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Research article

A Comparison of the Radiographic Axial Oblique View with Routine Mortise View of the Ankle Joint in Acute Injury

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Abstract

The purpose of the study was to assess the diagnostic potential of the axial oblique view in acute ankle injury prospectively. This was an exploratory study and objectives were to determine the radiographic features that the axial oblique view demonstrates better than the mortise view. To compare axial oblique view and mortise view in fracture evaluation and assessment of ankle stability. 60 Patients with acute ankle injuries were randomly placed in control and study groups. The control group had 3 routine views namely AP, Lateral and Mortise while the study group had AP, Lateral and Axial oblique views. 2 Radiographers and 2 radiologists unanimously scored each of the two views in question in terms of radiographic features displayed and fractures demonstrated. Radiologists further assessed joint stability by measuring joint spaces on mortise and axial oblique views. AP and Lateral were both standard views in the two groups. Axial oblique view demonstrated most radiographic features of interest on an ankle and statistical significance was on posterior malleolus, subtalar joint, base of 5^{th} metatarsal and sinus tarsi (p=0,00). Axial oblique view demonstrated all the common fracture types of the ankle with statistical significance in demonstration of trimalleolar and talar fractures (p=0.026) and (p=0.007) respectively. Joint spaces measured on axial oblique view did not correlate with injury of the participants. MCS and SCS correlated with injury in mortise views (p=0.004) and (p=0,00) respectively. Axial oblique view demonstrates more radiographic features and displays fractures better than mortise view. However, it is limited when it comes to joint stability assessment.
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Key words: ankle, fractures, radiographic features, joint stability

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Introduction

Plain radiography is the mainstay of ankle imaging when a fracture is clinically suspected. Routine investigation should always include lateral and internal oblique views [1]. Three routine views were emphasized by Brandser [2] and these are AP, Lateral and Mortise views. The mortise view minimizes the overlap of the tibiofibular joint seen in ordinary AP hence allows assessment of the ankle syndesmosis. However, some fractures are not adequately represented particularly those extending to the posterior aspect of the ankle and those occurring most frequently in the talus and calcaneus [3,4]. They are difficult to view in routine plain radiography. The integrity of the talus is critical to the normal functioning of the talocrural and subtalar joints. Injuries to the head, neck or body of the talus can interfere with normal motion of these joints and result in permanent pain, loss of motion and deformity [5].

Axial oblique view is an internal oblique view done in 45° medial rotation of the foot with 15° cranial tilt of the central x-ray beam. The theoretical advantage of this view is its ability to visualize the posterior part of the ankle, posterior articulations of the subtalar joint and unobstructed views of the medial and lateral malleolus. Tibiofibular and talocrural joints are satisfactorily demonstrated as well as the subtalar joint. However, not much is known about its ability to assess ankle in acute injury.

Assessment of the ankle also includes evaluation of the ankle stability by measuring joint spaces. These include tibiofibular clear space (TFCS) and normal value =<6mm measured in both AP and Mortise [6,7]. Tibio-fibula overlap (TFO) indicates a proper syndesmotic relationship and a normal overlap should be =>10mm [8]. Medial clear space (MCS) is a measure between the articular surface of the medial malleolus and medial edge of the talus. It should not exceed 4mm [9]. Superior clear space (SCS) should also not exceed 4mm. The aim of this study was to assess the diagnostic potential of the axial oblique view in acute ankle injury. The specific objectives were to determine the radiographic features that the axial oblique view better demonstrates than the mortise view. Furthermore, to compare axial oblique view and mortise view in fracture evaluation and assessment of ankle stability.

Materials and Methods

60 patients were enrolled in the study. This was a prospective exploratory study. Age range of the patients was 21-68years. Informed consent was obtained from all participants and ethical approval was given by a local ethics board *(JREC/356/12)*. Study was done at a local referral centre. Inclusion criterion was both male and female patients with requests for ankle x-rays from acute injuries.

Patients were randomly placed into a control group and a study group. Each case in the two groups received a series of three views. The ratio of control to case was 1:1. Control group received the routine views (AP, Lateral and Mortise). Study group received AP, Lateral and Axial oblique views. Both groups maintained three views in order to limit the radiation dose to the levels that the patient receives ordinarily when having an x-ray of the ankle. Philips conventional machine was used to take the images. Each patient wore a lead apron for radiation protection. Information such as gender, age, radiographic views done, date of examination and cause of injury were recorded for each participant. Axial oblique view and Mortise view were analyzed by two radiologists and two radiographers by means of scoring. Both radiologists had more than 15 years' experience and radiographers were selected on the basis of seniority. They had 14 years' and 5 years' experience respectively.

The views for each patient were being scored for radiographic features demonstrated and fractures displayed. Scoring for radiographic features was (1-3) where 1= clearly demonstrated, 2=unclearly demonstrated and 3= not demonstrated. Refer to *table 1* for radiographic features. For display of fractures the scoring was also (1-3) where 1= present, 2= absent and 3= ambiguous. Fractures were classified in five categories as shown in *table 2*.

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Table 1: Radiographic features of interest on an ankle

Distal tibia	Lateral Malleolus	Tibiofibular Joint	Calcaneus
Distal fibula	Medial Malleolus	Talocrural Joint	Base of 5th Metatarsal
Talus	Posterior Malleolus	Subtalar Joint	Sinus Tarsi

Table 2: Fracture classifications

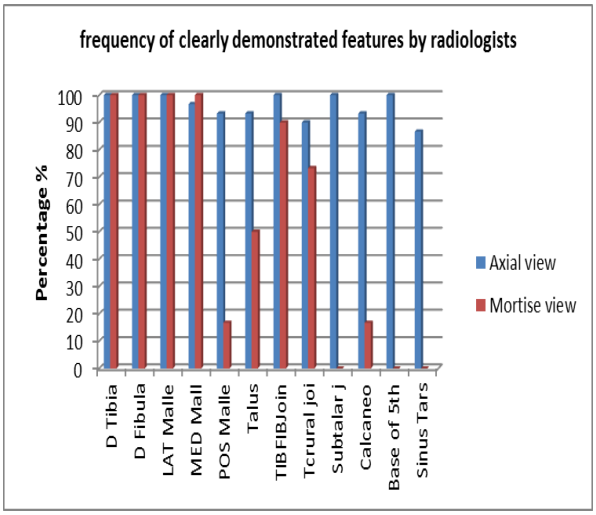
Unimalleolar	Any fracture that occurred on either distal tibia or fibula bones regardless of level of fracture
Bimalleolar	Fractures occurring on both distal tibia and fibula bones
Trimalleolar	Fractures on both distal tibia and fibula bones including the posterior tibial tubercle commonly referred to as posterior malleolus
Talar	Fractures on the talus and any avulsion fractures that may be present
Fracture/Dislocation	Any of the above fractures resulting in partial or complete dislocation of the ankle.

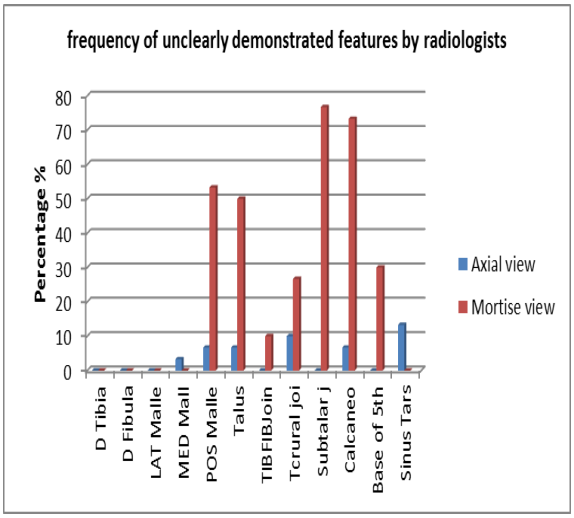
Radiologists further assessed the radiographs for joint stability by measuring MCS and SCS joint spaces and correlated these with injury in each patient.

Results and Discussion

Radiographic features

Study showed that there was fair agreement between radiologists and radiographers that axial oblique view better demonstrated posterior malleolus, subtalar joint, base of the 5th metatarsal and sinus tarsi than mortise view. Distal tibia, distal fibula, lateral malleolus and medial malleolus were equally demonstrated in both views. There was however, no statistical significance in differences for tibio-fibula joint (p=0,146) and talocrural joint (p=0,98) according to radiologists and talus (p=0,116) according to radiographers.





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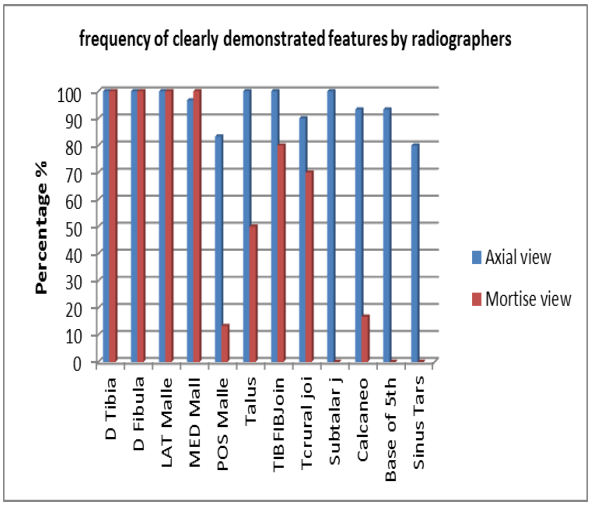
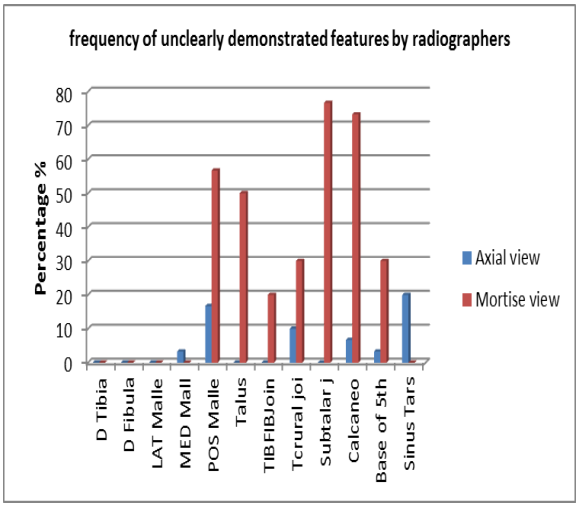
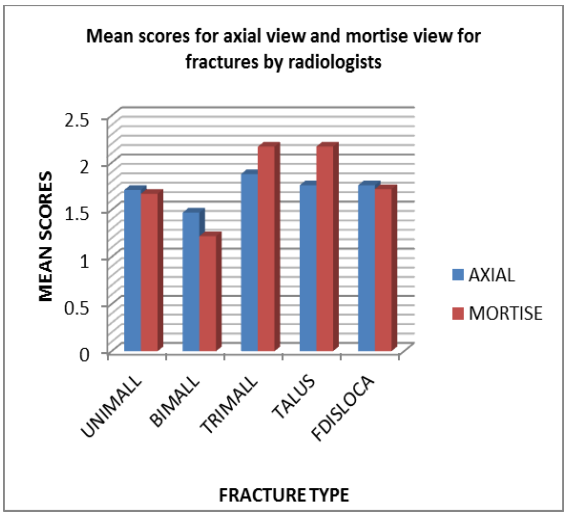
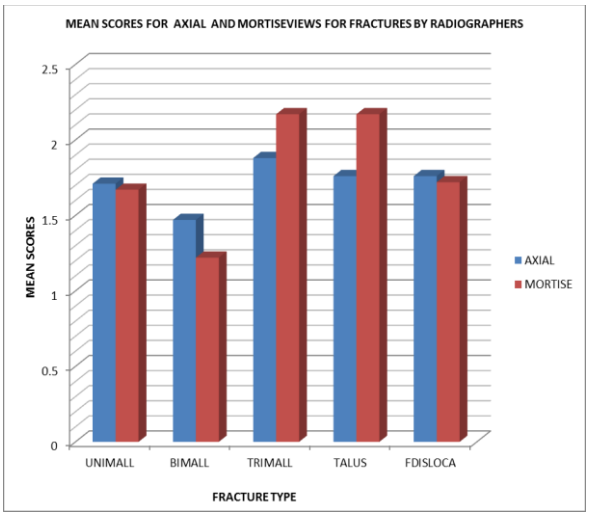




Fractures

There was no statistical significance in differences in demonstration of bimalleolar, unimalleolar and fracture/dislocations; (p=0,81), (p=0,12) and (p=0,07) respectively. Trimalleolar and talar fractures were better demonstrated in axial oblique view (p=0,026) and (p=0,007) respectively.





Joint stability

Measurements of MCS and SCS in axial oblique view were generally falling within the limits stipulated for the mortise view. However, Pearson's correlation test showed no correlation of the joint space measurement and recorded injury status.

MCS and SCS in mortise view correlated with injury status at 99% CI (p=0,004) and (p=0,000) respectively. TFCS also correlated with injury in participants at 95% CI (p=0,035).

Acute ankle injuries account for 3-5% of all attendances to the emergency departments in the UK and 10% in the US [10]. If ankle injuries are left without a definitive diagnosis or are underdiagnosed they result in long term disability

[4]. Accurate representation of all possible ankle fractures after injury with adequate views is important for guiding patient management and consequently improving patient's quality of life.

Our study has shown that mortise view adequately demonstrates radiographic features that satisfy the widely used definition of "ankle joint" which is the talocrural joint [11]. However, in essence the ankle comprises of the tibiofibular (ankle syndesmosis), talocrural and subtalar joints [12]. Injury to any of these joints causes pain and instability to the ankle. The tibio-fibula joint and the talocrural joint maybe well demonstrated but the subtalar is not. Subtalar instability often occurs in combination with talocrural instability [13]. Acute symptoms of subtalar injury can be the same as and can be camouflaged by lateral ankle ligament sprains. Owing to this, careful diagnosis is important in injury and this is possible through adoption of the best radiographic views.

The base of the fifth metatarsal was shown to be better presented by the axial oblique view. It needs to be demonstrated in at least one of the views in the series because of avulsion fractures that occur in that region. These fractures are easily missed on routine investigations. A study on missed fractures on emergency room ankle radiographs using the routine views reported that most commonly missed fractures were of the talus followed by fractures at the base of the fifth metatarsal [2]. This might have been because the fractures were not well demonstrated such that they could easily be missed.

The sinus tarsi may be referred to as tarsal sinus and is an important radiographic feature that is usually not displayed on any of the views in the routine series. It separates anterior and posterior articulations of subtalar joint and contains fat, nerves and arteries. This region is liable to a condition called sinus tarsi syndrome. This syndrome has been common in athletes and found to be associated with ankle sprains that may also result in talocrural joint instability. X-rays do not provide information specific to this syndrome but are necessary to rule out fractures of the talus or calcaneus and evaluate the subtalar joint.

The posterior malleolus contributes to the weight bearing surface hence any injury to this region if not well evaluated will disrupt the articular congruity [14].

Our study has also shown that axial oblique view is superior to mortise view in showing trimalleolar and talar fractures. The posterior part of the tibial plafond is the anchorage for the posterior part of the inferior tibio-fibular syndesmotic ligaments. It is commonly injured together with lateral and medial malleolus forming what are called trimalleolar fractures [14]. These fractures often result in loss of integrity of the entire posterior tibial lip. Rotation instability of the talus follows and causes pain and a risk of articular degeneration [15].

Even though this study has shown that the axial oblique view better demonstrates some fractures and radiographic features, there is need to further investigate with a bigger sample size and include orthopedic specialists. Orthopedic specialists will evaluate whether the view adds any new information which might change patient management protocols for certain injuries. This will enable solid conclusions to be made.

In this study, MCS and SCS in axial oblique view did not correlate with injury. This may be due to the fact that the measurement limits which were used were specifically stipulated for the mortise view. MCS and SCS correlated well with injury in mortise view. Our results are consistent with findings from literature [16]. MCS has been reported a reliable indicator for ankle stability [17].

The axial oblique view measurements of the joint spaces in this study may suggest that ankle joint stability cannot be assessed with this view. There is need to have standard measurements specific for this view that predict normal and injured ligaments. Although literature points out other radiological modalities such as CT and MRI which are ideal in assessment of ankle stability than radiographic measurements [18], they are highly expensive and found in

very few local institutes hence mostly inaccessible. Therefore, most developing nations such as Zimbabwe still rely on radiographic measurements.

Conclusion

The axial oblique view demonstrates the following radiographic features in a better way; posterior malleolus, subtalar joint, base of fifth metatarsal and the tarsal sinus. The mortise and axial oblique view have shown the same ability to diagnose unimalleollar, bimalleolar and fracture-dislocations that may occur after injury. Trimalleolar fractures and talar fractures are better demonstrated on the axial oblique view. The axial oblique view was limited in assessment of ankle stability.

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