The Revolution in Endodontic Imaging: Extraoral Periapical Radiography

**ABSTRACT**

**Aim** To evaluate the accuracy of extraoral periapical radiography in all phases of endodontic therapy and to determine the magnification error by comparing it with the radiographs obtained from the standard intraoral approach using intraoral films and sensors.

**Introduction** Good quality radiographs help the dentist to verify the appropriate working length, gutta-percha points adjustment and presence of voids in the root canal filling in endodontic therapy. Conventional intraoral periapical radiography is widely used in all the phases of endodontic therapy. Although this technique is advantageous, it is very difficult to be used in patients with severe gag reflex, pediatric patients, patients with restricted mouth opening, mentally retarded and dental phobia. An alternative is an extraoral periapical radiographic technique that can be utilized while performing endodontic therapy for such compromised patients.

**Materials and Methods** This is an in vitro, comparative study in which premolars and molars was included on a standard phantom head. The tooth specimens were divided into four groups on which radiation is exposed using the following radiographic technique,
- **Group A** - Intraoral radiography using intraoral films;
- **Group B** - Intraoral radiography using sensors;
- **Group C** - Extraoral radiography using intraoral films;
- **Group D** - Extraoral radiography using sensors.

The accuracy of extraoral periapical radiography in all phases of endodontic therapy was determined and magnification error was compared using scale function of measuring tool.

**Results** No statistically significant difference between the four experimental groups was observed ($P > 0.05$).

**Conclusion** In conclusion, this technique is not meant for replacing conventional intraoral radiography, however, it can be used for replacing intraoral periapical radiography when intraoral film is difficult to place in patient’s mouth.

**KEYWORDS** root canal treatment, extraoral periapical radiography, intraoral periapical radiography, dental phobia, newman and friedman technique

**INTRODUCTION**

Radiographic examination is one of the primary diagnostic tools used in dentistry to determine a disease state and to formulate an appropriate treatment plan. Good quality radiographs are required for endodontic therapy because they help the dentist to verify the appropriate working length, gutta-percha points adjustment and presence of voids in the root canal filling. At present, various radiographic techniques are employed for orofacial imaging. Conventional intraoral periapical radiography is widely used in all phases of endodontic therapy.

Intraorally, a periapical radiograph can be obtained either by a paralleling or a bisecting angle technique, in which paralleling method is the commonly employed approach. Certain indications for periapical radiograph include detection of dental caries, periapical pathologies, assessment of periodontal status, and root morphology before extraction, trauma to teeth and the associated structures, assessment for implant surgery as well as in endodontic procedures.

During root canal therapy, determination of the working length of the tooth is the most essential step in subsequent steps such as cleaning, shaping, and obturation of the root canal system cannot be performed without accurate working length estimation. Failure to obtain accurate working length can cause certain procedural complications such as ledge formation, apical perforation, over or under filling that can ultimately reduce the success rate of root canal therapy.
In some patients, obtaining a correct intraoral periapical radiograph can be very difficult. Although this technique is advantageous but is very difficult to be used in patients with severe gag reflex, pediatric patients, patients with restricted mouth opening, mentally retarded and dental phobic patients. An alternative is an extraoral periapical radiographic technique that can be utilized while performing endodontic therapy for such compromised patients.

For such patients, Newman and Friedman introduced an alternative technique in which diagnostic periapical radiographs were taken by using extraoral approach. The film was placed on the cheek adjacent to the buccal surface of tooth and X-ray beam was exposed from the opposite side of the face. In 2007, a device was developed by Chen et al., which can be used successfully to obtain X-ray by extra-oral technique.

**MATERIALS AND METHODS**

This in vitro comparative study was carried out on a standard phantom head using Newman and Friedman technique. Maxillary and mandibular premolars and molars were stabilized on typodont with the help of modelling wax. The tooth specimens were divided into four groups on which radiation was exposed using the following radiographic technique.

- **Group A** - Intraoral radiography using intraoral films
- **Group B** - Intraoral radiography using sensors
- **Group C** - Extraoral radiography using intraoral films
- **Group D** - Extraoral radiography using sensors

**Technique for extraoral periapical radiograph**

The phantom head was connected to the dental, with its mouth opened as wide as possible, so that for extraoral images, the X-ray beam can pass to the sensor in an unobstructed manner from the opposite side of the mouth.

**Maxillary premolars and molars**

*Phantom head position and image receptor:* Upright position while the Frankfort plane should be horizontal with the floor and mouth wide open.

*The center of the image receptor:* On the intersection of the ala-tragus and a parasagittal line and the upper border of the receptor parallel to the canthomeatal line.

*Position of the central X-ray beam:* The X-ray cone was angled approximately $-25^\circ$ from the horizontal plane while the central beam was directed midway between maxillary and mandibular premolars on the opposite side to the center of the image receptor as shown in Figure 1(a) and (b).

**Mandibular premolars and molars**

*Phantom head position and image receptor:* The same position with maxillary teeth was obtained. The receptor was placed against the cheek on the side of interest and its lower border was parallel and at least 2 cm above the inferior border of the mandible.

*Position of the central X-ray beam:* The X-ray cone was angled approximately $+20^\circ$ from the horizontal plane while the central beam was directed from 1 cm below the lower border of the mandible at the premolar/molar area contralateral to the center of the receptor as shown in Figure 2(a) and (b).

The images were analyzed using Image J software. The length was determined using the scale function of the measuring tool inbuilt in the software. The magnification error was determined by comparing the radiographs obtained from the standard intraoral approach using intraoral films and sensors and extraoral radiography images. Figure 3 shows intraoral and extraoral radiography images.
RESULTS

Eight readings were taken for each group. The readings were tabulated and compared for mean and standard deviation (Table 1).

One-way ANOVA

No statistically significant difference between the four experimental groups was observed ($P > 0.05$).

Discussion

For successful non-surgical root canal therapy and minimizing postoperative discomfort, it is necessary that the root canal system should be thoroughly debrided. One of the most important steps in root canal preparation is the determination of precise working length. All other steps of the procedure such as cleaning, shaping, and obturation cannot be preceded without determining the correct working length\textsuperscript{7,8}.

The most common radiographs used for working length determination are intraoral periapical radiograph\textsuperscript{9}. However, it is difficult to obtain ideal intraoral radiograph in certain cases such as patients with trismus, exaggerated gag reflex, pediatric patients, patients maxillary, and mandibular tori or patients with dental phobia, etc. and the thick and rigid sensor of digital radiograph are increasing the pool of patients. For such patients,
Newman and Friedman introduced an alternative technique in which diagnostic periapical radiographs were taken by using extraoral approach. The film was placed on the cheek adjacent to the buccal surface of tooth and X-ray beam was exposed from the opposite side of the face$^{10}$. However, this technique has some disadvantages. It cannot be used for anterior teeth, and the quality of images acquired using this technique might not be as sharp as those acquired using the conventional intraoral technique because the tooth-film distance in this technique is greater than that in the conventional technique$^{11}$. Moreover, the exposition time in this technique is higher than that in the intraoral technique; however, this factor can be minimized by reduction in the number of failed intraoral radiographs$^{12}$.

CONCLUSION

In conclusion, this technique is not meant for replacing conventional intraoral radiography, however, it can be used for replacing intraoral periapical radiography when intraoral film is difficult to place in patient’s mouth.

REFERENCES