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COMPARISON OF CONVENTIONAL RADIOGRAPHY AND COMPUTED TOMOGRAPHY IN PATIENTS ADMITTED TO THE EMERGENCY DEPARTMENT WITH EXTREMITY TRAUMA — A RETROSPECTIVE STUDY

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ABSTRACT

INTRODUCTION: This study aims to compare conventional radiography (X-ray) and computed tomography (CT) on diagnosis, operation plan, and hospitalization of patients with isolated extremity trauma admitted to the emergency department (ED).

MATERIAL AND METHODS: This study was designed retrospectively. Patients with trauma involving extremities presenting to a tertiary ED between January 2019 and 2020 for twelve months who underwent both extremity CT and X-ray imaging were included in the study. The sensitivity, specificity, PPV, NPV, and Kappa coefficients were calculated on the CT reports.

RESULTS: A total of 1306 patients were included in the study. Extremity fractures were detected in 620 (47.6%) and 775 (59.3%) patients evaluated with X-ray, and CT scans respectively. The diagnostic accuracy of the X-ray of all extremity fractures by anatomical region was evaluated. For the shoulder region compared with CT, X-ray had a sensitivity of 95%, specificity of 98%, PPV 98%, and NPV 96% [AUC: 0.969, 95% CI 0.935 to 1.000) in diagnosing proximal humeral fractures. For the elbow joint region compared with CT, X-ray had a sensitivity of 95%, specificity of 98%, PPV 88%, and NPV 99% in diagnosing supracondylar fracture (AUC: 0.973, 95% CI 0.924–1.000). X-ray had a sensitivity of 94%, and specificity of 100%, compared with CT at the wrist region, PPV of 100%, and NPV of 98% in diagnosing distal ulnar fractures (AUC: 0.974, 95% CI 0.941 to 1.000). The most common knee fracture was a proximal tibia fracture on X-ray. Compared with CT, X-ray had a sensitivity for the diagnosis of proximal fibular fractures with 85% sensitivity, 100% specificity, PPV 100%, and NPV 98% (AUC: 0.925, 95% CI 0.832 to 1.000). At the ankle region, distal tibia fracture was the most common fracture on X-ray. Compared with CT, X-ray had a sensitivity of 85%, specificity of 98%, PPV 96%, and NPV 94% (AUC: 0.922, 95% CI 0.879 to 0.966) in the diagnosis of distal fibular fractures. The sensitivity of the X-ray was very low compared to CT in the talus, calcaneus, navicular, and cuneiform bones.

CONCLUSIONS: For upper extremities, X-ray can be useful to determine diagnosing proximal humerus, supracondylar, distal radius, and ulna fracture. Additionally for lower extremities, it can be used in the diagnosis of proximal fibular fractures and distal tibia-fibular fractures. X-ray is beneficial for long bones and CT for carpal and tarsal bones.

KEY WORDS: extremity trauma; fracture; computed tomography; x-ray; emergency department

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INTRODUCTION

Extremity traumas are one of the most common presentations to emergency departments worldwide. Extremity fractures constitute a high cost in terms of public health [1]. It is essential to make an early and accurate diagnosis to prevent mortality and morbidity that may develop following trauma.

Conventional radiography (X-ray) often provides important information in assessing trauma patients in the emergency department (ED). These patients are initially evaluated with X-ray for diagnosis and treatment due to easy accessibility, straightforward interpretation, and low radiation dose. Studies have focused on the misinterpretation of fracture identification in X-rays [2–4].

Misinterpretations cause a delay in treatment in the emergency department and increase the risk of operation in patients, in addition to an increase in their pain. In long-term results, a poor outcome may occur [5–8]. In a study of 905 patients following lower extremity trauma, the mortality rate was 3.9%, and the overall complication rate was 15% [9]. The mortality rate is low in isolated upper extremity injuries. Mortality is highest in the presence of accompanying complications and arterial injury. In a review, the mortality rate was 2.2% in upper extremity traumas involving arterial injury [10].

Conventional radiography is insufficient in evaluating the joint areas related to each other. However, computed tomography (CT) is a valuable imaging modality for detecting or excluding occult fractures and surgical planning. It also provides additional information for the complete assessment of intra-articular fractures, the accuracy of fracture extension, and occult fractures [9]. Computed tomography can provide additional information like hemarthrosis or fracture-related fluid collection. However, high radiation dose and high cost are among the disadvantages of CT [10, 11]. A limited number of studies compare X-ray with CT in the literature's comprehensive evaluation of extremity fractures. These studies showed that CT scanning helps detect isolated wrist and knee fractures [12, 13]. Although multislice CT has a higher diagnostic efficiency than X-ray in the diagnosis and treatment phase, it is still debatable in which situations it would be used in patients with extremity trauma. Therefore, in this study, we wanted to compare X-ray and multislice CT on diagnosis, surgical intervention, and hospitalization of patients with isolated extremity trauma admitted to the ED.

MATERIAL AND METHODS

Study design and protocol

This study was designed as a retrospective observational study. Among the extremities trauma patients who underwent both extremity CT and X-ray imaging applied to the tertiary ED between January 2019 and 2020 for twelve months were included in the study. The sample size was not calculated, and patients were selected by investigating the hospital information system of all patients admitted to the emergency department. Approval for the study was obtained from the ethics committee of our institution.

This study retrospectively analyzed and recorded demographic data, complaints, and radiological images of patients in all age groups at admission in the ED records. Patients with multiple trauma and central pathology, pelvic, vascular, and non-traumatic radiological imaging were accepted as exclusion criteria (Fig. 1).

A protocol form was created to interpret for patients whose X-ray and extremity CT were studied. Trauma mechanism, presence of bone fracture on conventional radiography, anatomical localization, type of bone fracture, relationship with joint space, diagnosis at the time of admission, indications for CT, surgical treatment, and hospitalization requirement

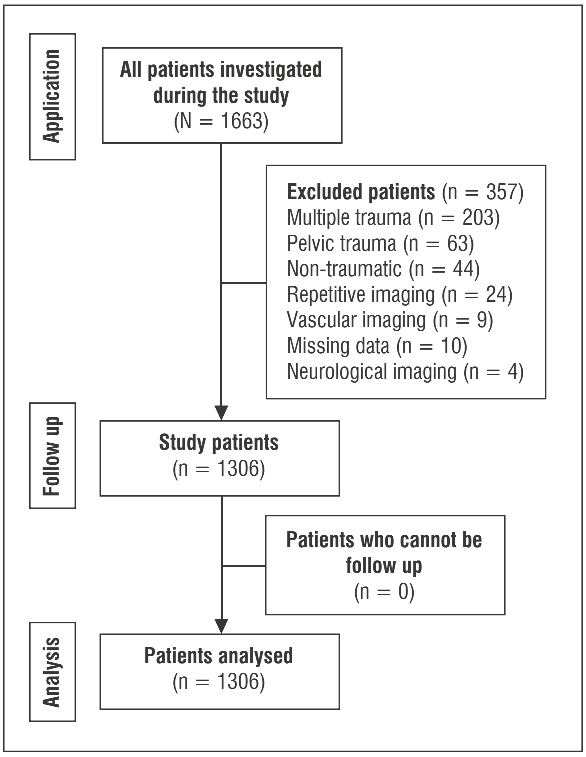

FIGURE 1. Study flow chart

were recorded in the protocol form. An X-ray was done using the brand (NOVA-FA, Prognosis Medical Systems Pvt. Ltd, India) in the emergency department. A multisection extremity CT scan Siemens Definition AS was performed. All CT images were interpreted by an expert radiologist at our institution and recorded as a report in the hospital's patient record management system. X-ray images were evaluated by a 4th-year emergency medicine residents and a specialist, blinded to extremity CT scan reports, and recorded their findings in the protocol form. Fracture findings in conventional X-rays were compared with the CT reports recorded in the patient record management system, using them as the gold standard.

Outcomes

The study's primary outcome was the diagnostic accuracy of X-ray and evaluation of CT in patients with isolated extremity trauma. Secondary outcomes were the decision of surgical intervention and hospitalization based on CT and X-ray findings.

Statistical analysis

All statistical analyzes were performed in SPSS 20 (Statistical Package for Social Sciences, IBM Corporation, IL, USA) and MedCalc 20 (MedCalc Software, Ostend, Belgium) program. Normality analysis of the data was studied with the Kolmogorov-Smirnov test. Numbers and percentages were given for categorical variables. For the diagnostic accuracy of X-ray the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and Kappa (K) coefficients were calculated based on the CT reports. Conventional radiography images were compared with CT scans. A coefficient graded the compatibility. Good compatibility was accepted if the (K) value was more significant than 0.75. A range of 0.75–0.40 was considered moderate compatibility, and less than 0.40 was considered bad compatibility [14]. The Chi-square test was used for all categorical variables.

RESULTS

During the study period, 1663 patients with extremity trauma admitted to ED were investigated. After 357 patients were excluded from the study according to the exclusion criteria, 1306 patients were included (Fig. 1). Of them, 824 (63.1%) were male. The mean and standard deviation (SD) age of patients was 35.9 ± 19.6 years. The most common injury mechanism was falling from the same level in 513 patients (39.3%). The elbow joint was the most frequently injured area in 286 (21.9%). The demographic data of the patients are shown in Table 1.

Table 1. Baseline characteristics of patients

Patient Characteristic	n (%)
Age (mean ± SD) [years]	35.9 ± 19.6
1–17	225 (17.2)
18–64	954 (73.0)
65–102	127 (9.7)
Male gender	824 (63.1)
Female gender	482 (36.9)
Mechanism of injury	1306 (100)
Motorcycle accident	133 (10.2)
Motor vehicle accident	44 (3.4)
Bicycle accident	86 (6.6)
Pedestrian accident	37 (2.8)
Fall on same level	513 (39.3)
Fall from height	127 (9.7)
Fall from the ladder	100 (7.7)
Assault	9 (0.7)
Firearm injury	15 (1.1)
Penetrating	11 (0.8)
Sprain	117 (9.0)
Blunt trauma	114 (8.7)
Location of trauma	
Elbow	286 (21.9)
Foot	27 (2.1)
Ankle	81 (6.2)
Foot and ankle	219 (16.8)
Hand	12 (0.9)
Wrist	216 (16.5)
Hand and wrist	125 (9.6)
Knee	203 (15.5)
Shoulder	137 (10.5)
Computed tomography indications	
Suspected fracture	691 (52.9)
Fractures extending to the joint space	133 (10.2)
[Co-existence of fracture	483 (37.0)
Operation planning	372 (28.5)
Surgical intervention	407 (31.2)
Hospitalization	424 (32.5)

SD — standard deviation

All extremity fractures were analyzed in this study according to their anatomic location. Identification of all lower extremity fractures by anatomical location was shown in Table 2. In the shoulder location, 61 (82.4%) fractures were found in X-ray, and the most common fracture was in the proximal humerus. Compared with CT, X-ray was 95% sensitive and 98% specific with a PPV 98%, and NPV 96% in diagnosing proximal humeral fracture [area under the curve (AUC): 0.969, 95% confidence interval (CI) 0.935 to 1.000] (Tab. 3). The radial head fracture was the most frequent at the elbow joint region, with 53 (35.5%) fractures on X-ray (Fig. 2). However, when compared with CT, X-ray was

Table 2. Evaluation of all extremity fractures on conventional radiography (X-ray) and computed tomography (CT)

Variables	X-ray n (%)	CT n (%)	Missed fracture on X-ray (%)	False negative	False positive	p value
Shoulder fractures						< 0.001
Proximal humerus	61 (82.4)	63 (78.7)	3 (3.9)	3	1	
Clavicula	5 (6.7)	5 (6.2)	0 (0)	0	0	
Scapula	8 (10.9)	12 (15.1)	5 (3.9)	5	1	
Total	74 (100)	80 (100)				
Elbow Fractures						< 0.001
Olecranon	20 (13.4)	44 (18.6)	25 (9.4)	25	2	
Radial head	53 (35.5)	79 (33.4)	27 (11.5)	27	0	
Ulna proximal	6 (4.0)	12 (5.1)	7 (2.5)	7	0	
Supracondylar	25 (16.9)	23 (6.8)	1 (0.4)	1	3	
Lateral condyle	20 (13.4)	33 (13.9)	13 (4.9)	13	0	
Medial condyle	21 (14.1)	33 (13.9)	13 (4.9)	13	1	
Epicondyle	4 (2.6)	12 (5.1)	8 (2.8)	8	0	
Total	148 (100)	236 (100)				
Hand and wrist fractures						< 0.001
Distal radius	108 (41.9)	127 (38.3)	19 (7.8)	19	0	
Distal ulna	55 (21.7)	58 (17.5)	3 (1.0)	3	0	
Carpal bones	42 (16.8)	88 (26.8)	52 (17.2)	52	6	
Metacarp	38 (14.9)	44 (13.2)	9 (2.8)	9	1	
Phalanx	12 (4.7)	14 (4.2)	2 (0.6)	2	0	
Total	255 (100)	331 (100)				
Knee fractures						< 0.001
Proximal tibia	49 (48.5)	66 (52.4)	17 (11.0)	17	0	
Distal femur	10 (9.9)	13 (10.3)	4 (2.1)	4	1	
Patella	25 (24.7)	27 (21.5)	6 (3.4)	6	4	
Proximal fibula	17 (16.9)	20 (15.8)	3 (1.6)	3	0	
Total	101 (100)	126 (100)				
Foot and ankle fractures						< 0.001
Distal tibia	83 (24.7)	104 (23.1)	23 (9.4)	23	2	
Distal fibula	81 (24.1)	91 (20.2)	13 (5.3)	13	3	
Tarsal bones	73 (21.9)	125 (28.6)	58 (22)	58	6	
Lisfranc	4 (1.1)	5 (1.1)	1 (0.3)	1	0	
Metatars	55 (16.3)	78 (17.3)	29 (9.9)	29	6	
Phalanx	40 (11.9)	44 (9.7)	6 (2.0)	6	2	
Total	336 (100)	449 (100)				

Table 3. The diagnostic accuracy of Conventional Radiography (X-ray) of all extremity fractures by anatomical location

Variables	Sensitivity %	Specificity %	PPV %	NPV %	Kappa	AUC (95% CI)
Shoulder fractures	93	98	98	92	0.911	0.968 (0.936–0.999)
Proximal humerus	95	98	98	96	0.941	0.969 (0.935–1.000)
Clavicula	100	100	100	100	1.000	1.000 (1.000–1.000)
Scapula	58	99	87	96	0.677	0.788 (0.611–0.964)
Elbow Fractures	69	100	100	68	0.642	0.845 (0.845–0.890)
Olecranon	41	99	90	90	0.526	0.705 (0.604–0.806)
Radial head	65	100	100	88	0.736	0.829 (0.763–0.895)
Ulna proximal	41	100	100	97	0.578	0.708 (0.520–0.897)
Supracondylar	95	98	88	99	0.909	0.973 (0.924–1.000)
Lateral condyle	60	100	100	95	0.731	0.803 (0.698–0.908)
Medial condyle	60	99	95	95	0.715	0.801 (0.696–0.906)
Epicondyle	33	100	100	97	0.489	0.667 (0.476–0.857)
Hand and wrist fractures	78	97	98	73	0.718	0.881 (0.844–0.917)
Distal radius	85	100	100	92	0.879	0.925 (0.888–0.962)
Distal ulna	94	100	100	98	0.968	0.974 (0.941–1.000)
Scaphoid	60	99	96	95	0.721	0.803 (0.710–0.897)
Triquetrum	28	99	80	97	0.409	0.641 (0.466–0.817)
Hamatum	33	100	100	97	0.491	0.667 (0.477–0.857)
Psiforme	25	100	100	99	0.397	0.625 (0.300–0.950)
Trapezium	16	99	50	98	0.244	0.582 (0.323–0.841)
Trapezoid	33	99	50	99	0.396	0.665 (0.288–1.000)
Capitatum	0	98	0	99	–0.008	0.497 (0.243–0.751)
Lunatum	0	100	0	98	0,000	0.500 (0.215–0.785)
Metacarp	79	99	92	97	0.836	0.890 (0.718–0.997)
Phalanx	85	100	100	98	0.857	0.928 (0.871–0.986)
Knee fractures	82	96	97	81	0.816	0.881 (0.830–0.932)
Proximal tibia	74	100	100	88	0.796	0.871 (0.806–0.936)
Distal femur	69	99	90	97	0.770	0.844 (0.690–0.997)
Patella	77	97	84	96	0.779	0.878 (0.783–0.972)
Proximal fibula	85	100	100	98	0.911	0.925 (0.832–1.000)
Foot and ankle fractures	82	98	98	77	0.766	0.903 (0.868–0.938)
Distal tibia	77	99	97	90	0.814	0.885 (0.836–0.934)
Distal fibula	85	98	96	94	0.874	0.922 (0.879–0.966)
Talus	42	100	100	96	0.584	0.714 (0.572–0.857)
Calcaneus	75	99	93	96	0.817	0.875 (0.795–0.954)
Navicular	41	99	83	97	0.544	0.707 (0.519–0.895)
Cuneiforms	38	99	85	93	0.498	0.679 (0.471–0.889)
Cuboid	47	99	81	96	0.582	0.734 (0.586–0.881)
Lisfranc	80	100	100	80	0.887	0.900 (0.691–1.000)
Metatars	66	98	94	90	0.754	0.824 (0.681–0.967)
Phalanx	91	92	68	98	0.757	0.934 (0.843–0.982)
Hospitalization	81	100	98	76	0.853	0.906 (0.883–0.928)
Surgical intervention	84	100	100	93	0.879	0.920 (0.899–0.941)

AUC — area under the curve; PPV — positive predictive value; NPV — negative predictive value; CI — confidence interval

FIGURE 2. The elbow images of a 25-year-old male patient; **A.** Lateral conventional radiography (X-ray) image; **B.** Anterior-posterior X-ray image; **C.** Axial computed tomography (CT) image, arrow: a linear fracture in radial head; **D.** Coronal CT image, arrow: a linear fracture in radial head; **E.** Sagittal CT image, arrow: a linear fracture in radial head that extends into the joint space

95% sensitive, 98% specific, PPV 88%, and NPV 99% in diagnosing supracondylar fracture (AUC: 0.973, 95% CI 0.924–1.000). When the hand and wrist locations were examined, the most common region in X-ray was distal radius fractures 108 (41.9%). However, compared with CT, X-ray was 94% sensitive, 100% specific, PPV 100%, and NPV 98% (AUC: 0.974, 95% CI 0.941 to 1.000) in the diagnosis of distal ulna fractures. According to the K value, X-ray showed high compatibility compared to CT in identifying the fracture in the proximal humerus, supracondylar, and distal ulna fractures. The diagnostic accuracy of the X-ray of all extremity fractures by anatomical region was shown in Table 3. Among the knee fractures, the most common one was proximal tibia fracture, with 49 (48.5%) fractures on X-ray (Tab. 2). However, compared with CT, X-ray was 85% sensitive, 100% specific PPV 100%, and NPV 98% (AUC: 0.925, 95% CI 0.832 to 1.000) in the diagnosis of proximal fibular fractures (Tab. 3). At the ankle region, distal tibia fractures were the most common 83 (24.7%) fractures on X-ray. However, compared with CT, X-ray was 85% sensitive, 98% specific, PPV 96%, and NPV 94% (AUC: 0.922, 95% CI 0.879 to 0.966) in the diagnosis of distal fibular fracture. Demonstrative images of the ankle fracture are shown in Fig. 3. According to the K value, in the distal tibia and fibula fractures, the X-ray showed a higher similarity than CT in the definition of the fracture. The diagnostic accuracy of the X-ray of all extremity fractures by anatomical region was shown in Table 3.

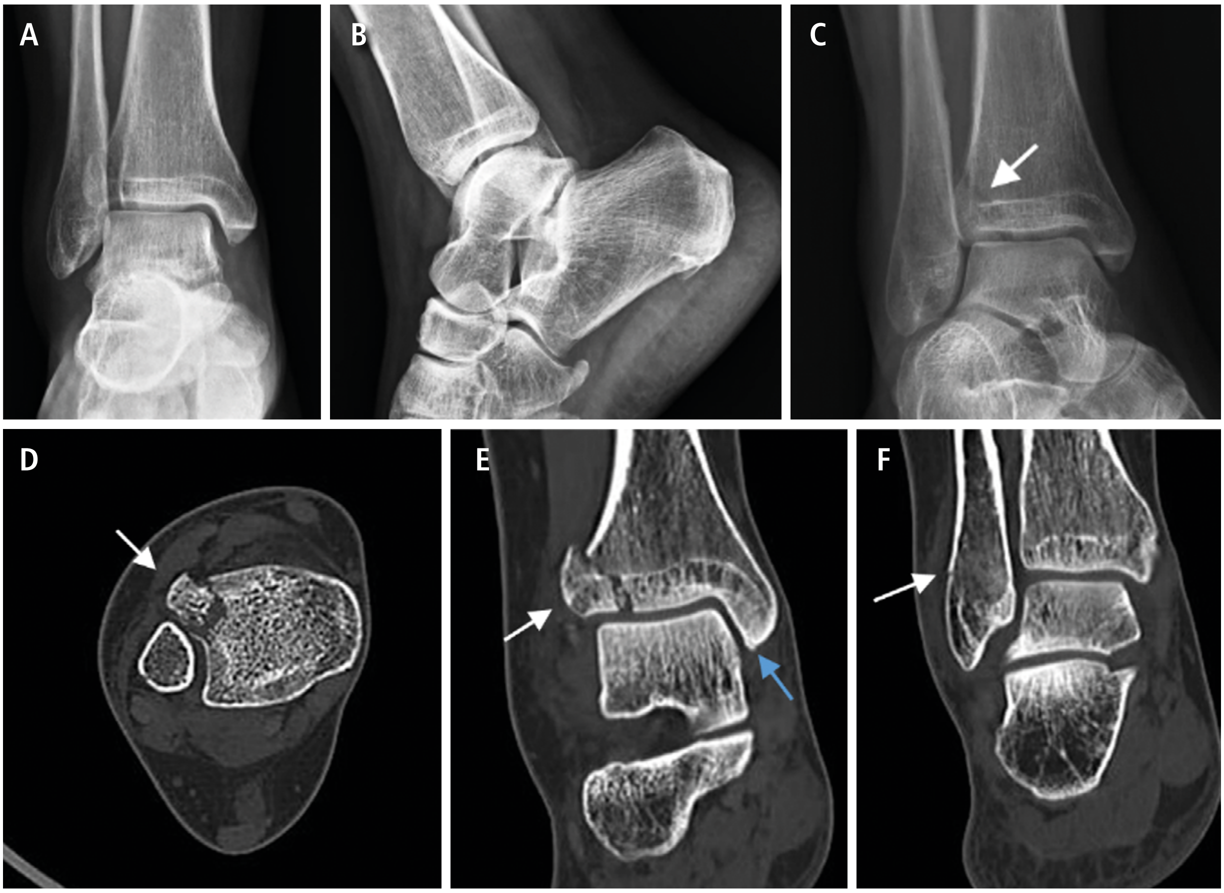

FIGURE 3. The ankle images of a 38-year-old female patient; **A.** Anterior-posterior conventional radiography (X-ray) image; **B.** Lateral X-ray image; **C.** Ankle stress X-ray image, arrow: tibial plafond fracture (oblique fracture); **D.** Axial computed tomography (CT) image, arrow: the displaced fracture in tibial plafond; **E.** Coronal CT image, white arrow: an oblique displaced fracture in tibial plafond that extends into the joint space, blue arrow: an avulsion fracture in the medial malleolus; **F.** Coronal CT image, arrow: an oblique fracture in the lateral malleolus

Extremity fractures were detected on the X-ray images in 620 (47.6%) patients. On CT, fractures were found in 775 (59.3%) patients. When the detected fractures on X-ray and CT were compared, X-ray was 78% sensitive 98% specific, PPV 98%, and NPV 76% (AUC: 0.885, 95% CI 0.866 to 0.904, K:0.736) in diagnosing fracture. In our study, the ability of X-ray to diagnose fracture according to the K value was shown to be highly compatible with CT. In addition, the effect of fracture on X-ray at the decision of hospitalization and operation plan was evaluated. The hospitalization prediction of X-ray was 81%sensitive 100% specific, PPV 100%, and NPV 91% (AUC: 0.906, 95% CI 0.883 to 0.928, K:0.853). The prediction on the operation decision was 84% sensitive 100% specific, PPV 100%, and NPV 93% (AUC: 0.920, 95% CI 0.899–0.941, K:0.879) (Tab. 3). In our study, X-ray was highly compatible with CT in hospitalization and surgery according to the K value.

DISCUSSION

Recent studies on the evaluation of bone fractures suggest that CT scanning is the most commonly used imaging modality following X-ray. However, CT scanning has been recommended in selected patients due to its high radiation dose and high cost [10, 11, 15].

There are many studies in the literature comparing imaging methods in the evaluation of extremity traumas. However, the extremity regions were evaluated separately [9, 12, 13, 16–18]. This study focused on the diagnosis, and localization of all extremity fractures in the emergency department (ED), and it was found to be important because it was a comprehensive study in terms of results. In this study, all extremity bones were evaluated separately according to anatomical localization.

In this study, proximal humeral fractures were the most common fracture in the shoulder. X-ray sensitivity in diagnosing proximal humeral fracture was 95%, and the specificity was 98%. The number of studies in the literature on this subject is limited. In a study conducted with 44 patients, CT, and X-ray were compared in the diagnosis of proximal humeral fractures, and it was shown that X-ray was helpful in the initial diagnosis of the fracture, but the diagnostic feature of CT was better in complex fractures [19].

In our study, when compared with CT at the elbow joint location, X-ray was found to have a high sensitivity of 95% and a specificity of 98% in diagnosing supracondylar fracture. However, X-ray has been found to have low sensitivity for fractures of the medial condyle, lateral condyle, epicondyle, radial head, olecranon, and proximal ulna. It is identified that elbow joint fractures cannot be adequately identified and evaluated with an X-ray. In a study conducted on patients with minor trauma who applied to the ED, the most common misdiagnosis was found in upper extremity fractures at 30%. Elbow joint fractures are among the most frequently missed injuries at this location, with 10% [20]. Etli et al. [13], in their study comparing the diagnostic efficiency of fractures due to wrist injuries with X-ray and CT, found that the most commonly identified fractures were in the distal radius and ulna. Compared with CT, the highest sensitivity of 95% with X-ray in diagnosing radius fractures [13].

Similarly, X-ray had the highest sensitivity and specificity in our study compared to CT in diagnosing the distal radius and ulna fractures. Standard posteroanterior, lateral, and oblique radiographs are usually sufficient to diagnose distal radius fractures [21]. Carpal bone fractures are common among wrist injuries. Early diagnosis and appropriate management of these fractures prevent the delayed union, pseudoarthrosis, avascular necrosis, and delayed healing [22]. Studies have revealed that X-ray has low sensitivity and specificity in identifying particularly lunate, triquetrum, capitate, and hamate fractures of the carpal bones [23]. Similar to our study, the sensitivity of X-ray in diagnosing carpal bone fractures in hand and wrist trauma was evaluated as less than 60% [13]. The reason for the low sensitivity of X-ray in diagnosing carpal bone fractures here is that the patient group with CT was composed of patients with a higher risk for fracture. Moreover, fractures in the hand and wrist region may be overlooked due to the superimposition of the adjacent bones of the metacarpal bone bases [20].

Knee traumas are among the common causes of admission to the ED. Early and accurate diagnosis is vital because delayed diagnosis causes shortened knee joint range of motion and deformity [15, 24, 25]. In this study, proximal tibial fractures with low sensitivity were found with 78% sensitivity as the most common fracture in X-ray at the knee location. Proximal fibular fractures had the highest value with 85% sensitivity. In a study comparing the diagnostic efficiency of X-ray and CT for knee traumas, the most common fracture was tibia fractures, and the diagnostic efficacy of X-ray in all bones had 89% sensitivity. In the same study, the diagnostic efficiency of X-ray for fibular fracture was similar to ours, with 82% sensitivity [26].

Early diagnosis of ankle trauma can minimize the risk of inadequate or delayed treatment. X-ray is the standard imaging method for the initial evaluation of bones after trauma [5]. Our study compared the diagnostic efficiency of fractures of the bones in the foot and ankle locations in X-ray and CT. In X-ray, distal tibia and fibula fractures were among the most common fractures. When the diagnostic efficiency of X-ray was compared with CT, their sensitivities were 77% and 85%, respectively. In another study, the effectiveness of ankle traumas in diagnosing fractures in X-ray and CT were compared, and the most common fractures were found to be distal tibia, lateral and medial malleolus. The sensitivity of the X-ray in identifying distal tibia and fibula fractures was 57% and 100%, respectively. In addition, the sensitivity of the talus and calcaneus was found to be very low [12]. Ankle fractures may go unnoticed on X-ray images due to overlapping structures, possible suboptimal position, technique, and other problems. Although the anatomical integrity is damaged due to trauma, CT could provide a quick evaluation [10, 11]. In our study, the sensitivity of X-ray was very low compared to CT in the talus, calcaneus, navicular, and cuneiform bones, following the literature.

The decision-making process regarding the operation plan is related to some characteristics of the fractures: Fracture type, angulation, fracture stabilization, fracture length, loss of function, and displacement are essential factors in treating bone fractures. In addition, the extension of the fracture to the joint area and the fracture involving the epiphyseal line affect the treatment decision. In this study, 84% sensitivity and 99% specificity were the most common fragmented type of fracture in X-ray when the fracture types were examined in all extremity traumas. Nevertheless, compared with CT, X-ray had a higher 100% sensitivity and 99% specificity for the diagnosis of segmental fracture. The sensitivity was low in oblique, linear, and avulsion-type fractures. Etli et al. compared the sensitivity of X-ray to CT in fissure type, avulsion, and circular type were lower than 60%. Similar to our study, the sensitivity and specificity of X-ray in evaluating the extension of fractures into the joint space were 75% and 90%, respectively [13]. Therefore, we recommend evaluation with CT to determine the type of fracture in fractures extending into the joint space.

Limitations

This study had some limitations: The first is a single-center and retrospective study. Secondly, since the patients were evaluated retrospectively, only X-ray images were examined without physical examination. The lack of expertise of the observers evaluating the X-ray images may have affected the interpretation of the results. If the fracture is so obvious on X-ray, CT may not be indicated. Also if no obvious fracture on the X-ray, those patients may not undergo a CT scan. All such cases were not included in this study. So the diagnostic accuracy of X-rays in patients with extremities trauma may differ. When a fracture is missed on CT, the accuracy of CT and X-ray can not be compared.

CONCLUSIONS

In this study, conventional X-ray and CT were compared in diagnosing extremity fractures in patients admitted to the emergency department due to isolated extremity trauma and predicting the decision for hospitalization and operation. When the images of all bones in X-ray were compared with CT, it was found that X-ray had low sensitivity and high specificity in determining fracture diagnosis. Also, the ability of X-ray to diagnose fracture according to the K value was shown to be highly compatible with CT These results showed high compatibility between X-ray and CT in diagnosing bone fractures. The sensitivity and specificity of the X-ray were high in identifying fractures of the proximal humerus, supracondylar, distal radius, and ulna. However, the sensitivity of X-ray in adjacent bones is low in fractures extending into the joint space and also of the fractures involving carpel and tarsal bones. In addition, it has been revealed that X-ray has lower sensitivity in hospitalization and operation decision than CT.

Article information and declarations

Ethical approval

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