

## Original Article

# Ankle X-ray Use at Mater Dei's Accident and Emergency Department

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**Abstracts**

**Aim:** To determine the amount of X-rays performed at the Accident and Emergency Department (A&E) at Mater Dei Hospital to investigate ankle injuries.

**Objectives:** A comparison between the X-ray report and the examining physician's request was also performed. The audit will propose the possibility of implementing a standard protocol of care for ankle injuries namely, based upon the Ottawa Ankle Rules.

**Methods:** A retrospective observational study was carried out between the 20th September and the 20th December 2015. All ankle X-rays performed at A&E during this period were analysed using the Picture and Archiving System (PACS).

**Results:** The commonest reason for requesting an X-ray following a traumatic event was to identify the presence of a fracture. Only 27.8% of these X-ray reports identified a fracture. X-rays were also requested for non-traumatic injuries very often due to swelling. Physicians' requests often contained minimal clinical details but only one request had no details whatsoever.

**Conclusion:** Ankle X-rays were most commonly performed to identify a fracture but very often no fracture was identified. Fractures were a relatively uncommon finding raising the possibility of inappropriate prescription of X-rays. Use of guidelines or an alternative investigation could be beneficial in order to reduce inappropriate radiography usage. Appropriately filled in request forms including clinical presentation would help the communication between the physician and the radiologist.

**Introduction**

Ankle injuries are amongst the commonest encounters at the Accident and Emergency (A&E) department. The World Health Organisation estimates the use of radiation to amount to a total of 3.6 billion medical investigations such as X-rays, per year.<sup>1</sup> The use of ionising radiation, even if in small doses, may predispose to an increased risk of developing a malignant tumour. Age, gender, type of X-ray and area of the body being investigated affects the amount of radiation one is exposed to.<sup>2</sup> In 2016, 15% of 117 million patients in the United States of America who presented to A&E had an ankle injury<sup>3</sup>. Most studies highlighted the fact that ankle injuries are very often associated with X-ray exposure.<sup>4</sup> Borg M. et al confirm that in 2008 in Malta, 95% of the patients who registered at St Luke's hospital A&E department for an ankle injury, were then exposed to an X-ray investigation.<sup>5</sup> This brings forward the importance of establishing guidelines to aid physicians in deciding when an X-ray needs to be requested. The latter is especially important to distinguish between bony and isolated soft tissue injuries.<sup>3</sup>

The development of the Ottawa Ankle Rules (OARs) by Stiell et al. helped clinicians to determine whether an X-ray investigation was required or not.<sup>6</sup> The latest version of the OARs state that an X-ray investigation should be requested by a physician if specific criteria are met.<sup>6</sup> As seen in Figure 1, bony tenderness elicited at specific

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points around the ankle or foot confirms the need for an X-ray investigation. The OARs are known on an international basis since Silveira P.C. et al state that in the United Kingdom, United States of America and Canada, approximately 90% of emergency physicians are aware of the OARs.<sup>7</sup>

The aim of this audit was to establish the number of ankle/ankle-foot x-rays requested which proved to be beneficial. The study was carried out over a period of three months. The objectives included;

- To compare the radiologist report against the request put forward by the examining physician
- To verify the need of a protocol involving guidelines such as the Ottawa Ankle Rules
- Discuss other means on how to identify ankle fractures

## Methods

This audit is a retrospective observational study carried out between the September 20th and the December 20th, 2015 at Mater Dei Hospital A&E Department.

## Inclusion and Exclusion Criteria

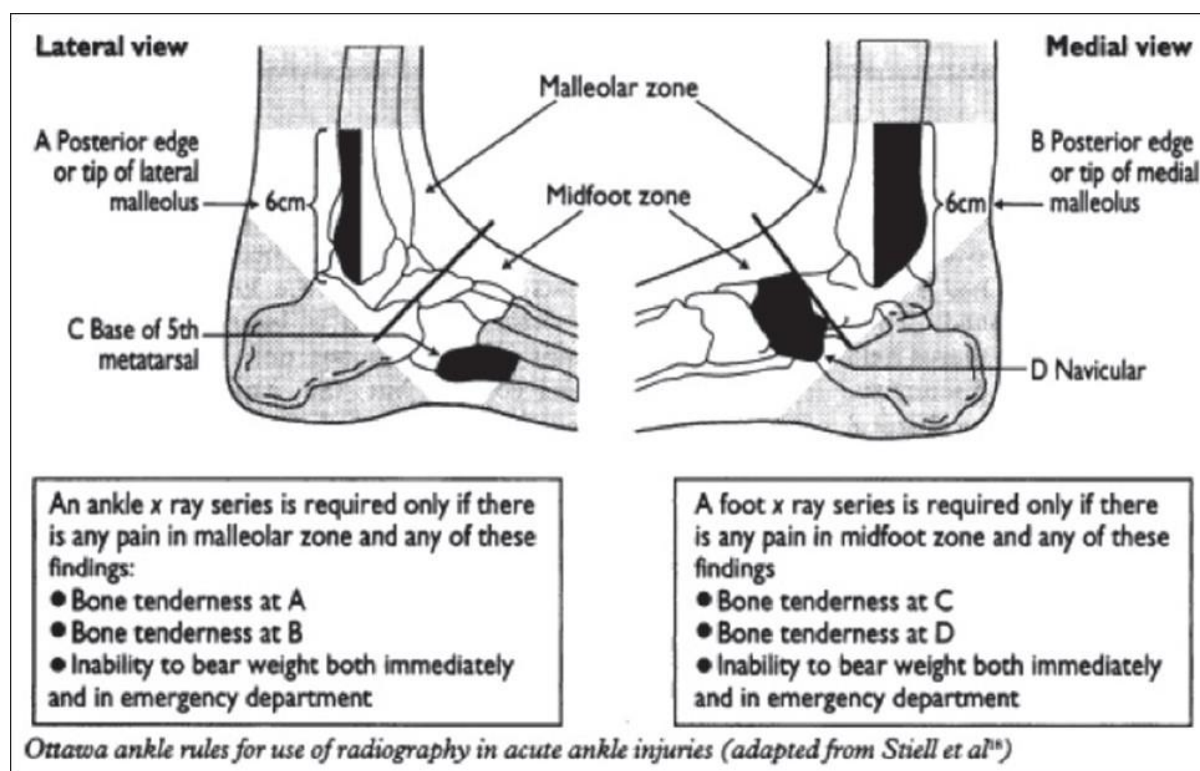
The minimum age chosen was 12 years and ages ranged up to 103 years. The cut off point of 12

years was chosen since bone ossification of the tibia, fibula and talus would have started by that age.<sup>8</sup> All ankle/ankle-foot X-rays requested by A&E physicians during the study period were included during data collection. All imaging records chosen were requested at the A&E department of Mater Dei hospital by physicians working in the different areas of the department including the Minor Care Clinic. Any radiological examination which had not been reported by a radiologist was excluded but records with incomplete information provided by the examining physician (e.g. no clinical examination details), were still included.

## Data Collection and Analysis

Data was recorded on an excel sheet including the date, the different X-ray views performed (ankle/ankle-foot X-ray), age of patient, gender, reason for an X-ray request/clinical finding and the report provided by the radiologist. No identifiable data was recorded. Data was then analysed using the IBM SPSS statistics software (version 24). Statistical tests carried out were the chi-squared test where a p-value of <0.05 was considered as significant and the independent t-test.

*Figure 1: Description of the Ottawa Ankle Rules.<sup>6</sup>*



### Permissions

Permission was granted by the Chairman (at the time) of the A&E department. Ethical approval was obtained by the University Research Ethics Committee. Data was recorded from the Picture Archiving Communication System (PACS) having been granted permission from the Data Protection Officer of Mater Dei Hospital.

### Results

The total number of participants was 615 (male  $n=318$ , female  $n=297$ ). The mean age for the study population was 45.8 years  $\pm$  SD 20.66 years. Figure 2 demonstrates the indication for an X-ray

request by A&E physicians following a traumatic mechanism of injury.

The most common request (Figure 2) by the A&E physicians was to assess for the presence or the absence of a fracture in the foot/ankle region. Figure 3 shows the indication for an X-ray request by A&E physicians following a traumatic mechanism of injury by gender. Female population predominates in all mechanisms except in motor vehicle accidents where there is a significant difference between male and female participants ( $p=0.000$ ). The most common reason for an X-ray for both males and females was to identify the presence of a fracture.

**Figure 2:** Indication for X-ray requests following traumatic mechanism of injury

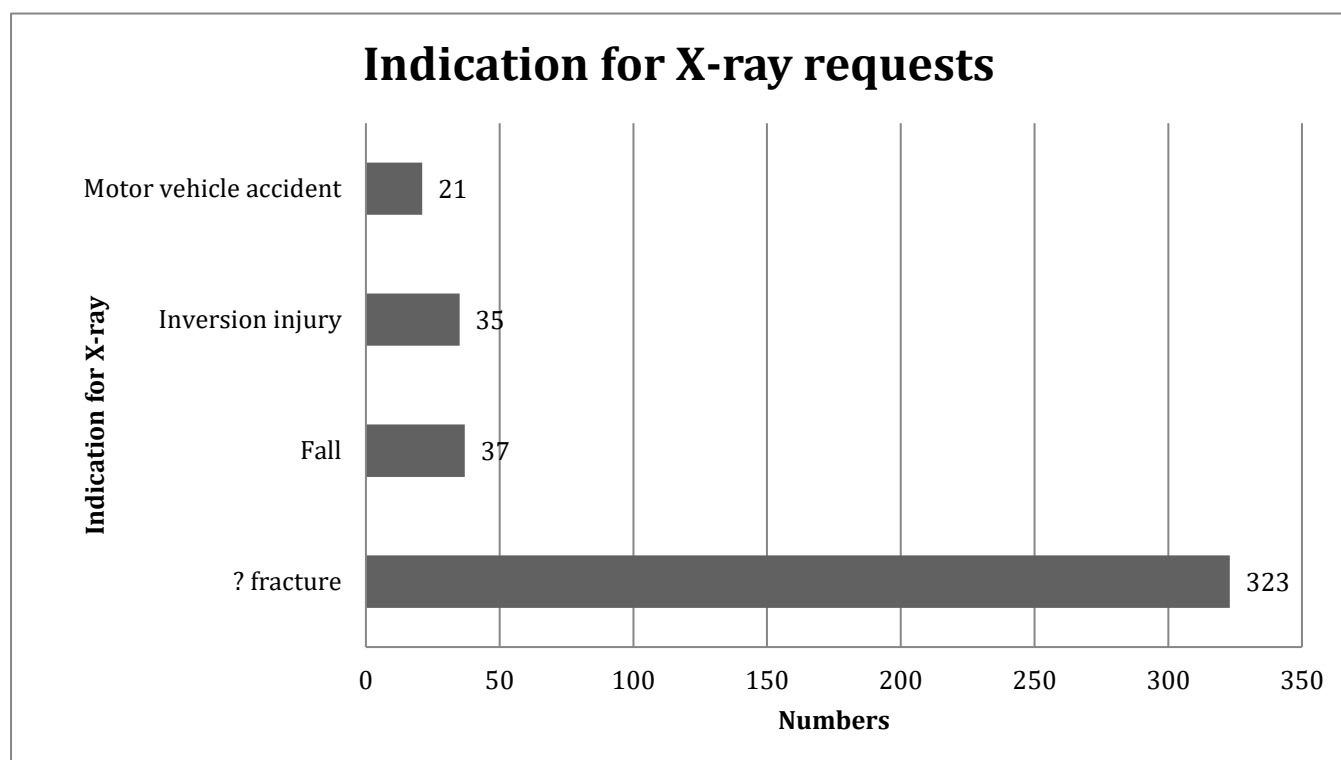


Figure 3: Indication for X-ray request (mechanism of injury) and number of females and males per request.

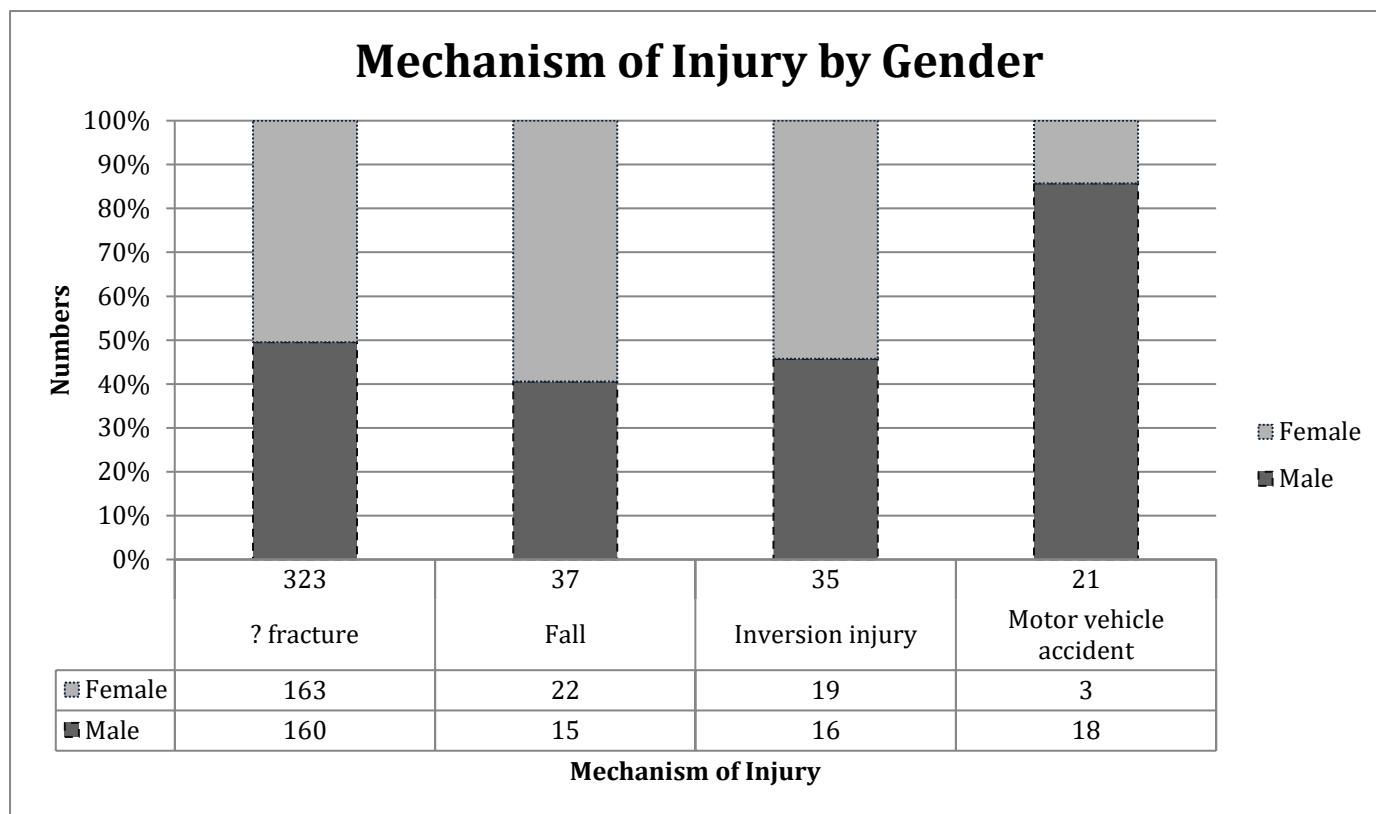
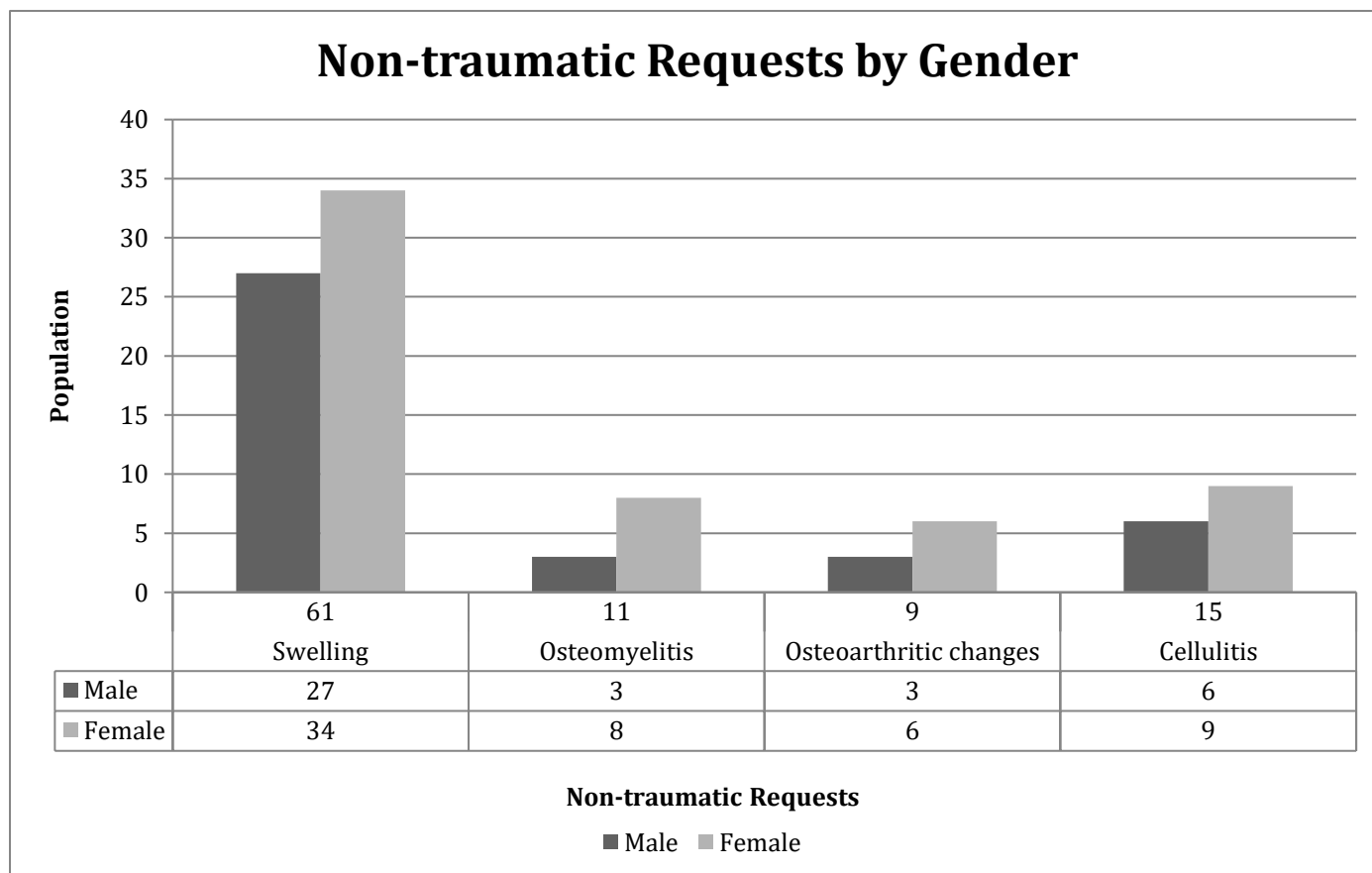
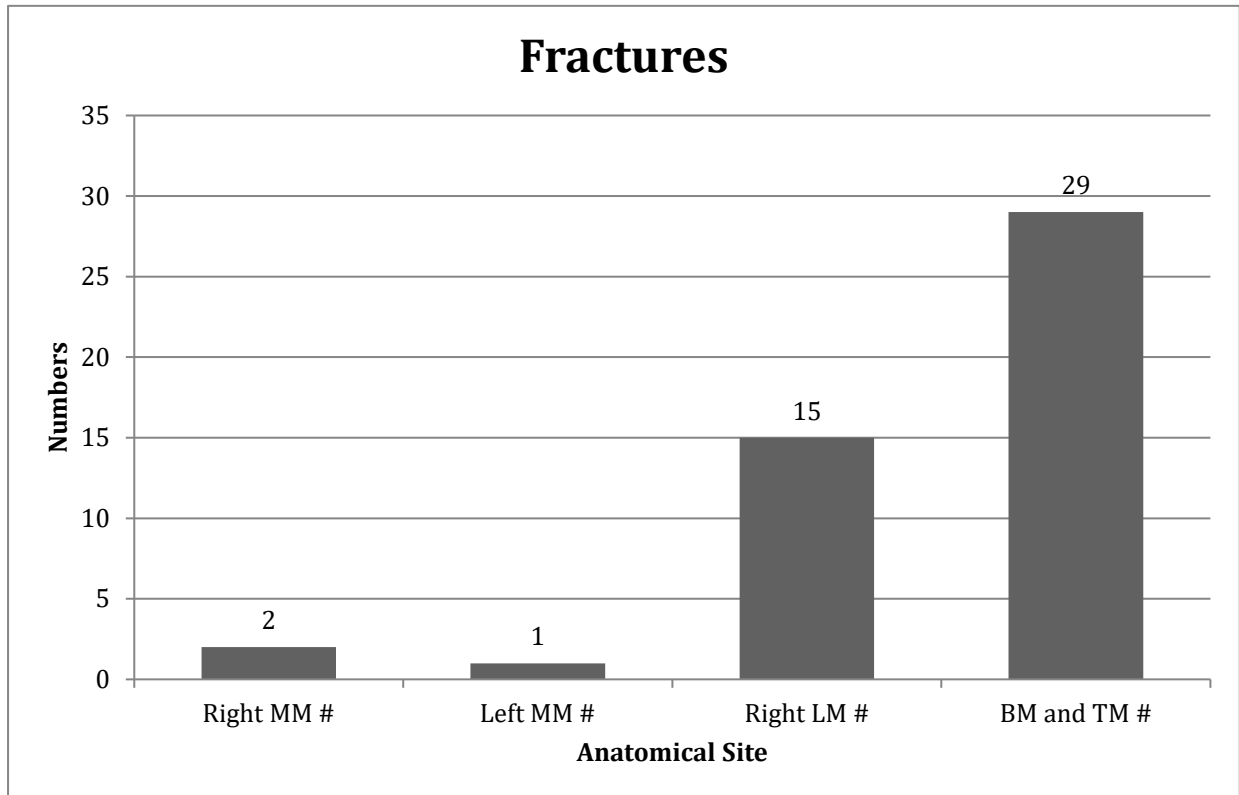


Figure 4: X-ray requests following non-traumatic events by gender



**Figure 5:** Demonstrates the percentages of fractures identified by foot-ankle X-rays. MM – Medial Malleolar, LM – Lateral Malleolar, BM – Bimalleolar, TM - Trimalleolar and # - fracture.



The audit also showed that ankle/ankle-foot X-rays were also requested for reasons which were non-traumatic, as seen in Figure 4. The presence of swelling was the commonest reason to request an X-ray, followed by cellulitis, osteomyelitis and finally osteoarthritic changes. Females predominate in all requests ( $p=0.0001$  respectively).

Out of the 323 patients for whom their physician requested an ankle/ankle-foot X-ray, 76.4% did not have any fractures whilst 27.86% of patients were reported to have a fracture. The most common fracture was at the lateral malleolus with 15.7% (Figure 5). 10.5% of patients had a post reduction X-ray in plaster. As seen in Figure 5, the most common fractures occurred were complex fractures (bimalleolar and trimalleolar fractures). Requests made by physicians were also analysed. It is important to note that age and gender are automatically filled in the request form by the software. These requests ranged from one-word requests “*trauma, ffh*” (fall from height) to more detailed requests such as “*57yr old fell from box own height complaining of pain at right ankle. Tender at base of 5th metatarsal and on inversion? #*”. Reports made by radiologists were all filled appropriately and the most common report was “*no #*”. The radiologists also reported back the presence of any incidental findings which may be present e.g. “*calcaneal spurs*”.

## Discussion

This study shows that physicians prefer using X-rays in order to confirm their diagnosis especially when they need to rule out the presence of a fracture. Noteworthy was the fact, that during the period of the study, the least X-ray requests were to investigate any fractures following a motor vehicle accident even though statistics show that MVAs were increasing compared to the same period in 2014. This could be due to the fact that a trauma CT scan was requested instead.<sup>9</sup>

In Crosswell et al. 2014, they reported the fracture rates in patients who underwent an ankle/foot/ankle-foot X-ray.<sup>10</sup> They reported that physicians prescribed X-rays partly to fulfill patients' expectations as well as to ease the patient

load. They further state that X-rays are increasingly being used as a means of defensive medicine to avoid potential lawsuits for missed fractures. Crosswell et al. claimed that most X-rays were normal as was the case in our study in which only 27.86% reports confirmed the presence of a fracture.<sup>10</sup>

The use of X-rays can have a negative effect on the body by ionisation of molecules which results in free radical production. This may cause DNA damage and increase the risk of malignant transformation.<sup>11</sup> A proportion of X-rays were performed to supplement a clinical suspicion and this shows that guidelines might need to be implemented in order to help physicians identify situations where an X-ray would really be useful.

A means to avoid X-ray use was proposed by Shojaee M. et al.<sup>12</sup> They recommended the use of ultrasound as an alternative means of identifying ankle fractures. They state that the use of ultrasound is accurate as well as cost-effective and most importantly a means to reduce radiation exposure. In their study, sensitivity amounted to 98.9% whilst specificity was 86.4%. One of the limitations mentioned is the dependency on the operator's skills.<sup>12</sup> Barata et al. stated that ultrasound has high sensitivity and specificity for ‘long bone fractures’.<sup>13</sup>

The Ottawa Ankle Rules are an ideal tool when it comes to selecting the right clinical scenarios requiring the use of radiological studies. These guidelines, as stated by Silveira et al.<sup>7</sup>, are ‘validated’ and ‘evidence-based’ rules. Silveira et al., implemented a software tool which consisted of a questionnaire including the OARs and every physician had to fill this questionnaire on encountering a patient with ankle pain.<sup>7</sup> The questionnaire's score suggested whether an X-ray was needed or not. Following the implementation of this tool, use of OARs increased from 55.9% to 66.7%, clearly showing that physicians found this tool quite useful.<sup>7</sup>

Although most studies highly recommend the OARs, a study carried out by Ashurst J.V. et al. in 2014 contraversed this view.<sup>14</sup> In this study, researchers observed physicians during their encounter with their patient and noted whether a

radiographic investigation was requested or not. The researchers concluded, that even if the physicians involved were aware of the OARs, 58 out of 60 patients would still request an ankle X-ray. It also shows that physicians feel more 'secure' if they have an investigative confirmation on whether a fracture is present or not as physicians still felt uncertain about their clinical diagnosis.

However, since the OARs have a sensitivity of almost 100% and a reasonable specificity, Wang X. et al. in 2013 argued that physicians should rely more on these guidelines.<sup>15</sup> They do however also mention that the OARs can be quite subjective since they depend upon the depth of palpation of the physician as well as the patient's pain tolerance. Eliciting pain during palpation may be both due to bone tenderness as well as soft-tissue injury. Wang et al. clearly state that using the OARs can significantly decrease the use of unnecessary X-rays and result in a more cost-effective approach without affecting the quality of healthcare.<sup>15</sup> They also suggest that the OARs should be introduced in developing countries where radiological facilities can be minimal.<sup>15</sup>

Another objective of this audit was to review the physician's X-ray request forms. A study carried out by Salazar L. et al investigated the rate of complete documentation of examination findings on patients with ankle/foot injuries at an emergency department.<sup>16</sup> The OARs were used as a standardised reference point. In this study complete documentation was considered if all components of the OARs were documented. Only 29% were noted to have complete documentation for ankle examination whilst 16% of patients had complete documentation for foot examination. It was also noted that some patients with incomplete documentation still had a radiograph obtained. The researchers concluded from their results that most documentation was incomplete regardless of whether a radiograph was requested or not. The researchers suggest that complete documentation would also be cost-effective apart from ensuring patient safety and avoidance of medico-legal issues.<sup>16</sup>

On comparing our study to the study by

Salazar et al., it emerges that the majority of the physicians in Malta did not provide a detailed X-ray request form. As reported, filling the appropriate information would make it more cost-effective. In addition, lack of documentation can lead to disorganised communication, delay in care and also risk of medico-legal issues.<sup>16</sup>

### Study Limitations

One of the main limitations is that a small population was used for this audit. This decreases the statistical power of the audit. Reports were limited to the main emergency department in Malta's Mater Dei Hospital only, further limiting the amount of requests which could be evaluated. Another limitation was the paucity of clinical details filled on the request form. This lack of information does not aid the reporting radiologist. It is suggested to repeat the study to assess the validation of X-ray requests. During these three months, a major incident occurred which might have led to an increase in X-ray requests.

### Conclusion

This audit shows how common ankle X-rays are used in Malta's main emergency department. Unsurprisingly, the main reason for its use is to identify a fracture. Approximately a quarter of X-rays exhibited the presence of a fracture. This means that a proportion of the patients might have been exposed to X-rays unnecessarily. Requests were also made for non-traumatic incidents, the most common request being for swelling. Guidelines such as the OARs could aid physicians when deciding which investigation would be most appropriate for the patient. Details on X-ray requests should be included in order to aid and inform the radiologist about all the clinical findings identified by the physician. Adequate requests would improve communication between the physician and the radiologist.

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