

ANKLE AND FOOT: NERVE IMAGING

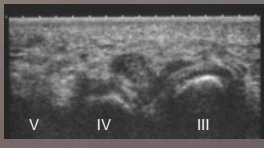
Ankle & Foot: nerve imaging

Objectives

Indications referral [appropriateness] criteria


Investigation standardized documentation

Interpretation typical US findings in typical clinical situations



Your diagnosis, please

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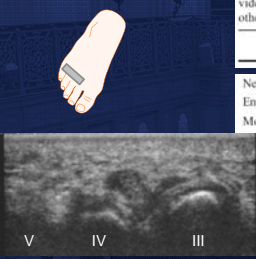
US: number 1, followed by MRI

Indications for US imaging

Table 4 Ankle: Detailed results for evidence levels and RG (third column on the right) after the third round. Grade 0: not indicated; Grade 1: if other imaging techniques are not appropriate; Grade 2: equivalent to other imaging techniques (other techniques might provide significant information); Grade 3: first choice level technique, other techniques rarely provide more information

	Evidence level	Final consensus
Nerves		
Entrapment	A	3
Morton neuroma	A	2

Klauser A et al. Clinical indications for musculoskeletal ultrasound. Eur Radiol 2012; 22:1140


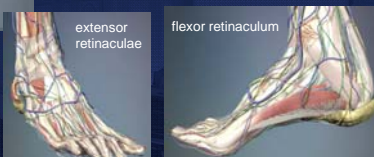


Morton neuroma

Retinacula and fasciae: anatomic structures predisposing to nerve entrapment

The nerves of the foot

- Tibial nerve:** medial
medial plantar nerve
lateral plantar nerve
- Deep peroneal nerve:** ventral
- Superficial peroneal nerve:** ventral
- Sural nerve:** dorso-lateral

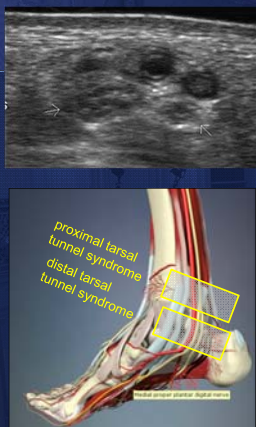



Tarsal tunnel: each tissue component may be involved

Medial: tibial nerve injury

- Numbness or pain in the foot, plantar paresthesias
- Tension stress on nerve without morphology, pes cavus deformity
- Space occupying lesions:
 - tenosynovitis
 - varicose veins
 - distal end of muscle belly, flexor digitorum accessorius longus
 - posttraumatic bone deformity
- Direct nerve injury after penetrating trauma, fractures with or without posttraumatic neuroma

Bashir WA, et al. Sem Musculoskel Radiol 2008

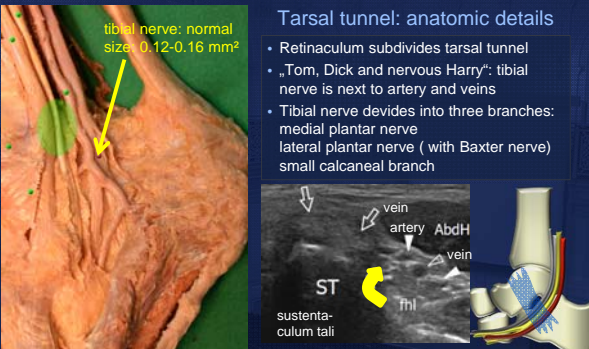


Intimate relationship between nerve branches and vessels may cause compression

Tarsal tunnel: anatomic details

- Retinaculum subdivides tarsal tunnel
- „Tom, Dick and nervous Harry”: tibial nerve is next to artery and veins
- Tibial nerve divides into three branches:
 - medial plantar nerve
 - lateral plantar nerve (with Baxter nerve)
 - small calcaneal branch

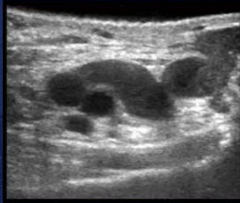
tibial nerve: normal size: 0.12-0.16 mm²



Martinoli C et al. Insights Imaging 2010 1:99

Tibial nerve compression due to venous engorgement

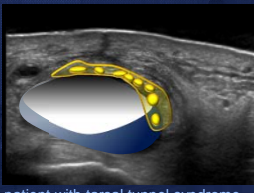
50 ys female with tarsal tunnel syndrome



<https://www.meduniwien.ac.at/orgs/index.php?id=3113>

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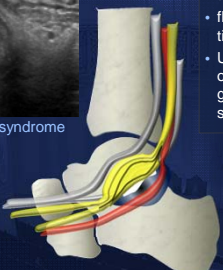
Ganglionic cyst



patient with tarsal tunnel syndrome

Ganglionic cysts

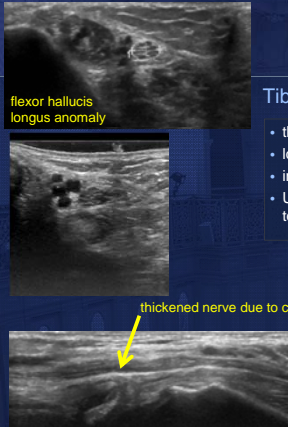
- originate from joint or tendon sheath
- fluid is squeezed into soft tissues or into nerve
- US-guided aspiration + obliteration of neck of ganglion may relief symptoms



Nerve imaging = muscle imaging

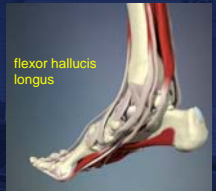
Tibial nerve abnormality: US findings

- thickening
- loss of fascicular structure
- impingement during flexion or extension
- US-guided Tinel's test (local paresthesia due to probe or finger compression)



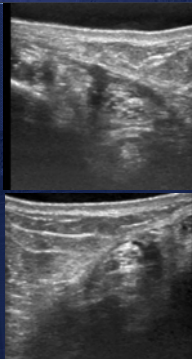
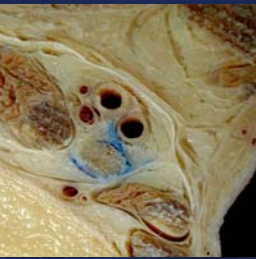
flexor hallucis longus anomaly

thickened nerve due to compression

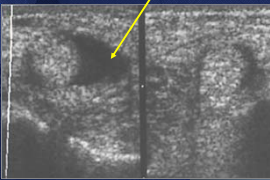


flexor hallucis longus


Thickened retinaculum after surgery

Jogger's foot: entrapment of medial plantar nerve on Henry's knot



„Posticus“-Tendovaginitis




Henry's knot

Gray's anatomy


"Tom, Dick, and nervous Harry"

- M. tibialis posterior
- M. flexor digitorum longus
- M. flexor hallucis longus

"Tom hates Dick"




deep peroneal nerve is not running really deep



deep peroneal nerve

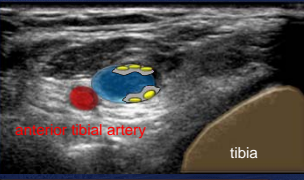
- running between tendons of tibialis anterior and extensor hallucis longus
- below extensor retinacula

deep fibular nerve



patient hit by a piece of glass, impaired extension of greater toe (due to paresis of extensor hallucis brevis muscle)

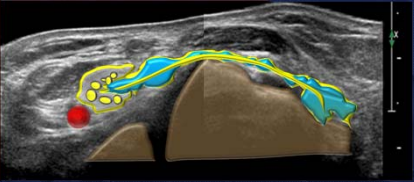
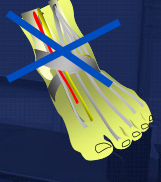
deep peroneal nerve injuries are rare



anterior tibial artery

tibia

patient with shin splints (chronic form) after ankle sprain: anterior capsular disruption of upper ankle joint causes intraneural ganglion along articular branch of nerve

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supination trauma, dancers

superficial peroneal nerve

Superficial peroneal nerve: anatomy

- runs superficially to extensor retinacula and extensor hallucis longus tendons
- pierces the fasciae of lower leg and dorsum of foot

Nerve sheath tumors: DDX is with US may be improved with better equipment

Schwannoma: US findings

- target sign
- fusiform contact to nerve
- may be biopsied – take care of severe pain

Sural nerve: a lateral superficial structure

Sural nerve anatomy

- lateral Achilles tendon margin and small saphenous vein as anatomic landmarks
- posttraumatic soft tissue edema may cause impairment

patient felt like a shot when stepping on this foot

DDx Neuralgia vs Neuroma is a clinical decision

Morton's neuroma

- DDx: Morton neuralgia: without space occupying lesion intermetatarsal bursitis

ACR appropriateness criteria

Imaging Modality	Rating	Comments	REL*
X-ray foot	9	Radiographs have lower value in soft-tissue masses in the foot. Radiographs may not precisely be used for advanced imaging.	Min
MRI foot with or without contrast	8	Use of contrast depends on clinical question and radiologist discretion. Use contrast to provide context in foot studies. Appropriate if appropriate.	None
US foot	6	Can be very useful, especially for Morton's neuroma. With Doppler to provide soft-tissue characterization.	None
CT foot with or without contrast	3	Use of contrast depends on clinical question and radiologist discretion.	Min
To-Fluor bone scan foot	1		Med
FDG-PET foot	1		High

Reliability: 1=Low, 2=Intermediate, 3=Good, 4=Very Good, 5=Excellent

Diabetic neuropathy

Diabetic foot syndrome

- Soft tissue abscess
- Foreign bodies

foreign body

Indirect signs of nerve damage

Muscle and soft tissue abnormalities: a sign of nerve damage

- edema: posttraumatic with subsequent nerve injury nerve edema due to dysfunction
- muscle atrophy: denervation
- Soft tissue mass: neuroma, solid tumors

Rhabdomyosarcoma

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Ankle and Foot: nerve imaging

Indication	US for the 1st line diagnostic workup
Investigation	vessels and tendons: important structures for orientation
Interpretation	retinaculae and fasciae: important anatomic landmarks of the osteo-fibrous tunnels and fascial holes

Images from

- Stummvoll G, Pretterklieber M, Kainberger F (eds.): [Motion and Performance], Facultas-Publishers, Vienna
- modified after Primal Pictures Ltd.

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