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MINIREVIEWS

Foot and ankle history and clinical examination: A guide to everyday practice

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Abstract

This review summarises the key points in taking a history and performing a comprehensive clinical examination for patients with foot and/or ankle problems. It is a useful guide for residents who are preparing for their specialty exams, as well as family doctors and any other doctor who has to deal with foot and ankle problems in adults.

Key words: Foot; Ankle; History; Examination and clinical assessment

Core tip: Patients present with foot and ankle problems can have either single or multiple pathologies. Obtaining adequate history and performing good clinical examination is a key in reaching the accurate diagnosis. Adjuvant tools like radiological images can be used to confirm what has been clinically suspected.

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INTRODUCTION

Patients commonly present with foot and ankle problems, either in primary or secondary care clinics. However, many physicians find it challenging to assess these patients[1]. This is probably related to the complexity and multiplicity of joints in this part of the body.

There are 26 bones, 33 Joints and more than 100

ligaments, tendons and muscles in each foot[2]. On average, we walk 10000 steps per day, 1000000 steps per year and 115000 miles in our lifetime. The foot stands 3-4 times body weight during running.

This review summarises the keys points in taking a full history and performing a systematic clinical examination for patients with foot and ankle problem. It is a useful guide for residents who are preparing for their specialty exams, but also for any doctor who may have to deal with these problems in practice.

HISTORY

The common reasons for patient's presenting to the foot and ankle clinic are: Pain, swelling, deformity, stiffness, instability and/or abnormal gait[2]. For new patients or when the diagnosis has not been confirmed before, we recommend that the examiner should not read the previous notes prior seeing the patient. This good practice allows the examiner to have more lateral thinking, with fresh eyes looking into the problem.

Pain

Ask the patient to finger point to the exact site of the maximum pain. If the pain was diffuse and not localized to one spot, try to identify the area/side of maximum discomfort. Correlate the site with the anatomical location as described in Table 1. Ask about the radiation of pain and quality or nature of it (sharp, dull or burning), whether it is related to weight bearing (degenerative changes, stress fracture or Inflammatory conditions like plantar fasciitis), the radiation (towards the toes or up the leg), severity of the pain (0-10), prevents activity, waking up during the night, time (early morning or night pain which disturbs the sleep), duration, pattern (constant/intermittent), aggravating factors (like walking distance, walking on flat or uneven floor; Going up and down the stairs; relation with shoes), and any alleviating factors (rest, analgesia, preferred type of foot wear)[3].

The chronicity and the severity of the pain can help to establish whether there is an element of central sensitization where by the patient becomes more sensitive and experiences more pain with less provocation. Factors like sleep deprivation and depression can drive central sensitization[4]. Finally, it is important to clarify what is the patients' belief about their foot pain.

Deformity

Enquire about the duration and when the patient or their family member first noticed the deformity, which area it involves, is it progressing, and whether it associated with other symptoms (for example, skin ulcer, pain, recurrent infection, rapid wear of shoes, or cosmetic).

Table 1 Correlations between the anatomical site of the pain and the possible underlying causes[6]

Location of pain	Common possible pathology	
Anterior ankle pain	Degenerative disease	Impingement Ankle joint capsule injury ex. Sport injury with maximum ankle joint plantar flexion
Medial pain below the medial malleolus	Sinus tarsi syndrome Subtalar degenerative changes Tarsal coalition of mid facet	Spring ligament or deltoid ligament pathology Tibialis posterior pathology or medial impingement
Postero-medial pain	Tibialis posterior tendonitis	Flexor hallucis longus Tarsal tunnel syndrome
Posterior pain	Achilles tendinopathy Posterior impingement	Os trigonum pathology
Postero-lateral pain	Peroneal tendon	
Lateral pain	Stress fracture of distal fibula ATFL injury Lateral impingement	Sinus tarsi syndrome Subtalar pathology Calcaneal fracture malunion
Heel pain	Plantar fasciitis Calcaneal stress fracture Entrapment of first branch of lateral plantar nerve	Fat pad atrophy/contusion Tarsal tunnel syndrome Foreign body reaction Plantar fascia rupture
Mid foot pain	Degenerative disease Post traumatic arthritis	Tarsal bones stress fracture Ligament injury ex Lisfranc injury Insertional tendinopathy of peroneal brevis
Forefoot pain	Metatarsalgia Morton neuropathy Stress fracture Freiberg disease	Metatarsophalangeal joint synovitis Nail pathology
Forefoot pain - big toe	Hallux valgus/rigidus Inflamed bunion	Sesamoiditis Sesamoid fracture
Forefoot pain - 2nd, 3rd and 4th toe	Claw toe Hammer toe	Mallet toe
Forefoot pain - little toe	Inflamed bunionette	

ATFL: Anterior inferior tibiofibular ligament.

Swelling

It is important to establish whether the swelling is localized to one area or the whole leg or ankle, whether it is uni- or bilateral, associated with activities, as well as the frequency and the duration of swelling. Generalized bilateral swelling that involves the whole foot and ankle is usually related to more systematic pathology, such as cardiac or renal problems. Swelling which includes the area only around the ankle joint may be related to the tibio-talar joint (for example, degenerative changes or inflammatory arthropathy). On other hand, localized swelling is more likely result from a specific local pathology. As an example, swelling anterior to the distal fibula may indicate chronic injury of the anterior inferior tibio fibular ligament (ATFL) and swelling posterior to the distal fibula may indicate peroneal tendon pathology[5]. Acute painful or painless swelling with or

Table 2 Important points not to miss during the history taking[6]

Important key points not to be missed in general medical history
Age
Occupation
Participation in sports
History of lower back pain
History of problems with other joints (for example, hip and knee)
Diabetes
Peripheral neuropathy
Peripheral vascular disease
Inflammatory arthropathy
Rheumatoid arthritis
Vasculitis

without the deformity of the mid foot deformity could result from Charcot neuropathy.

Instability

Enquire as to when the first episode of instability or sprain occurred, how often it happens and what can precipitate it[6].

History of trauma

History of trauma with details of immediate symptoms and treatment, surgery, injections or infection with date and details of any identified.

Associated symptoms

It is important to look out for red flags symptoms such as night sweating, temperature or weight loss, which may be related to an infection or neoplasm. Neurological symptoms like numbness, limb weaknesses or burning sensation are usually related either to spinal problem or peripheral neuropathy.

General medical history

It is important to cover all the key points that are summarised in Table 2.

CLINCIAL EXAMINATION

The examination begins from the first moment of meeting the patient by observing the gait and whether he/she uses any walking aids. The patient should be adequately exposed and ideally patients should wear shorts with bare feet. Ask for chaperone if appropriate.

Inspection of the patients footwear, insole, and walking aides

Start by examining the patient shoes and whether they are commercial or surgical shoes. Look at the pattern of the wear, which usually involves the outside of the shoe heel. Different patterns of wear indicate abnormal contact of the foot with the ground. Early lateral, proximal, and mid shoe wear, indicates a supination deformity; wear on the medial border indicates a pronation deformity[2]. In case of absence of any wear, it may simply reflect new or unused pair of foot wears. Look for any orthosis or walking aides. Inspect any insole and ask the patient which type of insole is comfortable and which type is painful.

Table 3 Correlations between the different gait patterns and the functional assessment

Examination of gait	Assessing the following aspects
Tiptoe walking	Ankle flexibility
	Posterior impingement
	Achilles/tibialis post function
	Midfoot function
	MTPJ problems
	Fractures (Stress)
	S1/2 function
Heel walking	Ankle mobility
	Anterior impingement
	Tibialis anterior function
	L4/5
	EHL/EDL function
	Plantar fasciitis/heel problems
Inner borders (inversion)/ outer borders (eversion) foot walking	Sub talar mobility
	Tibialis posterior function
	Peroneal tendons function
	5th ray problems
	Medial and lateral gutter impingement
	1st ray problem

Examination in a standing position

In most clinical setting the patient is sitting on the chair at the start of the examination. First ask the patient to stand up, and assess the alignment of the lower limbs as a whole. In particular look for any excessive varus or valgus knee deformity. Inspect the alignment of the spine in case of scoliosis, and look for any pelvic tilt. Inspect for any thigh or calf muscles wasting[7].

Look from the side for the feet arches (is there any pes cavus or pes planus), any swelling or scars. Inspect for any big toe deformity (hallus valgus, hallux valgus interphalangeus or hallus varus), lesser toes deformity (mallet toe, hammer toes, claw toes)[1]. In normal ankle, you should not be able to see the heel pad on the medial side when you inspect from the front. If this was visible then it is called "peek a boo" sign which exists with pes cavus[2]. It is important to compare both sides as a false-positive sign may be caused by a very large heel pad or significant metatarsus adductus[8].

Inspect the ankle from the back for any bony bumps like calcaneal boss[1]. The normal ankle alignment is neutral. Also notice if there is a "too many toes" sign. In a normal foot you should not be able to see more than 5th and 4th toes when you look at it from behind. If there were more toes visible (3rd or 3rd and 2nd), then it is called "too many toes" sign which can indicate an increased heel valgus angle.

Ask the patient to stand onto tiptoes. Both ankles should turn into varus. This indicates normal subtalar movement and, in case of flat feet, if a medial arch

Table 4 Different types of abnormal gaits

Type of the gait	Physical findings and observations	Possible cause
Antalgic gait	Short stance phase of the affected side Decrease of the swing phase of the normal side	Pain on weight bearing could be any reason from Back pathology to toe problem, *e.g.*, degenerative hip joint
Ataxic (stamping) gait	Unsteady and uncoordinated walk with a wide base	Cerebral cause Tabes dorsalis
Equinus (tiptoes) gait	Walking on tiptoes	Weak dorsiflexion and/or plantar contractures
Equinovarous gait	Walking on the out border of the foot	CETV
Hemiplegic (circumductory) gait	Moving the whole leg in a half circle path	Spastic muscle
Rocking horse (gluteus maximum) gait	The body shift backward at heel strike then move forward	Weak or hypotonic gluteus maximum
Quadriceps gait	The body leans forward with hyperextension of the knee in the affected side	Radiculopathy or spinal cord pathology
Scissoring gait	One leg crosses over the other	Bilateral spastic adductors
Short leg (Equinus) gait (more than 3 cm)	Minimum: Dropping the pelvis on the affected side Moderate: Walks on forefoot of the short limb Severe: Combination of both	Leg length discrepancy
Steppage gait (high stepping - slapping - foot drop)	No heel strike The foot lands on the floor with a sound like a slap	Foot drop Polio Tibialis anterior dysfunction
Trendelenburg (lurching) gait	Trunk deviation towards the normal side When the foot of the affected side leaves the floor, the pelvis on this side drops	Weak gluteus medius
Waddling gait	Lateral deviation of the trunk with an exaggerated elevation of the hip	Muscular dystrophy

Table 5 Movements of the ankle joint and possible causes of restrictions[3,9]

Movement	Normal range of motion	Possible causes of restriction
Dorsiflexion	0-20 degrees	Tight Achilles tendon Tightness of the posterior ligaments Loss of flexibility in the ankle syndesmosis Impingement of anterior soft tissue or osteophytes
Plantar flexion	0-50 degrees	Anterior capsule/ligaments contractures Posterior impingement
Inversion	0-35 degrees	Tension in the joint capsules and the lateral ligaments[1]
Eversion	0-15 degrees	Tension in the joint capsules and the medial ligaments[1]

[1]Inversion and eversion is mostly the motion of subtalar joint, the most common causes of restriction including subtalar arthritis, tarsal coalitions or calcaneal fracture malunion.

forms on standing on tip toes then this is a flexible pes planus[1].

Gait: Enquire if the patient can walk without a support and be prepared to provide support for elderly patients and those who may unsteady on their feet. Ask the patient to walk as per their normal gait. Observing the gait from the front and the back help to assess the shoulder and pelvic tilt. Looking from at the hip movements, knee movements, initial contact, three rockers, stride length, cadence and antalgesia.

The patient should then be asked to walk on his/her tiptoes, then heels, inner borders and finally the outer borders of the feet. Correlate your finding with possible causes as described in Tables 3 and 4. Beware not to miss a foot drop.

Examination in a sitting position

By this stage, a fair idea of the possible diagnosis may have been established. Hence, you should be able to direct the rest of the examination accordingly. We recommend at this stage to ask the patient to sit on the examining couch, with the legs hanging loosely from the side. Raise the bed so the patient's foot is at the level of the examiner's hand, and sit on a chair opposite the patient.

Look: Start with meticulous inspection of the sole then the rest of the foot. Look for skin discoloration, scar, ulcer, lack of hair (circulatory changes), nails, any skin thickening (callosity), hard/soft corns and any signs of infection[7].

Feel: First ask the patient if there are any areas which are painful to touch, so you can try to avoid causing pain during the examination. Then you start with gentle feel of the skin temperature, always comparing to the other side.

The second part of the palpation is to establish area of tenderness. Always follow a systematic method of palpation so you will not miss any part. We recommend to start the palpation for tenderness from proximal fibula, Achilles tendon, distal fibula, peroneal tendons, PTFL, CFL, ATFL, AITFL, Sinus tarsi, Calcaneum, Calcaneocuboid (CC) joint, Cuboid, lesser Metatarsals, Phalanges, 1st IP and MTP joint, 1st ray, TMT joints, Cuneiforms, Navicular, TN joint, Talus, Ankle

Table 6 Examination techniques of muscles functions[3]

Muscle	Ankle position	Manoeuvre of the test
Tibialis Anterior	Maximum Dorsiflexion and inversion	Try to plantar flex the ankle with your hand and ask the patient to resist, use your second hand on the tendon to feel the contraction (Figure 1)
Tibialis posterior	Plantar flexion and inversion	Patient inverts the foot in full plantar flexion whilst the examiner pushes laterally against the medial border of the patient's foot (in an attempt to evert the foot). The examiner needs to use second hand on the tendon to feel the contraction (Figure 2)
Peroneal longus and peroneal brevis	Plantar flexion and eversion	Patient everts the foot in full plantar flexion and the examiner pushes medially against the lateral border of the patient's foot (in an attempt to invert the foot) (Figure 3)
Extensor hallucis longus	Neutral	Patient extends the great toe and the examiner try to planter flex it (Figure 4)
Extensor digitorum longus	Neutral	Patient extends the lesser toes toe and the examiner try to planter flex it[1] (Figure 5)
Flexor hallucis longus and flexor digitorum longus	Neutral	Patient curls the toes downward and the examiner tries to dorsiflex them[1]

[1]It can be difficult to neutralize the intrinsic muscles completely.

Table 7 Examination techniques of performing the foot and ankle special tests[2,3,9,10]

Name of the test	Purpose of the test	Maneuver
Anterior drawer test	Lateral ligament complex	The leg hangs loosely off the table The examiner hold the patient's leg just above the ankle joint with one hand The examiner uses the other hand to hold the ankle in plantar flexion and try to gently to pull the ankle forward - anterior translation (Figure 6) Look at the skin over the anterolateral dome of the talus to watch for anterior motion of the talus with this maneuver - sulcus sign
Inversion stress test	Stability of the lateral ankle ligaments (ATFL)	The knee is flexed 90 degree With one hand perform inversion stress by pushing the calcaneus and talus into inversion while holding the leg form the medial side with the other hand (Figure 7) The test is positive when there is excessive inversion and/or pain
Calf compression or "squeeze" test	Syndesmotic injury	The leg hangs loosely off the table - knee flexed The examiner uses both hand to squeeze at midpoint of the tibia and fibula Pain caused by this maneuver indicates Syndesmotic injury
External rotation stress	Syndesmotic injury	The leg hangs loosely off the table - knee flexed and foot fully dorsiflexed The examiner uses one hand to stabilize the lower leg With the other hand they externally rotate the foot Pain caused by this maneuver indicates Syndesmotic injury
Coleman block test	To assess the flexibility of the hindfoot, *i.e.*, whether the cavus foot is caused by the forefoot or the hindfoot	A block is placed under the lateral border of the patients foot The medial forefoot is allowed to hang over the side The first metatarsal will be able to drop below the level of the block, *i.e.*, eliminate the contribution by the first ray (Figure 8) With a flexible hindfoot, the heel will fall into valgus or neutral termed forefoot-driven hindfoot varus In case of rigid hindfoot or hindfoot-driven hindfoot varus the heel will remain in varus, and no correction will be happen
Semmes-weinstein monofilament test	To assess the degree of sensory deficit	Pressure testing using a 10 g Semmes-Weinstein mono- filament. Especially useful in diabetic charcot feet (Figure 9)

Figure 1 Test for tibialis anterior muscle.

Figure 2 Test for tibialis posterior muscle.

Table 8 Examination techniques of performing the foot and ankle special tests[2,3,9,10]

Name of the test	Purpose of the test	Manoeuvre
Silfverskiold test	Differentiate between a tight gastrocnemius and a tight soleus muscle	The leg hangs loosely off the table - knee flexed Dorsiflex the ankle to the maximum Patient should then extend their knee Repeat the ankle dorsiflexion (Figure 10) If there was more ankle dorsiflexion with the knee flexed then there is gastrocnemius tightness
Thompson's test	Achilles' tendon rupture	Patient lies is prone on the bed or kneel on a chair The examiner gently squeeze the gastrocsoleus muscle (calf) If the tendon is intact, then the foot passively plantar flexes when the calf is squeezed
Test for tarsal tunnel syndrome	Compressions of the posterior tibial nerve underneath the flexor retinaculum at the tarsal tunnel	Tap inferior to the inferior to the medial malleolus to produce Tinel's sign
Test for flat foot	Differentiate between flexible *vs* rigid	Ask patient to stand on tiptoes If the medial arch forms and heel going into varus then it is flexible flat foot Beware of rupture tibialis posterior tendon or tarsal coalition
Test for stress fractures	Stress fractures	Place a tuning fork onto the painful area If it increases the pain, then it is positive Other test: One spot tenderness on palpation with finger
Babinski's response	Upper motor neuron disease	Scratch the lateral border of the sole of the foot A positive response is dorsiflexion of the great toe
Oppenheim's test	Upper motor neuron disease	Run a knuckle or fingernail up the anterior tibial surface A positive response is dorsiflexion of the great toe
Mulder's test	Morton's neuroma	A mass felt or audible Click is elicited by palpating (grasping) the forefoot (web space) with the index finger and thumb of the examiner

joint, Medial malleolus, Tibialis post, Tibialis anterior, extensors and other flexors and finally plantar fascia.

Move: Start with active movement by asking the patient to perform dorsiflexion, plantar flexion, inversion, and eversion. Always compare both sides (Table 5).

This will be followed by passive movement of dorsiflexion: As the patient is already sitting, the knee is flexed to 90 degrees then repeat the test with knee straight (Silfverskiold test). Keep the foot in a neutral position (0 degree of inversion and eversion), hold the back of the leg with one hand and use the palm of the other hand to push the sole of the examined foot[9].

Table 9 Three common pathologies and the related necessary clinical tests[7]

Special pathology	Required tests
Pes cavus	Claw toes Examine peroneal tendons Tibialis anterior and posterior Coleman block test Examine the Achilles tendon Full lower and upper limb neurological examination Hand - inspect for muscle wasting Spine
Pes planus	Single leg sustained tip toe test Testing tibialis posterior power Too many toes sign Examine the Achilles tendon
Hallux valgus/ rigidus	Dorsal osteophyte Passive ROM Grind tests Correct the deformity Examine the Achilles tendon

Table 10 Medical Research Council scale to assess the strength of muscle[8]

Grade	Description
Grade 0	No contraction
Grade 1	Flicker or trace of contraction
Grade 2	Active movement with gravity eliminated
Grade 3	Active movement against gravity
Grade 4	Active movement against gravity and resistance
Grade 5	Normal power

Now move the palm of the hand to the dorsum of the examined foot to produce the passive plantar flexion.

Supination and pronation are triplanar movements. Supination is the combination of Inversion, Plantarflexion and adduction. Pronation is the combination of Eversion, Dorsiflexion and Abduction.

Inversion: Place one hand over the back of the leg and use your other hand to grasp the calcaneus between your index finger and thumb and use your forearm to fully dorsiflex and lock the talus in the ankle. Rotate the calcaneus in a medial direction to test for inversion and move your hand in a lateral direction to test for Eversion[9].

Midfoot movements: Stabilize the calcaneus and talus with one hand and use the other hand to move the foot medially to test for Adduction). Move the foot laterally to test for the abduction[9]. It is also important to examine the motion of midfoot (transverse tarsal joint) on sagittal plane (specially for patients with end stage ankle arthritis). The motion of 1st TMT joint should be examined as well (for patients with hallux valgus or flexible flatfoot).

Forefoot movements (metatarsophalangeal and interphalangeal joints): You should test the

Figure 3 Test for the peroneal tendons.

Figure 4 Test for extensor hallucis longus.

Figure 5 Test for extensor digitorum longus.

Figure 6 Anterior drawer test.

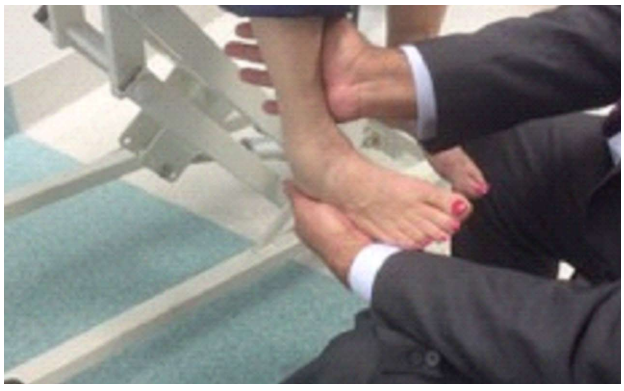

Figure 7 Inversion stress test.

movement in each joint separately. If there is any deformity, try to find whether it is correctable or not (for example, a fixed flexion deformity).

The examination of muscular function and the special tests should be the next step of the assessment. Both of these aspects are summarised in Tables 6, 7, 8 and 9. The strength of each muscle is assessed using the medical research council (MRC) scale Table 10.

The examination of the foot and ankle is not complete until you perform neurovascular examination, an examination of the spine (deformity like scoliosis, hair tuft on the lower back), leg length, hip joint examination and knee joint examination.

Finally, it is important to consider Functional testing which is important and needs to be appropriate to the level and background of the patient for instance, a single leg squat or squat jump for higher level athletes may indicate issues not obvious with more static tests.

CONCLUSION

The assessment of foot and ankle pathology can

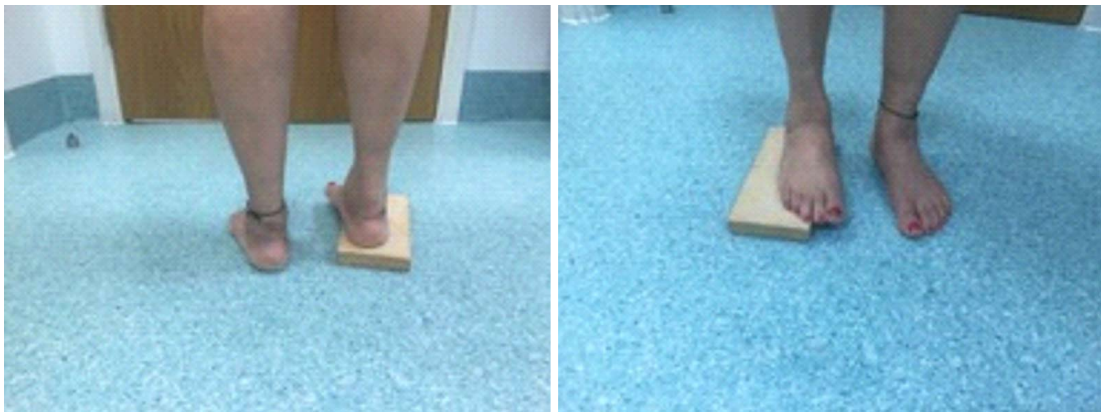

Figure 8 Coleman block test.

Figure 9 Semmes - weinstein monofilament test.

Figure 10 Silfverskiold test.

be challenging, hence the importance of following a systematic method for its clinical assessment. We have described here one way of performing the clinical examination. It has been built using the best available evidence, and has been tested and evolved through the experience of the senior author. We recommend this approach for residents who are preparing for their specialty exams, for clinicians in family or sports medicine, and for any physician who has to deal with foot and ankle patients.

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