Perspectives of primary health care physicians on diagnosing and referring patients with apparent osteolytic lesions on plain X-ray films: a cross-sectional study

Ali Alyami¹,² Yasser Alshomrani¹,³ Rayyan Suqaty¹ Shaddy Futtiny¹ Faisal Alnaqib¹ Muath Albarakati¹ Ahmad Alhazmi¹,⁴

¹King Abdullah International Medical Research Center, Jeddah, ²Department of Orthopaedic Surgery, College of Medicine, King Saud Bin Abdul-Aziz University for Health Science, Jeddah, ³Department of Orthopaedic Surgery, ⁴Department of Surgery, Faculty of Medicine, Umm Alqura University, Makkah, Saudi Arabia

This article was published in the following Dove Press journal: Advances in Medical Education and Practice 7 March 2016

Background and objectives: The identification and diagnosis of musculoskeletal symptoms are major challenges for primary care physicians. A lack of clinical suspicion, limited exposure, and referral of patients to nonspecialized centers can delay the management of cases, which in turn can increase morbidity and mortality.

Subjects and methods: Four different sets of X-ray films were shown to 91 primary health care physicians. The first two were normal, whereas the third and fourth showed bone lesions. Participants were asked to indicate the presence of an abnormality, the diagnosis, and the approach to referral if required.

Results: There was a variation in the results for the first two sets of normal X-ray films. Most participants (73.6%) were able to diagnose the first case correctly. However, 73.6% of participants were unable to diagnose the second case correctly. A high percentage of participants (90.1%) were able to detect abnormalities in Cases 3 and 4, with nearly all participants indicating that they would refer patients to centers other than bone oncology centers in the western region of Saudi Arabia if they suspected bone tumors. Only 25.8% of participants were aware of these bone oncology centers.

Conclusion: Physicians in many primary health care centers need practice in reading normal X-ray films to avoid unnecessary referral of patients to specialized medical centers. We recommend the development of a new system for referring patients suspected to have bone tumors to avoid a delay in the management of cases and to decrease morbidity and mortality.

Keywords: primary health care physicians, diagnosis, referral, osteolytic, lesion, X-ray film

Introduction
Musculoskeletal symptoms are common among people in various age groups, and account for up to 20% of complaints responsible for visits to primary care practitioners.¹ Identification and diagnosis of these complaints are major challenges for primary care workers.²

One such complaint is bone tumors. These can be primary or secondary tumors, and the primary tumors can be either benign or malignant.³ Although such tumors are not very common, when they do occur, they cause significant morbidity and mortality.⁴ Benign bone tumors are usually diagnosed incidentally and can be recognized on plain radiography, without the need for additional studies, which are unnecessary and sometimes invasive.⁵ On the other hand, malignant bone tumors are usually detected in the elderly and are often diagnosed as skeletal metastases, commonly from prostate...
cancer in men and breast cancer in women.\textsuperscript{6} Malignant bone
tumors are aggressive and show destructive growth patterns,
resulting in death in up to 50\% of patients.\textsuperscript{3,7,8}

Accurate patient history taking and clinical examination
together with radiological investigations can help in the
identification and diagnosis of bone tumors. Radiological
parameters can help determine whether the tumor is benign or
malignant and whether it is a primary or secondary tumor, in
addition to providing other details.\textsuperscript{3,9} Primary care practitioners
have limited exposure to and training in musculoskeletal
medicine, lack clinical suspicion, and usually refer patients
to nonspecialized centers. These factors can lead to a delay
in the diagnosis of bone tumors, which in turn may increase
morbidity and mortality.\textsuperscript{1,10}

Radiography is an important tool in diagnosing bone
tumors and tumor-like lesions. Important morphological
information obtained from radiography, such as the lesion
location, site within the bone, characteristics of the bone
matrix, characteristics of the bone response, and soft tissue
involvement, aid in the diagnosis.\textsuperscript{9,11,12} However, the misinterpre-
tation of imaging findings is an important cause of poor
outcomes in patients with bone tumors.\textsuperscript{13}

The general objective of this study was to obtain a broad
understanding of the perspectives of general practitioners
in evaluating and managing different cases of bone tumors.
The specific objectives were to explore the ability of general
practitioners to detect and diagnose cases of bone tumors
based on plain X-ray films and to determine the approach
to referring patients with osteolytic lesions suspected to be
bone tumors who visited the primary health care (PHC)
centers.

Materials and methods
Study design and setting
This study was designed as a cross-sectional study and was
conducted between March 1 and April 20, 2015. Data were
collected by using paper questionnaires distributed manually
and individually to physicians in PHC centers to explore the
participants’ understanding and analysis of different X-ray
films showing either bone lesions or normal findings.

Participants
Physicians working in PHC centers in Makkah city, the capi-
for at least 3 months were included in this study. Targeted
physicians are general practitioners, family medicine
residents, family medicine specialists, or family medicine
consultants.

Measures and outcomes
Each participant was shown four sets of bone X-ray films
on a tablet computer device (IPad Tablet). The images were
shown in RGB (red, green, and blue) colors with dimensions
of 720×540 pixels. Participants were able to zoom in or out
to be able to see all details of the X-rays.

The first two sets were normal X-ray films (Figures 1
and 2). Case 3 (Figure 3) showed an osteolytic eccentric
lesion at the metaphysis of the distal left tibia. Case 4 (Figure 4)
showed an aggressive osteolytic–sclerotic mixed lesion at
the metaphysis of the proximal right tibia.

Upon being shown the radiographic images, the general
physicians had to answer three questions for each set of X-ray
films: “Are the findings normal or abnormal?”, “If they are
abnormal, do they indicate benign or malignant pathology?”,
and “What is your next step?”. Subsequently, the participants
had to answer another three questions regarding the referral
of patients with bone lesions.

Sample size
The sample size was calculated using The Survey System
software with a margin of error of 5% and a confidence level
of 95\%. The estimated sample size was 97.

Statistical analysis
IBM SPSS software version 22.0.0 (IBM Corp., Armonk,
NY, USA) was used for statistical analysis. Data are presented
as percentages and frequencies. Statistical significance for
some variables was tested by using the chi-squared test.

Ethical considerations
The objectives of the study were explained to the partici-
pants, and they signed consent forms prior to study entry.
The research proposal was reviewed and approved by
the Committee of Bio-Medical Ethics of King Saud Bin
Abdul-Aziz University before the questionnaires were sent
to the target population. All data were anonymized, and
patient confidentiality has been maintained.

Results
Of a total of ∼130 doctors in PHC centers in Makkah city,
91 responded to the questionnaire (response rate, 70\%)
(Table 1).

Case 1
The Case 1 images (Figure 1A and B) were considered
normal by 73.6\% of participants and abnormal by 20.9\%; 5.5\%
were not sure. The proportions were significantly different
Diagnosis and referral of patients with osteolytic lesions

(P<0.001; Table 2). There were no significant associations between the participants’ responses to the question “Are the findings normal or abnormal?” for this case and their specialty and place of education (P>0.05). However, there was a significant relationship between the responses and their work experience (P=0.013; Table 3).

Case 2
The Case 2 images (Figure 2A and B) were considered abnormal by 73.6% of participants and normal by 14.3%; 12.1% were not sure. These proportions were significantly different (P<0.001; Table 2). There were no significant associations between the participants’ responses to the question “Are the findings normal or abnormal?” for this case and their specialty, work experience, and place of education (P>0.05). However, there was a significant relationship with their specialty (P=0.025; Table 3).

Case 3
The Case 3 images (Figure 3A and B) were considered abnormal by 90.1% of participants, 8.8% were not sure, and only 1.1% of participants considered the images normal. These proportions were significantly different (P<0.001; Table 2). There were no significant associations between the participants’ responses to the question “Are the findings normal or abnormal?” for this case and their work experience and place of education (P>0.05). However, there was a significant relationship with their specialty (P=0.025; Table 3).
Table 2 Responses to the question “Are the findings normal or abnormal?” for the different cases

<table>
<thead>
<tr>
<th>Case 1</th>
<th>Responses</th>
<th>Percentage</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal</td>
<td>73.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Abnormal</td>
<td>20.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I am not sure</td>
<td>5.5</td>
<td></td>
</tr>
<tr>
<td>Case 2</td>
<td>Normal</td>
<td>14.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Abnormal</td>
<td>73.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I am not sure</td>
<td>12.1</td>
<td></td>
</tr>
<tr>
<td>Case 3</td>
<td>Normal</td>
<td>1.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Abnormal</td>
<td>90.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I am not sure</td>
<td>8.8</td>
<td></td>
</tr>
<tr>
<td>Case 4</td>
<td>Normal</td>
<td>0.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Abnormal</td>
<td>90.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I am not sure</td>
<td>9.9</td>
<td></td>
</tr>
</tbody>
</table>

Note: Statistical significance was tested using a one-way chi-squared test.

Participants who considered the images abnormal were asked about the possible pathology of the lesions; 26.1% thought the lesion was benign, 37.6% thought it was malignant, 31.8% were not sure, and 4.5% considered another diagnosis possible. With regard to their next step, 95.4% of participants said they would refer this patient immediately to a higher care center, while 4.6% said they would either reassure or treat the patient in their own center.

Case 4

The Case 4 images (Figure 4A and B) were considered abnormal by 90.1% of the participants, while 9.9% of participants were not sure (P<0.001; Table 2). There was no significant association between the participants’ responses to the question “Are the findings normal or abnormal?” for this case and their work experience or place of education (P>0.05).

However, a significant relationship with their specialty was noted (P=0.007; Table 3). With regard to the pathology of the lesion, 55.1% of participants considered it a malignant lesion, 15.7% considered it benign, and 29.2% were either not sure or considered another diagnosis. With regard to their next step, 91% of physicians would have immediately referred the patient to a higher care center.

Perspectives on patients referral

Of the participants who said they would refer patients with benign or malignant osteolytic lesions apparent on X-ray films to higher care centers, most (95.5%) chose centers other than the two bone oncology centers in the western region.

Table 3 The association between participant’s characteristics (specialty, work experience, and place of education) and responses to the question “Are the findings normal or abnormal?” for the different cases

<table>
<thead>
<tr>
<th>Participant’s characteristics</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
<th>Case 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>AN</td>
<td>NS</td>
<td>N</td>
</tr>
<tr>
<td>Specialty</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GP</td>
<td>78.3%</td>
<td>17.4%</td>
<td>4.3%</td>
<td>0.961</td>
</tr>
<tr>
<td>FMR</td>
<td>69.2%</td>
<td>25.0%</td>
<td>6.2%</td>
<td></td>
</tr>
<tr>
<td>FMS</td>
<td>68.8%</td>
<td>23.1%</td>
<td>7.7%</td>
<td></td>
</tr>
<tr>
<td>Work experience</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5 years</td>
<td>77.8%</td>
<td>17.8%</td>
<td>4.4%</td>
<td>0.013</td>
</tr>
<tr>
<td>6–10 years</td>
<td>71.4%</td>
<td>23.8%</td>
<td>4.8%</td>
<td>4.8%</td>
</tr>
<tr>
<td>11–15 years</td>
<td>60.0%</td>
<td>40.0%</td>
<td>0.0%</td>
<td>20.0%</td>
</tr>
<tr>
<td>&gt;15 years</td>
<td>50.0%</td>
<td>0.0%</td>
<td>50.0%</td>
<td>25.0%</td>
</tr>
<tr>
<td>Place of education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In Saudi Arabia</td>
<td>72.3%</td>
<td>23.4%</td>
<td>4.3%</td>
<td>0.750</td>
</tr>
<tr>
<td>Other countries</td>
<td>72.7%</td>
<td>18.2%</td>
<td>9.1%</td>
<td></td>
</tr>
</tbody>
</table>

Note: Statistical significance was tested using a chi-squared test.

Abbreviations: N, normal; AN, abnormal; NS, not sure; GP, general physician; FMR, family medicine resident; FMS, family medicine specialist.
of Saudi Arabia, while only 4.5% of participants said they would refer patients to one of these two centers (Table 4). With regard to the participants’ familiarity with the bone oncology centers, 25.8% of the participants were aware of these musculoskeletal oncology centers, whereas 74.2% were not (Table 5). Of the participants who claimed to be aware of these centers, 56.2% could name only one center, 13.3% could name both, and 21.7% could not name either. There is no significant association between the participants’ familiarity with the bone oncology centers and their years of practice or their different specialty ($P \geq 0.05$).

**Discussion**

The main objective of our study was to explore the ability of PHC physicians to detect osteolytic lesions apparent on plain X-ray films and to determine the approach of referral to more specialized centers. We found a variation in the ability of PHC physicians to detect these osteolytic lesions.

Most participants correctly identified the Case 1 images as normal, but, unexpectedly, most participants considered the Case 2 images to be abnormal, which was not the case. This extreme variation in results between the first two normal cases reflects the poor ability of PHC physicians to correctly read normal bone X-ray films. A possible explanation for this is the inadequate training provided to medical students and general physicians, as stressed by Patel et al.\(^1\) Of the participants who considered the Case 1 and/or 2 images abnormal, most would have referred the patients to more advanced medical centers for additional investigations and management, which would have been unnecessary. Other studies have also reported similar results; Donald et al.\(^14\) concluded that diagnostic errors based on radiological investigations are not uncommon and are mostly related to the observer's perception, whereas Taylor et al.\(^15\) found that radiological diagnostic errors were multifactorial. The experience of PHC physicians may play a role in arriving at the correct diagnosis. In this study, more than half of the participants had $\leq5$ years of work experience, and more than half of the participants were general physicians. These factors may have affected their ability to diagnose and interpret X-ray films.

**Table 4** Responses to the question “Where will you refer patients with osteolytic lesions on X-ray films suspected to be benign or malignant tumors?”

<table>
<thead>
<tr>
<th>Response</th>
<th>Percentage</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>KAMC</td>
<td>3.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>NGH</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Other centers</td>
<td>95.5</td>
<td></td>
</tr>
</tbody>
</table>

Note: Statistical significance was tested using a one-way chi-squared test.

**Abbreviations:** KAMC, King Abdullah Medical City; NGH, National Guard Hospital.

**Table 5** Responses to the question “Are you familiar with the musculoskeletal oncology centers in the western region of Saudi Arabia?”

<table>
<thead>
<tr>
<th>Response</th>
<th>Percentage</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>25.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>No</td>
<td>74.2</td>
<td></td>
</tr>
</tbody>
</table>

Note: Statistical significance was tested using a one-way chi-squared test.
On the other hand, Case 3 (Figure 3) showed an osteolytic eccentric lesion at the metaphysis of the distal left tibia with a well-defined sclerotic margin, ~16.49×40.12 mm in size, with no obvious matrix, cortical erosion, periosteal reaction, or soft tissue extension. These features are characteristic of nonaggressive lesions, with the most likely diagnosis being non-ossifying fibroma. The radiological diagnosis of non-ossifying fibroma in this case was confirmed by pathological examination. According to a musculoskeletal oncology surgeon, such tumors are generally treated conservatively by observation because of the possibility of self-healing. However, in cases of painful lesions or with a high risk of fracture, curettage, bone grafting, and fixation can be performed. For Case 3 in this report, the patient was treated conservatively by observation. The lesion healed spontaneously, and the patient is doing well and has no complications.

Case 4 (Figure 4) showed an aggressive osteolytic–sclerotic mixed lesion at the metaphysis of the proximal right tibia with subtle extension into the epiphysis through the growth plate. It was 85.02×22.54 mm in size with no matrix. Lateral cortical destruction with periosteal reaction was noted, and the lesion had an ill-defined margin. These features are typical of aggressive tumors and strongly indicate malignancy. Such cases would require magnetic resonance imaging for local staging and for planning a biopsy. Pathological examination in this case confirmed the diagnosis of Ewing sarcoma. Staging was performed and showed no evidence of metastasis. The patient was started on neoadjuvant chemotherapy, which was followed by wide surgical resection, reconstruction, postoperative chemotherapy, and extensive physiotherapy so that the patient could resume normal activities.

Most participants (91%–95%) stated that they would have immediately referred Cases 3 and 4 to higher care centers. However, most of them would have referred these patients to centers other than the bone oncology centers in the western region of Saudi Arabia. In fact, only a quarter of the participants were aware of these musculoskeletal oncology centers. This would have affected the immediate care of the patients, leading to a delay in appropriate management and increasing morbidity and mortality. George et al10 and Ashwood et al19 also reported a significant delay in the referral of patients with malignant bone tumors. Our results might be explained by the fact that most PHC centers in Saudi Arabia have their own policy for patient referral, with physicians referring all patients to a single tertiary center, even if it does not have the specialty required for the diagnosis. Additional studies should be conducted to address the issue of delay and to determine whether the current guidelines are adequate for making the right referral decision.

Our study has some limitations. Most importantly, the questionnaires were completed by the participants on their own, in separate locations. Hence, the interpretation might have differed. Ideally, the study should have been conducted at a single site under supervision. However, this was not done because it was too difficult to coordinate and get all participants together on a given date.

**Recommendations**

- Physicians at PHC centers need to practice viewing normal X-ray films to avoid unnecessary referral of patients to specialized medical centers.

- Future studies should quantify the delay in treatment of patients referred to specialized medical centers unnecessarily in order to develop new recommendations for decreasing this delay time.

- A new system for the referral of patients with suspected bone tumors should be developed to avoid a delay in their management and to decrease morbidity and mortality.

- Future studies should include a larger area, for example, the entire Makkah province, to obtain more precise results. Further, a larger number of cases should be studied, and a scoring system should be created for the answers.

**Acknowledgments**

The authors would like to thank Dr Zahid Altaf for his input on radiological opinions. Furthermore, the authors would like to thank the following people who helped with data collection: M Basuony, A Jalal, R Magliahi, B Allugmani, M Albakri, J Alsaedi, M Shaheen, K Alhazmi, M Alhuthali, and A Alahmadi.

**Disclosure**

The authors report no conflicts of interest in this work.

**References**


