



1. BDS, MSc
Lecturer, Operative Dentistry
Department, Faculty of Dentistry
LUMHS, Jamshoro
2. BDS, FCPS
Assistant Professor
Oral & Maxillofacial Surgery
Department, Faculty of Dentistry
LUMHS, Jamshoro
3. BDS, MSc, FCPS
Associate Professor
Operative Dentistry Department
Faculty of Dentistry LUMHS,
Jamshoro
4. BDS, MSc
Assistant Professor
Community Dentistry Department
Faculty of Dentistry LUMHS,
Jamshoro
5. BDS, MSc, MBE
Lecturer, Faculty of Dentistry
LUMHS, Jamshoro

Correspondence Address:

Dr. Naveen Khawaja
Office: Dental Department
Aga Khan Maternal & Child Care
Centre,
Main Jamshoro Road, Hyderabad.
naveen_500@hotmail.com

Article received on:

03/06/2015

Accepted for publication:

11/11/2015

Received after proof reading:

00/00/2015

INTRODUCTION

Determination of precise working length (WL) is of great importance for achieving success in treating endodontic patients, to reduce the risk of inadequate cleaning of root canals or injury to periapical tissues due to over instrumentation, removal of necrotic tissues and precise preparation of canals become easy by working length in treatment of root canals.^{1, 2}

WL is described as the distance between coronal point of reference and the end point where canal must be prepared and obturated.³

Different approaches are practiced to determine WL including conventional or digital radiography, tactile sensation and presence of fluid on paper point. Each of these approaches has its own restrictions, e.g. distorted and magnifying issues in radiographs with correct position of root apices.²

⁴ These techniques have sensitivity of exploring and interpreting, providing 2-dimensional image

ELECTRONIC APEX LOCATOR VERSUS CONVENTIONAL R ADIOGRAPH; DETERMINATION OF WORKING LENGTH: A PROSPECTIVE IN-VIVO STUDY

Dr. Naveen Khawaja¹, Dr. Suneel Kumar Punjabi², Dr. Abdul Qadir Dal³, Dr. Munir Ahmed Banglani⁴, Dr. Ramesh Lal⁵

ABSTRACT... For successful endodontic outcome, accurate working length has to be determined. Even with improved systems of working length (WL) measurement, different readings may be recorded in different electrolytes present in the canal. **Methodology:** Total 90 patients were selected for this prospective in vivo study resented at Department of Operative Dentistry, Liaquat University of Medical & Health Sciences, Jamshoro, during 6 months i.e. from 1st Sep 2014 to 28th Feb 2015, with single rooted permanent mandibular first premolars with matured apices. After extirpated pulp tissue a file was inserted in the canal and WL was obtained by radiograph as well as by electronic apex locator (EAL). The measurements determined by both methods were compared by applying paired sample t-test. SPSS 18 was used for data analysis. **Results:** Among 90 subjects 37 were males. Mean±SD WL obtained radiographically was 19.8±1.03-m whereas mean±SD WL obtained electronically was 18.9±1.05 mm. Mean difference between measurements of both methods was 0.87-mm, which was statistically significant (P <0.05). **Conclusion:** The electronic apex locator was better than the radiograph in determining working length of root canal at statistically significant level.

Keywords: Electronic apex locators, Dental radiographs, endodontic working length.

Article Citation: Khawaja N, Punjabi SK, Dal AQ, Banglani MA, Lal R. Electronic apex locator versus conventional radiograph; determination of working length: a prospective in-vivo study. Professional Med J 2015;22(12):1612-1616. DOI: 10.17957/TPMJ/15.2957

of a 3-dimensional structures, making unable to signify actual location on the bases of conventional radiographs.^{5, 6} Difficulty in making accurate WL increases when radiographs superimpose the root canal system due to its anatomy. The preferred technique in this situation is electronic apex locator.² Electronic apex locator (EAL) was first time used to determine WL by Sunada in 1962. These are being improved with time to achieve more accurate evaluation of root canal length.⁷

Disadvantages of radiography were overcome by electronic techniques, e.g. the canal length can be determined to the apical foramen's end.⁸ EALs have advantages of simple and rapid application, reduced risk of radiation, detection of perforated tissues, safe use in pregnancy, and in patients with vomiting reflex, and mentally retarded.^{9, 10}

The present study was carried out to find out another method to determine WL in endodontic therapy that is superior than currently practiced

radiographic imaging so that the number of cases of endodontic failures due to inaccurate working length measurement is reduced.

METHODOLOGY

This prospective in vivo study was done at Department of Operative Dentistry, Liaquat University of Medical & Health Sciences, Jamshoro. The duration of study was 6 months from 1st Sep 2014 to 28th Feb 2015 with sample size of 90 Patients. All cases of both gender presented with irreversible pulpitis with Permanent first mandibular right or left premolar teeth required endodontic treatment. Mandibular 1st premolar teeth were (Vital and non vital). Teeth with sound cusp anatomy and normal architecture were included.

The Patients that used cardiac pace maker or with contributing medical history, metallicity restored teeth, canal that is not visible in radiographs, with open apices, with root resorption, with fractured roots were eliminated from this study. Detailed medical and dental history was recorded. Written informed consent was obtained from all patients who were included in the study.

Standardized radiography was performed in every patient to sort out the cases who did not meet the inclusion criteria.

Xylocaine with adrenaline 2% (Medicaine, Made in Korea) was administered. Access was done for the cleaning, shaping and obturation, preparation were carried out for conventional endodontic access, high speed hand piece with a number (02) round bur and number (02) tapered fissure bur (Alpha Dental Diamond burs USA Certified ISO 9002) was used to serve this purpose. Tooth vitality was determined by the direct observation of presence of bleeding from the pulp chamber and the root canal after access opening, Pulpal tissue was extirpated using H file no 15 and sodium hypochlorite (Micko Industrial Chemicals Co. Pvt. Ltd. PO Box 1917, Lahore) was used in 27 gauge needle to irrigate the canal, which was dried then by using paper points (Aceonedent, Korea Industrial Company, 103-606 Technopark, 346 Samjung-dong, Ojung gu, Buchon-si, Kyo-

nggi-do, Korea). In Electronic working length determination it was done prior to inserting working length file in the canal to overcome the measurement errors due to moist canal.

The objective was to determine the length at which the canal should be prepared and then obturated afterwards. The length of 1-2mm short of apex at radiographs is optimum whereas in electronic technique length of 1-2mm short of apical constriction is optimum. To determine WL radiographically John Ingle method was used. In this technique preoperative radiography is used to calculate WL, and then a file of appropriate size introduced in root canal up to 2-mm of radiographic apex. To mark the coronal reference point a rubber stop fixed appropriately at the end of buccal or lingual cusps and then radiography is performed for the diagnosis. The file was withdrawn after the exposure of radiograph. Finally, WL was measured on the basis of this radiograph. If WL was found to be >2-mm on this radiograph, the process was repeated after readjustment of the file to achieve accurate WL.

During the development time of the radiograph, the length of root canal was obtained by using apex locator as per standard instructions of manufacturer through following steps.

In order to complete a circuit of apex locator one pin of connecting wire was inserted into apex locator and from second part of connecting wire the clip as lip holder was applied to the patients lip and the file holder was attached to the file. Before inserting a file into the canal first same coronal reference point in radiographic technique was fixed than outside surface of tooth was dried by air from triple syringe. Pulp chamber was dried by cotton pellet and using paper points dried root canal Reading was determined by inserting a file into the canal and pushing it apically until the apex locator show bar reading in apical constriction zone (green bar). Sometime file was pushed more apically than apex locator show bar reading in apex zone (red bar). In this condition file was pulling back until bar reading reached in apical constriction zone (green bar). The file was with-

drawn once the digital reading was recorded. The length of WL file was measured to calculate the electronic WL.

All measurements were recorded on data sheet. The results of both methods were compared and the data were analyzed by using SPSS 18.

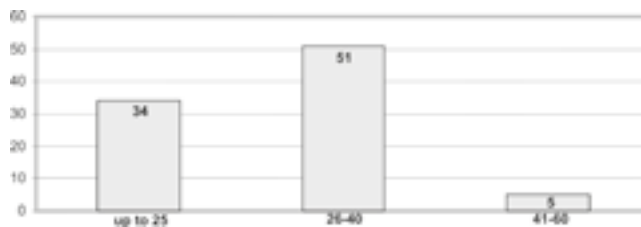


Figure-2. Age Distributions of Patients (n=90)

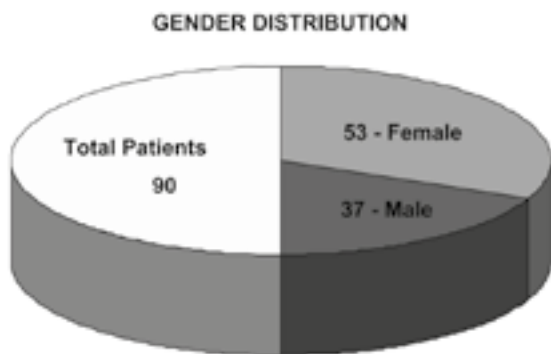


Figure-1. Showing Gender Distribution (n=90)

TOOTH DISTRIBUTION OF CASES

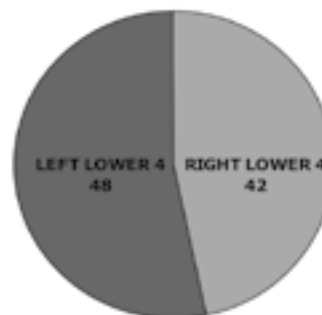


Figure-3. Tooth distribution of Cases (n=90)

Quantitative variables like WL for both methods were analyzed for mean with standard deviations. To compare the results of both methods statistically, paired sample t-test was used whereas P-value up to 0.05 was considered significant.

RESULTS

Total 90 cases were recruited for this study. Among them 53 were females and 37 were males (Figure 1). The age distribution of the subjects is detailed in (Figure 2). The mean±SD age of the subjects was 27±7 years. Forty-two teeth were right first premolars whereas 48 teeth were left first premolars (Figure III). The mean±SD WL was 19.5±1.03 mm when measured radiographically whereas it was 18.9±1.05 mm when measured

electronically, as detailed in Table-I.

The mean difference of WL between both methods was 0.87-mm (P <0.05) which was statistically significant, as detailed in Table-II.

DISCUSSION

The exact obtainment of WL is essential for successful endodontic therapy, because if it is not measured accurately it may cause adverse effects upon the treatment results.^{11, 12} Precision of WL has major contribution to a harmless and effective instrumentation.^{13, 14}

Ideally Root canal preparation should be carried out to the apical constriction or cemento-dentinal

	Minimum	Maximum	Mean	Standard deviation
Radiographic Working length	18.0mm	22.0mm	19.8mm	1.03
Electronic working length	17.0mm	21.5mm	18.9mm	1.05

Table-I. Illustrate data mean and standard deviation for radiographic and electronic working length determination (n = 90)
Paired t test applied t-value = 32.02 p = 0.001

	Mean	Standard deviation	t-value	Sig. P-value
Radiographic and Electronic working length	0.87	0.27	32.02	0.001

Table-II. Paired test mean difference between radiographic and electronic working length

junction.¹⁵ Apical constriction is an ideal spot to determine WL.²

In the present study we compared the results of measuring WL by two methods i.e. radiography and electronic method, considering all possible errors that may encounter during clinical practice. The results of the present study revealed that electronically measured WL is different from radiographically measured WL most of the time, and this difference (0.8-mm) is statistically significant ($P < 0.05$).

The results of the present study concur with other studies. In a similar study the authors attempted to associate the location of cementodentinal junction with constriction of apex to the foramen of apex. They determined WL electronically as well as radiographically and compared the results of both methods by locating different points. The electronic method was proved to be superior to radiographic method with statistical significance.¹⁶

As already stated that for WL the ideal location is apical constriction for treating root canal, which is at the distance of 0.5-1 mm from main foramen.² The results of the present study show that EAL is better than radiograph for locating the main foramen as well as a point between apical constriction and foramen.^{17, 18}

CONCLUSION AND SUGGESTIONS

It was concluded by the results of the present study that electronic apex locators (EALs) have significantly higher accuracy and reliability within 1-mm than radiographs. We suggest that when appropriately used, EAL only is sufficient to determine WL. Hence, the radiographs should be avoided in order to prevent unnecessary exposure to radiation as well as to save time and to make patient feel less uncomfortable.


Copyright© 11 Nov, 2015.

REFERENCES

- Goldberg F, Marroquín BB, Frajlích S, Dreyer C. **In vitro evaluation of the ability of three apex locators to determine the working length during retreatment.** J Endod 2005;31:676-8.
- Diwanji A, Rathore AS, Arora R, Dhar V, Madhusudan A, Doshi J. **Working length determination of root canal of young permanent tooth: An in vitro study.** Ann Med Health Sci Res 2014;4:554-8. DOI: 10.4103/2141-9248.139314
- Saroosh E. **Comparative role of radiographs and electronic apex locator in working length determination.** Paki Oral & Dent J 2011; 31:187-90
- Ruddle CJ. **Cleaning and shaping root canal systems.** In: Cohen S, Burns RC, editors. **Pathways of the Pulp.** 8th ed. St. Louis, MO: Mosby; 2002. p 231-91.
- Tselnik M, Baumgartner JC, Marshall JG. **An evaluation of root ZX and elements diagnostic apex locators.** J Endod 2005;31:507-9.
- ElAyouti A, Weiger R, Löst C. **Frequency of overinstrumentation with an acceptable radiographic working length.** J Endod 2001;27:49-52.
- Gordon MPJ, Chandler NP. **Electronic apex locators.** In Endod J 2004;37:425-437.
- Altunbaş D, Kuştarci A, Arslan D, Er K, Kocak S. **Comparison of various current electronic apex locators to determine the working length using the clearing technique.** Niger J Clin Pract 2015;18:359-63.
- Kaufman AY, Keila S, Yoshpe M. **Accuracy of a new apex locator: an in vitro study.** Int Endod J 2002; 35: 186-192.
- Desai N, Tegginmani V. **Accuracy of working length determination using tri auto Zx and protaper instruments: An in vitro study.** J Dent Allied Sci 2012; 1:48-51.
- Sikander M, Ahmed A, Jalil S. **Accuracy of Electronic Apex Locator in Determining the Working Length in Primary Molars with Root Resorption: An in Vitro Study.** Paki Oral & Dent J 2014; 34: 711-13.
- Jain Saru, Kapur Ravi. **Comparative evaluation of accuracy of two electronic apex locators in the presence of various irrigants: An in vitro study.** Contemp Clin Dentist 2012; 3: 140-45.
- Hoer D, Attin T. **The accuracy of electronic working length determination.** Int Endod J 2004; 37: 125-131.
- Desai N, Tegginmani V. **Accuracy of working length determination using tri auto Zx and protaper instruments: An in vitro study.** J Dent Allied Sci 2012; 1:48-51.
- Gordon M.P.J. and Chandler N.P. **Electronic apex locators.** Int Endod J 2004; 37:425-37.

16. Hassanien EE, Hashem A, Chalfin H. Histomorphometric **Study of the Root Apex of Mandibular Premolar Teeth: An Attempt to Correlate Working Length Measured with Electronic and Radiograph Methods to Various Anatomic Positions in the Apical Portion of the Canal.** J Endod 2008;34:408-12.
17. Lee SJ, Nam KC, Kim YJ, Kim DW. **Clinical accuracy of a new apex locator with an automatic compensation circuit.** J Endod 2002; 28:706-9.
18. iqbal Z, Memon RA. **Comparison between Radiographic and Electronic working length determination in root canal treatment in vivo study.** Isra medical journal 2013;5:41-46.

AUTHORSHIP AND CONTRIBUTION DECLARATION

Sr. #	Author-s Full Name	Contribution to the paper	Author=s Signature
1	Dr. Naveen Khawaja	Cases Done, Writing Intro	
2	Dr. Suneel Kumar Punjabi	Discussion Writing, Literature, Searching	
3	Dr. Abdul Qadir Dal	Cases Done, Literature search, Editing	
4	Dr. Munir Ahmed Banglani	Editing & References	
5	Dr. Ramesh Lal	Editing & Abstract writing	