Review Article

Intra oral periapical radiography – basics yet intrigue: A review

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Abstract

There had been a long standing requirement for dental students which would help them to understand the basic techniques for intraoral periapical radiographs. Intra oral periapical radiography is an adjunct to the clinical examination and provides useful information about the joint components. The periapical view shows the entire crown and root of the teeth which provides vital information to aid in the diagnosis of the most common dental diseases. This article highlights the basic principle, techniques, advantages and disadvantages of intraoral periapical radiography.

Key words: Periapical radiographs, paralleling technique, bisecting technique.

Introduction

Radiographic examinations are one of the primary diagnostic tools used in dentistry to determine disease states and formulate appropriate treatment.¹ Dr. Otto Walkhoff is credited with the first dental radiograph. Dental radiographs are valuable diagnostic tools when the image quality is adequate for proper interpretation.² Dental radiography is consistently under-utilized in veterinary practice. In many procedures, diagnostic radiographs are essential for the production of a treatment plan and treatment may be contraindicated without them.³ Periapical radiographs (“peri” meaning “around” and apical meaning “apex” or end of tooth root) record images of the outlines, position and mesiodistal extent of the teeth and surrounding tissues.⁴

In periapical radiograph it is essential to obtain the full length of the tooth and at least 2 mm of the periapical bone.⁴ The purpose of the intraoral periapical examination is to obtain a view of the entire tooth and its surrounding structures.⁵ Intra oral Periapical radiography is a commonly used intraoral imaging technique in dental radiology and may be a component of intraoral periapical radiologic examination. Periapical radiographs provide important information about the teeth and surrounding bone. The film shows the entire crown and root of the teeth and surrounding alveolar bone which provides vital information to aid in the diagnosis of the most common dental diseases; specifically tooth decay, tooth abscesses and periodontal bone loss or gum disease. Additional important findings may be detected, including the condition of restorations, impacted teeth or broken tooth fragments and variations in tooth and bone anatomy.⁶

Need of Intraoral Periapical Radiographs

Periapical radiograph should show all of a tooth including surrounding bone.⁷ There are certain indications for the intra oral periapical radiography that includes:

Assessment of Periodontal Status:-

Intra oral periapical radiographs can be used for assessment of periodontal status for following significant features:

1. Receding bone height related to C.E.J.
2. Loss of bone at interproximal space or at furcation.
3. Widening of periodontal space.
4. Loss of integrity of lamina Dura.
Exodontia:-
1. For diagnosis and planning of treatment of fractured teeth.
2. For the distinction between complicated crown fracture (pulpaly exposed) and uncomplicated crown fracture (not pulpaly exposed).
3. Pre extraction planning for the developmental anomalies.
4. Assessment of root morphology, resorptive lesion and ankylosis.
5. Post extraction radiographs for root fragments and other co-lateral damages.

Conservative/Operative Procedures:-
1. Detection of the dental caries.
2. Intraoperative or post operative radiographs for the demonstration of file, position of gutta percha point in canal, and adequate filling of pulp canal.
3. Internal resorption, detection of developmental anomalies.
4. Detection of missing teeth, teeth with developmental anomalies E.g.- dilacerations, supernumerary teeth, fusion etc.
5. Evaluation of implant postoperatively.

Technique for Periapical Radiography:-
Two exposure techniques are implemented for periapical radiography. Prior to presenting technique a clear of understanding of the technique must be established, although the bisecting angle technique is utilized by the practitioners, the paralleling technique is the method of choice for intraoral radiography. The paralleling angle technique provides less image distortion and reduces excess radiation to the patient.

The Paralleling Technique:-
The paralleling technique is also known as "right angle technique" or "long cone technique". It is used for both periapical and bitewing radiographs. In the case of periapical radiograph the film receptor should be placed parallel to the crown and root of the teeth being imaged and the central ray of the x-ray beam is directed at the right angle to the teeth and film. The orientation of the film, teeth and the central ray minimized the geometric distortion.

The Paralleling principle, in essence, follows the five rules of accurate image formation to minimize the undesirable image characteristics of unsharpness, magnification and shape distortion. These rules are as follows:
1. The x-rays should originate from as small a focal spot as possible, that determined by manufacturer. Efforts should be made to minimize voluntary and involuntary motion unsharpness of film or x-ray tube. This will increase the size of the focal spot.
2. The distance between the focal spot and the object to be examined should always be as long as is practical.
3. The film should be as close as possible to the object being radiographed.
4. As far as is practical, the long axis of the object should be parallel to the film.
5. The central ray should be as nearly perpendicular to the film as possible to record the adjacent structures in their true spatial relationship.

Instruments:-
The film holder consists of the 3 basic components:
1. A mechanism for holding the film packet parallel to the teeth that prevents the bending of the film.
2. A bite block or platform.
3. Beam Aiming Device: This may or may not prevent the collimation of the beam.

A number of commercial devices are available that will hold the film parallel and at varying distances from the teeth:
1. The XCP instruments (extension cone paralleling)
2. The precision rectangular collimating instruments which restrict the beam size at the patient's face to the size of radiograph.
3. The Stabe disposable film holder.
4. The snap- A-Ray intra oral film holder
5. A haemostat inserted through a flattened rubber bite bock which will serve in much the same manner as the Snap-A-Ray film holder.

The choice of holder is a matter of personal preference, RIN XCP holders as shown in the Fig.2.
Technique:-
Select the appropriate holder and the film
Maxillary and Mandibular Incisors & Canine
The anterior holder should be used and the small film
packet with its long axis vertical.
Maxillary and Mandibular Premolar & Molar
Poster holder should be used (right or left) as per the
case and large film packet (31x 41) mm with its long
axis horizontal.

Key Points:-
1. Smooth white surface of the film must face towards
the x-ray sources.
2. End of the film packet with imposed orientation dot
should place opposite to the crown of the tooth.
3. Patient is positioned with head support with occlusal
plane horizontal.

Placement of The Film In Patient’s Mouth:-
For Maxillary Incisors & Canine:-
Placed the film sufficiently posterior to enable it’s
height to be accommodate in palatal vault.

For Maxillary Premolar & Molar:-
Place the film in the middle of the palate to
accommodate its height in palatal vault.

For Mandibular Incisor & Canine:-
Film is positioned in line with the lower canine or first premolar.

For Mandibular Premolar & Molar:-
Film is placed in lingual sulcus next to appropriate teeth.

The holder is rotated so that teeth to be imaged a
touching the bite block placed the cotton wool roll on
the reverse side of the bite block to keep the tooth &
film parallel and make holder comfortable to stabilize
holder. Ask the patient to bite gently. Locator ring is
moved down the indicator rod until this just in contact
with the patient face to obtain the correct focal spot to
the film distance. Although the beam indicating device
with locator ring this automatically both vertical and
horizontal angles and centre the beam over the film.

Exposure is made.

Point of entry for different teeth used in paralleling
 technique is described in Table.1

Table 1: Point of entry for different teeth used in paralleling
technique

<table>
<thead>
<tr>
<th>TEETH</th>
<th>POINT OF ENTRY OF CENTRAL RAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maxillary central incisor</td>
<td>Midway between alpha and beta, below the contact point of incisor</td>
</tr>
<tr>
<td>Maxillary lateral incisor</td>
<td>Through the incisal edge of the crown or from incisal</td>
</tr>
<tr>
<td>Maxillary canine</td>
<td>Through the center of the canine tooth, the point is usually below the occlusal plane</td>
</tr>
<tr>
<td>Maxillary premolar</td>
<td>Through the center of the premolar, the point is usually below the occlusal plane</td>
</tr>
<tr>
<td>Maxillary molar</td>
<td>Through the center of the molar, the point is usually below the occlusal plane</td>
</tr>
<tr>
<td>Mandibular central incisor</td>
<td>Midway between the buccal and lingual, below the contact point of incisor</td>
</tr>
<tr>
<td>Mandibular lateral incisor</td>
<td>Through the center of the incisor, the point is usually below the occlusal plane</td>
</tr>
<tr>
<td>Mandibular canine</td>
<td>Through the center of the canine, the point is usually below the occlusal plane</td>
</tr>
<tr>
<td>Mandibular premolar</td>
<td>Through the center of the premolar, the point is usually below the occlusal plane</td>
</tr>
<tr>
<td>Mandibular molar</td>
<td>Through the center of the molar, the point is usually below the occlusal plane</td>
</tr>
</tbody>
</table>

Advantages:-
1. Less magnification so geometrically accurate image
can be produced.
2. The shadow of zygomatic process appears above
apices of the molar teeth.
3. Good representation of periodontal bone level.
4. Minimal foreshortening or elongation gives accurate
information about the periapical region of image of teeth.
5. Detection of a proximal caries because of well
demonstration of crown of the teeth.
6. Automatically determine vertical and horizontal
angulations by positioning device if placed correctly.
7. No coning of or cone cutting as the x-ray beam is
aimed accurately by the centre of the film.
8. Reproducible radiographs are possible relative
postures of film & teeth and x ray been is always
maintained in respective of patient’s position.

Disadvantages:-
1. Positioning of the film can be uncomfortable for the
posterior teeth.
2. Inexperienced operator can face difficulty in placing
the holders in the mouth.
3. Cannot be performed satisfactory using short focal
spot to skin distance.
4. Difficulty in placing the holder in lower third molar regions.
5. Holders used to be clavicle or disposable.
6. Cannot done in cases of shallow flat palate.
7. Sometimes apical region of the teeth may appear
near the edge of the film.

Bisecting Angle Technique

Bisecting angle technique is used for periapical
radiography it is a useful alternative technique when
ideal receptor placement cannot be achieved due to
patient’s trauma or anatomical obstacles such as tori,
shallow palate, and shallow floor of the mouth, short
tremum, or narrow arch width. This technique is more
operator sensitive. If angle is not correctly bisected
elongation or foreshortening will occur.

Principle:-

The bisecting angle technique is based on geometric
principle that states that two triangles are equal if they
have two equal angles and a common side, it is called
"Scieszynak’s Rule of Isometry". Isometry is defined as
equality of measurement when the rule of Isometry is
applied to dental radiography. (Fig.3)

Fig 3: Rule of Isometry - Angle A is
bisected by the line AC. Line AC is
perpendicular to line BD. Angle DAC is
equal to angle CAB, and angle ACB is
equal to ACB. If two triangles have to
equal angles a common side, then it can be
said that the two triangles are equal.
Therefore, triangle DAC is equal to
triangle CAB.

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It is used to determine correct vertical angulations of cone (B.I.D.). Bisecting angle rule states that the central ray is directed through the marginal plane of tooth, perpendicular to a line bisecting the angle formed by the plane of long axis of tooth and plane of the film.\(^4,7\) (Fig.4)

**Instruments Used:**

Many methods can be used to support the file for bisecting angle technique. The preferred method is to use a film holding instrument (SNAP-A-RAY) OR BISECTING TECHNIQUE INSTRUMENTS.

Two such film holders are the DENTSPLY/RINN BISECTING ANGLE INSTRUMENT (B.A.I.) film holders and the dentsply/rinn stable disposable periapical x-ray film holders.

**Dentsply/Rinn (B.A.I.) Instruments:**

These instruments are designed to add in the determination of horizontal and vertical angulations, minimized distortion film bending and preventing cone-cutting.

**Dentsply /Rinn Stab Film Holder's:**

These film holders are made of exposed /rigid poly styrene material that allowing the patient's teeth to penetrate the bite blocks portion and the film holder, locking it into position.

**Technique:**

When using the bisecting angle technique the head position is very important, the rule for head position or patient's positions as follows:

1. The occlusal plane of teeth to be radiographed should be parallel to the floor.
2. Sagittal plane should be perpendicular to the floor for maxillary projection, here ala-tragus line is parallel to the floor.

3. In mandibular projection, mandibular occlusal plane changes when mouth is opened, so patient's head should be tilted slightly backward so that occlusal plane of the mandible will parallel to the floor when mouth open. Here lip commissural -tragus line is parallel to the floor.

Place the film to set the tooth to be imaged as close as possible. The angle formed between long axis of tooth and long axis of film assessed and mentally bisected. Place the x ray tube at right angle of the bisecting line with central ray aiming to the tooth apex. As per geometric principle of similar triangles, the length of tooth will be equal to length of the imaged tooth.\(^4,7,8\)

**Point of entry for different teeth used in Bisecting Angle technique is described in Table 2.**\(^10\)

**Table 2: Point of entry for different teeth used in bisecting technique**

<table>
<thead>
<tr>
<th>IMAGE FIELD</th>
<th>POINT OF ENTRY OF CENTRAL RAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maxillary central incisors</td>
<td>In maxilla, through lip of the nose.</td>
</tr>
</tbody>
</table>
| Maxillary lateral incisors | Through the side of the nose, about 1 cm below.
| Maxillary canine | Through the side of the nose, about 1 cm above.
| Mandible central incisors | Through the side of the mouth, about 1 cm below.
| Mandible lateral incisors | Through the side of the mouth, about 1 cm above.
| Mandible canine | Through the side of the mouth, about 1 cm below.
| Mandible premolars | Through the side of the mouth, about 1 cm above.
| Mandible molars | Through the side of the mouth, about 1 cm below.

**Vertical Angulation**

1. Rule for vertical angulations in bisecting angle technique is to direct the central ray through the centre of the filed under examination, perpendicular to the line bisecting the angle formed by the planes of long axis of the tooth and the plane of the film.
2. Plus (+) vertical angulations mean cone is above the horizontal pointed downward.
3. Minus (-) vertical angulations means cone is below the horizontal pointed upward. The ranges of prescribed vertical angulations are listed in **Table 3.**\(^4,7\)

**Table 3: Ranges of prescribed vertical angulations for bisecting angle technique**

<table>
<thead>
<tr>
<th>PROJECTIONS</th>
<th>MAXILLA</th>
<th>MANDIBLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incisors</td>
<td>+40°</td>
<td>-15°</td>
</tr>
<tr>
<td>Canines</td>
<td>+45°</td>
<td>-20°</td>
</tr>
<tr>
<td>Premolars</td>
<td>+30°</td>
<td>-10°</td>
</tr>
<tr>
<td>Molars</td>
<td>+20°</td>
<td>-5°</td>
</tr>
</tbody>
</table>

**Horizontal Angulation**

1. In the horizontal plane the central ray should be aimed through the inter proximal contact areas.
2. Horizontal angulations determined by shape of arch and position of tooth.
Periapical Radiography

Advantages:
1. Placement of the film is simple and quick.
2. Positioning of the file is comfortable in all areas of the mouth.
3. The image tooth will be the same length as tooth itself and should be adequate for diagnostic purpose if all angulations are used correctly.

Disadvantages:
1. Periodontal bone levels are shown poorly.
2. Non reproducible.
3. The shadow of zygomatic process overlies the root of maxillary molars.
4. Horizontal & vertical angles has to be assessed for every patient.
5. The technique required experienced operator.
6. An incorrect horizontal angulation causes overlapping of crown and root.
7. Incorrect vertical angulations will cause foreshortening or elongation of image.
8. Buccal roots of maxillary premolar and molar get foreshortened
9. Crown of teeth are often distorted thus preventing detection of proximal caries.
10. If central ray is not aimed at the centre of the film coning off or cone cut may result.7,8

Conclusion
Diagnostic intra oral periapical radiography has evolved as an inseparable branch of dentistry. Intra oral periapical radiography is an important diagnostic aid and routinely used for investigating the periapical and periodontal diseases. Proper intra oral periapical technique not only helps to confirm the diagnosis but also aids treatment planning and management and baseline for assessing the outcome of each pulpal, periapical and periodontal pathologies.

References