



RESEARCH ARTICLE

EVALUATION OF WORKING LENGTH DETERMINATION IN PRIMARY MOLARS BY TACTILE, RADIOVISIOGRAPHY AND ELECTRONIC APEX LOCATOR- A COMPARATIVE IN VIVO STUDY

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ABSTRACT

Aim: The aim of this study was to compare the accuracy of Tactile, Radiovisiography and Electronic Apex Locator in determination of working length in primary molars.

Materials and Method: In this study, 80 patients between the age group of 5-9 years were selected. After local anesthesia administration, tooth isolation and access cavity preparation was done. Pulp extirpation was done with the no. 15 H file and canals were irrigated using irrigating solution. File was introduced in the canal until tactile resistance was felt and rubber stop was adjusted. Distance from the tip of file to the rubber stop was measured and registered as tactile length. The same file was again introduced into the canal and intra oral digital radiograph was taken. This was registered as the radiographic length. Root canal length was clinically determined with the help of an electronic apex locator and was registered as the electronic working length.

Statistical Analysis and Results: The data obtained was compiled, tabulated on a master chart and statistical analysis was carried out using one-way analysis of variance (ANOVA) and Tukey's Test for pairwise comparison. Using ANOVA test, we found that there was significant difference between the three methods. Using Tukey's Test for pairwise comparison, we found that there was no significant difference between RVG and Electronic Apex Locator method, while a significant difference was found between Tactile method and RVG, also in Tactile method and the Electronic Apex Locator method.

Conclusion: From the results of this in vivo study, it can be concluded that a combination of digital radiography and electronic apex locator provides reliable and precise information about root canal length in deciduous teeth.

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INTRODUCTION

Maintenance of the integrity and function of the primary dentition until physiologic exfoliation constitutes the main objective in Pediatric Dentistry. To maximize the success of endodontic treatment in primary teeth, the evaluation of root morphology is a factor of concern. Estimation of root canal length is probably more difficult in the primary dentition, because of its altered anatomy and various stages of apical resorption. (Neena et al., 2011) Correct working length determination is one of the main factors responsible for the success of pulpectomy. Various methods are implemented for

the determination of working length with some advantages over the others: (Muthu Shanmugaraj et al., 2007) The tactile method is being used by clinicians in correlation with pretreatment radiographs. (Subramaniam et al., 2005) Conventional technique, which involves radiographs, is needed before, during and immediately after the endodontic treatment causing repeated radiation exposure. (Katz et al., 1991) The above problem associated with conventional technique was overcome with the introduction of Intra oral digital radiography which eliminates film processing time, reduction of radiation dosage, improves diagnostic performance by zoom function. (Parks and Williamson, 2002) Electronic determination of the working length in root canal treatment is non-radiographic method and safest without radiation exposure. (Kumar et al., 2004)

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Aim

The purpose of this study was to compare the accuracy of tactile method, radiovisiography and electronic apex locator for determining working length in primary molars.

Objectives

1. To determine the working length in primary molars using tactile method, electronic apex locator and radiovisiography during endodontic procedures.
2. To compare the mean working length using these methods.
3. To compare the accuracy of tactile method, radiovisiography and electronic apex locator for determining working length in primary molars.

MATERIALS AND METHODS (AGHAREED GH AND MOHAMMED, 2009) (FIG. 1)

The study was conducted in 80 children of age group 5-9 years who reported to the Department of Pedodontics and Preventive Dentistry, Bharati Vidyapeeth Dental College & Hospital, Pune and indicated for pulpectomy of primary mandibular second molars. An informed consent was obtained from parents of the subjects included in the study. The criteria for selection of patients were healthy children between the age group of 5-9 years indicated for pulpectomy of primary mandibular second molars. Primary mandibular second molars having adequate tooth structure with more than 2/3 of root length and radiographically visible canals. Exclusions were children with special health care needs, primary mandibular second molars with more than 2/3 resorbed roots and patients who were medically compromised. Topical anesthetic gel was applied at the injection site of the patients who fulfilled the inclusion criteria, followed by the administration of local anesthesia with lignocaine and 2% adrenaline. After administration, tooth was isolated with rubber dam. All caries was removed before pulpal exposure to minimize bacterial contamination following exposure.

The roof of the pulp chamber was removed by joining the pulp horns with bur cuts. This procedure was accomplished using no. 330 bur. The coronal pulp was then amputated using a sharp spoon excavator. No.15 H-file was used gently to remove as much organic material as possible from each canal and the root canals were then irrigated using sodium hypochlorite solution (3%) and normal saline. The pulp chamber was dried using sterile cotton pellets (Fig.2, 3).

Root canal length determination by Tactile Sense method

Tactile measurements were completed by using no. 15 K- file; the file was introduced into the canal until an increase in the tactile resistance was detected. Rubber stop was adjusted on the file in such a way that it touched the occlusal reference point. Then no. 15 K-file was carefully withdrawn and the distance from the tip of the file to the rubber stop was measured using an Endogauge (Dentex Mini endo Block); the values were noted down and were registered as tactile working length (Fig. 4).



Fig. 1. Armamentarium



Fig. 2. Access cavity preparation

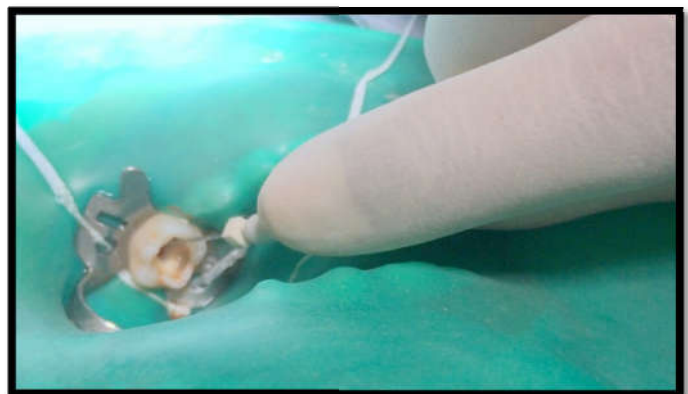


Fig. 3. Insertion of no.15 K- file into the canal



Fig 4. Working length measurement by Tactile method

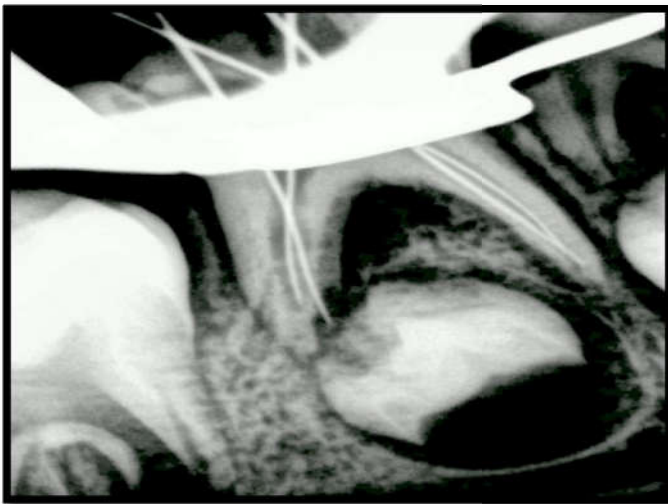


Fig. 5. Intraoral Digital Radiograph (RVG)



Fig. 6. Working length determination with electronic apex locator

Table 1. Descriptive statistics of root canal length (mm) analyzed and expressed in terms of mean and standard deviation

	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Tactile	320	14.83	1.14	0.06	10.00	17.50
RVG	320	16.07	1.82	0.10	6.60	18.80
EAL	320	16.06	1.72	0.10	11.00	19.00
Total	960	15.65	1.69	0.05	6.60	19.00

Table 2. Pair wise comparison Using Tukey's Test

Group 1	Group 2	Mean Difference (I-J)	Std. Error	P-Value
Tactile	RVG	-1.24531*	0.13	.000
	EAL	-1.22719*	0.13	.000
RVG	TACTILE	1.24531*	0.13	.000
	EAL	0.02	0.13	.989
EAL	TACTILE	1.22719*	0.13	.000
	RVG	-0.02	0.13	.989

Root canal length determination by Digital Radiography method

Using the same measurement, the file was then placed in the canals and an intraoral digital radiograph was taken using the bisecting angle technique. The exposure factors and distances between the source and the tooth, and the tooth and the digital sensor were standardized by using a 70- kV, 8-mA X-ray device (X mind Satelec) with 0.4-s exposure time. Size 1 RVG

sensor (Kodak 5000 Digital Radiography System) was held against the tooth at a distance of 15 cms from the X-ray tube. The X-ray tube was adjusted such that the central ray of the X-ray bisected the angle formed between the long axis of the RVG sensor and the tooth. The actual root length was measured with the 'measurement tool' of the RVG software. Working length was determined with the help of point to point measurement from occlusal reference point to the apex and the readings were noted down (Fig. 5).

Root canal length determination by Electronic Apex Locator method

The Root ZX, J. Morita Corporation was used on EMR Mode-Electronic measurement of a root canal (A full automatic apex locator, Tokyo, Japan). After digital radiographic working length determination, the canal was irrigated using 3% sodium hypochlorite solution and flushed copiously with saline. Then the canal was thoroughly dried with paper points. The file was attached to the file holder and the lip clip was attached to patients lip. The file was advanced apically in the canal until the beeping sound and the light emitting diode (LED) marked APEX on the panel began to glow, indicating that the tip of the file had reached the predetermined length of the apical constriction. The file was withdrawn with a slow counterclockwise turn until the pulsing audition and the flashing light went out. The distance from the tip of the instrument to the rubber stopper was measured using an endogauge (Dentex Mini endo Block); the measurements were noted down and registered as electronic working length (Fig. 6). The working length measurements so obtained by the tactile method and electronic apex locator were compared with the working length obtained by the Radiovisography (RVG).

RESULTS

The data obtained was compiled, tabulated on a master chart and analyzed statistically. Results obtained from this study can be summarized as follows- (Table 1, 2).

- Using ANOVA test, since P-Value is less than 0.05, we found that there is significant difference between these three methods.
- Using Tukey's Test for pairwise comparison, we found that there was no significant difference between RVG and Electronic Apex Locator method, while a significant difference was found between Tactile method and RVG, also Tactile method and the Electronic Apex Locator method.

DISCUSSION

The establishment of the apical limit of canal preparation is an important phase of root canal treatment. Methods for determining the root canal length of the primary teeth should yield accurate and reproducible results. (Neena *et al.*, 2011) In primary teeth, technical failures can induce over instrumentation, overfilling, and root perforation/fracture or even damage to the permanent tooth. On the other hand, under filling is also a risk factor accounting for an ongoing disease. Thus, accurate determination of the root canal working length

is one of the most important steps in endodontic therapy. The present study was carried out in 80 patients between the age group of 5-9 years indicated for pulpectomy of mandibular second deciduous molars and who fulfilled the inclusion criteria so as to evaluate the accuracy of working length determined by tactile method, RVG and electronic apex locator to aid in successful pediatric endodontic treatment. The present study showed that the mean of tactile method was 14.83 ± 1.14 , for digital radiography was 16.07 ± 1.82 and for electronic apex locator was 16.06 ± 1.72 . We noticed that there is significant difference in the mean root length measurements from the three techniques. ($P < 0.05$) Table 1. In this study, results indicated that the sole use of tactile method is generally depreciated because of its nonreliability. The results obtained in this study were also in agreement with the study carried out by Subramaniam *et al.* (2005) Also, results of this study obtained by pair wise comparison, showed a significant difference of the tactile method compared with the RVG and electronic apex locator ($P < 0.05$). This was in agreement with the study carried by Shanmugaraj *et al.*, which concluded that an inaccuracy of the tactile method could be highly noticed in cases of incomplete pulp extirpation, periapical lesions, physiologic root resorption, and narrow and curved root canals. (Muthu Shanmugaraj *et al.*, 2007) Similar results were obtained for tactile method in a study carried out by A.C.V. Mello- Moura *et al.*, which was mainly because of the variation in canal constriction caused by physiological resorption. (Mello-Moura *et al.*, 2010) It has been reported that intraoral 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, and the elimination of chemical usage reduces the need for a dark room, films, mounts and processing equipment. The radiovisio-graphic images appear instantly on the monitor screen after exposure of the sensor image; and can be used for patient education directly. Decreased exposure time also allows lower radiation dosage and reduces the chair side time. (Melius *et al.*, 2001)

Use of electronic apex locator for determining working length has reduced radiation dosage and time. In 1918, Custer was the first to develop the idea that root canal length could be estimated by the use of an electric current. The Root ZX (J. Morita, corp., Tokyo, Japan) (developed by Kobayashi and Suda) electronic apex locator, is able to detect the narrowest diameter of the root canal under both wet and dry conditions. It uses the impedance ratio instead of impedance difference, Impedance values at two frequencies (8 and 0.4 kHz) and calculates a quotient of impedance. (Pagavino *et al.*, 1998) In the present study, it was found that RVG and Electronic apex locator method for working length determination were almost similar in accuracy, while tactile method and RVG showed a significant variation in accuracy. Martinez – Lozano *et al.* showed similar results between RVG and electronic apex locator. (Martinez-Lozano *et al.*, 2001) The study carried out by Neena *et al.* also showed similar results. (Neena *et al.*, 2011) This study also showed a significant difference between tactile method and electronic apex locator, which was similar in a study carried out by Maha M. Misbah *et al.* (2011) From present study, we can say that, although the electronic apex

locator yields quick and instant results, it should be used in conjunction with RVG as electronic apex locator alone cannot define the anatomy of the roots. Also, it cannot determine the number and curvature of the roots or the presence or absence of disease. Study done by Musaab Hamed Saeed *et al.* also supports these findings. (Saeed Hamed Musab *et al.*, 2011) Hence, the present study indicates that the intraoral digital radiography and electronic apex locator methods for determining the root canal length in primary teeth can be considered as reliable and safe methods in the endodontic treatment of children. Combination of these methods will help to improve accuracy and in turn success of the endodontic treatment.

Summary and Conclusion

This study was conducted in 80 children of age group 5-9 years who reported to the Department of Pedodontics and Preventive Dentistry, Bharati Vidyapeeth Dental College & Hospital, Pune who were indicated for pulpectomy of primary mandibular second molars. An informed consent was obtained from parents of the subjects included in the study. After administration of lignocaine local anesthesia, tooth was isolated using a rubber dam and access cavity preparation was done. The working length of each canal was determined by tactile method, RVG and electronic apex locator and the readings were compiled and tabulated on a master chart. The following conclusions can be drawn from this study:

1. Tactile method showed variations in the results due to its unpredictability.
2. Intraoral digital radiography is the safest method in determining the working length with significant reduction in radiation exposure.
3. Apex locator is comparable to intraoral digital radiography in determining the working length without radiation exposure in the primary teeth.

Hence, we can say that the incorporation of these new techniques of electronic apex locators and digital radiography can be of immense use in pediatric endodontic procedures.

From the results of this in vivo study, it can be concluded that digital radiography and electronic apex locator methods of determining the root canal length in primary teeth can be considered reliable and precise. Because these methods increase the safety and comfort of endodontic treatment in children, their use should be further evaluated and it certainly warrants more clinical studies.

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