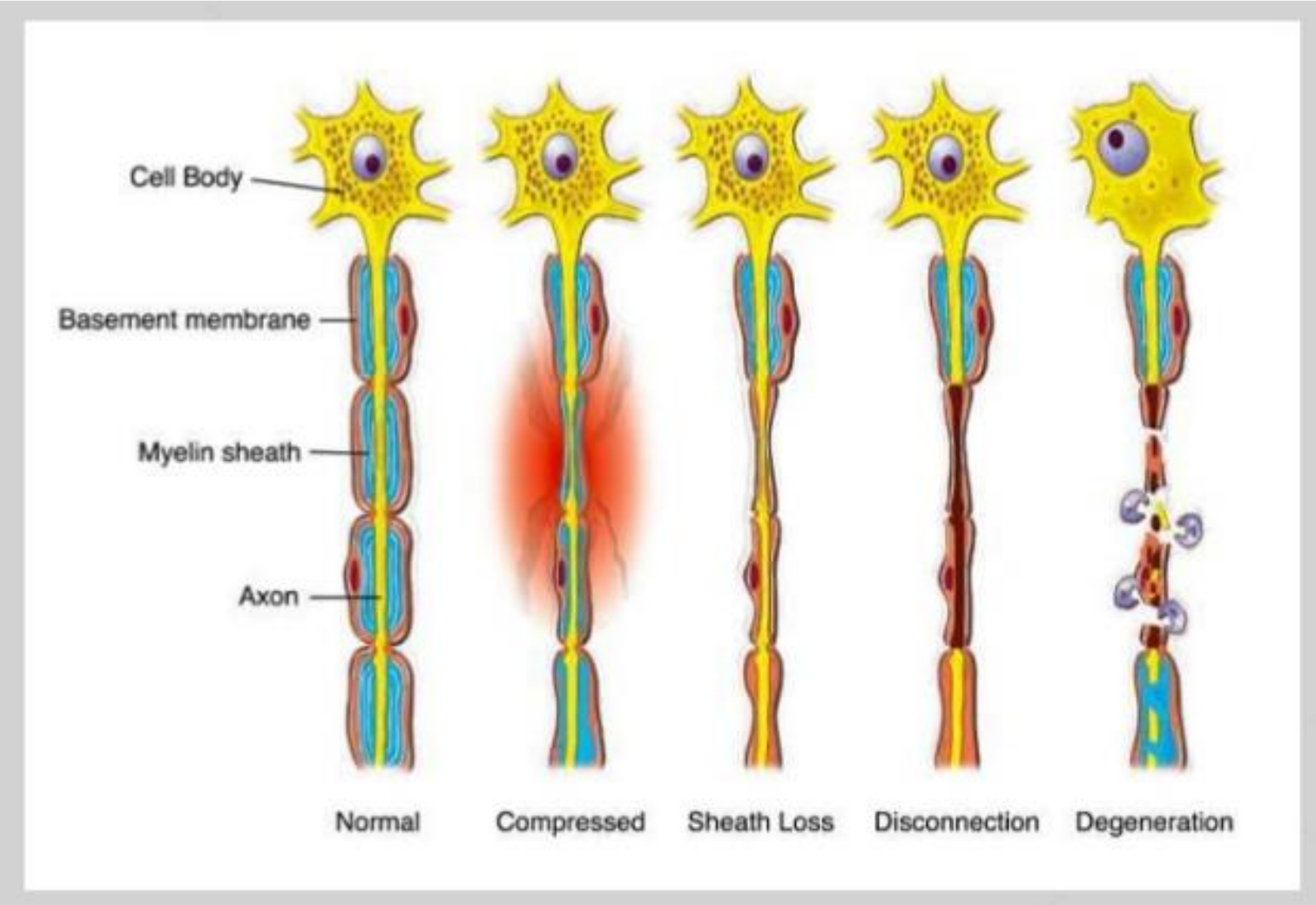


Head & Neck Trauma

Nerve Compression



Nerve Pathology



What is a Trigger Point?

Hyper-irritable in the head and neck in patients with migraines and other types of headaches, that correspond to points of peripheral nerve compression.

Occipital Neuralgia

Trigger Points

Greater and/or lesser occipital nerve trigger points are key findings to diagnose the condition

Other trigger points are often involved

- Temporal
- Supraorbital
- Post-auricular

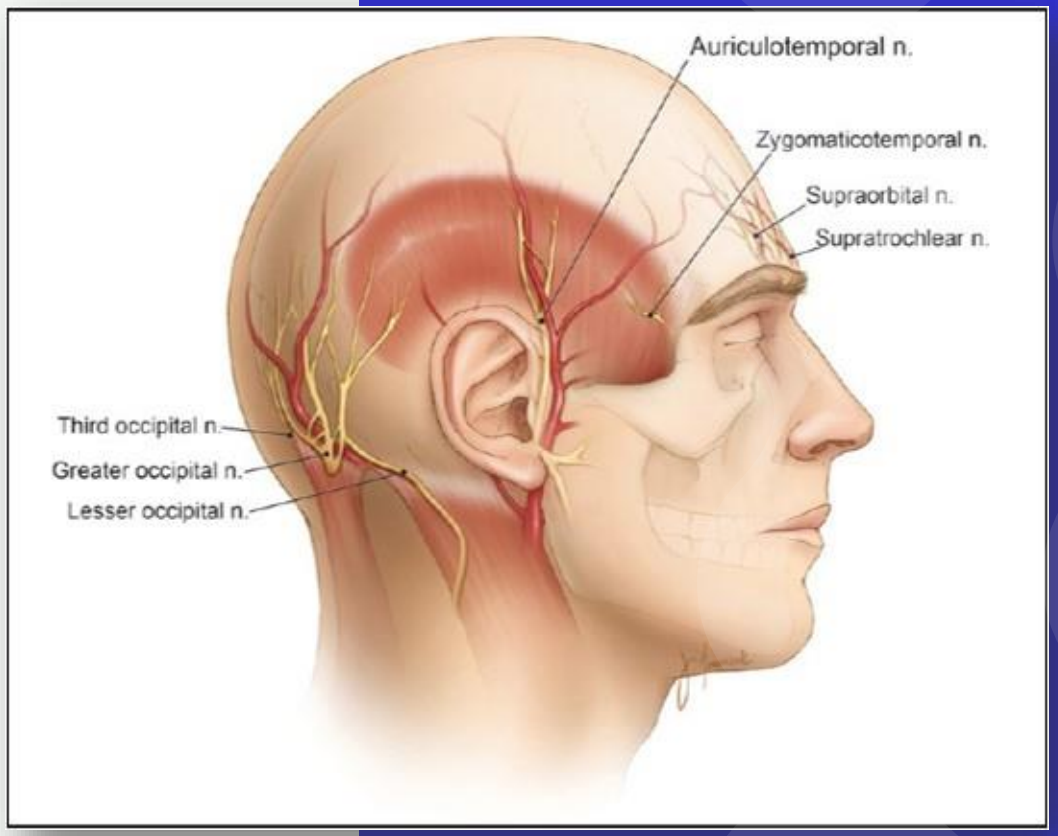
Temporal Trigger Points

Temporal Neuralgia & Migraine

→Common in migraine

→Associated with TMJ

→Often a vascular compression



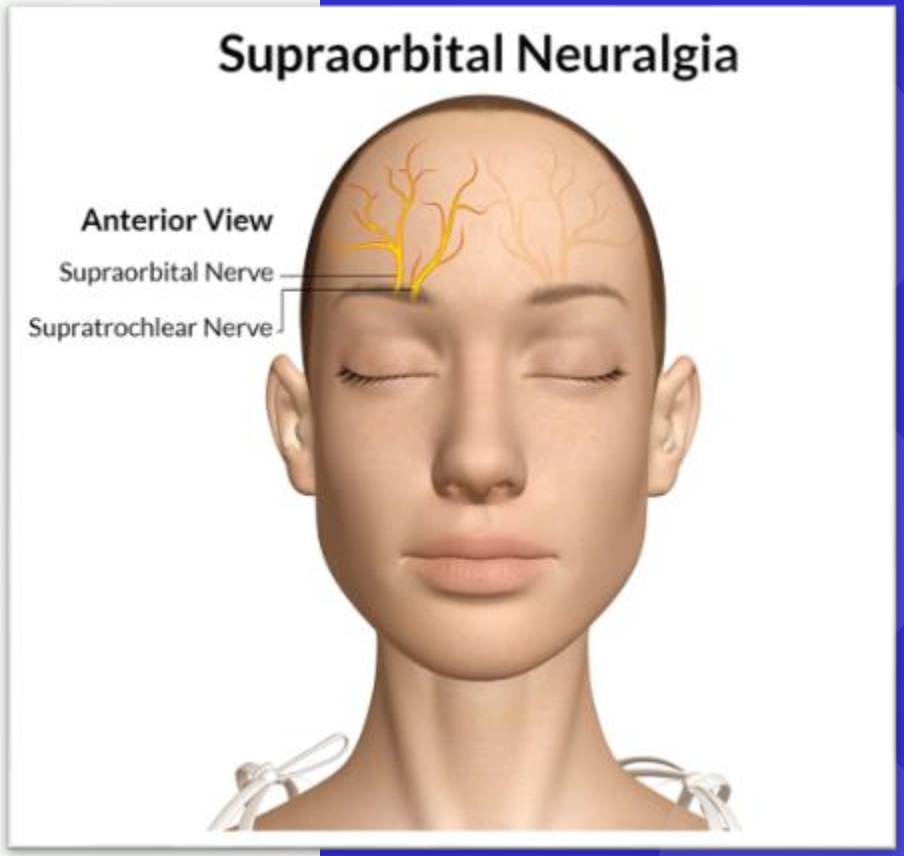
Supraorbital Trigger Points

Supraorbital Neuralgia & Migraine

→Brow/forehead pain

→Often unilateral

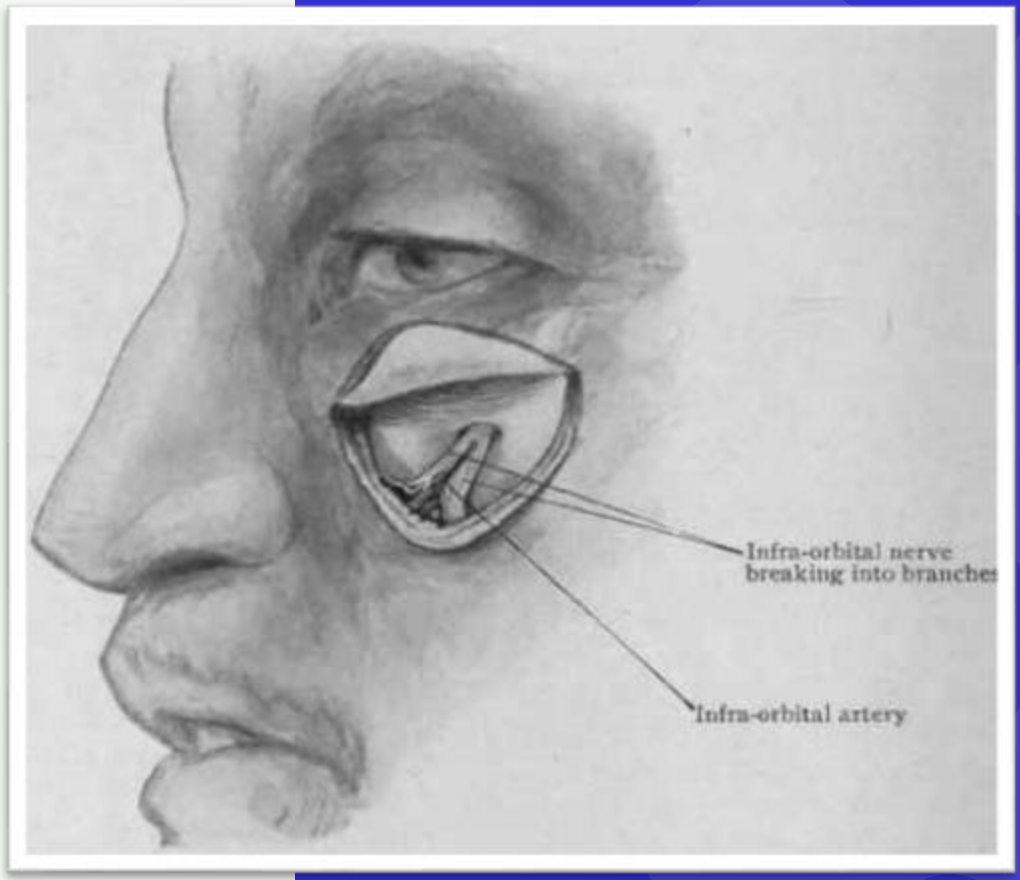
→Also common in migraine bilaterally



Infraorbital Trigger Points

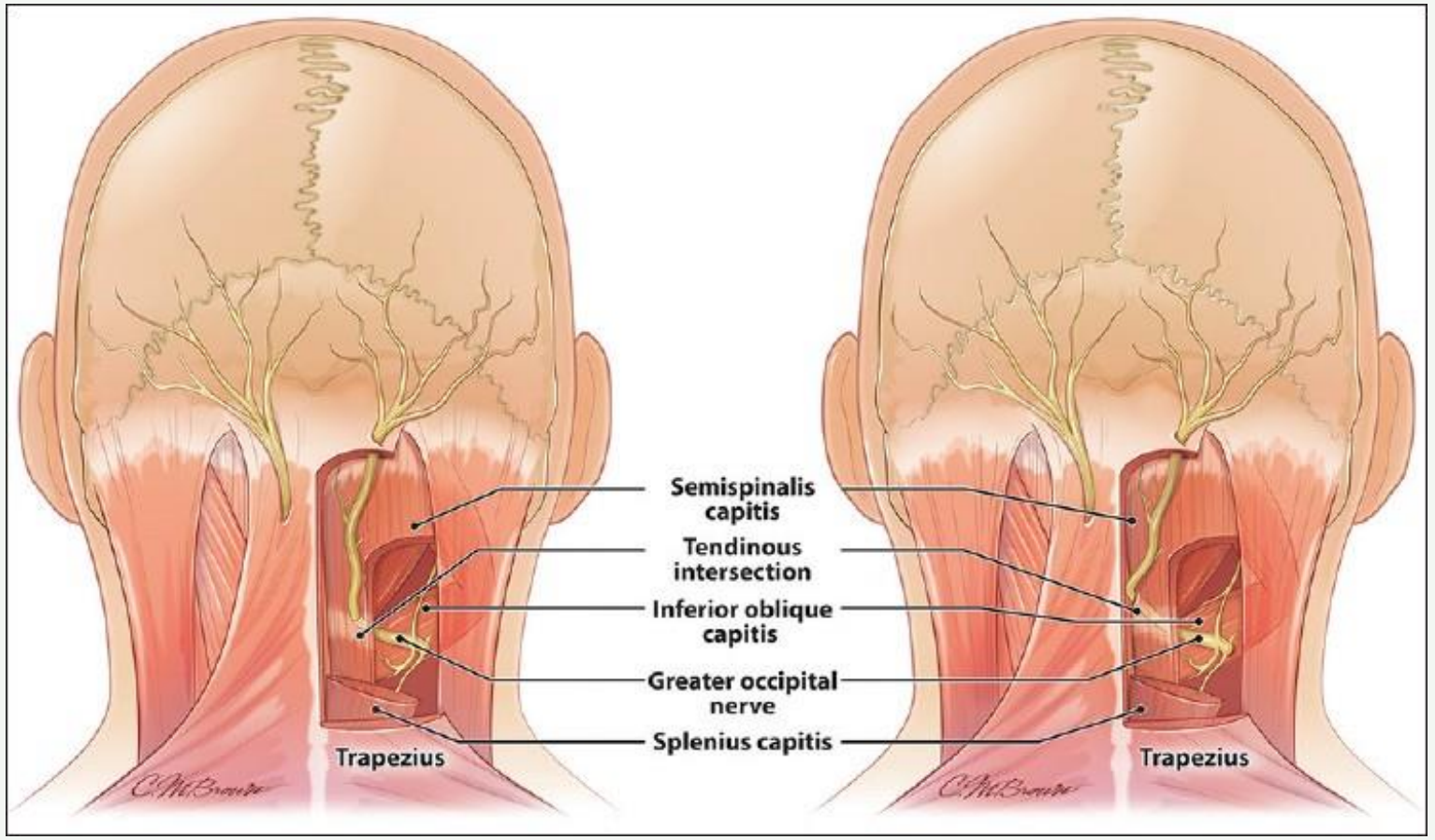
Trigeminal Neuralgia

- →Cheek/facial pain
- →Dental pain and numbness
- →Facial trauma
- →Associated with trigeminal neuralgia



Occipital Trigger Points

Occipital Neuralgia



Occipital Neuralgia

The International Headache Society defines occipital neuralgia as:

A paroxysmal jabbing pain in the distribution of the greater or lesser occipital nerves or of the third occipital nerve (nerves running up the back of the neck and head), sometimes accompanied by diminished sensation or dysesthesia (abnormal sensation) in the affected area. It is commonly associated with tenderness over the nerve concerned.

Occipital Neuralgia

OCCIPITAL NEURALGIA CAUSES SIMILAR PROBLEMS TO MIGRAINE HEADACHES BUT MAY RESPOND DIFFERENTLY TO CERTAIN FORMS OF TREATMENT

MIGRAINE

CAUSE
Unknown

PAIN DESCRIPTION

Moderate to severe pain
Throbbing/pulsing pain
Pain on one side of the head

OTHER SYMPTOMS

Nausea
Sensitivity to light & sound
Vomiting
Aura (seeing flickering lights, spots or lines)
Double or blurred vision

OCCIPTIAL NEURALGIA

CAUSE

Injury or irritation of the occipital nerves (peripheral nerves that run up the back of the head, providing sensation to this area) resulting from an accident/trauma or a pinched nerve (which can be due to conditions such as arthritis in the neck)

PAIN DESCRIPTION

Pain that starts at the base of the skull and goes to the scalp
Pain in both sides of the head
Pain behind the eye

OTHER SYMPTOMS

Pain when moving the neck
Sensitivity to light and sound

Occipital Neuralgia

Prevalence and Impact

- 1 in 6 report migraine or severe headache
- 3% of all ER visits (approx. 6 million)
- High disability rates and co-psychiatric diagnosis
- 25% of chief complaints at a community hospital-based headache clinic

Occipital Neuralgia

Pure vs. Mixed

Observations from our 20-year experience in evaluating hundreds of patients

Early post-trauma = Pure occipital neuralgia

Late post-trauma = Occipital neuralgia + Migraine

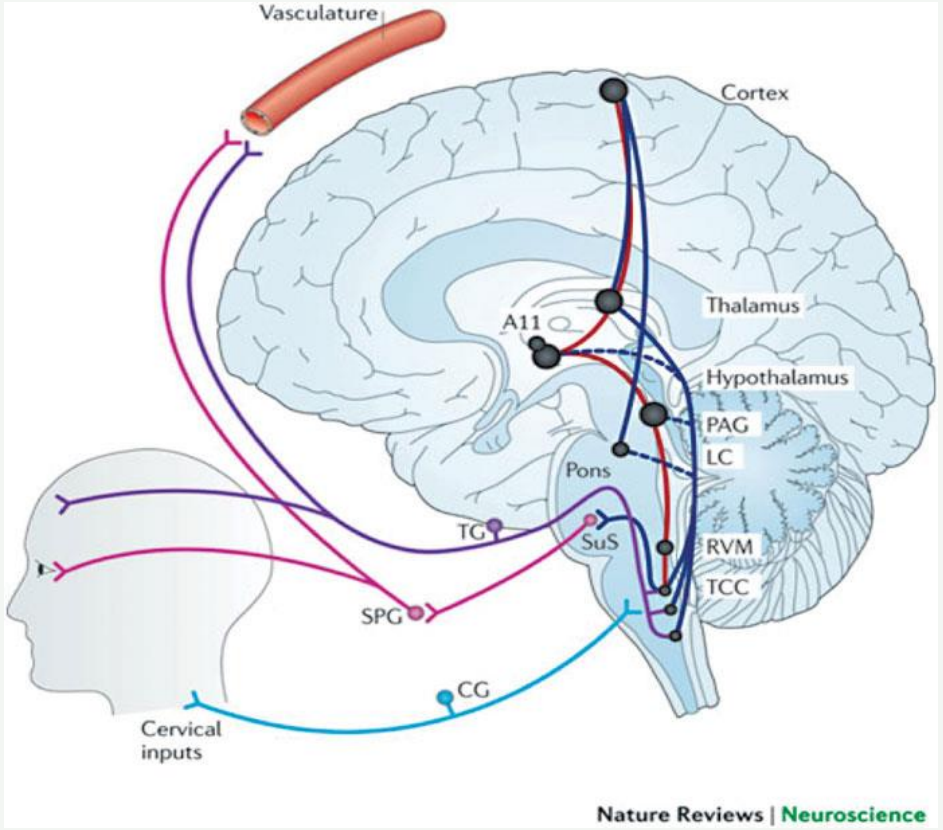
Early intervention is advantageous and more likely to “cure”

Occipital Neuralgia

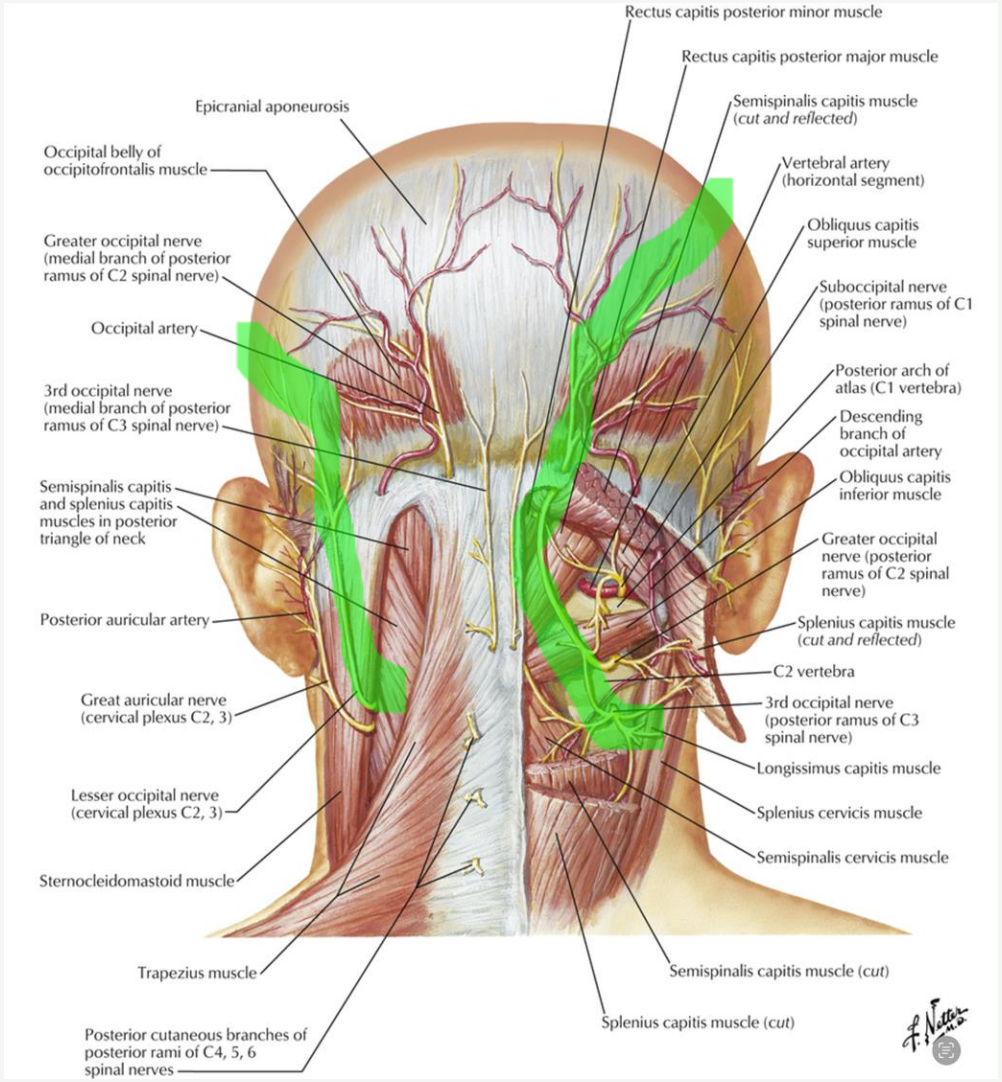
Pure vs. Mixed

HYPOTHESIS

Chronic, unresolved post-traumatic occipital neuralgia promotes inflammatory mediators in the neurovascular and cerebral systems, thus increasing susceptibility to migraines and other manifestations of headache



Occipital Neuralgia Anatomy



Occipital Neuralgia Symptoms

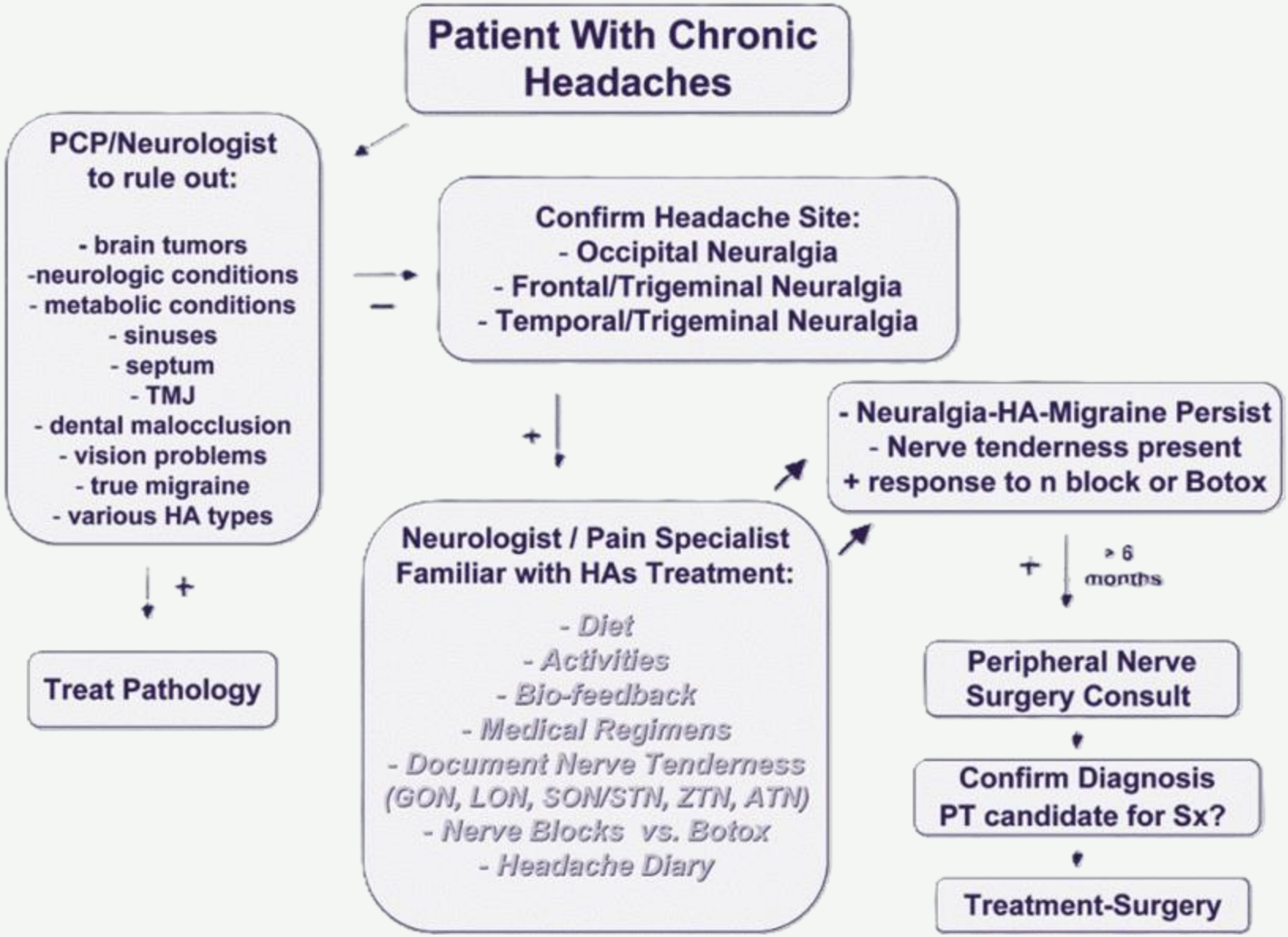
Pure Occipital Neuralgia

- Non-remitting nerve pain (intensity varies)
- Clearly identifiable trigger points
- Absence of pressure or “vice-like” feeling

Mixed Occipital Neuralgia + Migraine

- Constant jabbing nerve pain with varying intensity
- Episodic deep generalized pressure or “vice-like” feeling
- Nausea, aura, light sensitivity are common

Diagnosis & Treatment



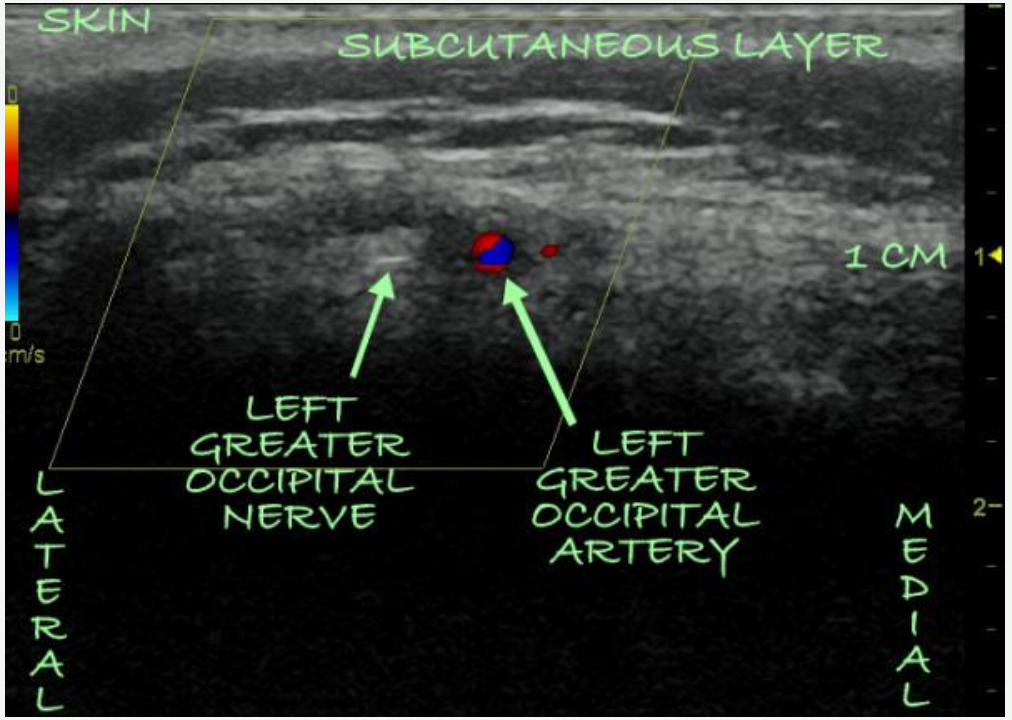
Occipital Neuralgia - Diagnosis

MRI Brain & Cervical Spine

- Eliminate possibility of brain tumor, and other intracranial pathology
- Evaluate for cervical disc disease, spinal cord compression (esp. C2-C3)
- MRI *cannot* identify occipital nerve compression
- In pure occipital neuralgia MRI evaluation should be normal

Occipital Neuralgia - Diagnosis

Headache Ultrasound (2016)

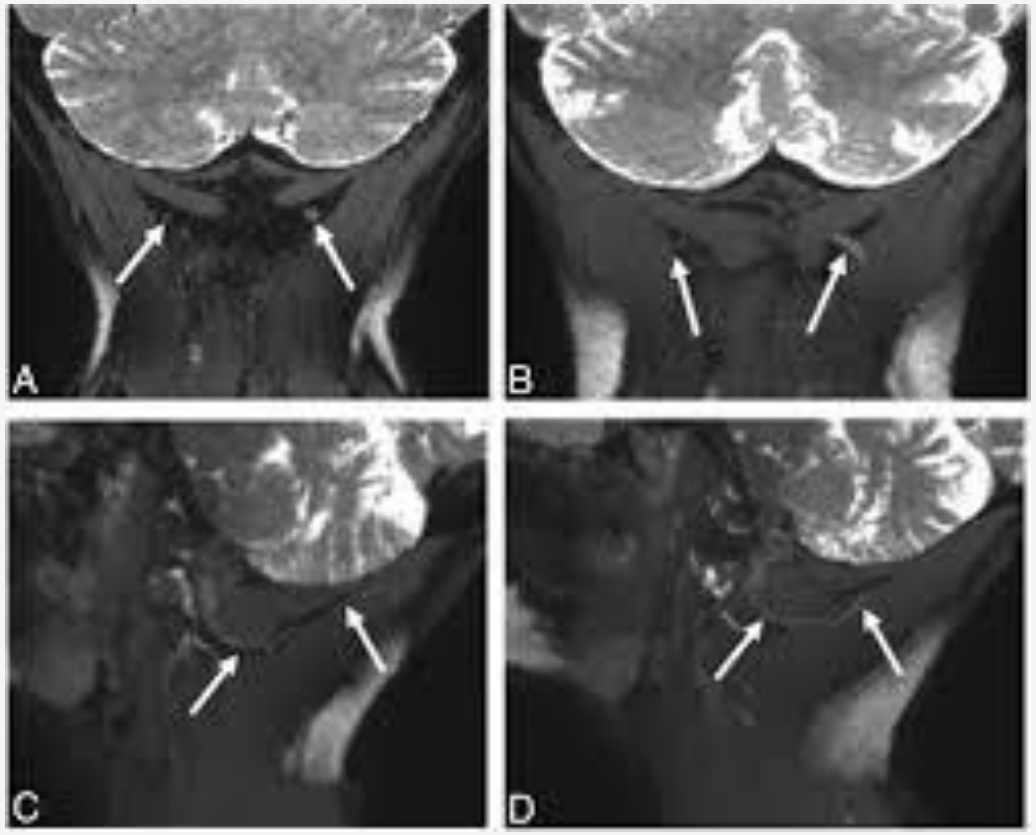


- Ultrasound can reliably distinguish normal from abnormal entrapped occipital nerves (both the level and causes for entrapment)
- Also promotes accurate location for nerve blocks

Occipital Neuralgia - Diagnosis

MR Neurography

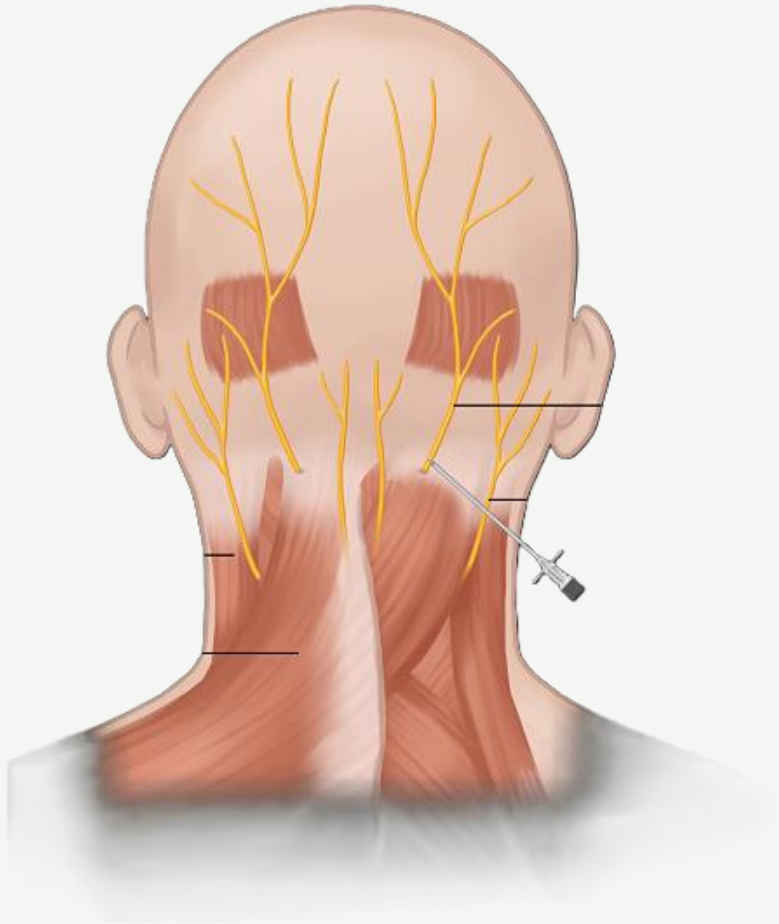
- Nerve selective imaging to evaluate peripheral nerve anatomy and pathology
- Am J Neurorad (2017)
  - 18 patients with unilateral occipital neuralgia
  - Nerve diameter and signal intensity greater on the involved side



Occipital Neuralgia - Diagnosis

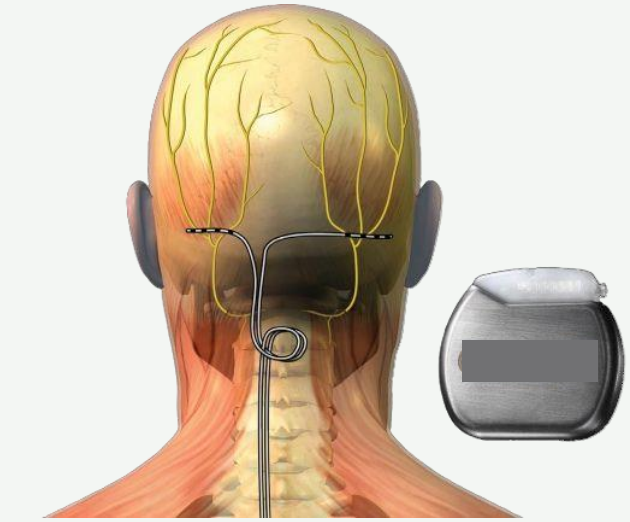
Diagnostic Trigger Point Blocks

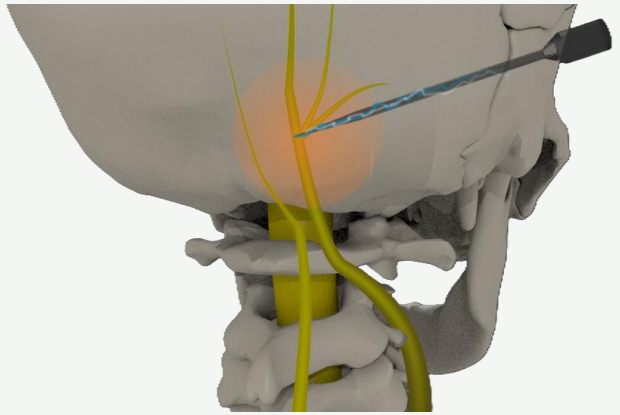
- Probably the most important preoperative diagnostic test
- A favorable response to office-based injection is often an indicator of surgical success
- Also provides temporary therapeutic benefit



Occipital Neuralgia – Treatment Options

- Pharmacologic therapy
- Trigger point injections
  - Local anesthetic +/- steroids
- Botulinum toxin injections
- Radiofrequency ablation
- Implantable nerve stimulator
- Occipital nerve decompression
- Alternative therapy
  - Acupuncture
  - Myofascial release





Occipital Neuralgia

Current Treatment Dilemmas

- Effects of long-term pharmacologic therapy
  - Dependence/abuse, side effects, polypharmacy, tolerance, alteration of pain thresholds
- Multiple healthcare professionals involved without coordinated care
- Skepticism of each provider regarding counterparts' treatment plan
- Certain effective treatments not considered a covered service by some insurance carriers

Occipital Neuralgia

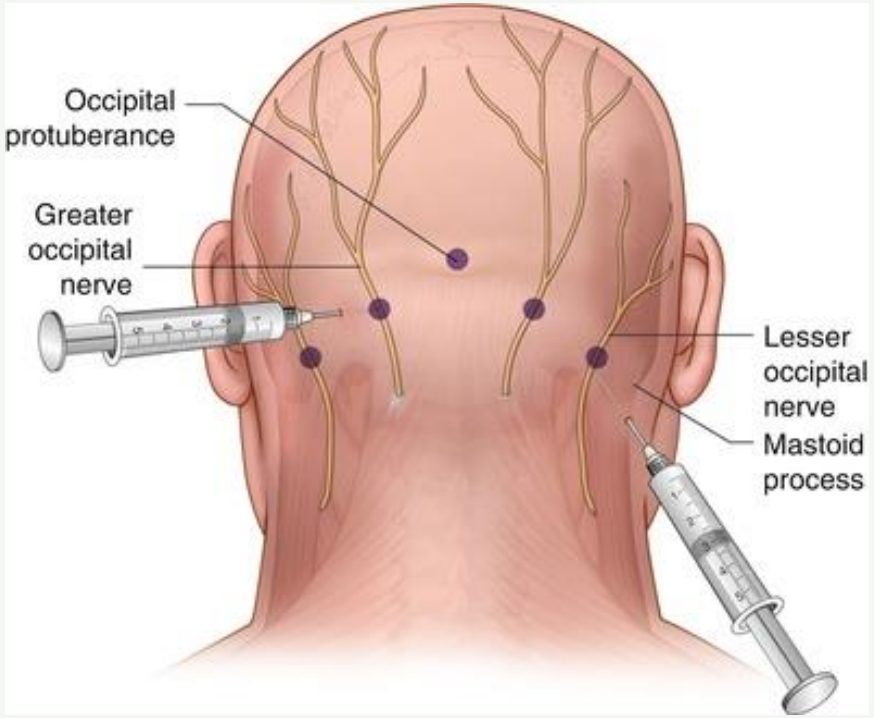
Medical Professionals Treating Occipital Neuralgia

- PCP (Internist/Family Medicine)
- Neurologist
- Pain Management
- Sports Medicine
- Physiatrist
- Physical Therapist
- Acupuncturist
- **Peripheral Nerve Surgeon**

Occipital Neuralgia

Trigger Point Injections aka Occipital Nerve Blocks

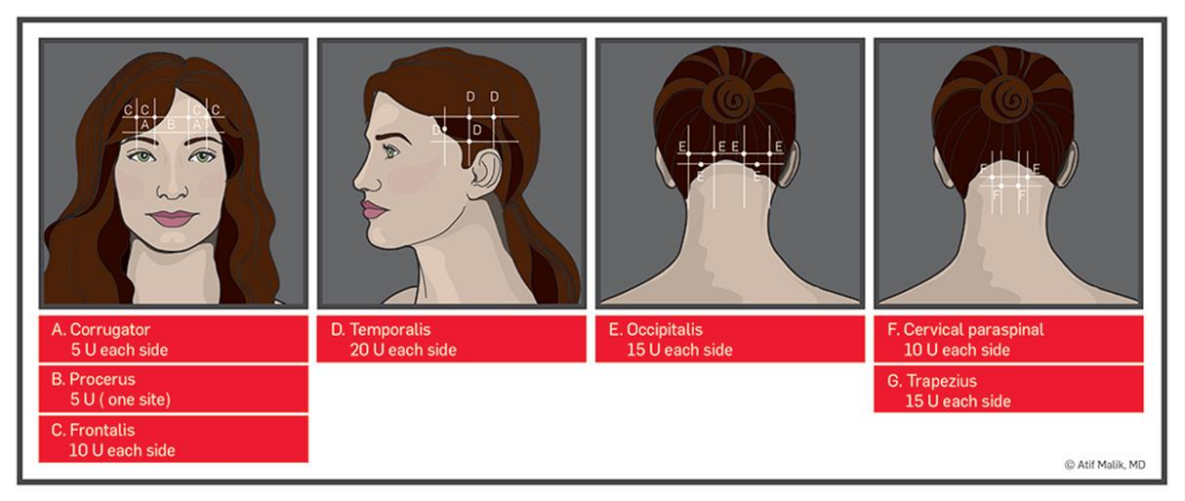
- Office based procedure
- Local anesthesia +/- steroid
- Onset: within minutes
- Duration: variable (days to a few weeks)



Occipital Neuralgia

Botulinum Toxin

- FDA approved in 2010 for migraine headaches
- A preventative treatment:
  - Onset: 5-7 days
  - Duration: 3-4 months
- Criteria for many insurance carriers
  - >14 days/month, >4 hours per episode

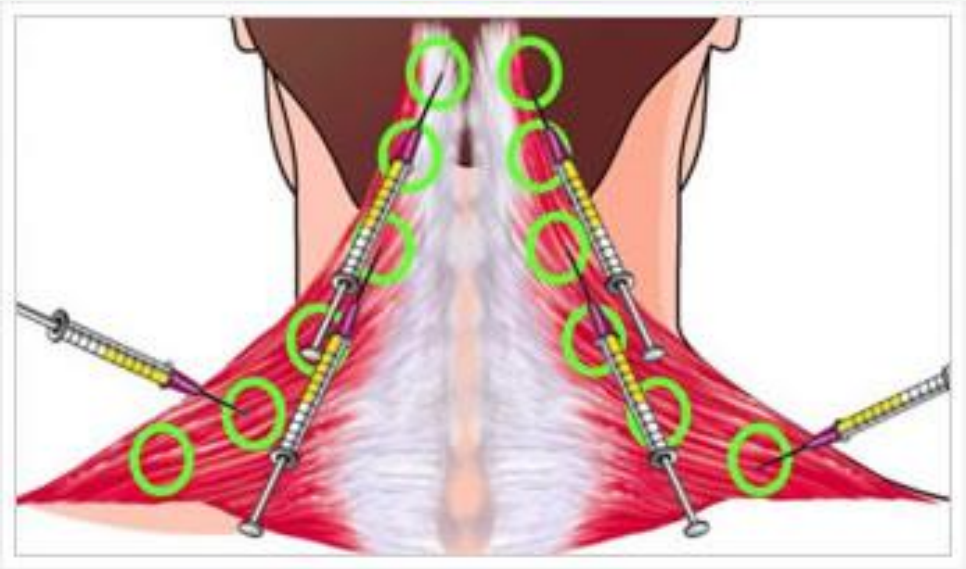


Occipital Neuralgia

Botulinum Toxin

Proposed mechanism of benefit

- Relaxes muscles around the nerves in the head and neck that may act as triggers
- Reduces concentration of inflammatory chemicals



Trigger Point & Botox Injections

- Botulinum toxin injections often provide better lasting results than medication for patients with occipital neuralgia
- Patients who have success with trigger point injections, and/or Botox, may continue with surgery as an intended permanent way of reducing or eliminating their pain
- Post-traumatic occipital neuralgia patients tend to respond well to injection therapy and nerve decompression surgery
    - Occipital neuralgia is primarily due to “nerve trigger points” as opposed to migraines, in which the underlying problem may be due to a combination of factors

Occipital Nerve Decompression Surgery

Criteria associated with most successful surgical outcomes

1. History of trauma
2. Absence of abnormality on MRI C-spine/brain
3. Favorable response to trigger point block and/or Botox
4. Pure occipital neuralgia symptoms versus mixed with migraine
5. No narcotic abuse/dependence or polypharmacy

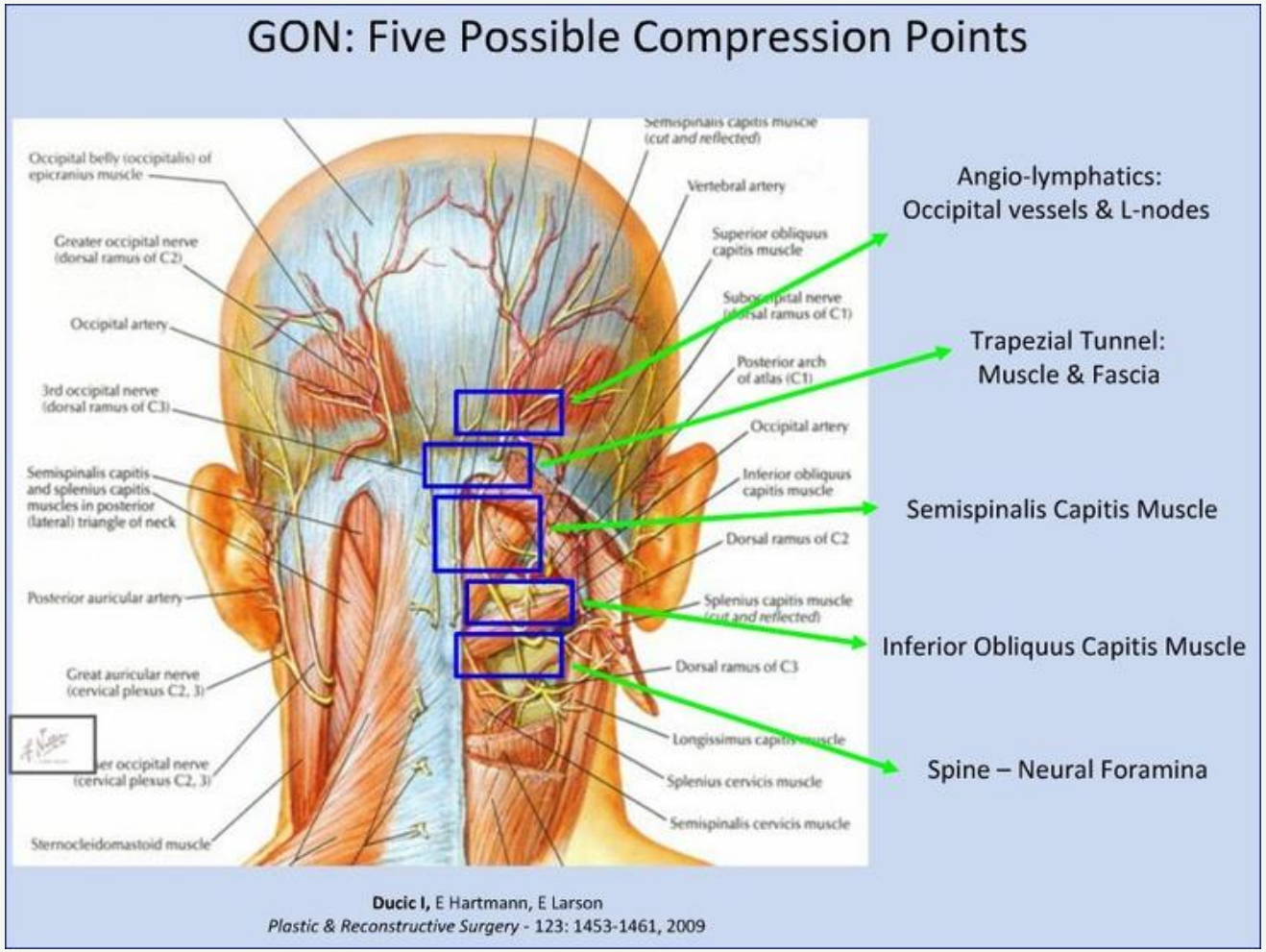
Occipital Neuralgia

Occipital Nerve Decompression Surgery

- A procedure aimed at alleviating nerve impingement at “trigger points,” localized sites in the head and neck that correspond to headache symptoms.
- Major nerves are decompressed and preserved, while small nerves of lesser importance are removed.
- Preserved nerves are “protected” from future impingement by wrapping in fat or using collagen nerve tube protectors.

Occipital Neuralgia

Occipital Nerve Decompression Surgery

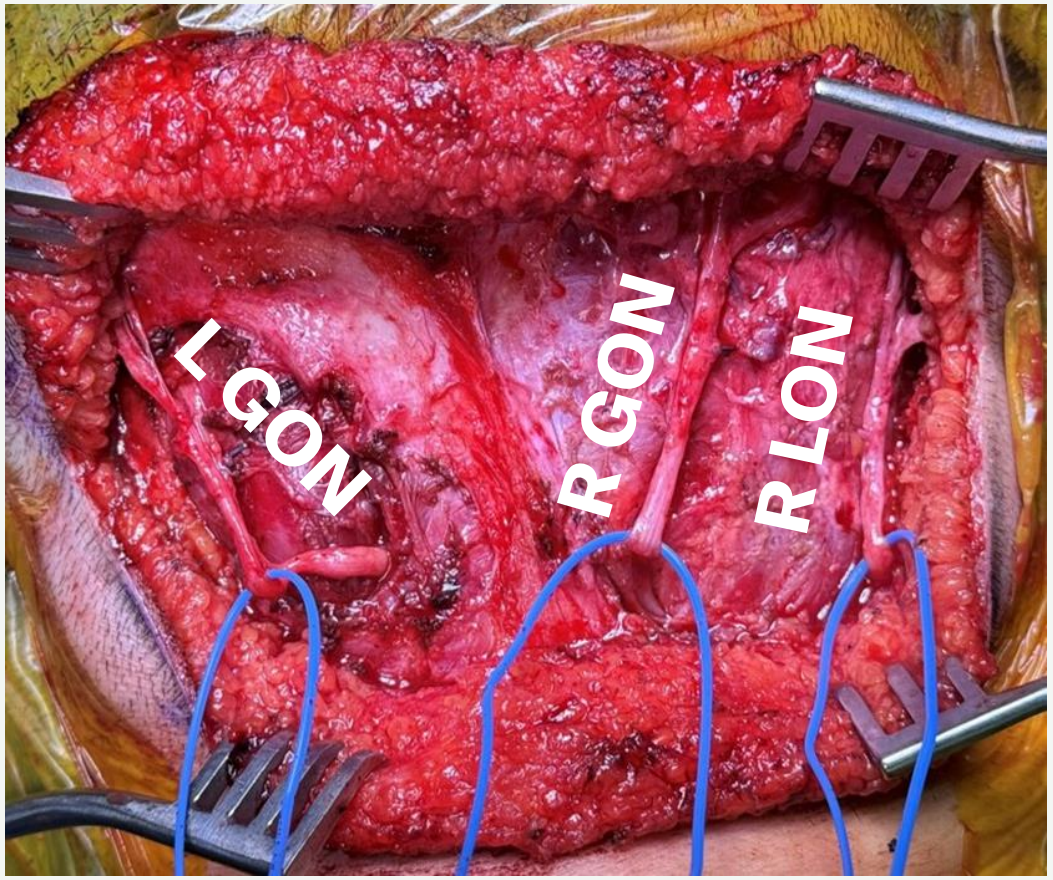


Occipital Neuralgia

Occipital Nerve Decompression Surgery

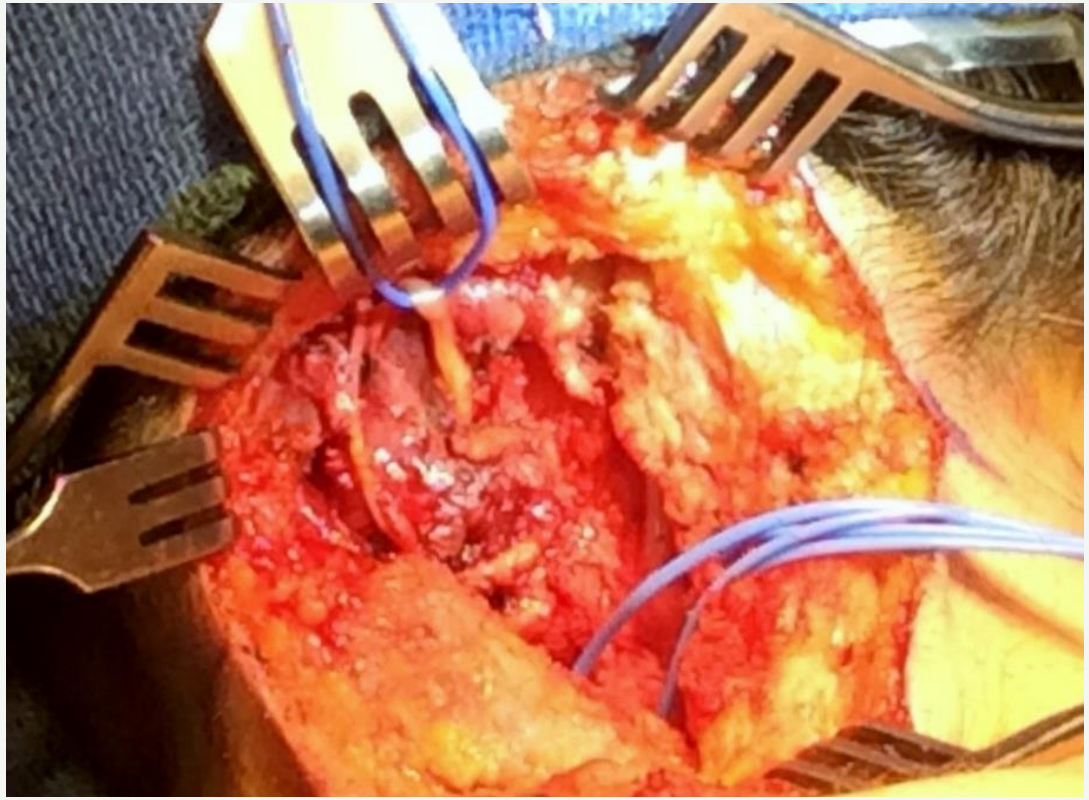
- Outpatient procedure
- General Anesthesia
- 2-5 hours
- Minimally invasive
- 1-2 week recovery
- Low risk (i.e. no risk of paralysis)
- Improvements often recognized early

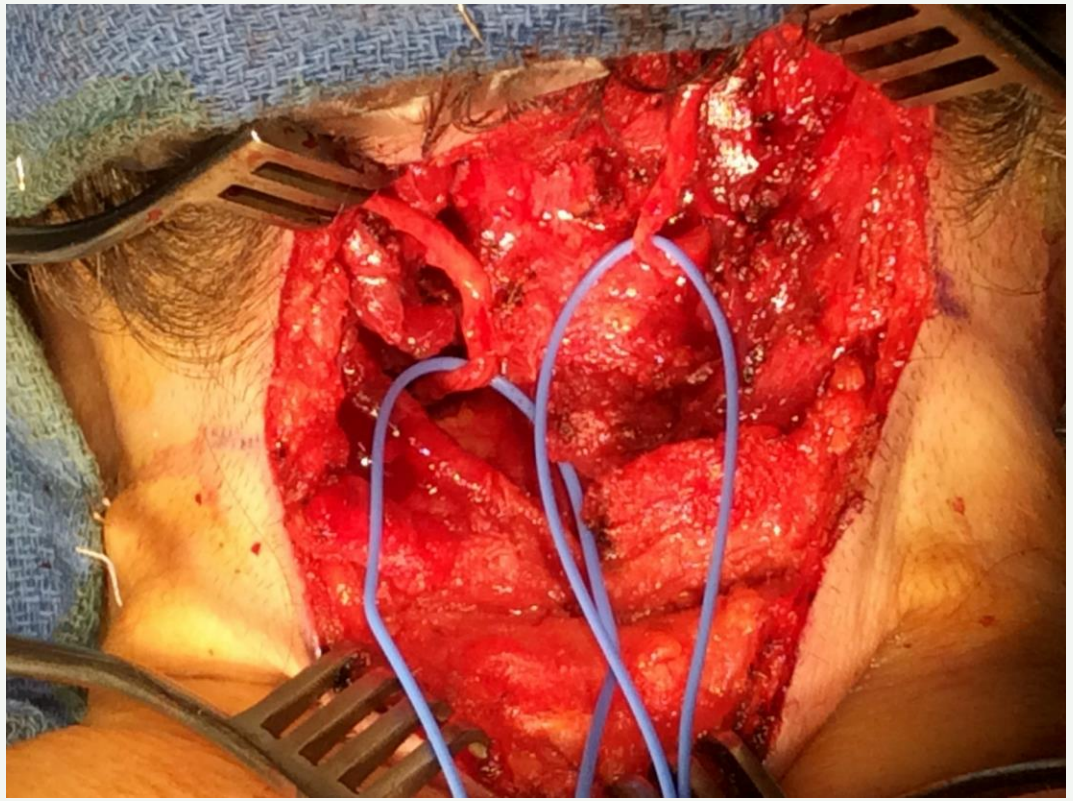
Occipital Nerve Decompression Surgery



Occipital Nerve Decompression Surgery

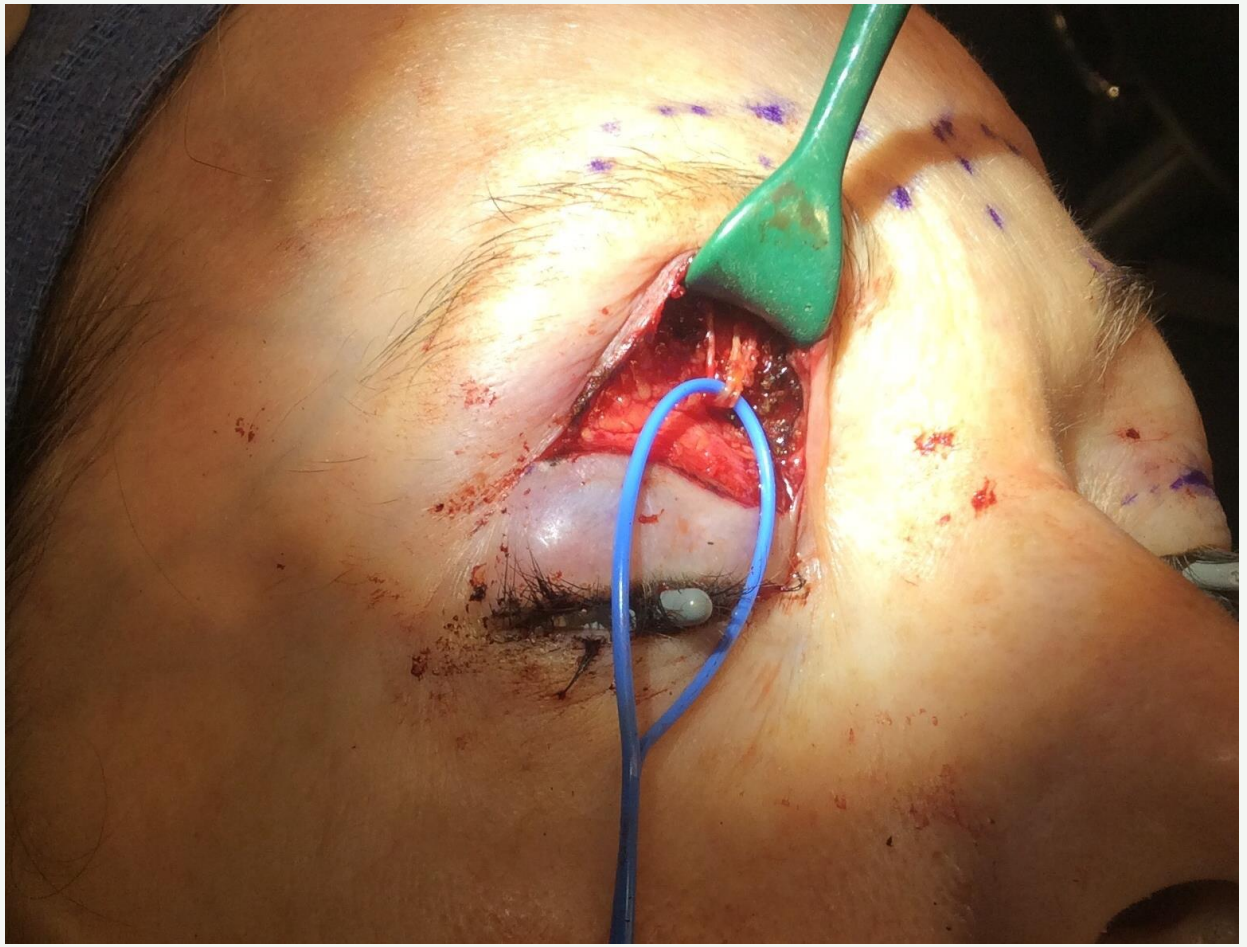
Post-Traumatic Occipital Neuralgia





Nerve Decompression Surgery

Post-Traumatic Headache (Supraorbital Trigger Point)



Occipital Nerve Decompression Surgery

Evidence-based Outcomes

- Ducic et al. 2014

  Systematic Review of Peripheral Nerve Interventional Treatments for Chronic Headaches

Treatment	# of Articles	Total Patients	Average Success Rate
Nerve Decompression Surgery	14	1,253	86%
Peripheral Nerve Stimulation	9	184	68%
Radiofrequency	3	131	55%

Nerve decompression has the highest reported success rate and has been the best-studied modality out of the three interventional peripheral nerve treatments included in this study

Occipital Nerve Decompression Surgery

Evidence-based Outcomes

- Faber et al. 2012
  - –Surgery is an effective and cost-effective treatment option for migraine headaches
  - –Surgical treatment reduces direct and indirect migraine costs
    - •Medication: $1997/per patient/annually
    - •Alternative treatments: $450/per patient/annually
    - •3 fewer PCP visits
    - •8.5 fewer missed work days

Total median cost reduction = $3950/per patient/annually

Occipital Nerve Decompression Surgery

Our Experience

- Innovative treatment offered for 20 years
- Amongst the 10 centers with the greatest experience in the U.S.
- Presented findings at the largest U.S. headache society meeting
  - 2016 Annual American Headache Society Meeting
  - >80% improvement in post-traumatic occipital neuralgia
  - 15% of patients are “cured”
- 2025 Presentation at The American Society of Plastic Surgery

Case Study 1

Post-Traumatic Occipital Neuralgia

- 33 year-old male
- 5 yrs s/p construction site accident
  - “Whiplash” injury from a fall
  - Two prior cervical laminectomies
  - Multiple epidurals
  - Chronic, disabling posterior headache pain
  - Chronic analgesic use
  - Unable to work or drive
- Diagnosis
  - Occipital Neuralgia

Case Study 1

Post-Traumatic Occipital Neuralgia

Diagnosis

Repeat MRI C-spine

- No residual C-spine issues

Trigger Point Injections

- (+) response to injections

Treatment

Nerve Decompression Surgery

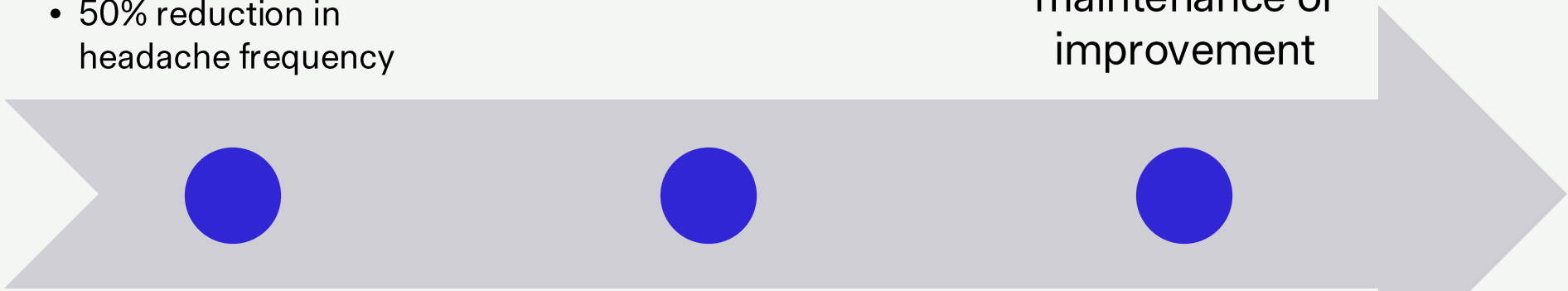
- Greater Occipital, Lesser Occiptial nerves
- Outpatient procedure
- IV Sedation + Local anesthesia
- 1 hour

Case Study 1

Post-Traumatic Occipital Neuralgia

2 Month Follow-up

- Weaned off chronic analgesics
- Started driving again
- 40% reduction in pain intensity
- 50% reduction in headache frequency



6 Month Follow-up

- Returned to work

Long term maintenance of improvement

Case Study 2

Post-Traumatic Occipital Neuralgia

- 19 year-old female
- “A 2-year headache!”
  - Began immediately following head injury
  - Cheerleading accident
- Refractory to medical therapy
- Unable to attend school full-time
- Responsive to diagnostic lidocaine trigger point injections
  - Occipital and supraorbital trigger points

Case Study 2

Post-Traumatic Occipital Neuralgia

Diagnosis

MRI
- No abnormalities

Trigger Point Injections
- (+) response to lidocaine trigger point injections
- Occipital & supraorbital trigger points

Treatment

Nerve Decompression Surgery
- Occipital & supraorbital trigger points

Case Study 2

Post-Traumatic Occipital Neuralgia

- 100% Relief
- No subsequent headaches to date
- Requires no medical therapy
- Coaching cheerleading full time

Case Study 3

Post-Traumatic Occipital Neuralgia

- 28 year-old female
- Headache began after head injury
  - MVA 5 years prior
- Limited response to medical and injectable therapy
- Great difficulty maintaining full-time work

Case Study 3

Post-Traumatic Occipital Neuralgia

Diagnosis

MRI

- No abnormalities

Trigger Point Injections

- Limited response

Treatment

Nerve Decompression Surgery

Case Study 3

Post-Traumatic Occipital Neuralgia

- 6 months to wean off medical therapy
- Dramatic improvement with minimal residual headache
- Long term follow up with maintenance of results
- Returned to work full-time
- Currently pregnant with first child

Patient Testimonial: Post-Traumatic Occipital Neuralgia

Occipital Neuralgia

Occipital Nerve Decompression Surgery

Key Takeaways

1

With proper patient selection nerve decompression surgery can be extremely effective for occipital neuralgia

2

It is often to the patient's detriment to delay surgery referral until all other treatment options have been exhausted [Consider referring early (6-12 months) in the process]

3

Even partial success after surgery can restore one's functional status and reduce disability scores

Pelvic Pain

Hakan Usal, MD

The Institute
for Advanced Reconstruction

THE CHALLENGE

Nerve disorders as a cause of pelvic pain are likely under-diagnosed, leading to failed treatment efforts and frustration for both the patient and provider.

Pelvic Pain

Myriad Etiologies

- Gynecological causes
- Urological causes
- Tumors
- Hip
- Sacroiliitis
- Infectious

- Hernias
- Colorectal
- Lumbar Disc Disease
- Nerve Injury or entrapment
- Psychological causes
- Interstitial Cystitis

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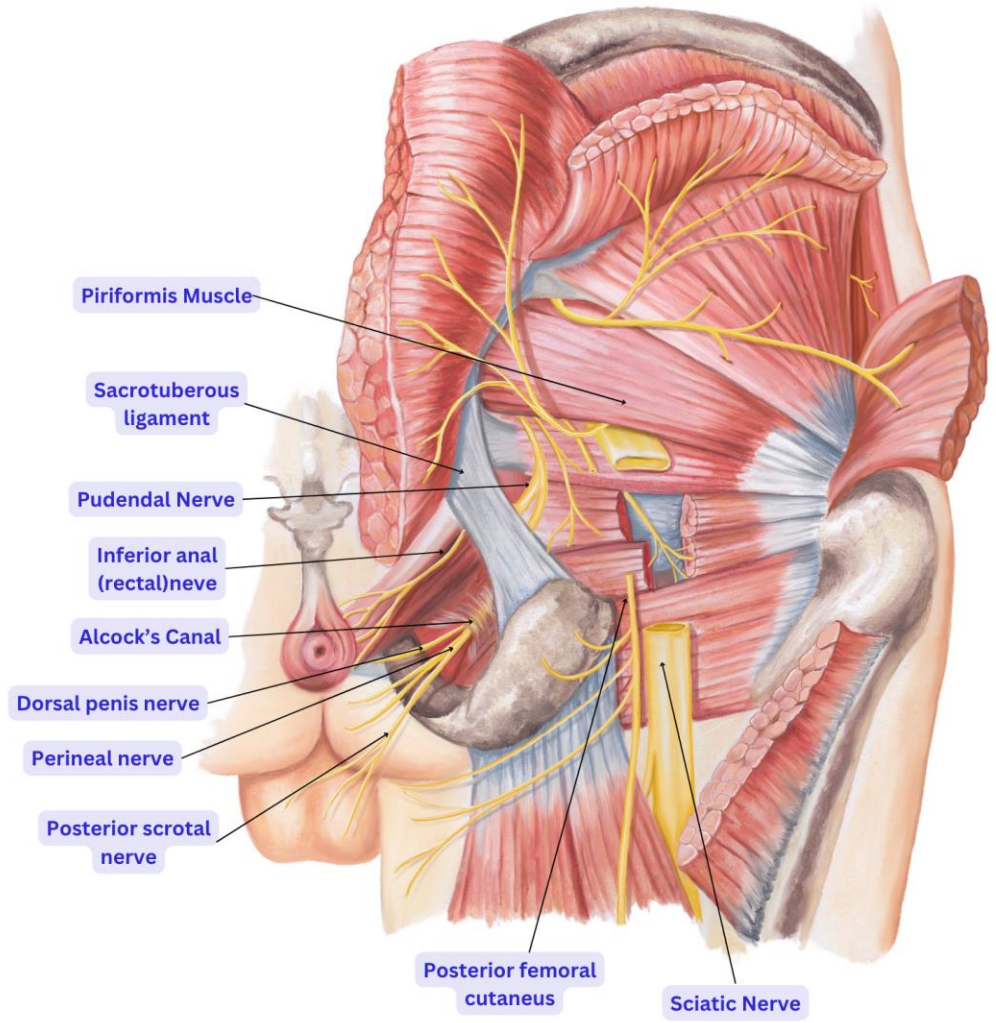
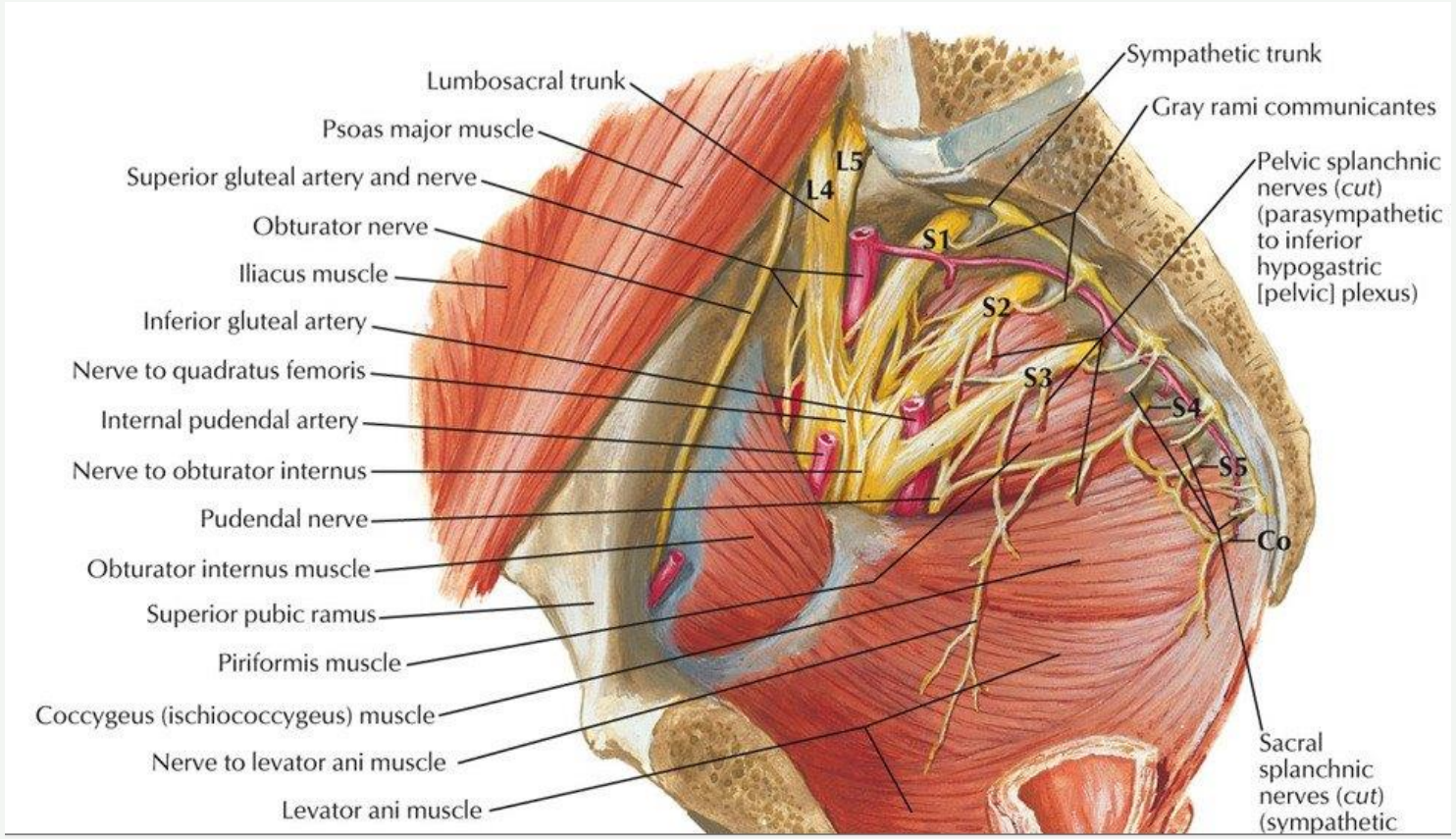
Pelvic Outlet Syndrome



Pudendal Nerve Anatomy

- **S2 – S4**
- **Motor (20%)**
- **Sensory (50%)**
- **Autonomic (30%)**



Pelvic Pain

Pudendal Neuralgia

History (Risk factors):

- Cycling & weightlifting (squats)
- Peri-anal abscess
- Fall
- Surgery (pelvic, urogynecologic, colorectal)

Pelvic Pain

Pudendal Neuralgia

Symptoms:

- Pain with sitting (“golf ball sign”)
- Pain or numbness in the clitoris, vagina, penis, perineum, or anus
- Urinary symptoms
- Uncomfortable arousal
- Constipation
- Childbirth

Symptoms & Diagnosis

- **Pain or numbness in the perianal, perineal, labial/scrotal, or clitoral/glans**
- **Pain with defecation**
- **Dysuria**
- **Sit pain**
- **“Golf ball” sign**
- **Sexual dysfunction / ED / PGAD**
- **Painful orgasm or arousal**

Essential criteria
Pain in pudendal nerve territory
Pain predominantly experienced while sitting
Pain does not wake patient at night
Pain with no objective sensory impairment
Pain relieved by diagnostic pudendal nerve block
Complementary diagnostic criteria
Burning, shooting, stabbing pain, numbness
Allodynia or hyperpathia
Rectal or vaginal foreign body sensation
Worsening of pain during the day
Predominantly unilateral pain
Pain triggered by defecation
Presence of tenderness on palpation of the ischial spine

Pudendal Neuralgia

1

Extensive testing is required to rule out other possible conditions.

2

- Typical PN symptoms
- An abnormal electrophysiological test (MRI, MRN)

3

- Pain elicited upon pressing along the anatomy of the nerve
- Elimination of other diseases or conditions as the cause
- A positive response to the pudendal nerve block

Pudendal Neuralgia

Conservative Treatments

01

Physical Therapy

02

Neuromodulators

Gabapentin, TCAs etc

03

Image Guided Steroid Injection or Block

Pudendal Neuralgia

Our Protocol

Pre-procedure Workup

- Physical Therapy for 3-6 months prior to surgery
- MRI lumbar spine – r/o hernia stenosis
- MRI pelvis or neurography if prior surgery or trauma
- Urology or gynecology clearance

Treatment Steps

- If criteria met -> image-guided steroid block
- Acute patients – series of 3 blocks
- Chronic patients – less likely to have positive response from blocks – surgery is less effective the longer symptoms persist


Cascade Surgical Studio
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ES-IX 1 : L1
Output:
L1
Polarity:
Normal
Biphasic:
Pulse Count:
1
Pulse Width (µs):
350
Sweep (ms/Div):
5
Delay (Div):
0
Reject HiZ:
L MEP
AS
L GAS
100 µV/Div 200 ms/Div
100 µV/Div 5 ms/Div
Store Buffer
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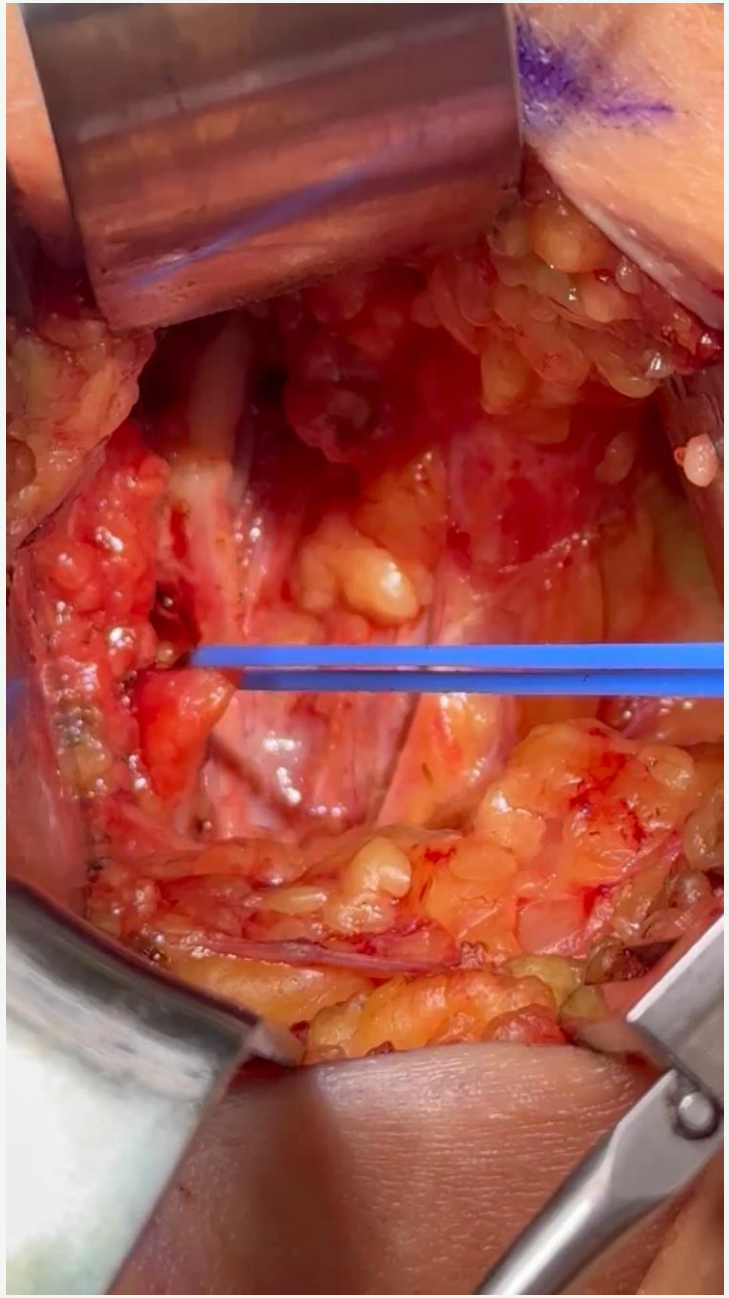
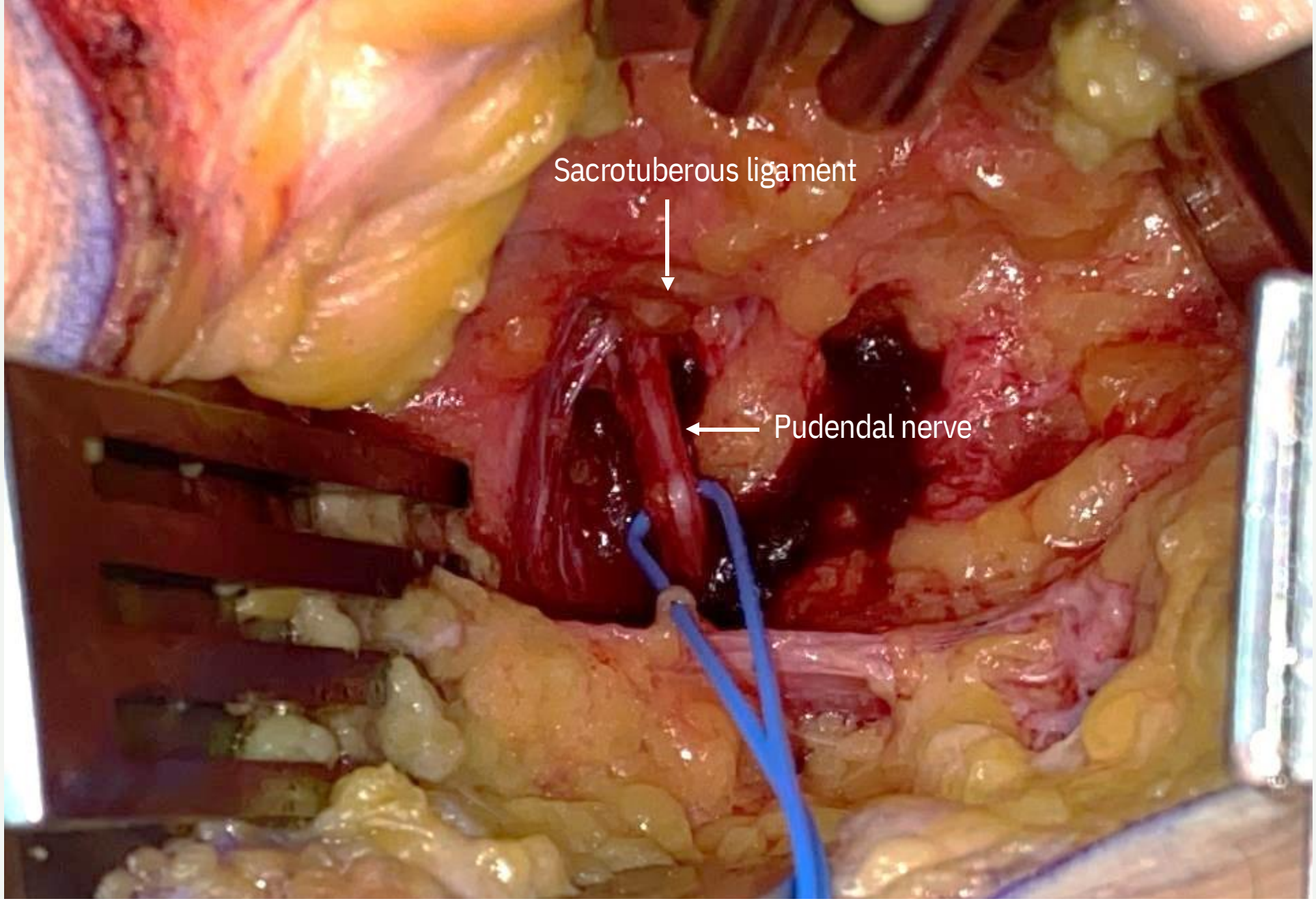
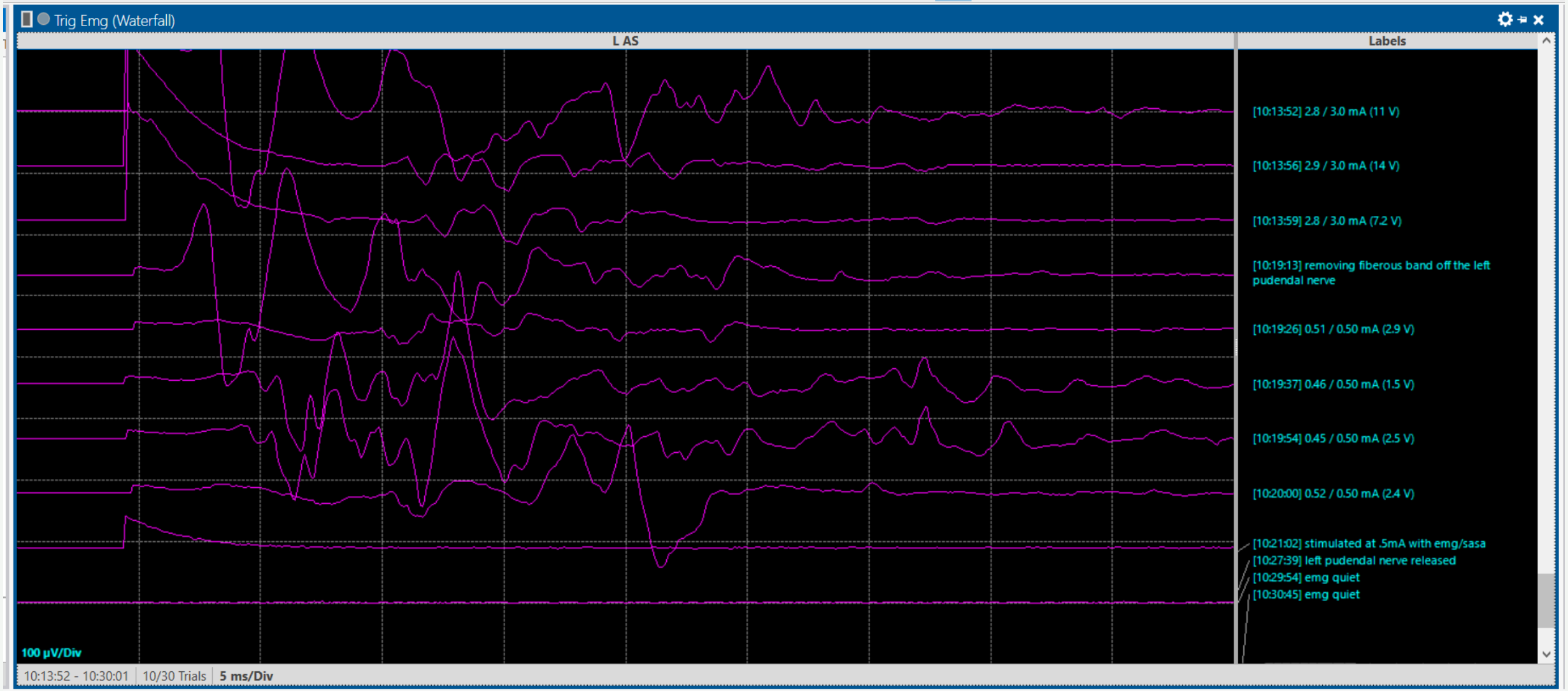
Search




Sacrotuberous ligament
Pudendal nerve
Anus

Pudendal Neuralgia



Surgical Treatment Outcomes

- Some patients especially those with long duration symptoms, may not improve
- A period of worsened pain/burning is common for patients (between months 1-3)
- Rarely (<1% in our experience), may permanently feel worse after surgery
- Salvage options include RF/Cryoablation, peripheral nerve stimulator, etc

Core Muscle Injuries Sports Hernia

Hakan Usal, MD

Core Muscle Injuries

Also known as “athletic pubalgia” or “sports hernia”

An injury to the core muscles of the abdomen and legs

There are several nerves that are often injured in addition to the muscles

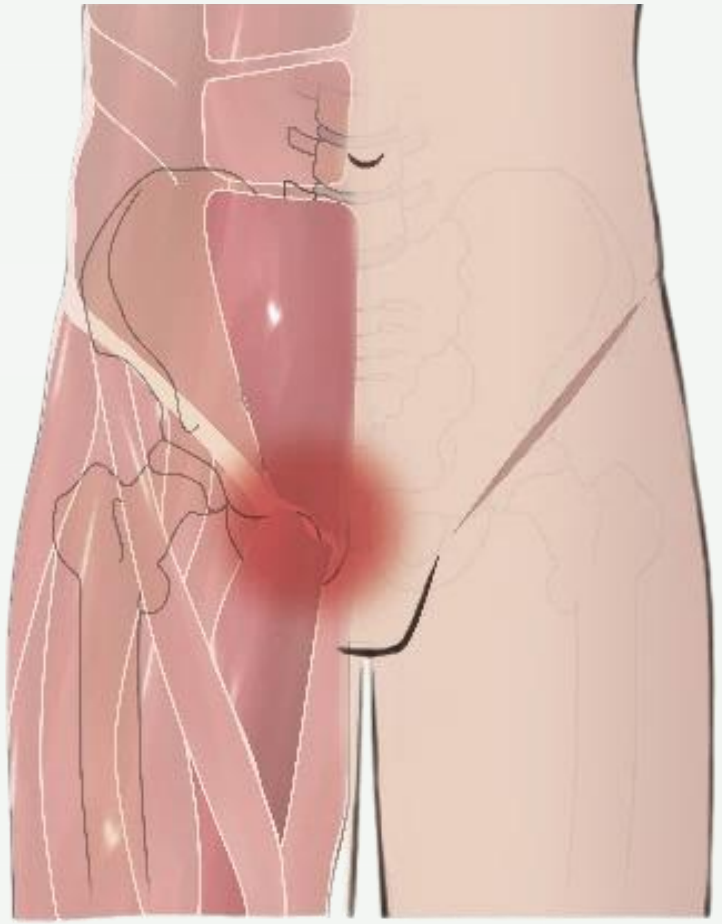
Injury causes chronic groin pain, especially with strenuous physical activities

Can result from a sudden injury, but often the injury occurs slowly over time

Core Muscle Injury

Symptoms

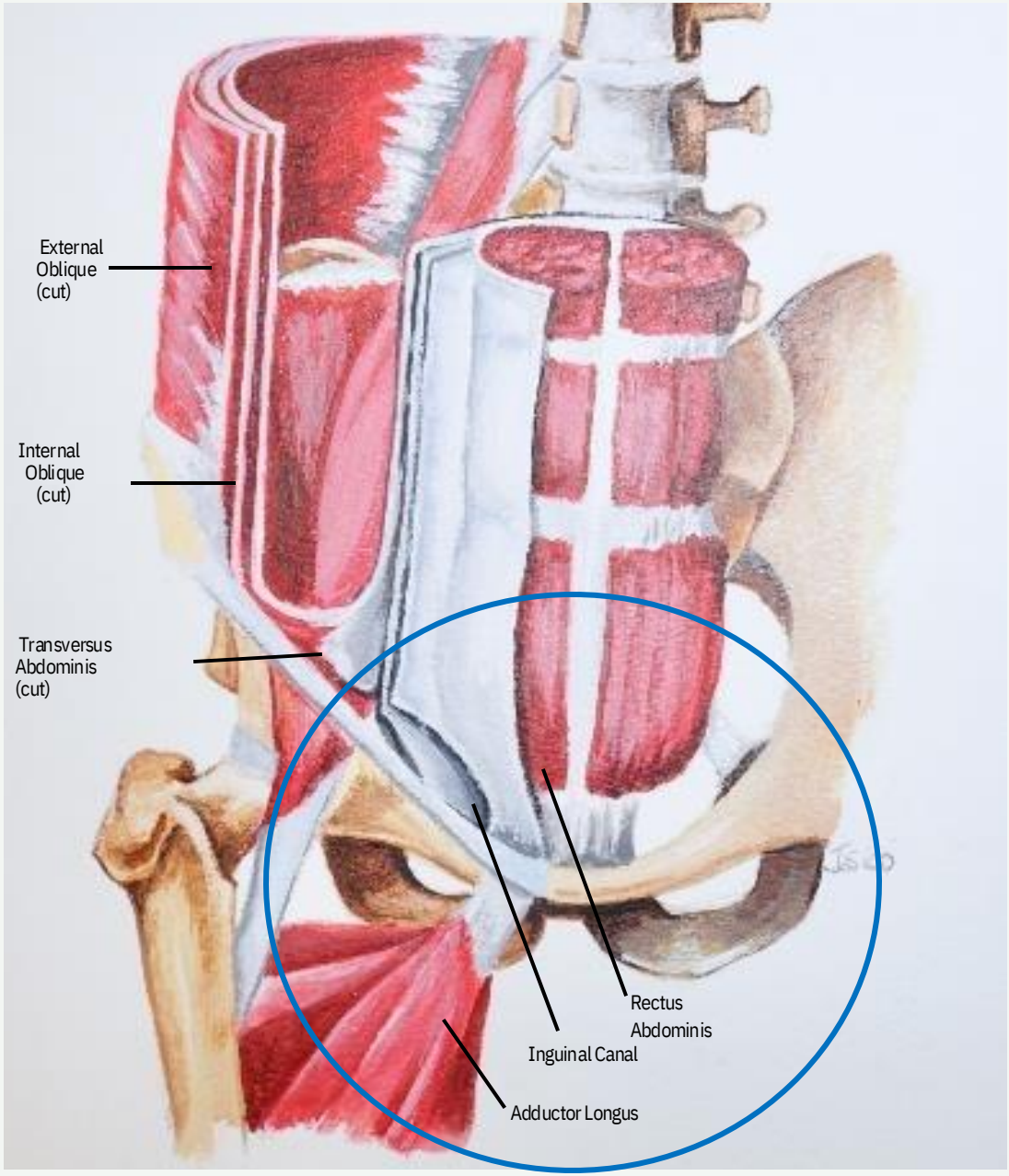
- Groin pain
- Lower abdominal pain
- Hip pain
- Pain that does not improve with rest
- Numbness, tingling, or electric shock pain in the groin/genital area



Core Muscle Injury

Causes

- Sports
- Groin strain
- Heavy lifting
- Overuse
- Workplace injuries



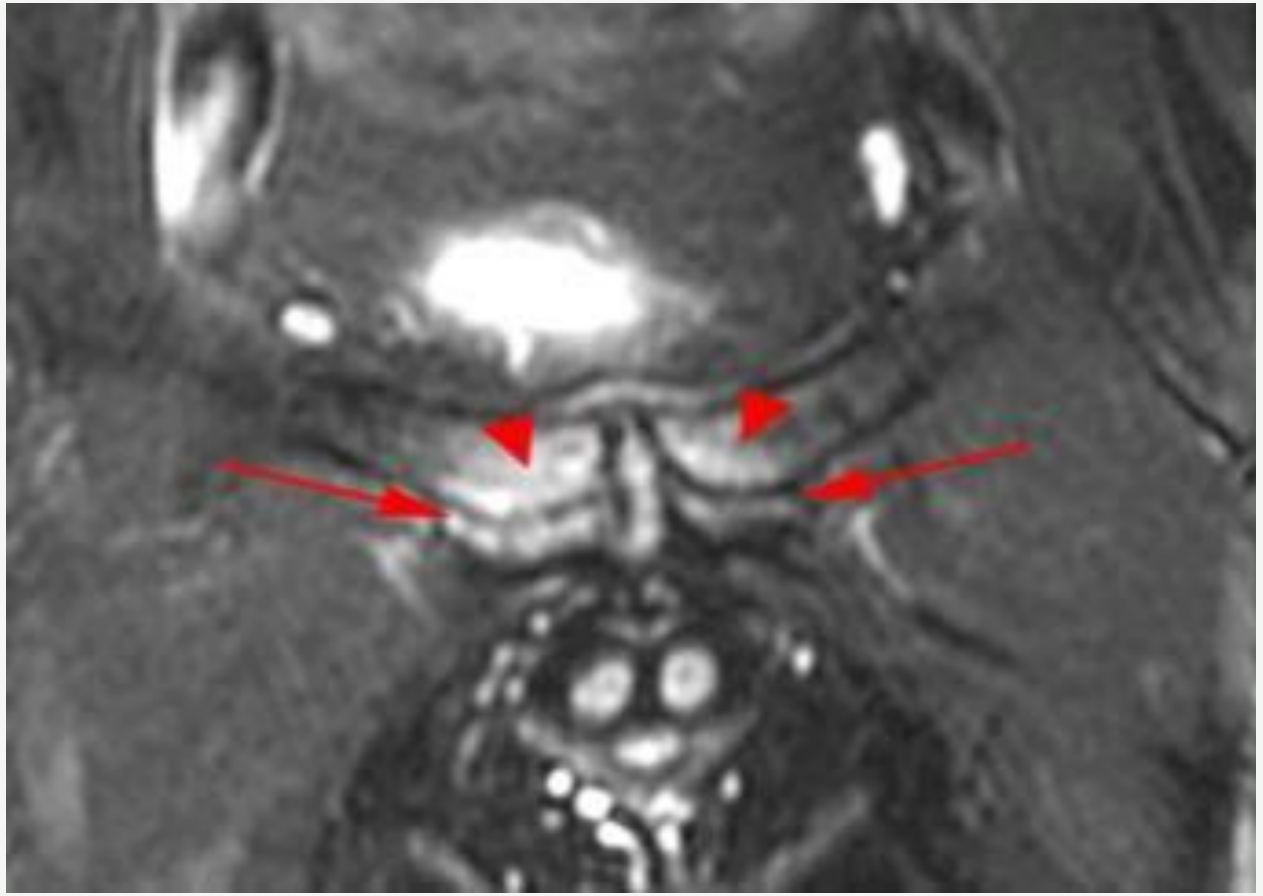
Diagnosis

Physical Exam

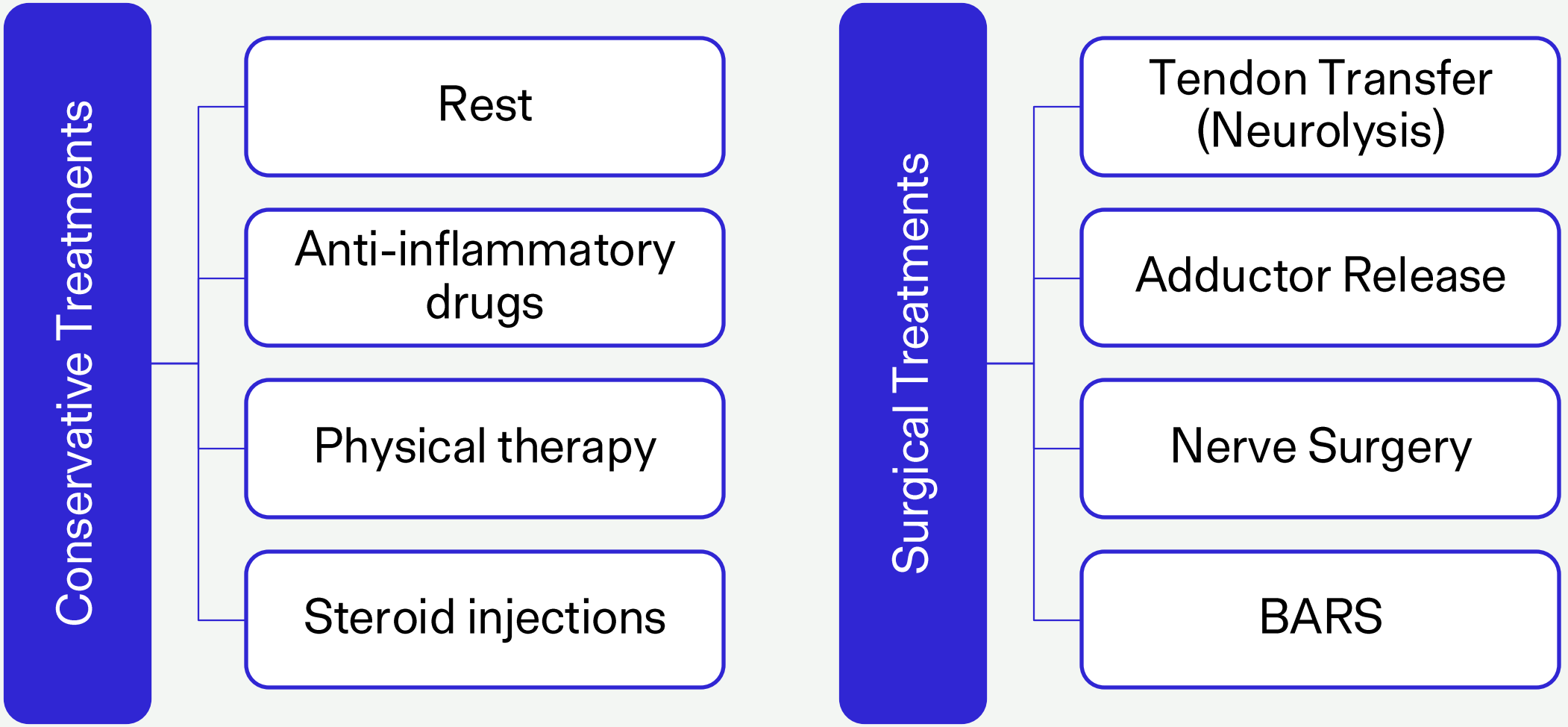
- Rested sit-up
- Pain with groin adduction

MRI

- Rectus Disinsertion



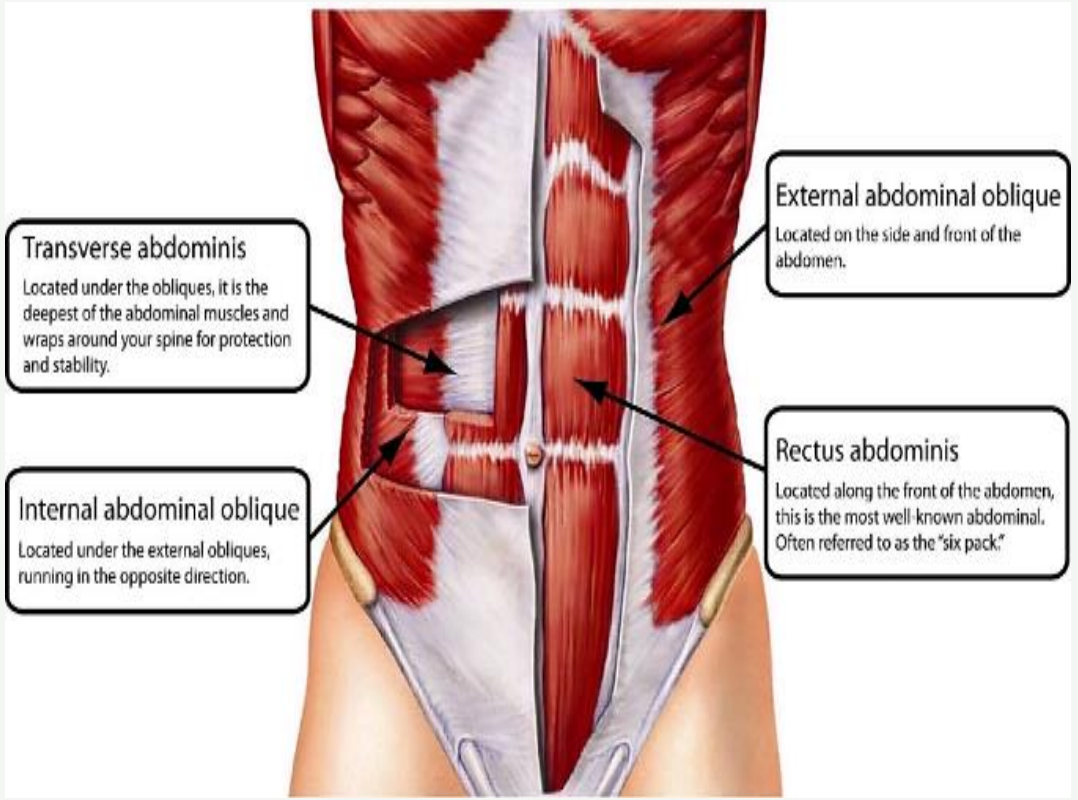
Core Muscle Injury Treatments



Tendon Transfer

Goal is to aid the injured rectus

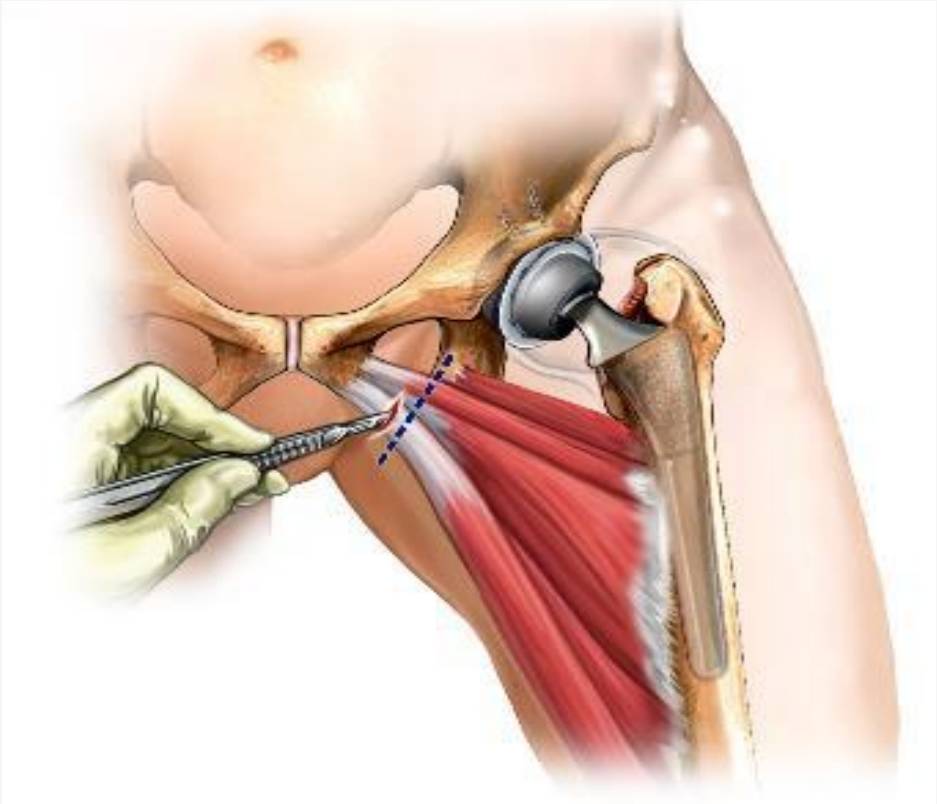
Transfer transversalis and internal oblique



Adductor Release

Goal is to change the force put on the pelvic joint

Partial release of the adductors



Nerve Surgery

1. The most common nerves that can be injured with the core muscles are the genitofemoral nerve, ilioinguinal nerve, and obturator nerve

2. Nerve injuries are often overlooked

3. Failure to treat the injured nerves can lead to continued pain and shock feelings in the groin and genitals

BARS

Bone anchored mesh reinforcement of the core muscles

Goal is to reinforce the repair and guard against re-injury

The BARS technique differs from the standard hernia mesh. During a BARS procedure, the mesh is placed over the top layer of muscle, away from the nerves and structures in the inguinal canal. This allows for a very strong repair of the injured core muscles.

Recovery

Surgical success is defined by a return to pre-injury physical activity

95%
of patients return to their prior activities after surgery

90%
of patients experience pain relief after surgery

1. Surgery is done as an outpatient procedure
2. Physical therapy protocol begins almost immediately
3. Most patients are fully recovered by 6 weeks
4. Most patients return to normal physical activity by 3 months

Joint Denervation

Michael Rose, MD, FACS

The Institute
for Advanced Reconstruction

JOINT DENERVATION SURGERY

“Surgical transection of afferent joint pain fibers transmitting pain to the brain. Denervation offers the promise to preserve or improve joint function and is an alternative in painful osteoarthritis to more destructive surgical procedures, such as arthrodesis or resection arthroplasty with endoprostheses.”

-Joint Denervation: An Atlas of Surgical Techniques

Joint Pain & Nerves

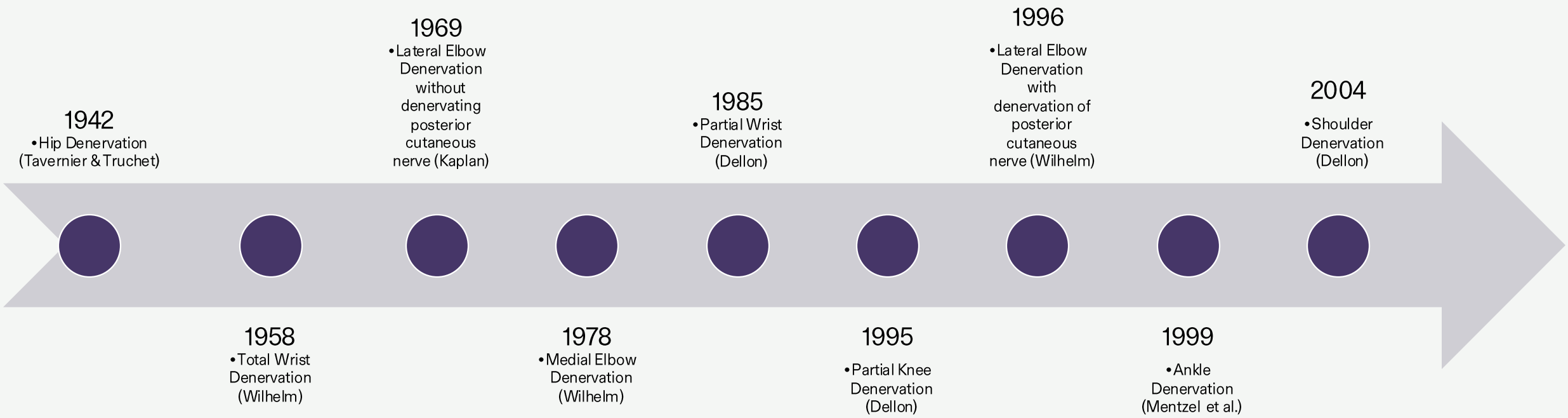
No Nerve = No Pain

Each joint in the body is innervated by one or more **sensory nerves.**

The sensory division of the peripheral nervous system carries **sensory** information to the central nervous system.

Joint Denervation Surgery

Background

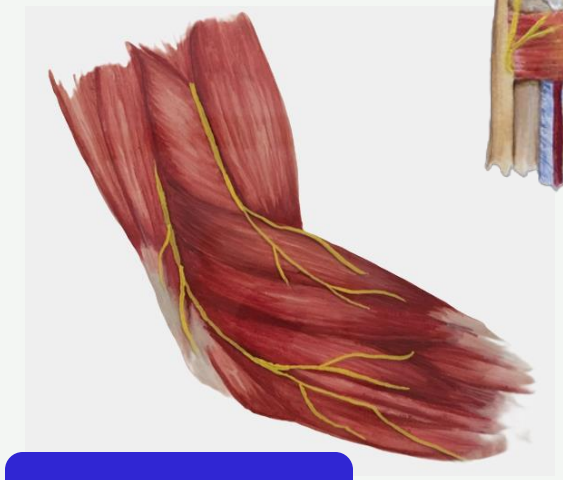


Joint Pain & Nerves

- Patients may be evaluated by multiple medical providers and told that there is nothing wrong with the painful joint
- MRIs and x-rays may also suggest that there is nothing wrong, yet the joint pain persists

Joint Denervation

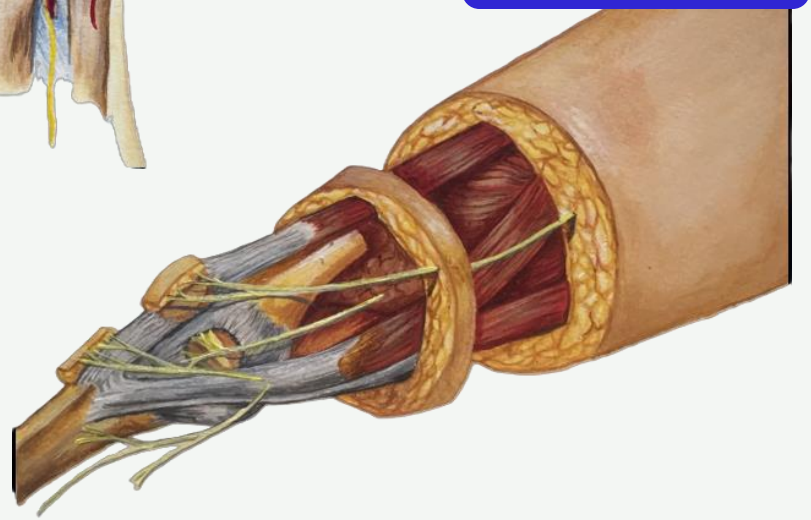
Areas we can treat



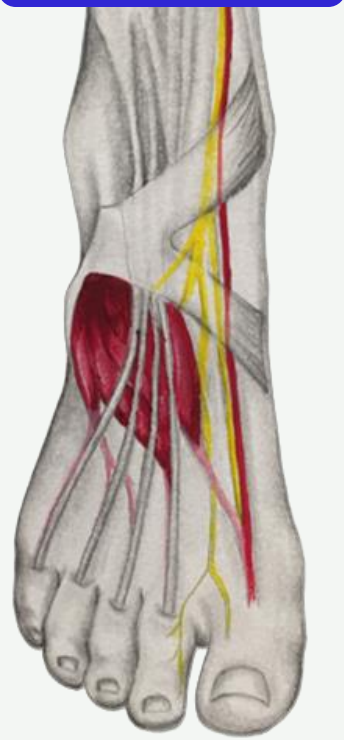
Elbow

Wrist

Knee



Ankle



Joint Denervation Surgery

Pre-Operative Testing

Rule out Other Injuries	CT
	MRI
	X-Rays
Physical Exam	Tinel's sign
Nerve Block	Sensory nerve(s) of affected joint are injected with a small amount of numbing medication
	Medication only lasts a day or so
	If pain is reduced or gone, then the pain may be treated with nerve surgery

Joint Denervation

Surgical Treatment Benefits

- Significant and often immediate pain relief
- Ability to discontinue pain medications
- With pain relief, normal joint function can be restored, increasing a patient’s range of motion and general functionality
- Ability to perform pre-injury activities and return to work
- Relatively simple procedure, often performed in an outpatient setting
- Reduced cost compared to joint fusion or replacement
- Future joint fusion or replacement is still possible

Neuropathy

Michael Rose, MD, FACS

Peripheral Neuropathy

What is neuropathy?

Damage or dysfunction of the peripheral nerves

Causes

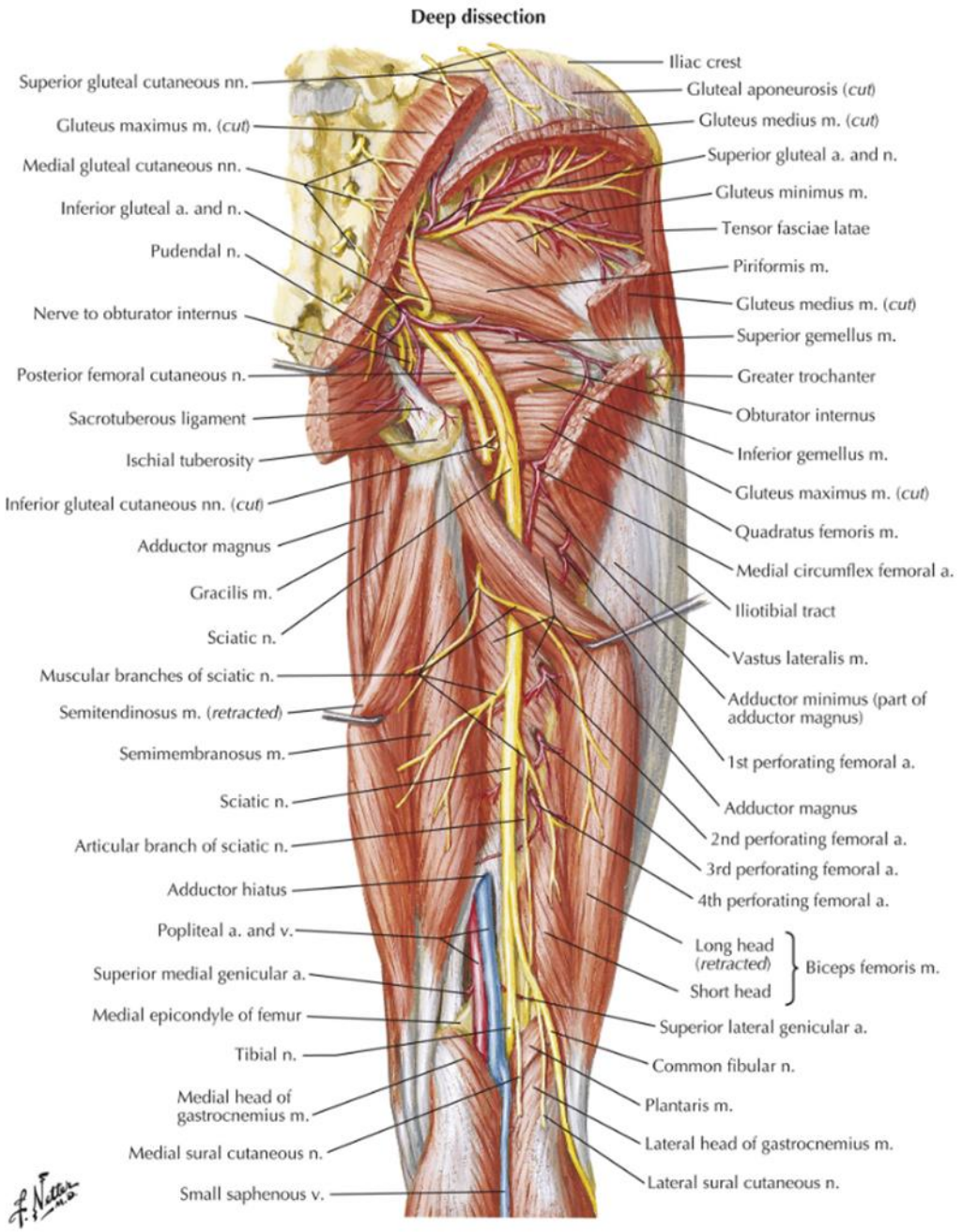
- Diabetes
- Chemotherapy
- Alcoholism
- Trauma
- Compression

Symptoms

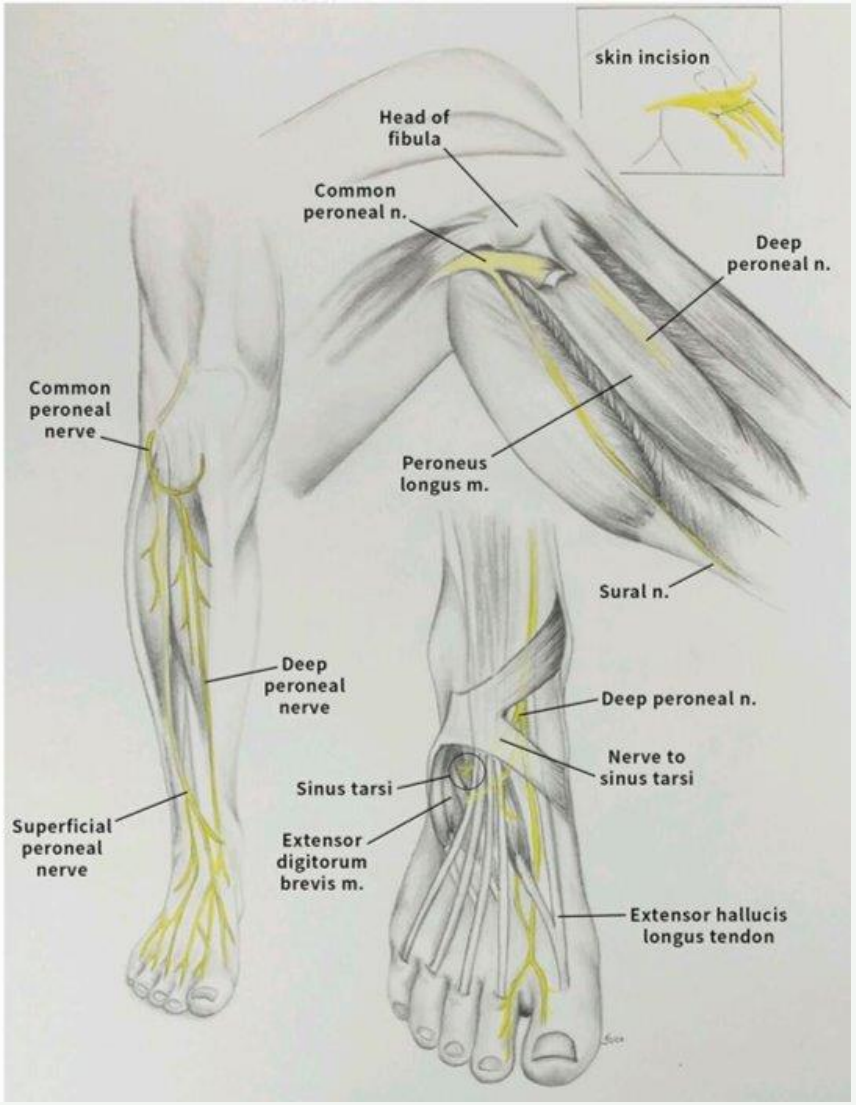
- Numbness
- Tingling
- Burning
- Pain
- Weakness

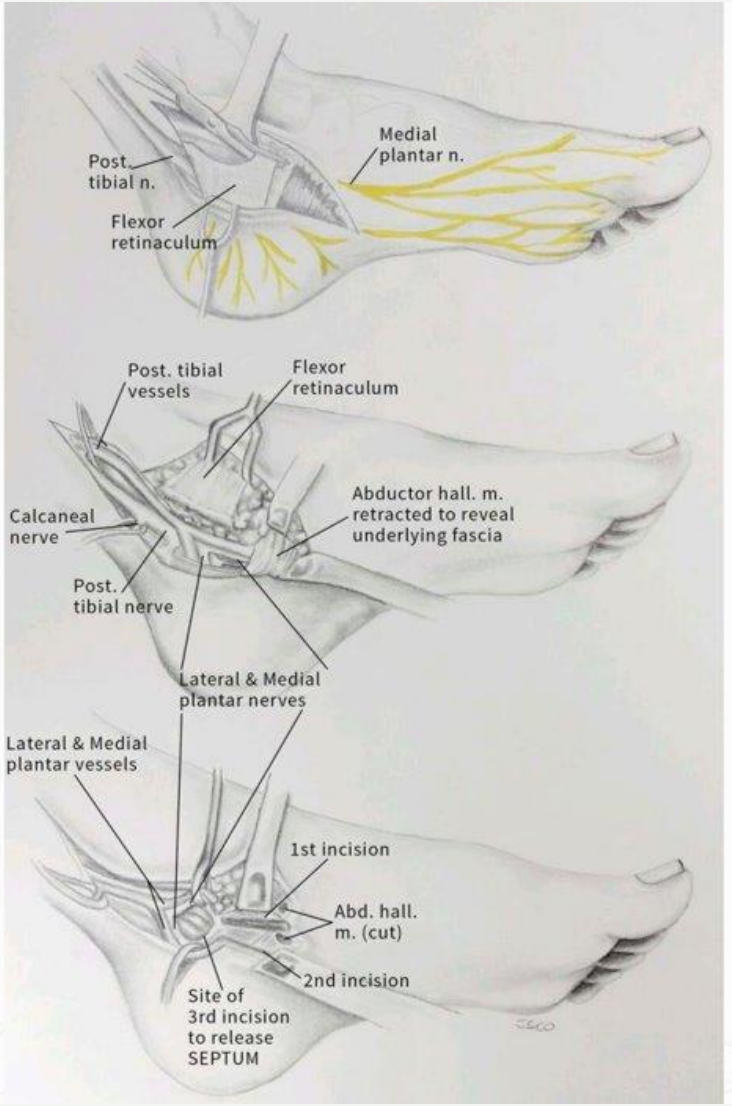
Diagnostic Evaluation

- Which patients should have surgery?
- Neuropathy diagnosis
- Good circulation
- Reasonable health
- Tinel's sign
  - If you tap in the known areas of anatomic narrowing and the patient reports electric sensations (tingling, vibrations, etc.) along the expected sensory distribution of the nerve being tapped, then you have a positive Tinel's sign

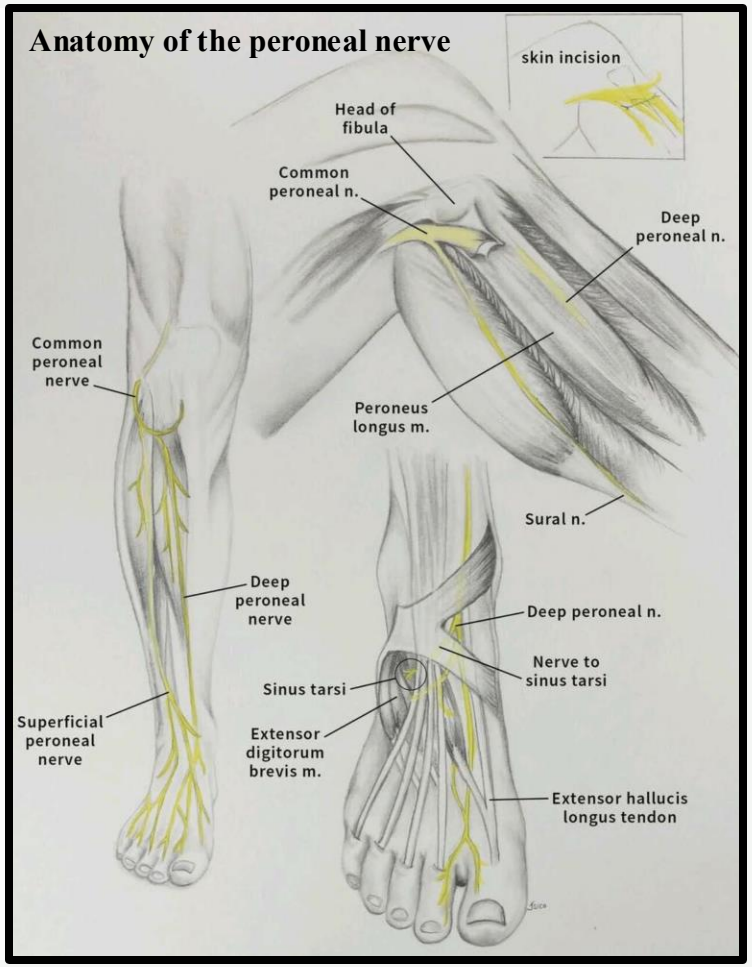


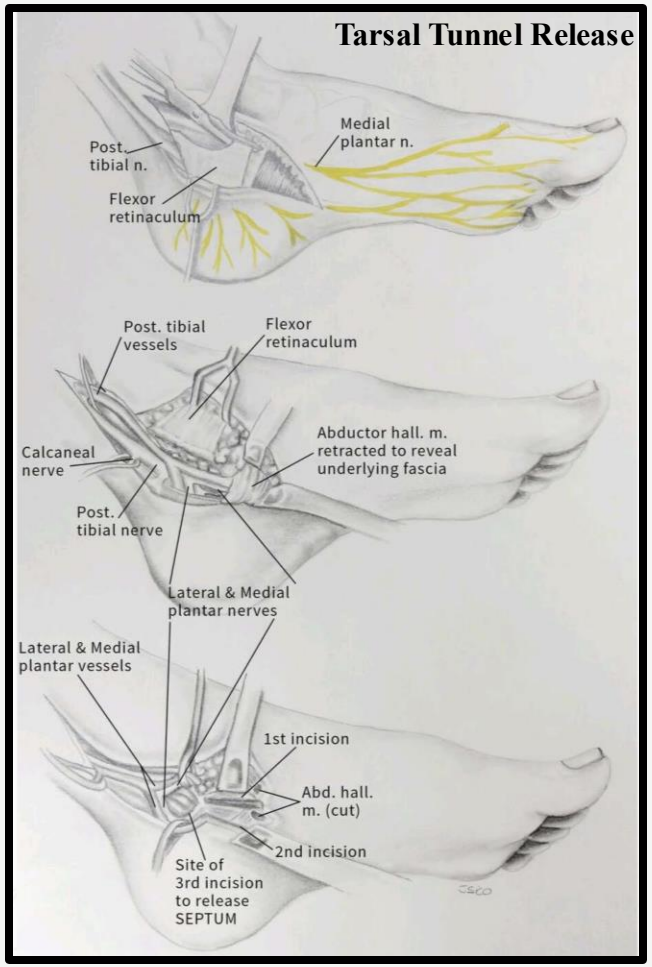
Surgical Treatment of Peripheral Neuropathy





Surgical Treatment





Peripheral Neuropathy

Surgical Treatment Outcomes

- Increase in quality of life
- Reduction in symptoms of pain and tingling
- Prevention of ulcers and amputations
- 70% success rate

Foot Drop

Michael Rose, MD, FACS

Foot Drop

- Inability to raise the front part of the foot
- Causes dragging of the toe when walking or walking on the heel

Symptoms of Foot Drop

- Difficulty lifting the foot
- Dragging the toes on the floor when walking
- Difficulty walking or climbing stairs
- Slapping the foot down with each step
- Raising thigh when walking (high stepping gait)
- Frequent falls
- Decreased sensation, tingling, numbness or burning from lower lateral leg to top of foot
- Numbness along lateral leg, dorsal foot and/or first toe webspace
- Pain in foot

Anatomy Review

Foot Dorsiflexion (lift) & Toe Extension

- Tibialis anterior
- Extensor hallucis longus (EHL)
- Extensor digitorum longus (EDL)
- Peroneus tertius

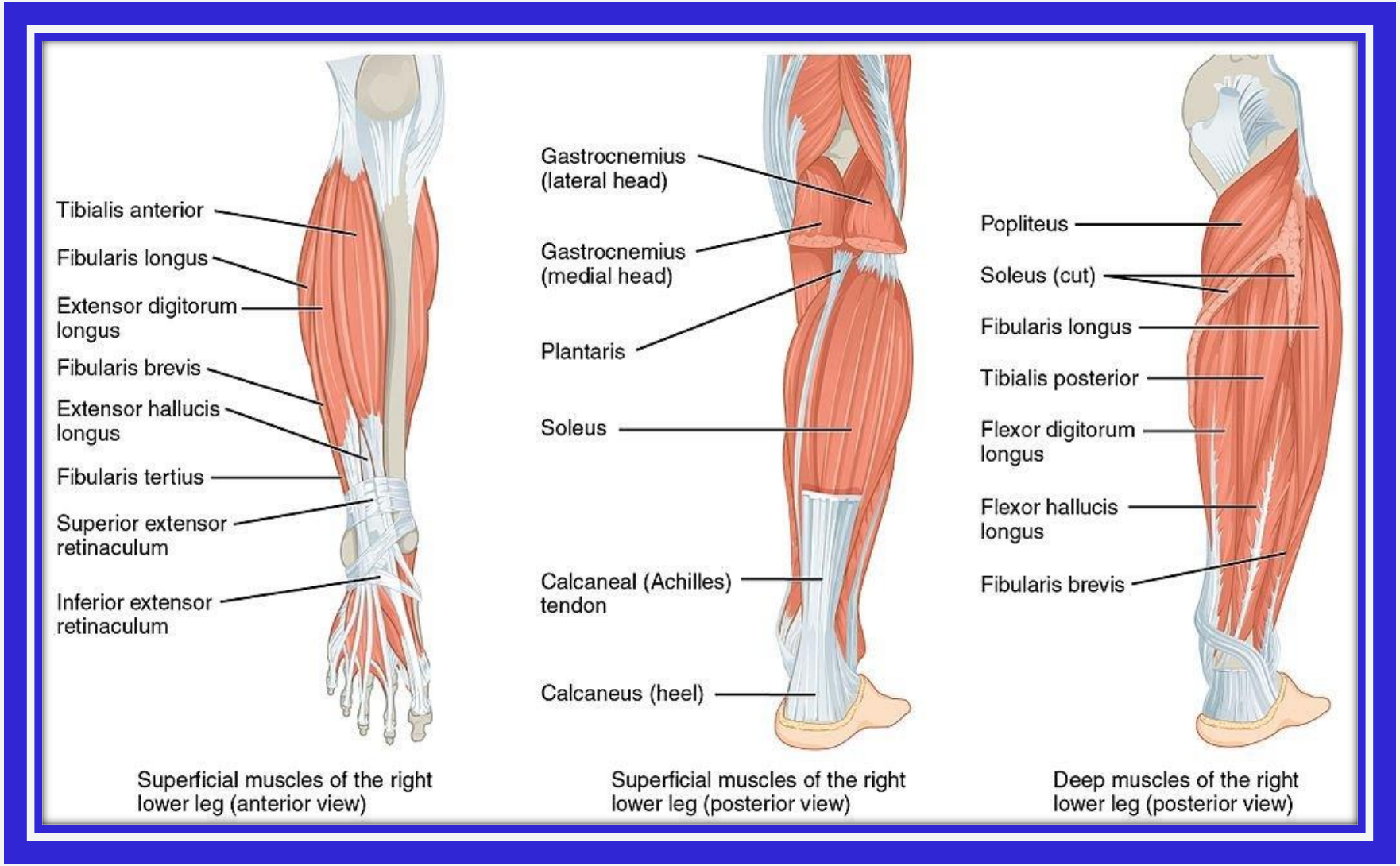
Ankle Eversion (turn out)

- Peroneus longus/Fibularis longus
- Peroneus brevis/Fibularis brevis

Ankle Inversion (turn in)

- Tibialis posterior

Anatomy Review - Muscles



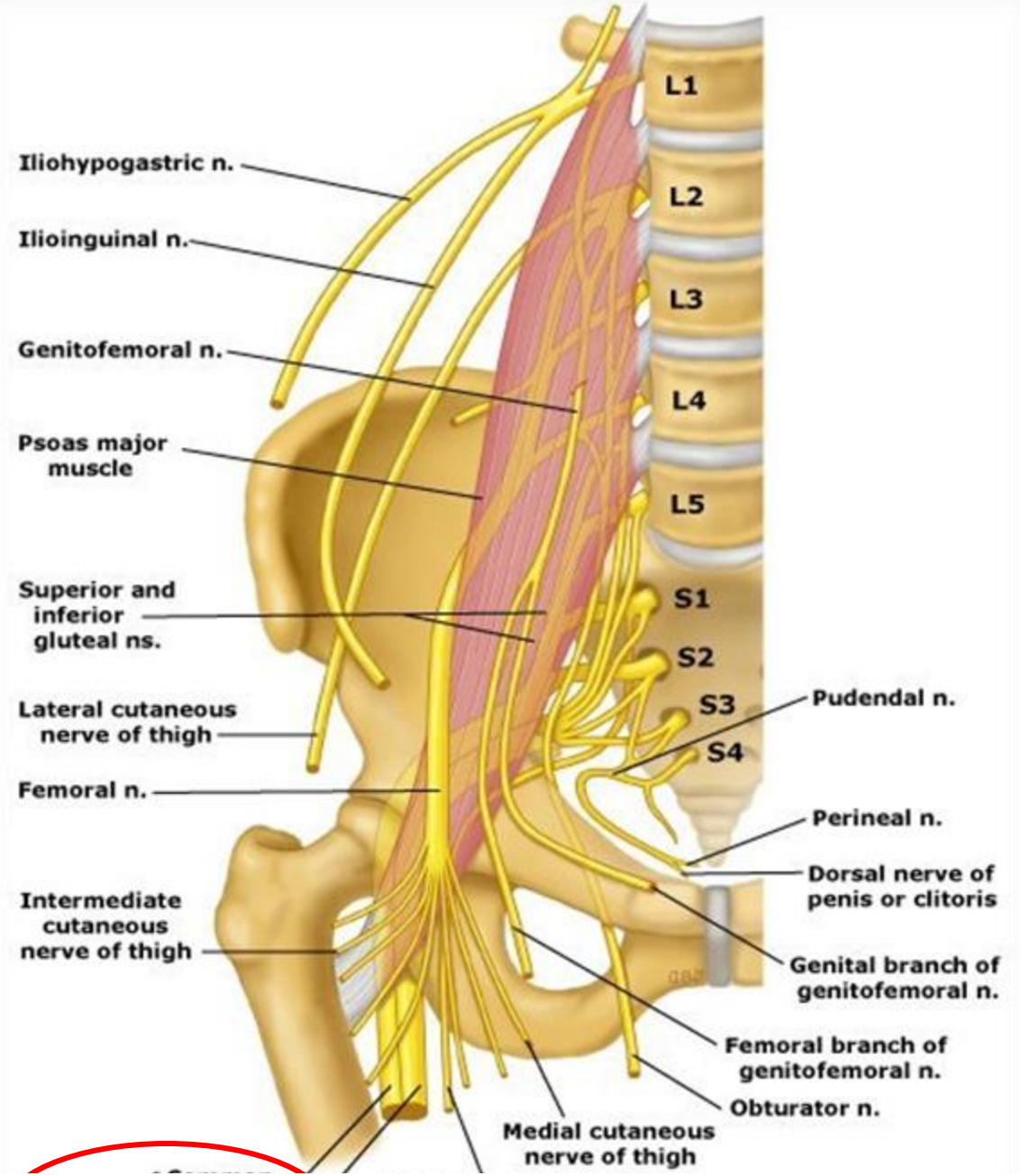
Superficial muscles of the right lower leg (anterior view)

Superficial muscles of the right lower leg (posterior view)

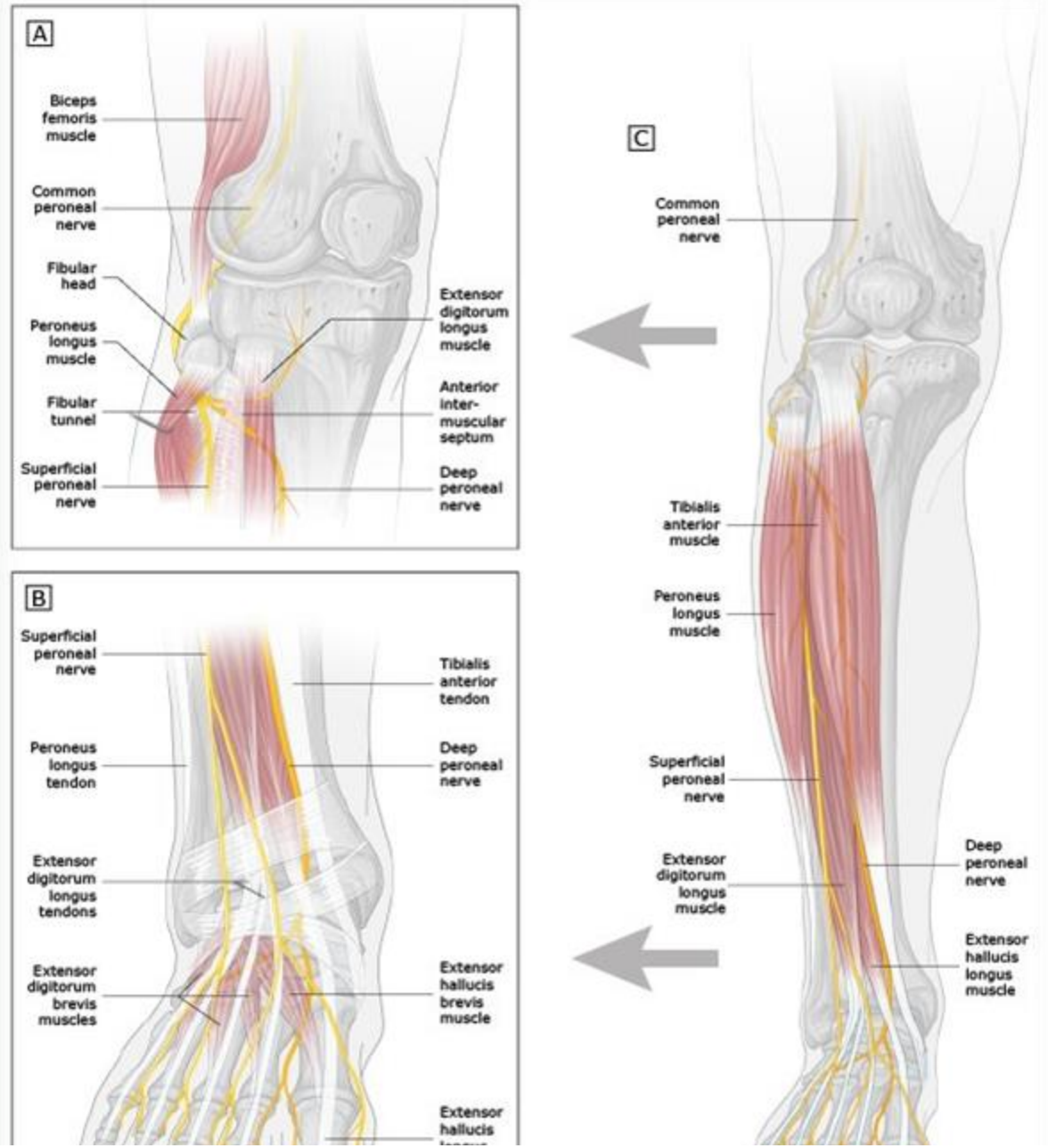
Deep muscles of the right lower leg (posterior view)

Anatomy Review Nerves

- Peroneal nerve
- Sciatic nerve
- Nerves in the lumbar or sacral plexus



Anatomy Review
Nerves



Etiologies

Compressive Disorders

- Most common cause
- Common Sites of Entrapment:
  - Fibular head
  - Hip
  - Ankle

Trauma

- Second most common cause
  - Orthopedic injuries
  - Musculoskeletal injuries
  - Ligamentous injuries
  - Childbirth

Compartment Syndrome

- Leading to inadequate blood supply to the peroneal nerve, loss of muscle function and subsequent foot drop

Iatrogenic

- Protracted positioning during anesthesia
- Prolonged bed rest
- Splinting
- Pneumatic compression devices

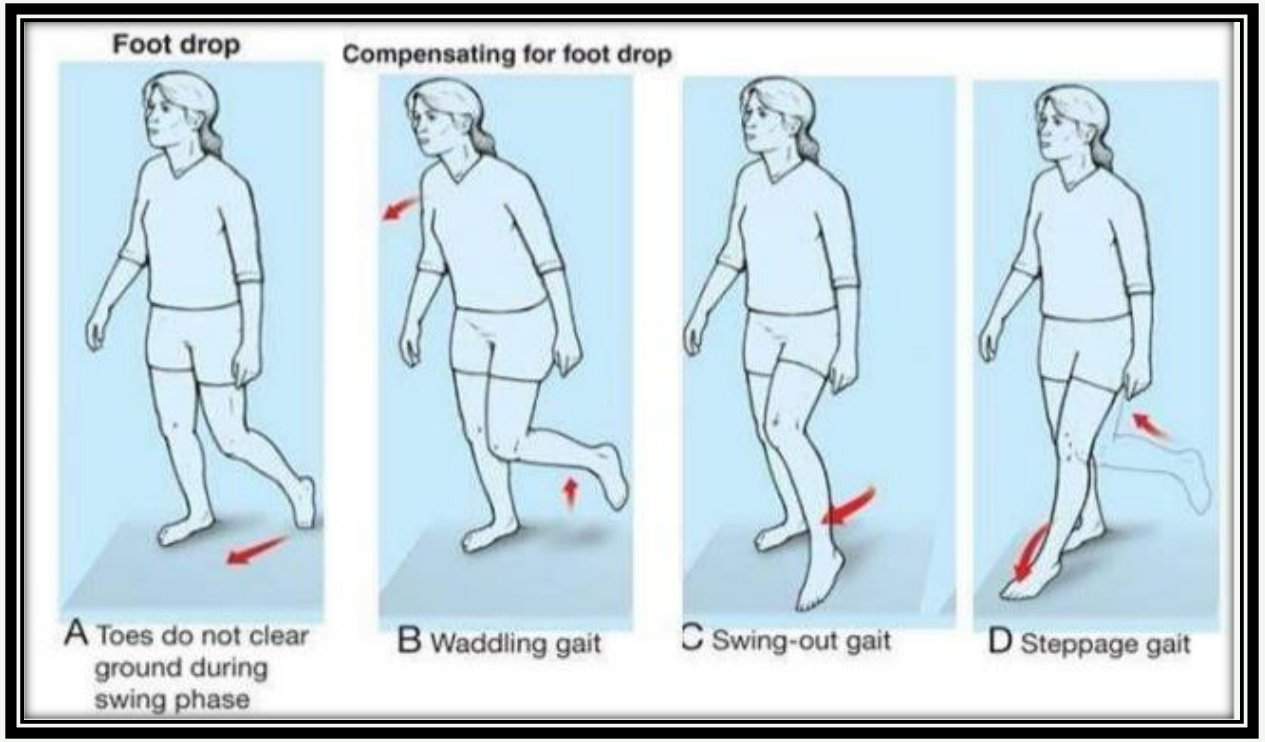
Neurologic Disorders

- Charcot-Marie-Tooth
- ALS
- MS
- Diabetic Neuropathy

Physical Exam

→Sensorimotor and vascular examination

- Signs of trauma, previous surgery, vascular insufficiency, ulcers, edema



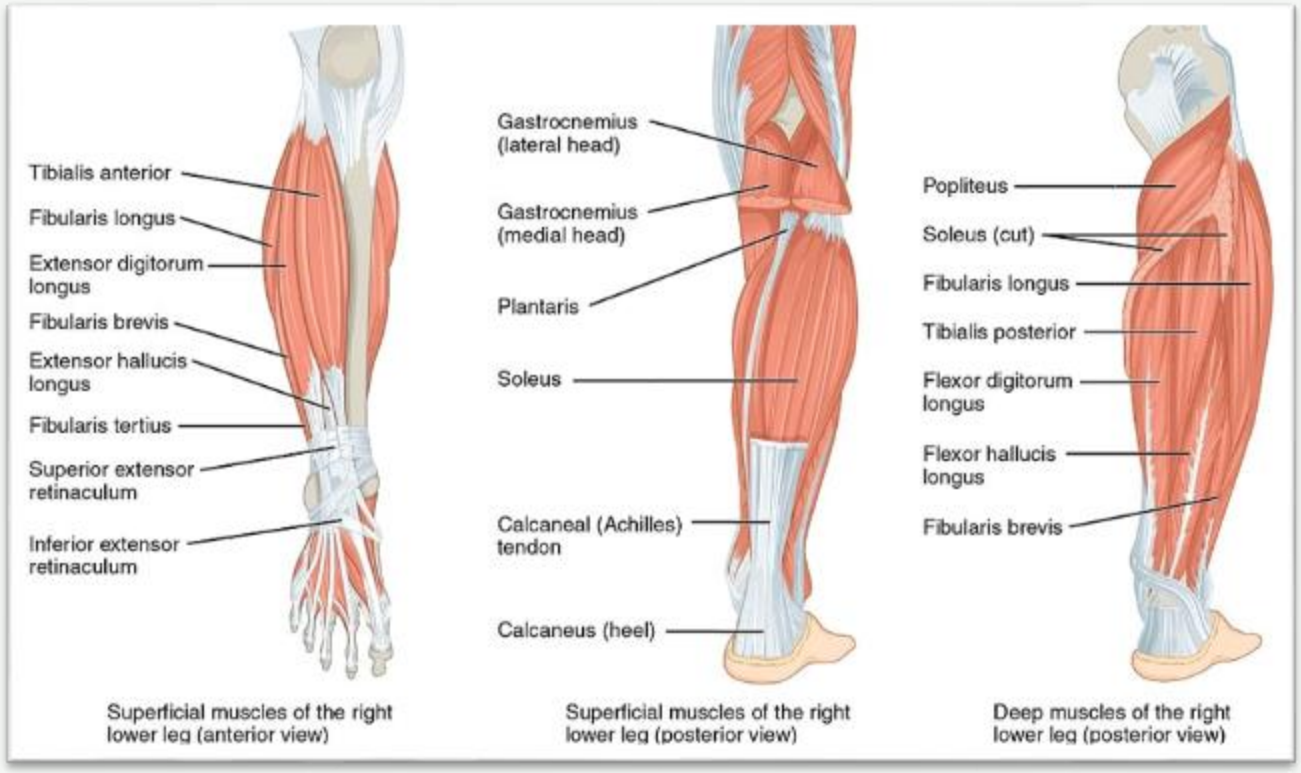
→Weakness of the ankle dorsiflexors, toe extensors, and ankle evertors

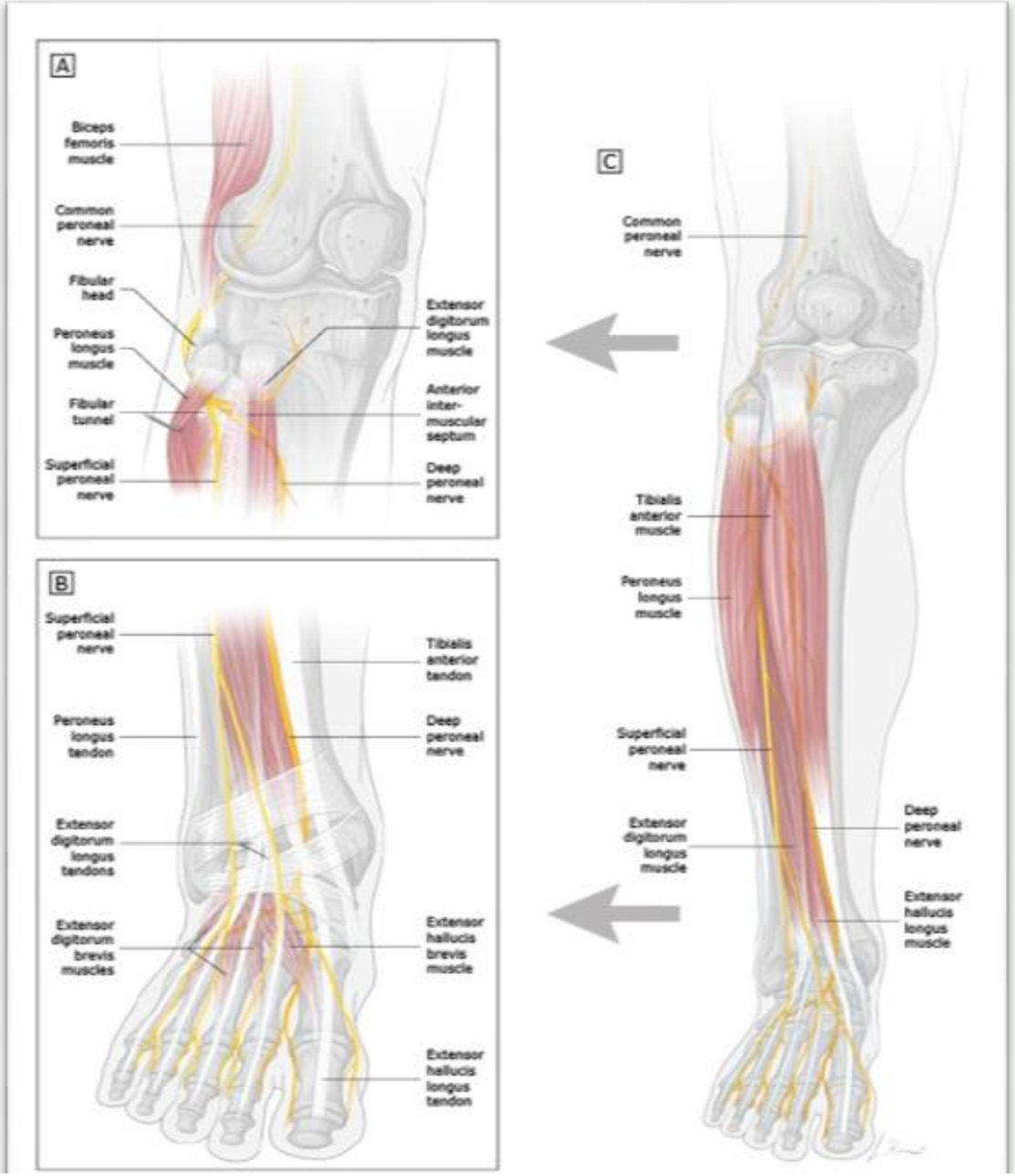
→Assess for areas of decreased or abnormal sensation in the leg and foot

→Tinel's sign – locate areas of nerve irritation of entrapment

Treatment

- Nerve decompression
- Nerve transfer
- Tendon transfer





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Questions?

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References - Occipital Neuralgia

1. Ducic I, Felder JM 3rd, Fantus SA. A systemic review on peripheral nerve interventional treatments for chronic headaches. *Ann Plast Surg*. 2014;72(4):439-445.
2. Ducic I, Hartman EC, Larson EE. Indications and outcomes for surgical treatment of patients with chronic migraine headaches caused by occipital neuralgia. *Plast Reconstr Surg*. 2009;123(5): 1453-1461.
3. Faber C, Garcia RM, Davis J, et al. A socioeconomic analysis of surgical treatment of migraine headaches. *Plast Reconstr Surg*. 2012;129(4):871-877.
4. Guyuron B, Reed D, Kriegler JS, et al. A placebo-controlled surgical trial of the treatment if migraine headaches. *Plast Reconstr Surg*. 2009;124(2):461-468.
5. Kaufman MR, Jarrahy R. Nerve decompression surgery for post-traumatic headache: A report of microsurgical techniques, intra-operative findings, and surgical outcomes. Abstracts from the 58th annual scientific meeting American headache society. *Headache*. 2016;56(s1):ps32.
6. 13.4 Occipital Neuralgia. Ichd-3.org. https://www.ichd-3.org/13-painful-cranial-neuropathies-and-other-facial-pains/13-4-occipital-neuralgia/. Updated 2018. Accessed April 4, 2019.
7. Narouze S. Occipital Neuralgia Diagnosis and Treatment: The Role of Ultrasound. *Headache*. 2016; 56(4):801-807.
8. Hwang L, Dessouky R,Xi Y, Amirlak B, Chhabra A. MR Neurography of Greater Occipital Nerve Neuropathy: Initial Experience in Patients with Migraine. AJNR Am J Neuroradiol. 2017;38(11):2203-2209.

References

1. ISPOR. (2024). Economic burden of managing acute and chronic pain in the United States: National estimates from 2022 data. ISPOR International Congress. https://www.ispor.org/heor-resources/presentations-database/presentation/intl2024-3898/136819
2. Joint Economic Committee. (2022). The economic toll of the opioid crisis. United States Congress. https://www.jec.senate.gov
3. Vowles, K. E., McEntee, M. L., Julnes, P. S., Frohe, T., Ney, J. P., & van der Goes, D. N. (2015). Rates of opioid misuse, abuse, and addiction in chronic pain: A systematic review and data synthesis. Pain, 156(4), 569–576. https://doi.org/10.1097/01.j.pain.0000460357.01998.f1
4. Thomas, K. H., Dalili, M. N., Cheng, H.-Y., et al. (2024). Prevalence of problematic pharmaceutical opioid use in patients with chronic non-cancer pain: A systematic review and meta-analysis. Addiction. https://doi.org/10.1111/add.16616
5. Cicero, T. J., Ellis, M. S., Surratt, H. L., & Kurtz, S. P. (2014). The changing face of heroin use in the United States. JAMA Psychiatry, 71(7), 821–826. https://doi.org/10.1001/jamapsychiatry.2014.366
6. Muhuri, P. K., Gfroerer, J. C., & Davies, M. C. (2013). Associations of nonmedical pain reliever use and initiation of heroin use in the United States. SAMHSA. https://www.samhsa.gov/data/sites/default/files/DR006/DR006/nonmedical-pain-reliever-use-2013.htm

References

1. Dellon AL, Mont MA, Hungerford DS. Partial denervation for treatment of persistent neuroma pain after total knee arthroplasty. Clin Orthop Rel Res. 1995;316:145.
2. Dellon AL, Mont M, Mullik T, Hungerford D. Partial denervation for persistent neuroma pain around the knee. Clin Orthop Rel Res. 1996;329:216.
3. Dellon AL. Partial Joint Denervation II: Knee and Ankle. Plast Reconstr Surg. 2009;123(1):208.
4. Dellon AL. Partial joint denervation I: wrist, shoulder, and elbow. Plast Reconstr Surg. 2009;123(1):197.
5. Dellon AL. Partial dorsal wrist denervation: Resection of distal posterior interosseous nerve. J Hand Surg (Am). 1985;10:527.
6. Dellon AL, Mackinnon SE, Daneshvar A. Terminal branch of anterior interosseous nerve as source of wrist pain. J Hand Surg (Br). 1984;19:316.
7. Dellon AL, Horner G. Partial wrist denervation. In S. Levin (Ed.), Problems in Plastic and Reconstruction Surgery: The Wrist. Philadelphia: Lippincott, 1993. Pp. 252.
8. Kupfer DM, Lee GM, Shoemaker W, Dellon AL. Simplified approach to wrist denervation for triangulofibrocartilage complex disruption (Abstract). J Reconstr Microsurg. 1999;15:621.
9. Weinstein LP, Berger RA. Analgesic benefit, functional outcome, and patient satisfaction after partial wrist denervation. J Hand Surg (Am). 2002;27:833.
10. Wilhelm A. Tennis elbow: Treatment of resistant cases by denervation. J Bone Joint Surg (Br). 1996;21:523.
11. American Society of Plastic Surgeons. Microsurgery. https://www.plasticsurgery.org/reconstructive-procedures/microsurgery. Accessed May 10, 2019.
12. CDC/National Center for Health Statistics. 2012 Data Release. https://www.cdc.gov/nchs/nhis/nhis_2012_data_release.htm. Accessed May 10, 2019.
13. United States Bone and Joint Initiative. Chronic Joint Pain. https://www.boneandjointburden.org/2014-report/ib2/chronic-joint-pain. Accessed May 10, 2019.
14. Dellon, A Lee (Ed.). Joint Denervation. Switzerland AG: Springer Nature, 2019.
15. Rose NE, Forman SK, Dellon AL. Denervation of the lateral humeral epicondyle for treatment of chronic lateral epicondylitis. J Hand Surg Am. 2013;38(2):344.
16. Berry N, Neumeister M, Russell R, Dellon AL. Epicondylectomy versus denervation for lateral humeral epicondylitis. HAND. 2011;6(2):174.
17. Nahabedian MY, Johnson CA. Operative management of neuromatous knee pain: patient selection and outcome. Ann Plast Surg. 2001;46(1):15.
18. Dellon AL. Partial knee denervation: a review. J Sports Med Doping. 2014;4:153.
19. Dellon AL, Barrett SL. Sinus tarsi denervation: clinical results. J Am Podiatr Med Assoc. 2005;95(2):108.
20. Richter M. Langzeitergebnisse der Gelenkdenervation bei posttraumatischer Sprunggelenksarthrose [Dissertation]. Ulm (Germany): Ulm University, 2007.
21. Röhm A, Mentzel M, Schöll H, et al. Midterm results following denervation of the ankle [German]. Unfallchirurg. 2015;118:615.
22. Larson CM. Sports Hernia/Athletic Pubalgia: Evaluation and Management. Sports Health. 2014; 6(2): 139.
23. Dimitrakopoulou A, Schilders E. Sportsman's hernia? An ambiguous term. J Hip Preserv Surg. 2016;3(1):16.
24. Dogru Huzmeli E, Melek I. Neuropathic pain's biopsychosocial effects. Neurol Sci. 2017;38(11):1993-1997.
25. Dueñas M, Ojeda B, Salazar A, Mico JA, Failde I. A review of chronic pain impact on patients, their social environment and the health care system. J Pain Res. 2016;9:457-467.
26. Dahlhamer J, Lucas J, Zelaya, C, et al. Prevalence of Chronic Pain and High-Impact Chronic Pain Among Adults — United States, 2016. MMWR Morb Mortal Wkly Rep. 2018;67:1001-1006.
27. National Institute on Drug Abuse. Opioid Overdose Crisis. https://www.drugabuse.gov/drugs-abuse/opioids/opioid-overdose-crisis. Accessed April 13, 2020.