Clinical Ultrasound for Nerve Entrapments of the Lower Extremity

“This Plantar Fasciitis won’t go away”

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Objectives

- Briefly review common presentations of lower extremity nerve entrapments and discuss differential diagnosis
- Discuss strategies to diagnose entrapment including clinical ultrasound
- Discuss treatment options for lower extremity nerve entrapments

- Nothing to disclose
Nerves of the lower extremity
Imaging & Nerve Entrapment

- X-ray and CT scan rarely helpful (unless anatomic variant/spur/fracture)
- MRI or Ultrasound are tests of choice
- A recent study in which US was compared with MR imaging for the detection of peripheral nerve pathologic conditions showed that although US and MR imaging had equal specificity (86%), US had greater sensitivity than did MR imaging (93% vs 67%).
- MRI can showing edema or swelling in or around the nerve
  - Can also be better for deeper/more complicated structures
    - ie Lumbar plexus
Ultrasound and nerve entrapment

- Normal nerves have honeycomb appearance
  - Hypoechoic nerve fascicles are surrounded by hyperechoic connective tissue and collagen
- Chronic entrapment
  - Looking for local edema
  - Nerve diameter thickness (usually proximal to entrapment
  - Nerve becoming hypo echoic
  - Local scar (hyperechoic or bright signal in tissue surrounding nerve)
  - +sonographic tinel’s
  - Dynamic entrapment
What is Ultrasound?

- Imaging technology that uses high-frequency sound waves to characterize tissue.
- Relies on properties of acoustic physics to localize and characterize different tissue types.
  - Frequency of the sound waves used in medical ultrasound is in the range of millions of cycles per second (megahertz, MHz).
What is ultrasound?

- An ultrasound transducer sends an ultrasound pulse into tissue and then receives echoes back. The echoes contain spatial and contrast information.
  - gathers enough data to form a rapidly moving two-dimensional grayscale image.
Probes
Benefits

- Cost (10-20% the cost of MRI).
- Portability
- Patient friendly (Interactions, non claustrophobic)
- Non-ionizing (No radiation) & not carcinogenic
- High resolution
- Reproducibility (Follow the pathology)
- Easy follow up with repeat tests and measurement.
- Doppler to screen for inflammation/vascularity.
- EASY to compare OTHER SIDE
- Dynamic exam
Drawbacks

- Difficulty penetrating bone
  - Poor resolution of certain intra articular structures
    - Ie meniscus, ACL/PCL, labrum
    - Can not evaluate for bony edema
- Steep learning curve
What’s so great about US?

- Retrospective study of 1,012 patients treated by MSK and sports physicians over a 10-month period by Sivan et al. concluded that the use of clinic-based MSK US enables a one-stop approach, reduces repeated hospital appointments and improves quality of care.

Musculoskeletal Care. 2011;9(2):63-8
Diagnostic Workup of Nerve Entrapment

- Most of the time, it comes down to exam and clinical suspicion
  - Get a good history (prior surgery, recent pregnancy, trauma, etc)
  - Symptoms not fitting typical presentation
    - Burning, numbness, tingling
    - +Tinel’s
  - Not improving with good treatment plan
  - This is where I find the ultrasound very helpful
    - Extension of physical exam
    - Push on what hurts...then see what’s there!
Diagnostic

Morton’s Neuroma - Sonographic Mulder’s sign
Posterior tibial nerve through tarsal tunnel
Plantar nerves thru knot of henry
Superficial peroneal nerve
Sural nerve
Treatment of Nerve Entrapments

- The first step is getting the correct diagnosis
- Still a very important role for a good rehab plan with biomechanics assessment
  - Soft tissue work
  - Nerve glides
  - Pelvic realignment
  - Gait eval with corrections of weakness
Medications

- NSAIDS
- Oral steroids
- Neuropathic agents
  - Gabapentin
  - Lyrica
  - Topamax
  - Amitriptyline
  - Cymbalta
Injections

- Traditionally nerve blocks and peri-neural steroid injections were mainstay for diagnostic and therapeutic injections
  - Nerve blocks can give helpful information, but are by nature short lasting (lidocaine, bupivacaine, etc)
  - However what if this is a chronic entrapment?
  - What are targeting with the steroid?
Nerve Hydrodissection

- Injecting saline or anesthetic (+/- steroid) to mechanically “dissect” layers of tissue away from the nerve
- Can be helpful both diagnostically and therapeutically
  - Have to be able to see nerve
    - Where is the entrapment?
    - Easier with superficial nerves
  - Where to do it? How long of a section?
  - What solution do I use?
  - How often does this need to be done?
- Risks including infection, bleeding, and nerve injury
Some early papers looking at entrapment and peripheral neuropathies with PRP injections
- Promising results with improvements in NCS and pain
- Risk of increasing inflammation around an inflamed nerve?
- What is the mechanism?
  - Axonal vs. myelin regeneration
  - Hydrodissection with PRP?
Surgical decompression

- Can be very helpful in recalcitrant cases
- Decompress and/or relocate nerve
- Release overlying fascia or muscle
- Risk of nerve injury
- Risk of scar formation causing further nerve entrapment
Heel pain in a walker

- 36 yo F with R foot pain x several months
- Getting ready for a big overseas trip, but worried because she can’t walk much without severe 10/10 heel pain that makes her stop and go home
- Pain is located medial bottom of her heel, sharp with some burning
- Worse with walking, standing, activity, Better with rest
- Has tried PT, rest, ice, anti-inflammatory, inserts, PF injection that helped some for 2 months
- Denies any numbness, tingling, weakness. Does not radiate
- Exam: TTP plantar heel over PF, no TTP or Tinel’s over medial ankle, tarsal tunnel
Tarsal Tunnel
Outcome

- No heel pain for first time in months!
- Facilitate therapy
- Gradually increase walking and activity, using symptoms as guide
- Consider repeat injection in future vs. surgical referral if reoccurs
Softball player with B leg pain

- 19 yo UVA softball player
- B exertional leg pain
- Had prior B anterior and lateral fasciotomies for exertional compartment syndrome
- She has experienced improvement
- R side has improved significantly with only mild/intermittent residual discomfort
- The L side has also improved about 50%
- She continues to experience some exertional pain primarily laterally in the LLE
- She describes a dysethestic type sensation in the distal lower legs B.
Outcome

- Able to return to softball quickly (same week) with improvement in symptoms
  - Since we are not using steroid able to return to play very quickly based on symptoms
- Long lasting relief
  - >3 months first round
  - No recurrent symptoms since 2nd injection
- Continue rehab, soft tissue work, nerve mobility/glides
Chronic calf/achilles pain in a runner

- 19 yo F collegiate runner
- History of L LE compartment syndrome s/p fasciotomy, L strayer procedure.
- Returns to clinic due "stagnation" of her symptoms. She states she "can't run"
- Pain is most prominent in distal posterior left lower leg (behind achilles and then if continues activity it extends up into more proximal calf muscles.
- Pain occurs with running (if running faster than an 8:30 pace), going up hills.
- No numbness/tingling. No burning pain. Not having compartment syndrome symptoms anymore.
Sural nerve
Sural nerve
Outcome

- Gradual increase in running with improvement in symptoms
- Continued rehab with ATC
- Repeat hydrodissection 3 months later with sustained benefit
- Returned to Division 3 level running
Lateral ankle pain in a walker

43 yo M with L ankle and knee pain x several months
No specific injury or trauma
Pain is located lateral ankle and proximal knee
Pain is dull ache but can be sharp
Worse with walking, activity
Denies numbness, tingling, weakness

Exam: TTP diffusely over peroneals and lateral knee
5/5 strength
SILT
Noticeable varus knee thrust with ambulation

MRI: Mild peroneal tenosynovitis

So we tried an injection there with mild improvement

EMG: Slowing of common peroneal nerve at the level of the fibular head

MRI knee: Unremarkable
Outcome

- Improvement in pain and function
- Less ankle symptoms
- Improved walking tolerance
- Continue to work with PT on gait changes to control knee varus
- Knee brace with hinges
Fibular pain in a runner

40 yr old male runner
Initially presented in the spring with fibular pain
XR showed cortical changes c/w stress injury so was treated accordingly
Pain remained as patient returned to run

MRI normal
Minimal improvement with PT
Referred for consideration of peroneal/fibular border injection
Minimal improvement so returned for US evaluation
Nerve hydrodissection
Outcome

- Initially had increase in nerve like symptoms
  - This is actually quite common “waking up the nerve”
- Improvement in overall leg pain and function
- Gradual return to running
- Focus on lower quarter stability and run gait mechanics to offload lateral compartment
Anterior ankle pain in a runner

- 63 yr old male runner
- 1.5 years of right lateral ankle and right lateral shin pain.
- Pain most pronounced in anterior lateral ankle but can extend into dorsum of foot.
- Pain exacerbated by leg extension.
- Pain is "aching" and pulsating.
- It is worse with knee and ankle extension (worse when lying in bed at night and interferes with sleep).
- He denies associated numbness or weakness.
Returns to clinic

- Mild improvement in pain s/p SPN hydrodissection
- Normal EMG, MRI lower leg
- MRI L spine with B L5 spondylolysis with grade one listhesis
- LESI with mild benefit
- Gabapentin with side effects

- Returns again for follow up visit
- Now reporting 2-3 weeks ago he noted small nodule posterior to his knee. He states that pressing on this nodule recreates his symptoms (distal calf pain and anterior-lateral ankle pain).
Throw on the US
Outcome

- Referral to neurosurgery for consideration of excision
- Patient declined surgery
- Continued monitoring for growth, symptoms
- Can consider injection in the future
Take Home Points

- Nerve entrapments can mimic common running MSK diagnoses
  - Consider the nerve entrapments as part of differential
- Clinical US can be useful as an extension of the bedside exam
  - Push on where it hurts...what is there?
  - Helpful when all other diagnostic tests (MRI, XR, EMG) can be normal
- Nerve hydrodissection can be a helpful tool to treat patients with chronic entrapments who have failed other conservative management prior to surgical decompression
  - Important to incorporate rehab program post injection
Questions?

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Thank you!