A Study to Diagnose Ligament Injuries of Talo-crural Joint by Plain X-rays

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Abstract: *The ankle joint is one of the most frequently injured joints. The ankle injuries usually occur in the plantar flexed position of the foot. The lateral ligament is injured more often when compared to the medial. A sprained ankle results due to tear of the anterior talofibular and calcaneofibular ligaments when the foot is twisted in lateral direction. In forcible eversion of the foot the deltoid ligament may be torn. At times the deltoid ligament pulls the medial malleolus thereby causing avulsion fracture of the malleolus. Pott's fracture occurs when the foot is caught in a hole in the ground and the foot is forcibly everted. In this condition, at first there is an oblique fracture involving the shaft and lateral malleolus of thefibula. The strong eversion pull on the deltoid ligament causes a transverse fracture of the medial malleolus as well. If the tibia is carried anteriorly, the posterior margin of the distal end of the tibia is also broken, thereby producing a trimalleolar fracture. Although in our country the advancement in medicine is progressing greatly, the sophisticated imaging modalities like MRI and CT are still out of reach especially in the rural areas. Therefore although X-Rays have been the ideal imaging modality to identify fractures, in ligament sprain the injuries need to be evaluated so as to provide adequate treatment. So this study uses plain X-rays of the ankle to diagnose the abnormalities resulting from injuries to the ankle ligaments.*

Keywords: Ligaments, Sprain, X-Ray, Talo-crural Angle.

1. Introduction

Dorsiflexion and plantar flexion are the two main actions that are permitted at the talo-crural joint. The empirical axis of the ankle joint passes distal to the tips of both malleoli, i.e. at 5 mm ± 3 mm range (0 to 11 mm) distal to the tip of the medial malleolus and at 3 mm ± 2 mm range (0 to 12 mm) distal to and at 8 mm ± 5 mm anterior to the tip of the lateral malleolus[8]. The axis is inclined downwards and laterally in the frontal plane and is rotated posterolaterally in the horizontal or transverse plane. In the frontal plane, the angle between empirical axis of the ankle and midline of the tibia is 82.7degrees ± 3.7 degrees, with a range of 74 to 94 degrees in the transverse plane. The angle of ankle axis with transverse axis of the knee is 20 to 30 degrees. Some workers recognized two axis to the ankle joint[4,5,6,7]. A dorsiflexion axis inclined downwards and laterally and a plantar flexion axis inclined downward and medially. The changeover occurs within a few degrees of the neutral position of the talus.

The ankle joint is one of the most frequently injured joints[1]. The ankle injuries occur in the plantar flexed position of the foot. The lateral ligament is injured more often when compared to medial. A sprained ankle results due to tear of the anterior talofibular and calcaneofibular ligaments when the foot is twisted in lateral direction. In forcible eversion of the foot the deltoid ligament may be torn. At times the deltoid ligament pulls the medial malleolus thereby causing avulsion fracture of the malleolus. Pott's fracture occurs when the foot is caught in a hole in the ground and the foot is forcibly everted. In this condition, at first there is an oblique fracture involving the shaft and lateral malleolus of the fibula. The strong eversion pull on the deltoid ligament causes transverse fracture of the medial malleolus as well. If the tibia is carried anteriorly, the posterior margin of the distal end of the tibia is

also broken thereby producing a trimalleolar fracture.Conventionally X-ray techniques have been used to diagnose ligament injuries.Magnetic resonance (MR) imaging has opened new horizons in the diagnosis and treatment of many musculoskeletal diseases of the ankle and foot. It demonstrates abnormalities in the bones and soft tissues as well before these become evident at other imaging modalities.

Chen Yan-Xi et al.[3] in 2011 on a study of three-dimensional morphological characteristic measurements of ankle joint based on computed tomography (CT) image post-processing, commented that the mean talocrural angle (10.01±0.38)° measured 10.1 degrees with a standard deviation of 0.38 degrees. Tibiofibular clear space mean measurements were 2.78 mm, with a standard deviation of 0.19 mm. There was no significant correlation with gender, height and weight (P >0.05) in 100 cases, (50 males and 50 females).

Patil MS et al.[2] in 2012 in their study on anthropometric measurements of ankle mortise for evaluating mortise fracture reductions with an aim to develop contoured implants measured the talocrural angle, tibiofibular clear space, tibiofibular overlap and compared joint clear space at two places. Anteroposterior radiographs, of both ankles in 20 adult individuals formed the material. They agreed that the talocrural angle of two ankles of a given individual does not vary by more than 2 degrees. Tibiofibular clear space on anteroposterior radiographs measured a mean value of 2.4 mm with a standard deviation of 1.3 mm. Tibiofibular overlap on anteroposterior radiographs measured a mean value of 11.2 mm with a standard deviation of 4.4 mm. Joint spaces at two levels were almost equal.

Although in our country the advancement in medicine is progressing greatly, the sophisticated imaging modalities like

MRI and CT are still out of reach especially in the rural areas. Therefore although X-Rays have been the ideal imaging modality to identify fractures, in ligament sprain the injuries need to be evaluated so as to provide adequate treatment. So this study uses plain X-rays of the ankle to diagnose the abnormalities resulting from injuries to the ankle ligaments.

Aims and Objectives:

To study the radiological features of normal and abnormal talocrural joint.

2. Materials and Methods

This study was done in The Oxford Medical College Hospital and Research Centre, Bangalore. Thirty cases were selected, X-Raysof the feet were done and the following parameters were measured.
- Talocrural Angle.
- Tibial overlap.
- Tibiofibular distance.
- Joint Space A.
- Joint Space B.

Image 1: X-ray, AP view measurements

The above parameters were measured using computer software. The measurements were cross checked in comparison with that of normal X- rays.

3. Results

Table 1: Morphometry with each side and gender

Parameters	Side	Mean	Std.	Sig. (2-	Sex	Mean	Std.	Sig. (2-
Talocrural angle°	R	13.4	1.59	0.57	M	13.26	1.62	0.91
	L	13.06	1.57		F	13.2	1.56	
Tibial overlap	R	10.85	0.74	0.165	M	10.5	0.54	0.166
	L	10.5	0.60		F	10.85	0.79	
Joint space a	R	2.98	0.39	0.528	M	3.03	0.49	0.967
	L	3.08	0.46		F	3.02	0.36	
Joint Space b	R	3.06	0.36	0.963	M	3.11	0.43	0.479
	L	3.06	0.39		F	3.01	0.32	
Tibio Fibular Distance	R	3.56	0.36	0.776	M	3.64	0.29	0.274
	L	3.6	0.25		F	3.52	0.32	
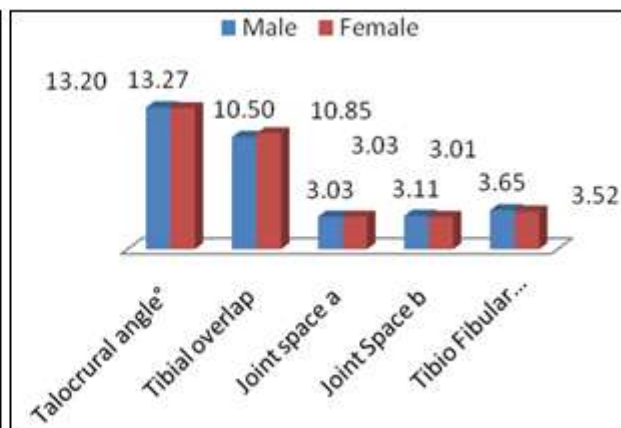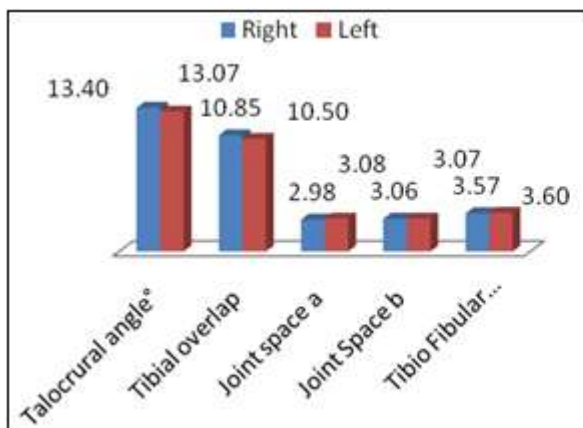
Graph No. 1 (left) and 2 (right): side and gender comparison of radiological parameters.

X-axis: Components to be measured. Y-axis: measurement in mm.

Irrespective of the side and sex to which it belongs, the mean value of the talocrural angle is 13.23 degrees, tibial overlap is 10.67 mm, tibiofibular distance is 3.58 mm, joint Space A is 3.03 mm, joint Space B is 3.06 mm.

The mean length values on the right side are 13.4 degrees, 10.85 mm, 3.56 mm, 2.98 mm and 3.06 mm. The mean length values on the left side are 13.06 degrees, 10.5 mm, 3.6 mm, 3.08 mm and 3.06 mm.

The mean length values in the males are 13.26 degrees, 10.5 mm, 3.64 mm, 3.03 mm and 3.11 mm. The mean length values in the females are 13.2 degrees, 10.85 mm, 3.52 mm, 3.02 mm and 3.01 mm.

4. Discussion

Irrespective of the side and sex to which the it belongs, the mean value of the Talocrural Angle is 13.23 degrees, tibial overlap 10.67 mm, tibiofibular distance is 3.58 mm, joint Space A is 3.03 mm, joint Space B is 3.06 mm. Joint space a is almost equal to joint space b.

The mean length values on the right side are 13.4 degrees, 10.85 mm, 3.56 mm, 2.98 mm and 3.06 mm with a standard deviation of 1.59 degrees, 0.74 mm and 0.36 mm, 0.39 mm and 0.36 mm. Joint space a is almost equal to joint space b.

The mean length values on the left side are 13.06 degrees, 10.5 mm, 3.6 mm, 3.08 mm and 3.06 mm with a standard deviation of 1.57 degrees, 0.60 mm and 0.25 mm, 0.46 mm and 0.39 mm. Joint space a is almost equal to joint space b.
The measurements are similar on both sides.

The mean length values in the males are 13.26 degrees, 10.5 mm, 3.64 mm, 3.03 mm and 3.11 mm with a standard deviation of 1.62 degrees, 0.54 mm and 0.29 mm, 0.49 mm and 0.43 mm. Joint space a is almost equal to joint space b.

The mean length values in the females are 13.2 degrees, 10.85 mm, 3.52 mm, 3.02 mm and 3.01 mm with a standard deviation of 1.56 degrees, 0.79 mm and 0.32 mm, 0.36 mm and 0.32 mm. Joint space a is almost equal to joint space b.
The measurements are similar in both sexes.

M.S. Patil et al.[2] in their study on anthropometric measurements of ankle mortise for evaluating mortise fracture reductions with an aim to develop contoured implants measured the talocrural angle, tibiofibular clear space, tibiofibular overlap and compared joint clear space at two places. Anteroposterior radiographs, of both ankles in 20 adult individuals formed the material. They agreed that the talocrural angle of two ankles of a given individual does not vary by more than 2 degrees. Tibiofibular clear space on anteroposterior radiographs measured a mean value of 2.4 mm with a standard deviation of 1.3 mm. Tibiofibular overlap on anteroposterior radiographs measured a mean value of 11.2 mm with a standard deviation of 4.4 mm. Joint spaces at two levels were almost equal.

The study on three-dimensional morphological characteristics measurements of ankle joint based on computed tomography (CT) image post-processing by Chen Yan-xi et al[3] showed that the mean talocrural angle (10.01±0.38°) measured 10.1 degrees with a standard deviation of 0.38 degrees. Tibiofibular clear space mean measurements were 2.78 mm, with a standard deviation of 0.19 mm. There wasno significant correlation with gender, height and weight (P >0.05) in 100 cases, (50 males and 50 females).

The study is in agreement with the other studies.

5. Conclusion

The measurements are similar on both sides.The male and the female side measurements are similar as well.

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