COMPARISON OF DIGITAL RADIOGRAPHY WITH CONVENTIONAL METHOD IN ROOT LENGTH DETERMINATION OF PRIMARY TEETH

Author: Dr. Neena I.E. Assistant Professor, Department of Pedodontics
neena.ganesh@gmail.com

ABSTRACT:
AIM: Working length determination in primary teeth endodontics using intra oral digital radiovisiography, and compare it with conventional method for accuracy. METHODOLOGY: This in vivo study was conducted on 30 primary teeth which were indicated for pulpectomy in the patients of the age group of 5-11 years. All experimental teeth had adequate remaining tooth structure for rubber dam isolation and radiographically visible canals. Endodontic treatment was required due to irreversible pulpitis or pulp necrosis. A standardized intraoral periapical radiograph of the tooth was taken using conventional method by paralleling technique. The distance between the source and the tooth, tooth and the films were standardized using X-ray positioning device. RESULT: From the results obtained we can conclude that intraoral digital radiography methods of determining the root canal length in primary teeth can be considered reliable and safe in endodontic treatment of children. CONCLUSION: The following conclusions were drawn from this present study. Intraoral digital radiography also proved to be safest method in determining working length with significant reduction in radiation dosage. Hence this techniques can be safely used as an alternate to conventional radiographic method in determining working length in primary teeth.

Keywords: Conventional radiography, Digital radiography, working Length, Primary teeth.

INTRODUCTION:
Maintaining the integrity and health of the oral tissues is the primary objectives of pulp treatment. It is desirable to attempt to maintain pulp vitality wherever possible. In permanent teeth, definitive rules for successful endodontic therapy have been established such as compact obturation and apical/coronal seal. In contrast, because of difficulties in estimating the exact root canal length there are no definitive rules for successful endodontic therapy. Root canal length (working length, root length, tooth length) determination is an important step in root canal therapy. These terms are used interchangeably however they refer to as the distance from the coronal reference point to the point at which canal preparation and obturation should terminate. Correct working length determination is one of the main factor leading to success in root canal treatment. Endodontic anatomy of primary teeth, in particular of molars is difficult to predict because of the resorption, Shape, dimension and position of the root apex are often continuously altered.

This is the reason, that makes it difficult to determine the exact location of the actual apex. To minimize periapical injury and possible damage to the succedaneous tooth, the root length should be carefully determined without exceeding the apex. Radiographic method described by Ingle is one of the most common and reliable method used in determining the working length, however accuracy is difficult to achieve. In this technique because of apical constriction which cannot be identified and the variables in techniques, angulations and exposure distort the image and lead to error. In addition there is radiation hazard both to the patient and dental personnel. The observers’ bias in radiographic interpretation may lead to errors. Technological advances have led to the introduction of digital radiology (DR), with many potential benefits in endodontic practice. In dentistry the first commercial integrated digital imaging system was radiovisiography, involving the use of an intraoral sensor instead of conventional X-ray film. The Radiovisiography allowed a substantial reduction in the duration of endodontic procedures, because it effectively eliminated the film-processing time.
In the same way, the zoom function had the potential to improve the diagnostic performance by magnifying areas such as the apical zone. Digital imaging incorporates computer technology in the capture, display, enhancement, and storage of direct radiographic images. Digital imaging offers some distinct advantages over film but like any emerging technology, it presents new and different challenges for the practitioner to overcome. The other advantage of digital intraoral radiograph is reduction of radiation dosage by up to 22% of F speed film. Digital radiography requires only approximately 23% of the x-ray dosage for a D speed film.5

The purpose of the present study is to compare the working length determined by digital radiography with that of conventional radiographic method for accuracy.

MATERIALS AND METHODS:
This in vivo study was conducted on 30 primary teeth which were indicated for pulpectomy in the patients of the age group of 5-11 years who visited Department of Pediatric and Preventive Dentistry, R.V. Dental college, Bangalore. Children were selected according to the inclusion criteria after obtaining consent from the parents.

All experimental teeth had adequate remaining tooth structure for rubber dam isolation and radiographically visible canals. Endodontic treatment was required due to irreversible pulpitis or pulp necrosis. A standardized intraoral periapical radiograph of the tooth was taken using conventional method by paralleling technique. The distance between the source and the tooth, tooth and the films were standardized using X-ray positioning device.

After administration of local anesthesia, tooth was isolated with rubber dam. Access cavity preparation was done using a round diamond bur under abundant water spray. Pulpal tissue of each tooth was extripated using broach and the root canals were irrigated using sodium hypochlorite solution. The pulp chamber was dried using sterile cotton.

From the preoperative radiograph the measurements were done using files with rubber markers which were in sizes ISO 15-20 by keeping 0.5 mm short of root apex. With this measurements the files were inserted into the canal and conventional radiograph was taken. With the same measurement in the canal the intraoral digital radiograph was taken.

The root lengths estimated from intraoral digital radiography was compared with the conventional method of root canal measurements for accuracy. Measurements were subjected to statistical analysis using ANOVA.

RESULTS: Table-1
Descriptive statistics of root length (mm):

<table>
<thead>
<tr>
<th>Technique</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional Radiograph</td>
<td>90</td>
<td>11.76</td>
<td>1.67</td>
<td>7.00</td>
<td>15.50</td>
</tr>
<tr>
<td>RVG</td>
<td>90</td>
<td>11.98</td>
<td>1.70</td>
<td>7.50</td>
<td>15.60</td>
</tr>
</tbody>
</table>

Totally 90 canals (30 teeth) measurements were taken in this study. conventional radiograph is 11.76 ,digital ANOVA

<table>
<thead>
<tr>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>2.585</td>
<td>2</td>
<td>1.293</td>
<td>.453</td>
</tr>
<tr>
<td>Within Groups</td>
<td>761.367</td>
<td>267</td>
<td>2.852</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>763.952</td>
<td>269</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The above ANOVA table shows the sum of squares between groups as 2.585, within group as 761.367, degree of freedom between group as 2 and within group as 267. From the above ANOVA table we notice that there is no significant difference in the mean root length measurements from the two techniques (P>0.05).

Table -3
PROXIMITY MATRIX Matrix File Input

<table>
<thead>
<tr>
<th>Case</th>
<th>CONVENTIONAL RADIOGRAPH</th>
<th>RVG</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONVENTIONAL RADIOGRAPH</td>
<td>0.00</td>
<td>16.90</td>
</tr>
<tr>
<td>RVG</td>
<td>16.90</td>
<td></td>
</tr>
</tbody>
</table>
DISCUSSION: The establishment of the apical limit of canal preparation is an important phase of root canal treatment. It is generally accepted that canal preparation and filling should be limited within the root canal. Thus accurate determination of the root canal working length is one of the most important steps in endodontic therapy.

Conventional radiographs are needed before, during and immediately after endodontic treatment and then periodically to evaluate the success or failure of the therapy. Therefore repeated exposure to dosage of radiations is required. Numerous animal and human investigations have studied the adverse effects of radiation on those areas in the path of ionizing radiation. These areas include the oral tissue, perioral tissues, head and neck region and human embryos and foetuses in pregnant women.

Conventional radiography as a method of determining the working length has shortcomings in that it depends on the child's co-operation as well as the operator's proficiency. In addition to this, minor degrees of resorption may not be visible, and overlapping by adjacent anatomical structures can obscure the clarity of the image.

The other important problem associated with intra oral periapical radiograph is positioning of the film inside the mouth. Error in placement of film and x-ray cone was eliminated by the design of the positioning apparatus, which allowed the fixation of the x-ray cone and reproducible placements of the experimental films and sensor. The other problem associated with intra oral periapical radiograph is developing, fixing, drying and storage of the film.

The above problems associated with conventional radiograph were overcome with the introduction of intra oral digital radiograph. A number of fundamental issues need to be resolved before digital radiology can be fully incorporated into clinical practice (Van Der Stelt 1995). The radiological diagnostic techniques used in the present study were chosen to reflect current interest in comparing the performances of digital and conventional radiology and assessing their applicability to root canal measurements.

It has been reported that Intracanal digital radiography has provided approximately 60% reduction in radiation dosage in comparison with conventional radiography.

It also permits immediate display of image, image enhancement, storage, retrieval and transmission. Other advantages include ease of repetition, the elimination of chemical usage. It also reduces the need for a dark room, films, mounts, processing equipment. The radiovisiographic images appeared instantly on the monitor screen immediately after exposure of the sensor. Image from intraoral digital radiograph can be used for patient education directly. Decreased exposure time also allows lower radiation dosage, reduces chair side time. Studies have shown that intra oral digital radiograph can be safely used in measurements of root length in root canal treatment.

Main disadvantage of intraoral digital radiography includes the cost of the equipment. Similar to conventional radiography placement of sensor in the child's mouth is a difficult task. Another possibility is the magnification of the actual images in the images obtained by intraoral digital radiography.

In the present study D-Speed film was used because it is still the most widely used intraoral film similar to the study conducted by E.Y.Ong and T.R.Pitt ford where they have used D-Speed film. Studies have shown no difference in clinical image quality between D and E-Speed film.

In this study 30 primary teeth were taken which would give a statistical significant result and patients selected were in the age group of 5-11 years since they would be having 2/3rd of the root length. Files selected to measure working length were in the range of 15-20 similar to the study conducted by Ssu-Kuang Chen et al where they have used files of 15-20 size. This is because the tips of the No 10K files were not identifiable because they were less than the 120 micron meter required.

A study by Velders et al showed that a size # 15 should be the threshold file size for length measurements and concluded that lengths of size 25 and 20 file in digital images were comparable with the lengths on the conventional film. Another study using density profile plot analysis for digital images noted that file lengths decreased perceptibility with sizes # 15 and #10 therefore a size 20 file was chosen for radiographic length determination of true canal length in this study.
Various studies have been carried out where there have been numerous technique employed in working length determination including radiography, apex locator, tactile perception, average tooth length and paper points, but reliability and reproducibility of conventional films have made them gold standard by which all imaging systems are compared. 

In our study though there was no significant difference between the two modalities and the gold standard conventional radiographic method, however measurements made from the direct digital images showed around 1.86% of magnification compared with that of conventional method and apex locator. This can be seen in other studies where direct digital radiograph has shown over prediction of the working length. One possible explanation may have been the lack of a reference point on the occlusal surface of the teeth from which measurements were made.

In this study although there was no significant difference in the mean root length measurements from the two technique.

In the present study D- Speed film was used for conventional radiographic method. Another study conducted using D and F Speed intraoral radiographs and digital and enhanced digital radiographic images for endodontic file length determination showed no significant difference among the four image types. Hence the result coincide with our study in use of film speed and accuracy in working length determination.

In the present study intra oral digital radiovisiography showed 1.86% of over prediction it may be due to magnification errors caused by positioning of the sensor in spite of using position indicating device or due to lack of correct reference point. So similar studies should be conducted on a larger samples to find out the cause of over prediction in working length determination using intra oral digital radiography.

From the results obtained we can conclude that intraoral digital radiography methods of determining the root canal length in primary teeth can be considered reliable and safe in endodontic treatment of children.

CONCLUSION: The following conclusions were drawn from this present study:

1. Intraoral digital radiography also proved to be safest method in determining working length with significant reduction in radiation dosage. Hence this techniques can be safely used as an alternate to conventional radiographic method in determining working length in primary teeth.

REFERENCES:


