Analyzing Periapical Lesions on Intraoral Periapical Radiographs: Incongruity in Diagnosis

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Nagendran Jeyavel Pandian, T Manigandan

ABSTRACT

Aim: To illustrate disagreement cases arising from a systematic study on the radiographic diagnosis of periapical radiolucent lesions.

Materials and methods: 152 cases of periapical radiolucent lesions taken with paralleling technique were analyzed separately by the observers. Disagreement cases were subjected to joint discussion based on Delphi technique for diagnostic consensus.

Results: A total of 121 cases (79.6 %) had an agreement on diagnosis. 31 cases which had diverse appearance were jointly discussed and an agreement was reached for all the cases.

Conclusion: A complete knowledge of the radiographic appearances of periodontal ligament space, Lamina dura and trabecular bone marrow pattern under normal and pathologic conditions and a systematic diagnostic sequence is mandatory for the radiographic diagnosis of periapical diseases.

Keywords: Periapical disease, Radiolucent lesions, Periodontal ligament space, Lamina dura.

INTRODUCTION

Intraoral periapical radiographs (IOPRs) are conventional screening aids, to visualize the tooth and the structures surrounding it. Though there are numerous advanced imaging modalities to visualize the periapical region of the tooth radiographically, IOPARs still remain as the best routinely employed method for evaluation, diagnosis and treatment planning.

The radiographic appearance of periapical lesions has countless presentations. The clinical challenges in diagnosing and treatment planning of periapical lesions, heavily relies on the radiographic changes surrounding the structures of the root. Categorization of the radiographic appearances of each lesion assumes significance, due to multidisciplinary treatment approach. The main aim of this study is to describe briefly about the radiographic diagnostic dilemmas encountered by the authors and to illustrate briefly the disagreement cases.

MATERIALS AND METHODS

A total of 152 cases of periapical radiolucent lesions in IOPARs taken with long cone paralleling technique with Owandy Elios AC intraoral radiology unit, were considered for this study. The size 2 Kodak Insight F speed films (Eastman Kodak, Rochester NY, USA) were processed manually by visual time dependant technique. The films were observed under optimal illumination at a viewing box with the aid of magnifying viewer and masking frame corresponding to the size of the dental film. The radiographs were observed by the authors and were interpreted systematically, as per the given proforma. The radiographic diagnostic criterias were considered as given in differential diagnosis of oral and maxillofacial lesions and—oral radiology principles and interpretation.

Any periapical radiolucent lesions in relation to any teeth were included in this study. Exclusion criteria include substandard and faulty radiographs and two or more separate periapical lesions in one IOPA.

PROFORMA FOR SYSTEMATIC RADIOGRAPHIC INTERPRETATION

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Tooth number Code/Description</th>
</tr>
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<tbody>
<tr>
<td>1. Crown</td>
<td>E:Enamel, D:Dentin, P:Pulp; M:Mesial; D:Distal; O:Occlusal; C:Cervical, B:Buccal, L:Lingual mm-from pulp chamber</td>
</tr>
<tr>
<td>i. Caries–Extent and location</td>
<td></td>
</tr>
<tr>
<td>ii. Restoration</td>
<td></td>
</tr>
<tr>
<td>Fractured</td>
<td></td>
</tr>
<tr>
<td>Poorly contoured</td>
<td></td>
</tr>
<tr>
<td>2. Pulp chamber</td>
<td>Enlarged/Decreased Size, Location Location</td>
</tr>
<tr>
<td>i. Pulp space</td>
<td></td>
</tr>
<tr>
<td>ii. Pulp stones</td>
<td></td>
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<tr>
<td>iii. Internal resorption</td>
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</table>

Contd.
3. **Root:**
   i. Number
   ii. Shape
   iii. Canal
   iv. RCT
   v. Post
   vi. Hypercementosis
   vii. Resorption

4. **Structures surrounding the root:**
   i. PDL widening—Coronal-c/middle-m/apical-a
   ii. Lamina dura—Change and location—Thickened/Discontinuity/Haziness
   iii. Alveolar crest
   iv. Furcation

5. **Periapical pathology:**
   i. Lesion
   ii. Size
   iii. Periphery
   iv. Effect on the surrounding structures

RADIOPHGRAPIC DIAGNOSIS

The radiographs were given to the observers again after a period of 1 month for analysing intraobserver variability. Percentual reproducibility of the diagnosis by each observer was calculated using Alman's formula for consistency ratio.\(^3\)

For each observer and diagnosis a measure of percentual reproducibility was calculated as follows:

\[
\frac{dd}{dd + dd + dp} \times 100
\]

The following are the abbreviations in this formula:

- \(d\) — Periapical lesions with the actual diagnosis
- \(dp\) — Periapical lesions with any other diagnosis.
- \(dd\) — Periapical lesions with the actual diagnosis reported at both the time
- \(dd\) and \(dp\) — Differing diagnosis at both the times.

Joint discussion was done for the disagreement cases. The Delphi technique for consensus\(^4\) was followed. The actual diagnosis was the one considered after the final round of consensus.

RESULTS

The number of concordant diagnosis was 121 cases (79.6\%) (Table 1). Intraobserver reproducibility was above 93 for all the authors. For 31 cases, there was disagreement on diagnosis. In the first round, the process began with an open ended questionnaire, stating the observer's reason for the diagnosis. These datas were analyzed by the investigators and another questionnaire was structured for round 2, wherein the observers agreed to some of their earlier disagreed views. At the end of round two, agreement was reached for another 25 cases. In the third round, consensus was achieved for the remaining 6 cases. The problems encountered for these cases were illustrated.

Some of the interesting disagreement cases were discussed (Table 2).

Some disagreement cases were discussed.

The initial diagnosis for Figure 1 was rarefying osteitis by some observers, which was disagreed as the lamina dura was intact. There was a history of extraction of the first premolar for orthodontic treatment and the radiolucency observed was concluded as a normal variant. It was emphasized that periapical rarefactions of the normal bone has to be considered in the diagnosis of periapical lesions.

The pictures (Figs 2A and B) were taken on the same day for the same patient. Figure 2A which depicted periapical radiolucency was diagnosed by some observers as periapical granuloma. But some noted the intact lamina dura at the apex and just concluded that it is an anatomical variant, which was confirmed by the second radiograph (Fig. 2B) in which the radiolucency was not seen. This can be due to variations in the projection geometry. Effects of beam angulations and lesion size on appearance of lesion in radiographs were stressed by Sisko Huumonen and Dag Orstavik.\(^7\)

### Table 1: Radiographic diagnosis based upon consensus (121)

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Radiographic diagnosis</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Initial/early phase of periapical periodontitis</td>
<td>58</td>
</tr>
<tr>
<td>2.</td>
<td>Periapical granuloma</td>
<td>19</td>
</tr>
<tr>
<td>3.</td>
<td>Periapical cyst</td>
<td>13</td>
</tr>
<tr>
<td>4.</td>
<td>Periapical rarefying osteitis</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>Periapical sclerosing osteitis</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>Periapical abscess</td>
<td>13</td>
</tr>
<tr>
<td>7.</td>
<td>Chronic periodontitis</td>
<td>8</td>
</tr>
<tr>
<td>8.</td>
<td>Periapical scar</td>
<td>1</td>
</tr>
<tr>
<td>9.</td>
<td>Residual cyst</td>
<td>1</td>
</tr>
<tr>
<td>10.</td>
<td>Osteomyelitis</td>
<td>1</td>
</tr>
<tr>
<td>11.</td>
<td>Periapical cemento-osseous dysplasia</td>
<td>1</td>
</tr>
<tr>
<td>12.</td>
<td>Traumatic bone cyst</td>
<td>1</td>
</tr>
</tbody>
</table>
Maxillary central and lateral incisors can show varied presentations. Figure 3 was considered initially as normal anatomic variation. But careful scrutiny of the pulp canal clearly shows a lateral canal and discontinuity of lamina dura on the mesial aspect of the root, making a radiographic diagnosis of periapical rarefying osteitis.

Figure 4 was considered as osteomyelitis, but the absence of definite coronal pathology warranted careful observation. The size of the mixed radiolucency and radiopacity and poorly localized epicentre of the radiolucency was observed and a diagnosis of intermediate stage of periapical cemento-osseous dysplasia was made. The tooth was tested as vital and osteomyelitis was thus ruled out.

The periapical radiolucency seen in Figure 5 associated with the central incisor was diagnosed as periapical granuloma. But some observed the calcified canal and were reluctant with the diagnosis. It was finally concluded that, even in case of calcified canal, which can occur as a result of trauma, periapical lesions can occur. This was in conjunction with a study conducted by M Abou-Rass and G Bogen,8 who stated that periapical lesions in calcified canals can harbor microorganisms.

The periapical radiolucency in Figure 6 was observed by some as just chronic periodontitis. But careful observation revealed that the lesion is non anatomic.5 Traumatic occlusion or history of trauma was considered. There was disagreement on the diagnosis based upon the size, but generally it was accepted that cysts are larger.6 Cortical/sclerotic border can be lost because of secondary infections, so a diagnosis of infected periapical cyst, should be considered. Occlusal radiographs were taken to reveal the cortical expansion in between cases of cysts. However, a definitive diagnosis periapical cyst/granuloma has to be arrived histopathologically.

The periapical radiolucency in Figure 7 was observed by some as just chronic periodontitis. But careful observation revealed that the lesion is non anatomic.5 Traumatic occlusion or history of trauma was considered. There was disagreement on the diagnosis based upon the size, but generally it was accepted that cysts are larger.6 Cortical/sclerotic border can be lost because of secondary infections, so a diagnosis of infected periapical cyst, should be considered. Occlusal radiographs were taken to reveal the cortical expansion in between cases of cysts. However, a definitive diagnosis periapical cyst/granuloma has to be arrived histopathologically.

Table 2: Disagreement cases and reasons for disagreement upon discussion

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Reasons for disagreement</th>
<th>Number of cases</th>
<th>Minutes of the discussion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Anatomic considerations</td>
<td>2</td>
<td>A second projection and/careful observation revealed that the lesion is non anatomic.5 Traumatic occlusion or history of trauma</td>
</tr>
<tr>
<td>2.</td>
<td>Widened PDL space, absence of coronal pathology</td>
<td>10</td>
<td>There was disagreement on the diagnosis based upon the size, but generally it was accepted that cysts are larger.6 Cortical/sclerotic border can be lost because of secondary infections, so a diagnosis of infected periapical cyst, should be considered. Occlusal radiographs were taken to reveal the cortical expansion in between cases of cysts. However, a definitive diagnosis periapical cyst/granuloma has to be arrived histopathologically.</td>
</tr>
<tr>
<td>3.</td>
<td>Periapical cyst/granuloma: No radiographic consensus, as in some bigger radiolucencies greater than 4 mm, there is no evidence of sclerotic reactions at the periphery to make a definitive diagnosis of cyst. The dimension cannot be strictly relied upon.</td>
<td>8</td>
<td>No endodontic treatment done. Consider anatomic variations too. History of periapical surgery After endodontic management They are not chronic to be considered as periapical granuloma. The technical aspect of projection of X-rays near the periapex can alter the size of the periapical radiolucency.7 A second radiograph always shows changes in the size of the periapical radiolucency.</td>
</tr>
<tr>
<td>4.</td>
<td>Mixed periapical radiolucencies and radiopacities Periapical rarefying and sclerosing osteitis Surgical defect or scar Healing periapical cyst</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Periapical radiolucencies less than 2 mm in diameter—is just considered as early periapical periodontitis</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

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The periapical radiolucency in Figure 6 was observed by some as just chronic periodontitis. But careful observation revealed that the radiolucency was vague, ill defined associated with resorption of the mid root region, leading to a suspicion that the radiolucency can be because of a tumor. Histopathological study proved it to be a schwannoma.
To arrive at a definitive diagnosis, the following points needs to be emphasized:
1. Optimum viewing conditions.
2. The sound knowledge about the normal anatomical landmarks.
3. Technical variations in taking the IOPARs.
4. The occlusal trauma, the tooth is subjected to-leading to changes in the lamina dura and periodontal ligament space.
5. Observe the considerable variations in the pattern of appearance of the structures surrounding the root in different patients and also from one area of the jaws to another, because of the density of the surrounding bone.
6. The effects of superimposed landmarks.

In this study, a systematic radio diagnostic approach was emphasized.

Systematic approach involves the following analytical steps:
1. Identification of the radiograph and the number of teeth present.
2. With regards to each teeth: observe-the stage of development, its position, the restorations or decay, root length, number of roots, its morphology, root resorption and crown-root ratio.
3. The structures surrounding the root: Scrutinize the integrity of the lamina dura, the PDL width, crestal bone loss (vertical/Horizental)-its level from CEJ, the furcation and calculus.
4. Periapical radiolucencies: Observe the epicenter; if multifocal the other radiolucent areas should be examined. The size, shape and periphery of the radiolucency should be analyzed. Well defined borders of the radiolucency are termed as punched out, if it is sharp and there are no bony changes at the periphery, corticated if the borders are thin and uniform and sclerotic if it is wide and non-uniform. Ill defined borders show a gradual transition and it can also be invasive or permeative.
5. Within the internal structure of the radioluency, observe whether it is totally radiolucent, mixed or completely radiopaque. Note the bone density and also the orientation of the septae.

6. The effects on surrounding structures like displacement and resorption of the teeth, displacement of inferior alveolar nerve canal and mental foramen and the periosteal reactions should be observed.

Becconassl-Ryan K, Tong D and Love RM9 stated that clinical and radiographic presentation alone is not sufficient for a definitive diagnosis. In this study it was observed that, the minute details of the radiograph should be carefully analyzed and definitely a suspicion index can be raised for pathological lesions. MB Saunders et al10 stressed the need for training in radiographic assessment for students. In this study it is observed that delicate changes in the radiographs have to be systematically evaluated.

The early phase of periapical disease is eroded lamina dura and widened periodontal ligament space at the apex. Also changes in the periapical bony pattern, anatomical depressions and rarefaction of the bones have to be considered when observing periapical changes. Kaffe and Grat11 suggested that changes in the continuity and shape of the lamina dura and periodontal ligament space should be analyzed with utmost care to decrease interobserver variations in the diagnosis. In this study, it was noted that failure to observe these delicate changes led to many disagreement cases in the first round.

Gefland M,12 stated that there are limitations on visual interpretation of radiographs. In this study, it is observed that there are limitations, but the limitations can be considerably reduced by following a careful systematic approach.

This discussion on the incongruities in the radiodiagnosis of difficult cases warrants an open discussion of the diagnostic and therapeutic problems encountered in endodontology. The immediate success after endodontic procedure can remain the same after an extended period of time, only if the clinical and radiographic diagnosis of the lesion is appropriate.

CONCLUSION

Radiographic interpretation is a multifaceted task which is perplexed by anatomical, biological and technical variables. Between the boundaries of well defined, normal periapical structures and pathological radioluencies, detection of the radiographic signs of disorders may be difficult. But knowledge about the anatomical considerations and the pathological sequel of periapical lesions coupled with a trained systematic approach will definitely aid in diagnosis and treatment planning.

REFERENCES


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