



# Anatomical and magnetic resonance imaging study of the medial collateral ligament of the ankle joint



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## KEYWORDS

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**Abstract** *Introduction:* The medial collateral ligament of the ankle joint also known as the deltoid ligament, is a multifascicular group of ligaments. It can be divided into a superficial and deep group of fibers originating from the medial malleolus to insert in the talus, calcaneus, and navicular bones. Wide variations have been noted in the anatomical description of the medial ligamentous complex of the ankle. The various components of the deltoid ligament are well visualized on both axial and coronal images on routine ankle MR imaging sequences including T1 weighted image and T2 weighted image.

*Aim:* This study was done to study the anatomy of the normal and variated attachment of the medial collateral ligament of the ankle joint, and also to study the MR imaging of the normal, variated and disrupted attachment of the medial collateral ligament.

*Materials and methods:* Twenty preserved cadaveric adult ankle specimens were collected from the dissecting room, Anatomy Department, Faculty of Medicine, Alexandria University. MR imaging of ten ankles was performed before and after disruption of every band of the ligament of medial side of the ankle.

*Results:* The medial collateral ligament of the ankle was found to consist of six bands or components, three of them are always present whereas the presence of the other three may vary. The exact attachments and measurements of these bands were described.

Axial imaging provided optimum views of the deep layers of the medial collateral ligament and the tibionavicular ligament. Coronal imaging allowed complete visualization of the tibio-calcaneal, and

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deep posterior tibiotalar ligaments. High resolution MR imaging allows excellent visualization of the collateral ligaments of the ankle.

*Conclusion:* The study of the anatomy of the ankle joint, its collateral ligaments and their functions aid for the proper diagnosis and treatment of the conditions affecting the ankle.

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## 1. Introduction

The ligaments of the ankle hold the ankle bones and joint in position and they protect the ankle joint from abnormal movements – especially twisting of the foot.<sup>1</sup>

The medial collateral ligament of the ankle joint also known as the deltoid ligament, is a multifascicular group of ligaments.<sup>2</sup> The deltoid ligament is a strong restraint that limits talar abduction and pronation.<sup>3</sup>

It can be divided into a superficial and deep group of fibers originating from the medial malleolus to insert in the talus, calcaneus, and navicular bones.<sup>4</sup>

Wide variations have been noted in the anatomical description of the medial ligamentous complex of the ankle. The medial ligamentous complex is multibanded and it can be considered as having superficial and deep components<sup>4,5</sup>; the tibiocalcaneal ligament constitutes the superficial layer of the deltoid ligament that spans the medial malleolus to the medial aspect of the calcaneus. The other three divisions, the anterior tibiotalar, intermediate tibiotalar ligament, and posterior tibiotalar ligament, they attach the medial malleolus to the talus. Although the tibiocalcaneal ligament is extremely thin and supports only negligible forces before failing, the tibiotalar ligaments are strong. Six bands or component have been described for the medial collateral ligaments. Four components were superficial (tibiospring, tibionavicular, superficial posterior tibiotalar, and tibiocalcaneal ligaments) of which only the tibiospring and tibionavicular ligaments were constant. Two bands were deep (deep posterior tibiotalar and deep anterior tibiotalar ligaments), of which the deep posterior tibiotalar ligament was constant.<sup>5</sup>

Because the tibioligamentous portion of the superficial deltoid has a broad insertion on the spring ligament, this ligament complex may interplay with the deltoid ligament in the stabilization of the medial ankle joint, and thus functionally cannot be separated from it. The tendon sheath of the posterior tibial muscle covers the posterior and middle part of the deltoid ligament.<sup>5,6</sup>

Medial instability is suspected on the basis of patient's feeling that his/her ankle is "giving – way" especially medially, when walking on ground or on downstairs, pain at the antero-medial aspect of the ankle, and sometimes pain on the lateral aspect of the ankle, especially during dorsiflexion of the foot.<sup>7</sup> Injuries to the medial side of the ankle and foot in the athlete can involve several different structures, abnormalities, and grades of injury. The tibialis posterior tendon (TPT), the spring and deltoid ligament complexes combine to provide dynamic and passive stabilization on the medial side of the ankle and hindfoot.<sup>8</sup>

Diagnosis of the medial ankle instability depends on patient's history of having sustained eversion trauma (i.e., outward rotation of the foot during simultaneous inward rotation of the tibia).<sup>7</sup>

Magnetic resonance (MR) imaging plays an important role in the diagnosis and treatment of many musculoskeletal diseases of the ankle and foot. It demonstrates the abnormalities of the bones and soft tissues before they become evident at other imaging modalities. Being noninvasive and has multi-planer capabilities making it valuable for the detection and assessment of a variety of soft tissue disorders especially the ligament (e.g., Sprain), MR imaging is increasingly being recognized as a modality of choice for the assessment of pathologic conditions of the ankle and foot.<sup>9,10</sup>

Routine ankle MR imaging sequences including T1 weighted image and T2 weighted image are performed in the axial and coronal planes. The foot is imaged in the axial plane (parallel to the long axis of the metatarsal bones) and coronal plane (perpendicular to the long axis of the metatarsals).<sup>10</sup>

In general the ligaments are readily identified as thin, linear and low signal intensity structures joining adjacent bones. The various components of the deltoid ligament are well visualized on both axial and coronal images. The deep tibiotalar component of the deltoid ligament normally demonstrates regular striations and thus has a heterogeneous appearance.<sup>11</sup>

The injured ligament is frequently thickened and heterogeneous. Injuries to the tibiotalar component of the deltoid ligament manifest as loss of the regular striations that are normally seen in the ligament.<sup>11,12</sup>

*The Aim* was to study the anatomy of the normal and varied attachment of the medial collateral ligament of the ankle joint, and also to study the MR imaging of the normal, varied and disrupted attachment of the medial collateral ligament.

## 2. Materials and methods

Twenty preserved cadaveric adult ankle specimens were collected from the dissecting room, Anatomy Department, Faculty of Medicine, Alexandria University.

Twenty human preserved ankle specimens were subjected to dissection and ten ankle specimens were subjected to MRI imaging to demonstrate anatomical and disrupted attachment of the medial collateral ligament of the ankle.

### 2.1. Anatomical study

This was carried out on twenty ankles from ten adult cadavers.

Each ankle was placed on the dissecting table in supine position. Three cutaneous incisions were prepared as follows: an upper semicircular incision just 0.5 cm above the ankle anteriorly, a posterior incision 1.5 cm away from the posterior aspect of the Achilles tendon and a lower longitudinal incision joining the upper and posterior incisions. The flap consisting of the skin and subcutaneous tissue was reflected upward and medially. A thin layer of adipose tissue was removed to expose the underlying tendons, ligaments and bones. The underlying

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