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Current Utilization of X-ray in Orthopedic Emergency Cases in the Northern Border Region of Saudi Arabia

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Abstract **Objectives: Purpose:** The current study aimed to identify the X-ray usage in surgical versus non-surgical orthopedic emergency situations across healthcare institutions in Saudi Arabia's Northern Border Region. **Methods:** This retrospective, cross-sectional study was conducted in the emergency departments of the hospitals across the Northern Border Region of Saudi Arabia. Using the convenient sampling approach the sample size was calculated to be 200. Data was analyzed using SPSS v. 27, chi-square test was applied to identify categorical association between the variables. A p-value of less than 0.05 was considered as significant at a 95% confidence interval. The data including demographics, injury details, X-ray reports and clinical outcomes were collected from patient medical records. A standardized data collection form was developed to extract relevant information. The patient records were divided into two groups based on the actual management pathway received within 30 days of the emergency visit: Group 1 (Surgical), which tracked surgery type, X-ray-to-surgery time and outcomes; and Group 2 (Non-Surgical), which recorded referral details, follow-up and outcomes. **Results:** Accident 149 (74.5%) was the most common reason for presenting complaint. The most common site of injury was upper arms in 131 (65.5%) cases followed by legs in 129 (64.5%) cases. Fracture was found to be the most common type of injury as documented in 172 (86%) patient records. Amongst the reported cases, 71 (35.5%) had open wound injury and that was significantly (p-<0.001) associated with accident (history of presenting complaint) and fracture (type of injury). As reported in 191 (95%) cases x-ray was ordered for every suspected case and also when there was a positive relevance of trauma in history, however, 129 (64.5%) records showed that x-ray was not advised if there was presence of swelling only. Patients without open wounds had positive management outcomes and as many as 19 (26.7%) patients with open wound had faced complications such as post-surgical pain and infection. Comment: The conclusion is relevant, but it would be stronger if it gave one direct recommendation for improving emergency X-ray protocols. **Conclusion:** X-rays were recommended for almost all patients as first investigations and fractures and accidents were strongly linked to open wounds. Injury type, empirical diagnosis, patient benefit and equipment availability were the main justifications for X-ray use. To curb overutilization, we recommend that emergency department's mandate the use of validated selective imaging guidelines (e.g., Ottawa rules) tailored to high-incidence injury presentations like open-wound accidents.

Key Words X-ray, Orthopedic Emergency, Saudi Arabia, Diagnostic Imaging, Emergency Medicine, Radiation Exposure, Patient Outcome

INTRODUCTION

The most frequent causes of emergency department visits globally are orthopedic problems, such as fractures, dislocations and severe injurie [1]. The choice of whether to seek surgery or non-surgical therapy for these disorders is influenced by several variables like the kind and extent of the damage, the patient's comorbidities and the availability of surgical resources. These conditions frequently call for prompt action [2]. X-ray imaging has long been the mainstay modality of diagnostic assessment in orthopedic crises because of its affordability, accessibility and capacity to deliver comprehensive anatomical data [3]. However, improper or excessive X-ray use can result in delayed treatment, higher medical expenses and needless radiation exposure [1]. To address these challenges, standardized tools such as the NEXUS criteria, Canadian C-Spine Rule and

Ottawa rules provide specific clinical triggers. These guidelines serve as vital benchmarks for balancing routine and selective imaging, ensuring diagnostic testing is reserved for patients who genuinely need it.

The application of diagnostic imaging in emergency medicine has not received much attention in Saudi Arabia. The gaps in imaging technology availability and usage were brought to light by a nationwide survey and retrospective review research on teleradiology in Saudi Arabia [4,5]. These studies also emphasized the necessity of focused interventions to improve access and guarantee appropriate use. Recent advances in integrated diagnostic technologies have further strengthened evidence-based imaging and improved diagnostic precision in clinical practice [6].

In orthopedic crises, the type and severity of the injury, patient age and comorbidities all influence whether surgery or non-surgical therapy is pursued [7]. Complex fractures, open injuries and situations where non-surgical procedures fail to restore anatomical alignment may necessitate surgical intervention. Non-surgical treatment, such as casting, splinting, or physiotherapy, is usually reserved for stable fractures and mild injuries. Referral to specialist centers may be required in circumstances when advanced surgical knowledge or resources are not accessible at the first location [1]. Studies have found that X-ray consumption trends varied considerably across surgical and non-surgical situations. For instance, surgical situations frequently need several X-rays for preoperative planning, intraoperative guidance and postoperative evaluation [8]. In contrast, non-surgical situations may need fewer X-rays, especially if the damage is stable and healing well. However, the appropriateness of X-ray utilization in both groups has been questioned, with some research indicating that unneeded imaging occurs in both surgical and non-surgical paths [2,8].

Optimizing patient treatment, reducing needless radiation exposure and better allocation of healthcare resources all depend on an understanding of the trends, suitability and results of X- ray use in orthopedic crises. By comparing the use of X-rays in surgical and non-surgical orthopedic emergency patients in Northern Border Region of Saudi Arabia, this study fills a major knowledge vacuum by offering information to support clinical judgment and policy. Although X-rays are essential for identifying fractures and directing care, particularly in trauma situations, their misuse results in higher expenses and excessive radiation exposure. Patient safety and system efficiency can be improved by minimizing needless tests while preserving diagnostic accuracy by following guidelines like ALARA and streamlining imaging procedures [1].

The Northern Border Region of Saudi Arabia has a diversified population, including metropolitan centers and distant rural regions, which may impact the availability and usage of diagnostic imaging services [9]. Despite the increased emphasis on evidence-based healthcare procedures, there is little information on how X-rays are utilized in orthopedic crises in this region. Understanding the patterns, appropriateness and results of X-ray use is critical for improving patient care, avoiding needless radiation exposure and allocating resources effectively. This study intends to close this gap by performing a cross-sectional investigation of X-ray usage in surgery Vs non-surgical orthopedic emergency situations across healthcare institutions in Saudi Arabia's northern area.

METHODS

This retrospective, cross-sectional study was conducted in Emergency Departments (ED) of hospitals across the Northern Border Region of Saudi Arabia. The urban and rural healthcare facilities were included in the study to ensure a representative sample of the population and to account for potential variations in resource availability and utilization practices. The data was collected from patient medical records, including injury details, X-ray reports and clinical outcomes. A standardized data collection form was developed in a way to include the treating physicians demographics (age, gender, residence), education level, job status and location. The patient records extracted included types of orthopedic injury (fracture, dislocation, soft tissue injury) and nature of the healthcare facility (public vs. private, urban vs. rural). It also included relevant information on the frequency of X-ray utilization, appropriateness of X-ray use (based on clinical guidelines) and clinical outcomes (e.g., time to diagnosis, treatment initiation, complications). Patients were divided into two groups based on whether they underwent surgical intervention within 30 days of their initial ED visit. Group 1 (Surgical) tracked surgery type, the interval between X-ray and surgery and clinical outcomes. Group 2 (non-surgical) recorded referral details, follow-up status and outcomes.

Inclusion and Exclusion Criteria

The set inclusion criteria were patients of all ages presenting to ED with suspected or confirmed orthopedic injuries (e.g., fractures, dislocations, traumatic injuries), cases presenting to ED during the study period (August to October, 2025), patients treated in hospitals located in the Northern Border Region of Saudi Arabia, cases where X-ray imaging was ordered by a healthcare provider for diagnostic purposes in an emergency setting, patients with documented clinical outcomes following X-ray imaging, cases with complete medical records, including patient demographics, injury details, X-ray reports and clinical outcomes, for surgical group patients who underwent surgical intervention within 30 days of their emergency visit and for non-surgical group patients who received non-surgical treatment or were referred to other facilities without surgical intervention.

The exclusion criteria included patients presenting with non-orthopedic conditions (e.g., medical or surgical emergencies unrelated to musculoskeletal injuries), cases with missing or incomplete medical records, such as undocumented X-ray results or unclear clinical outcomes, patients who underwent X-ray imaging in non-emergency settings (e.g., outpatient clinics or routine follow-ups), patients who underwent advanced imaging (e.g., CT scans or MRIs) without prior X-ray imaging, patients with multiple visits for the same injury, to avoid duplication of data. Only the initial

emergency visit will be included; patients who are not residents of the Northern region of Saudi Arabia, as the study aims to focus on the local population and pregnant patients, due to the potential risks of radiation exposure, unless X-ray imaging was deemed necessary and documented as such.

Sampling Method and Sample

The sample size was calculated using a 95% confidence level, a 7% margin of error and a conservative estimate of orthopedic emergencies to be 50% (p = 0.50) in the region by using a convenient sampling approach. The minimal sample size for the study was calculated to be 200.

Data Analysis

Data was analyzed using SPSS v. 27, chi-square test was applied to identify categorical association between the variables. A p-value of less than 0.05 was considered as significant at a 95% confidence interval.

Ethical Considerations

Ethical Approval (65/25/H) was issued by the Local Committee of Bioethics (LCBE) at Northern Border University. Patient anonymity was strictly maintained and the requirement for informed consent was waived as the study was retrospective and involved no direct patient interaction.

RESULTS

The mean age of the treating physicians was 39.81±7.32 years, 89 (44.5%) were and 119 (59.5%) were from urban areas. The whole demographic data of the treating physicians is described in Table 1.

As evidenced from the patient records, pain 181 (90.5%), followed by swelling 169 (84.5%) was found to be the most frequent finding as evidenced in the patient records of the ortho department (Figure 1).

According to patient data, accident 149 (74.5%) was the most common reason for the Presenting Complaint (PC). The upper arms 131 (65.5%) followed by the legs 129 (64.5%) were the most common location of the injury. Fractures 172 (86%) contributed to the most common type of injury (Table 2).

The patient records showed that almost all the patients who reported to the orthopedic OPD were advised X-ray as a preliminary investigation to rule out the diagnosis. Amongst the reported cases, 71 (35.5%) had open wound injury and that was significantly (p = 0.001) associated with accident as the history of PC and fracture as the type of injury (Table 3).

Table 1: Demographic Characteristics of the Treating Physicians

Variable	Characteristic	Frequency	Percentage
Age	21-30	36	18
	31-40	72	36
	41-50	48	24
	51-60	44	22
Gender	Male	111	55.5
	Female	89	44.5
Education	Graduation	68	34
	Masters	85	42.5
	PhD	47	23.5
Status	House officer	38	19
	PG trainee	73	36.5
	Physician	89	44.5
Location	Urban	81	40.5
	Rural	119	59.5
Job	Private	71	35.5
	Government	129	64.5

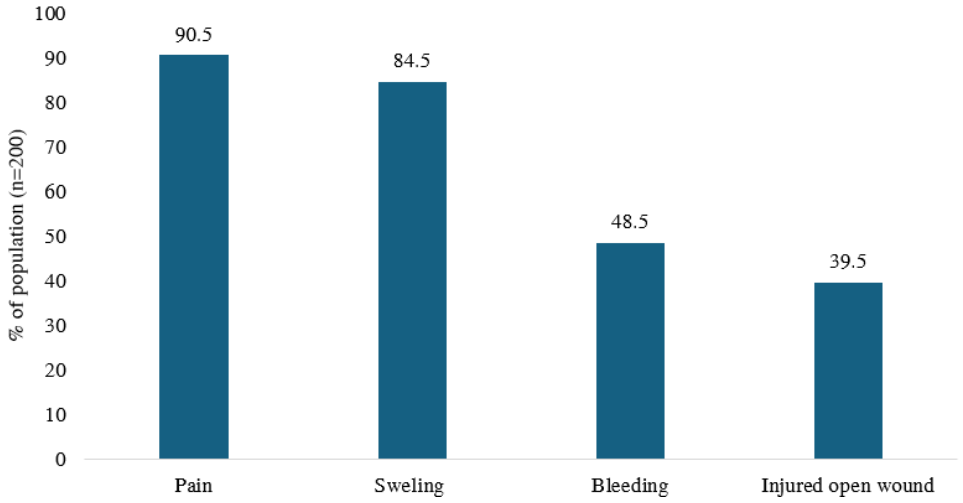

Figure 1: Pattern of the Presenting Complaints in the Orthopedic Department

Table 2: Pattern of History of PC, Area and Type of Injury in the Orthopedic Department

Variable	Characteristic	Frequency	Percentage
History of PC	Fall	123	61.5
	Accident	149	74.5
	Fight/Hit by an object	121	60.5
Area of injury	Head	79	39.5
	Chest	69	34.5
	Abdomen	43	21.5
	Upper arms	131	65.5
	Hands	95	47.5
	Legs	129	64.5
	Feet	73	36.5
Type of injury	Fracture	172	86
	Dislocation	91	45.5
	Soft tissue injury	71	35.5

Table 3: Association of Open wound Injury with the Type of Injury and History of PC

	Open wound (n = 71)				
Type of injury	Yes		No		p-value
Fracture	51	71.83%	20	28.16%	0.001*
Dislocation	13	18.31%	58	81.69%	
Soft tissue injury	7	9.86%	64	90.14%	
History of PC					
Fall	29	40.85%	42	59.15%	0.001*
Accident	41	57.75%	30	42.25%	
Fight/Hit by an object	18	25.35%	53	74.65%	

Table 4: Reasons and Attitudes of Doctors for X-ray Advice

	Reason for doctors' preference				
	Yes		No		
Type of injury	181	90.5%	19	9.5%	0.001*
Empirical diagnosis	159	79.5%	41	20.5%	
Patient benefit	187	93.5%	13	6.5%	
Availability of equipment	192	96%	8	4%	
Doctors' attitude towards X-ray advice					
Used in every suspected case	191	95.5%	9	4.5%	0.001*
Used when trauma is relevance to the history	191	95.5%	9	4.5%	
Used when there is swelling only	71	35.5%	129	64.5%	

Types of injury, empirical diagnosis, patient benefit and the availability of equipment were the significant reasons for ordering X-ray investigation. Furthermore in 191 (95%) reports X-ray was sought for every suspected case and whenever there was positive relevance of trauma with history; however, 129 (64.5%) records mentioned that x-ray should not be advised if there is swelling only (Table 4). Amongst 200, 169 (84.5%) mentioned that x-ray was sufficient for diagnosis. All the patients without open wounds had positive management outcomes; however, amongst 71 open wound patients, 19 (26.7%) faced complications such as post-surgical pain and infection.

DISCUSSION

A total number of two hundred patient records were analyzed. The majority of orthopedic patients' primary complaints were pain (90.5%) and edema (84.5%), which is consistent with findings from earlier research that regularly cites these as telltale indicators of musculoskeletal injuries [11]. According to Ahmed *et al.* trauma is a significant contributing factor to orthopedic crises and the high frequency of accidents (74.5%) as the primary reason of presentation supports their findings. In a similar vein, regional studies have shown that the most prevalent injury locations are the upper arms (65.5%) and legs (64.5%) [12]. The prevalence of fractures (86%) highlights the urgent need for focused trauma care techniques and is consistent with global trends in injury types needing orthopedic intervention [13].

According to recognized clinical guidelines, X-rays are almost always recommended as a preliminary inquiry in orthopedic outpatient departments to properly identify fractures and direct treatment regimens [11]. Open wound injuries accounted for 35.5% of cases in this study and they were substantially linked to fractures and accidents, indicating the high-energy trauma processes frequently observed in these types of injuries. With incidence rates ranging from 30% to over 40% in different populations, epidemiological evidence indicates that open fractures are frequently caused by traffic accidents, especially motorcycle wrecks [14,15]. Global trends are also supported by the prevalence of open fractures in younger age groups and men. While some studies emphasize heterogeneity based on regional trauma patterns and occupational dangers, others find somewhat greater open injury rates, such as 40.1% in inpatient orthopedic patients [16,17]. The Gustilo-Anderson classification highlights the severity and complexity of these injuries by identifying Type III open fractures as the most prevalent. To minimize problems like infection and non-

union, which continue to be major obstacles in the treatment of open fractures, our findings highlight the urgent need for imaging and multidisciplinary therapy [18,19].

Numerous important elements, including the kind of damage, empirical diagnosis, patient benefit and equipment availability, impact the choice to recommend X-rays; studies have shown both pro and con opinions. X-rays are a first-line diagnostic tool for serious bone issues because they may quickly and correctly identify fractures, dislocations and bone injuries, especially in emergencies. Two of its main advantages are its speed and accessibility, which enable prompt treatment decisions. Two of its main advantages are its speed and accessibility, which enable prompt treatment decisions [20]. However, MRI or ultrasound may be better at identifying soft tissue damage and minor bone fractures than X-rays. Recent studies have shown that ultrasound can complement conventional radiography by improving diagnostic accuracy in selected clinical conditions [21]. For instance, ultrasound is useful for certain fractures and is recommended in situations where radiation exposure is a concern, including in youngsters or pregnant women, as well as in places with limited resources because of its mobility and safety [22,23]. According to empirical evidence, X-rays can affect patients' perceptions of the necessity of therapy. For example, they may increase the perceived need for surgery in cases of osteoarthritis in the knee, which may not always be helpful and may result in overtreatment [24]. Furthermore, some research supports the chosen rather than routine use of X-rays, particularly in trauma situations when clinical judgment can safely cut down on unneeded imaging, reducing radiation exposure and expenses without sacrificing patient care [25]. The availability of equipment is another factor; although X-ray machines are widely used, not all places have access to sophisticated imaging techniques like MRIs, which might lead to a dependence on X-rays despite its drawbacks [26]. As a result, the justification for X-ray recommendations strikes a compromise between the kind of damage, diagnostic precision, patient outcomes and resource concerns, with continuous discussion over the best way to utilize them to optimize benefits and avoid harm [27].

In keeping with the widespread practice of employing radiography for first evaluation in trauma, the majority of 191 respondents (95%) think that X-rays should be utilized for every suspected trauma case, particularly where there is a positive relevance of trauma history. This is in accordance with recommendations for X-rays of the chest and pelvis in trauma rooms to detect injuries that are immediately life-threatening [28,29]. But when swelling is the sole symptom, 129 (64.5%) advise against using X-rays, raising issues with needless radiation exposure and a low diagnostic yield in soft tissue injuries without additional trauma indicators [30]. Research indicates that clinical criteria-based selective imaging, such the Canadian C- Spine Rules or NEXUS, can safely cut down on needless X-rays without omitting serious injuries [31]. To prevent misuse and improve patient care, there is strong agreement for restricting the use of X-rays when edema is the only factor present, even if most people prefer them when there is a suspicion of trauma [30]. According to studies demonstrating the high compatibility of X-rays with CT in detecting fractures, particularly in extremity trauma, where X-ray sensitivity and specificity are reported as high (78-95% sensitivity, up to 100% specificity), 169 (84.5%) of the 200 participants thought that X-rays were sufficient for diagnosis. X-ray adequacy in closed injuries was supported by the favorable treatment results of all patients without open wounds [32,33]. However, 19 (26.7%) of the 71 patients with open wounds had problems, including infection and post-operative discomfort, indicating that open wounds may need more thorough imaging and therapy because of the increased risk of complications. According to some research, even while X-rays are a good way to diagnose fractures at first, further imaging (like CT) could be required for complicated or open injuries to enhance results and prevent missed diagnoses [32,33].

CONCLUSION

This study demonstrates that diagnostic X-rays remain the primary, near-universal initial assessment for emergency orthopaedic cases, with fracture confirmations and high-energy accidents closely linked to open wound presentations. While factors such as injury severity, empirical diagnosis, perceived patient benefit and resource availability heavily drive imaging recommendations, the clinical outcomes vary significantly by presentation. Specifically, patients without open wounds experience favourable diagnostic utility from X-rays, whereas those presenting with open wounds face increased risks of subsequent complications, including infection and postoperative discomfort.

To mitigate these risks and curb diagnostic overutilization, emergency departments must transition away from routine, non-selective ordering practices. We recommend the formal implementation of validated, criteria-based selective imaging guidelines (such as the Ottawa rules) across emergency triage systems. Tailoring these structured protocols to high-incidence and complex presentations, particularly open-wound accidents, will optimize clinical decision-making, improve system efficiency, reduce secondary complications and protect patients from unnecessary radiation exposure.

Limitations

This study's limitations include its retrospective design and reliance on convenience sampling, which may introduce bias and limit generalizability. The geographic focus on the Northern Border Region restricts broader applicability. Additionally, the absence of radiological interpretation details and lack of control for confounding variables such as injury severity or comorbidities may affect the accuracy of clinical correlations.

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Authors Contributions

All authors contributed to research conception and design and data interpretation and manuscript writing. All authors have approved the final manuscript.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Ethical Statement

Ethical Approval (65/25/H) was obtained from the Local Committee of Bioethics at Northern Border University.

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