ROLE OF ULTRASONOGRAPHY IN IMPINGEMENT SYNDROMES OF THE ANKLE JOINT

Essay study submitted for partial fulfillment of M.S degree in Radiodiagnosis

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Introduction:

Joint impingement is a painful syndrome caused by the friction of the joint tissues which is both the cause and the effect of altered joint biomechanics.

From both an anatomical and a clinical viewpoint these syndromes are classified as bone impingement, soft tissue impingement and entrapment neuropathy depending on which joint portion impinges on the others.***(Kessel L. 1986, Hawkins and Kunkell 1990)***

Soft tissue and osseous impingement syndromes of the ankle can be an important cause of chronic pain particularly in the professional athlete .The main impingement syndromes are anterolateral, anterior, anteromedial and posterior impingement.

These conditions arise from initial ankle injuries which in the subacute or chronic situation lead to development of abnormal osseous and soft tissue thickening within the ankle joint. There is physical impingement and painful limitation of ankle movement**. *(Robinson and White, 2002)***

Deep peroneal nerve entrapment, the medial plantar nerve entrapment syndrome and the tarsal tunnel syndrome are the most important entrapment neuropathies of the ankle. ***(Masciocchi et al. , 1998)***

Accurate nerve examination must be performed particularly in patients with atypical ankle pain to detect focal tenderness or paresthesia. Ultrasonography is useful in this setting because it yields both clinical and morphologic findings. ***(Emmanuelle M. et al , 2003)***.

US is a rapid, widely available and inexpensive modality for evaluation of pathologic conditions of the ankle.***(Fessel et al , 1998).***

One of the most important features of ultrasound that it permits dynamic assessment. It is the only imaging technique that allows direct interaction between the patient and the operator through active, passive or resisted movement with the advantage of direct anatomical and functional visualization.

The operator can take the advantage of a comparative bilateral study to increase the diagnostic confidence. With all these advantages, U/S has became lately one of the best imaging modalities for the muscloskeletal system, even sometimes equal or even superior to MRI.***(Martino et al. , 2007)***

Aim of work :

To highlighten the role of ultrasonography in impingement syndromes of the ankle.

NORMAL ANATOMY OF THE ANKLE

It includes osseous component, soft tissue component and neurovascular bundles passing in this area.

A- The osseous component: (fig 2.1)

It includes both lower ends of the tibia and fibula including the medial and lateral malleoli and the tarsal bones. Tarsal bones are seven bones arranged in two rows:
the proximal row: talus and calcaneus, and
the distal row (from medial to lateral):medial, intermediate and lateral cuneiform bones, cuboid and navicular bones.

(MC.Minn,1994)

The calcaneus - the largest of the tarsal bones - articulates directly with the talus and the cuboid bones. Along the upper and medial surface of the calcaneus there is a bony shelf, the sustentaculum tali, which serves as a roof for the flexor hallucis longus tendon.

The talus rests between the distal tibia and the calcaneus, it has a prominent body leading anteriorly into the neck and head. The convex articular surface along the superior surface of the body of the talus is called trochlea. Behind the trochlea is the posterior process, which is grooved in the midline to accommodate the flexor hallucis longus tendon. This process is commonly seen unfused, in which case it is referred to as the os trigonum.

(Sinnatamby CS ,2000).

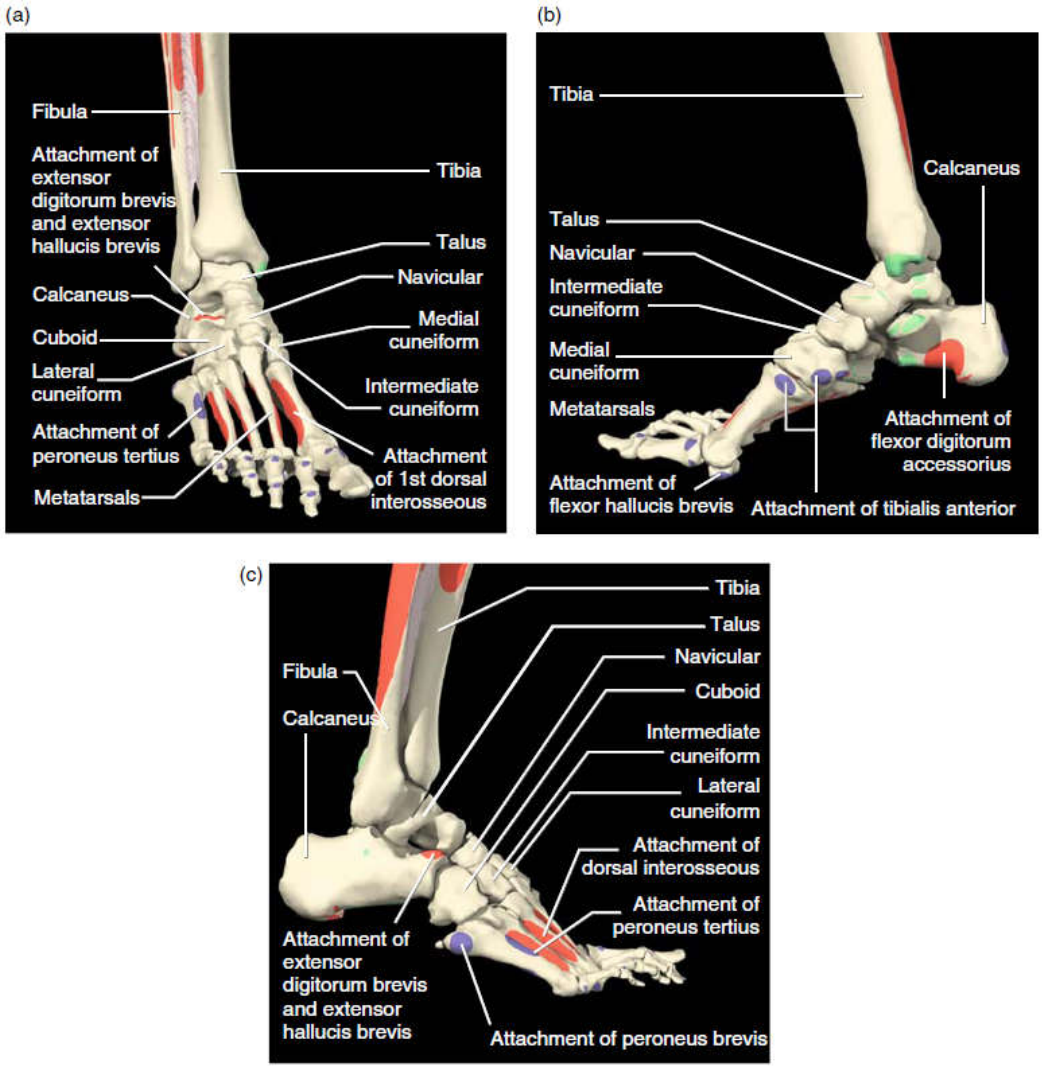

Fig 2.1 *The important bony landmarks and muscle origin (red) and insertion (blue) points of the muscles and bones around the ankle: (a) anterior (b) medial (c) lateral view.* ***(O`Neill and Glickman, 2008)***

B- The soft tissue component :

1-Muscles and tendons: (fig 2.1 and 2.2)

The tendons around the ankle are divided into: anterior, posterolateral, posteromedial and posterior groups.

a- The anterior (extensor) group:

Is contained within the space bounded by the deep fascia anteriorly and posteriorly by the interosseous membrane , (from medial to lateral) lies : the tibialis anterior (TA), extensor hallucis longus (EHL), extensor digitorum longus (EDL) and the peroneus tertius (PT) . The anterior tibial artery and vein and deep peroneal nerve are also found within this space.

b- The posteromedial group of tendons:

Lies at the level of medial malleolus from anteromedial to posteromedial they are the: tibialis posterior (TP) , flexor digitorum longus (FDL) , and flexor hallucis longus (FHL), (Tom , Dick, and Harry). They travel through the tarsal tunnel surrounded by separate tendon sheaths.

c- The posterolateral group of tendons:

Is composed of the peroneus longus (PL) and brevis (PB).

d- The posterior group of tendons:

Is composed of the Achilles and the plantaris tendons.

(*Farooki et al, 2000)*

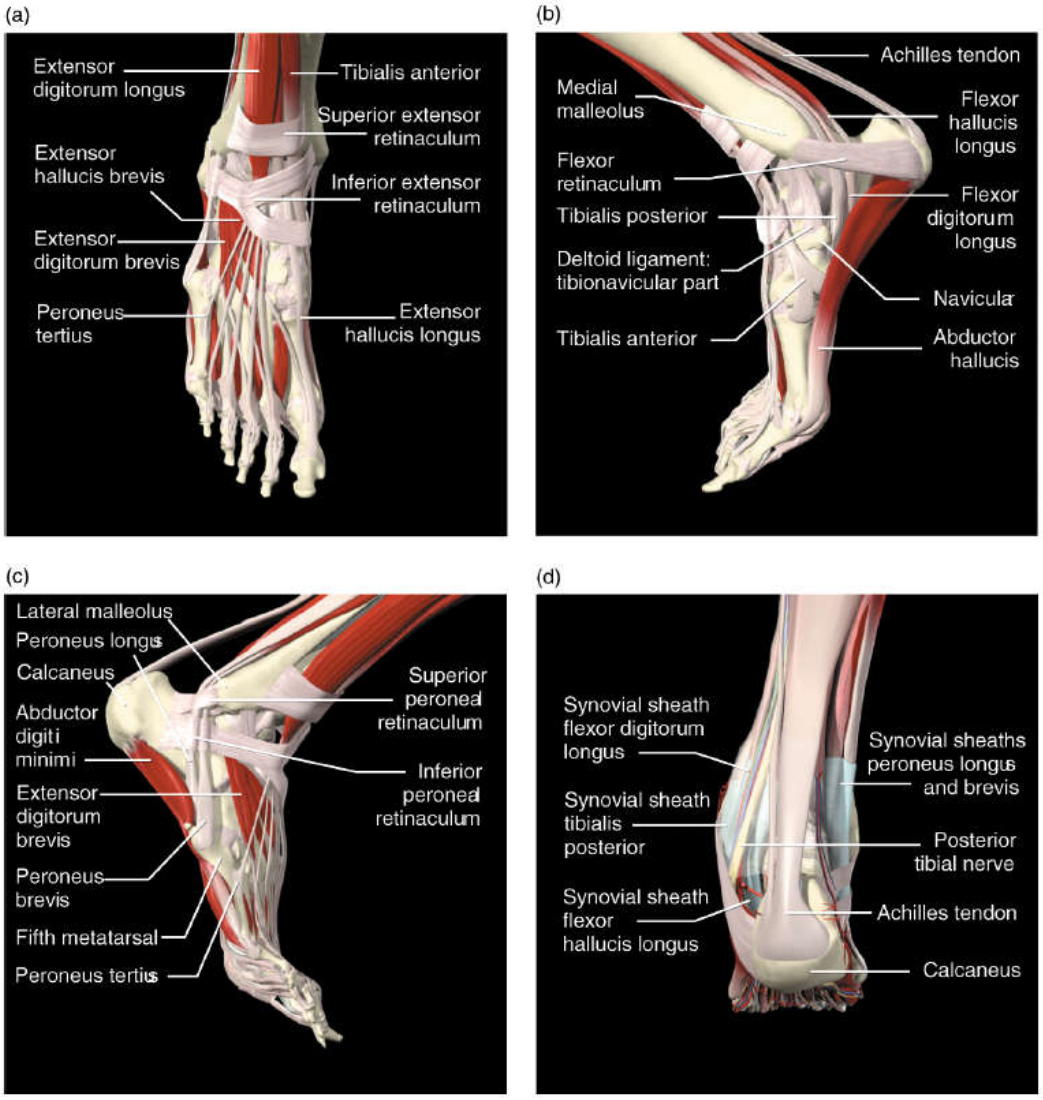

Fig 2.2 : The muscles, tendons and retinaculae around the ankle joint (a) anterior (b) medial (c) lateral (d) posterior. ***(O`Neill and Glickman,2008)***

Regarding the medial aspect of the ankle joint as the epicenter, the anterior **extensors** progress anteriorly following the mnemonic Tom (tibilias anterior), Hates (extensor hallucis longus) Dick (extensor digitorum longus. The **flexors** are arranged posteriorly as Tom (tibialis posterior), Dick (flexor digitorum longus) and Harry (flexor hallucis longus). ***(O`Neill and Glickman,2008)***

The following table describes the origin and the insertion of the muscles of the ankle.

MUSCLE	ORIGIN	INSERTION	MAIN ACTION
ANTERIOR COMPARTMENT:			
1- Tibialis anterior	Lateral proximal shaft of the tibia, interosseous membrane.	Medial cuneiform, base of foot metatarsal	Dorsiflexion and inversion of the foot
2- Extensor hallucis longus	Anterior fibula and interosseous membrane.	Base of the distal phalanx of the great toe	Dorsiflexion and extension of great toe
3- Extensor digitorum longus	Lateral tibial condyle, anterior shaft of fibula and interosseous membrane.	Base of middle and distal phalanges of 2^{nd} to 5^{th} toes	Dorsiflexion and extension of 2^{nd} to 5^{th} toe

4- Peroneus tertius	Lower third of the anterior surface of fibula and interosseous membrane.	Dorsal base of the 5th metatarsal	Dorsiflexion and eversion of the foot
LATERAL COMPARTMENT:			
1-Peroneus longus	Head and proximal lateral shaft of the fibula	Medial cuneiform and plantar aspect of base of 1st metatarsal	Eversion and plantar flexion of the foot
2-Peroneus brevis	Distal lateral shaft of the fibula	Base of 5th metatarsal	Eversion and plantar flexion of the foot
POSTERIOR COMPARTMENT:	*SUPERFIC-IAL GROUP*		
1-Gastro-cenemius	Lateral and medial heads from lat and med femoral condyles	via the Achilles tendon onto the posterior calcaneus	Plantar flexion of foot
2-Soleus	Posterior head of fibula and adjacent proximal	via the Achilles tendon onto the posterior calcaneus	Plantar flexion of foot

	shaft, soleal tibial line.		
3-Plantaris	Lateral femoral supracondylar line	posterior calcaneus ,medial to Achilles insertion	Plantar flexion of foot
POSTERIOR COMPARTMENT:	*DEEP GROUP*		
1-Tibialis posterior	Posterior aspect of interosseous membrane, tibia and fibula	Navicular tuberosity and fibrous expansions to cuboid, cuneiforms,2^{nd} to 4^{th} metatarsal bases.	Plantar flexion and inversion of the foot
2- Flexor digitorum longus	Posterior shaft of the tibia	Bases of distal phalanges of 2^{nd} to 5^{th} toes.	Plantar flexion of the 2^{nd} to 5^{th} toes
3- Flexor hallucis longus	Posterior fibula lower 2/3	Base of distal phalanx of great toe.	Plantar flexion of the great toe.

(O`Neill and Glickman,2008)

2- Ligaments: (fig 2.3)

Three distinct groups of ligaments support the ankle joint: the syndesmotic ligament complex ,the medial and lateral collateral ligaments .

a- The syndesmotic ligament complex *:*

It is made up of four ligaments:

The anterior tibiofibular ligament (ATBF), the posterior tibiofibular ligament (PTBF), the transverse tibiofibular ligament (TTF) and the interosseous tibiofibular ligament (ITF).

b- The medial (tibial) collateral ligament **(deltoid ligament):**

It is triangular with the base forming the more distal component, it originates proximal to medial malleolus, distal to this attachment it is composed of deep and superficial layers with marked intermingling of the two layers.

The superficial layer consists of three components (with regards to the direction in which fibers are oriented) :

The anterior tibionavicular lig (TN), the intermediate tibiocalcaneal lig (TC) and the posterior tibiotalar lig (TT).

The deep layer:

Which is covered internally by synovium.

c- The lateral (fibular)collateral ligament consists of :

Anterior talofibular ligament (ATAF), posterior talofibular ligament (PTAF) and calcaneofibular ligament (CF).

Other remaining ligaments of the ankle are:

The superior talonavicular ligament (STAN) which add stability to talonavicular joint and the inferior calcaneonavicular ligament (ICN) (spring ligament) which stabilizes the head of talus.

(Cheung Y et al, 2000)

The following table describes the origin and insertion of the ligaments of the ankle.

LIGAMENT	ORIGIN	INSERTION
THE SYNDESMOTIC LIGAMENT COMPLEX:		
1-Anterior tibiofibular ligament	Anterior margin of the fibular notch of the tibia	Distal aspect of the fibular shaft and proximal anterior lateral malleolus
2-Posterior tibiofibular ligament	Posterior surface of the lateral malleolus and proximal aspect of the fibular malleolar fossa	Posterior aspect of the tibia attaching as far medially as the medial malleolus

3-Interosseous tibiofibular ligament	Attach to the mid aspect of the distal fibular shaft at the proximal border of the fibular malleolar facet. It is continuous with the proximal interosseous membrane	Roughened area on the lateral aspect of the distal tibia.
THE MEDIAL (TIBIAL) COLLATERAL LIGAMENT:		
A-Superficial part consists of 3 parts :	*The superficial part originates from anterior caliculus of medial malleolus.*	
1-The anterior tibionavicular lig		To navicular tuberosity and medial edge of spring ligament
2-The intermediate tibiocalcaneal lig		To the sustentaculum tali of the calcaneus
3-The posterior tibiotalar lig		To the medial talar tubercle and the medial side of the talus.