COMPARISON OF WORKING LENGTH DETERMINATION IN MANDIBULAR SINGLE-ROOTED TEETH

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ABSTRACT:

OBJECTIVES:

The objective of this study was to compare working length calculated with conventional radiographs and an electronic apex locator (IPEX II) during the root canal treatment of mandibular anterior teeth.

METHODOLOGY:

A cross-sectional study was done in the Department of Operative Dentistry, Sardar Begum Dental Hospital, Peshawar during February and March 2018. A consecutive sampling technique was used for sampling. Only 30 patients fulfilled the inclusion criteria of our study. Detailed medical and dental history was taken. Only patient fulfilling inclusion criteria were enrolled in the study. Data were analyzed using SPSS version 20.

RESULTS:

The mean age for patients was 45.33±5.16. 33% out of 30 patients (10) were male and 20 were females. The mean working length calculated from radiographs was 22.25±1.29 (min 20.09-max 24.10). The mean working length calculated by the electronic apex locator (IPEX II) was 22.17±1.28 (min 20.00-max 24.07). The mean difference between working length calculated by radiograph and electronic apex locator was -0.084mm, which means the working length determined by radiographs and by electronic apex locator has no difference in mandibular anterior teeth with single canals.

CONCLUSION:

Both the methods can be used effectively in endodontics for single-rooted mandibular teeth, but if both are used in combinations can lead to an improvement in the working length accuracy, which may significantly reduce the number of radiographs exposure, and increase the success and comfort for endodontic patients.

KEYWORDS: *Working Length, Apex Locator, Conventional Radiograph, Mandibular Teeth, Endodontics*

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INTRODUCTION:

The success of endodontic treatment mainly depends upon the determination of working length and its maintenance during the cleaning and shaping of canals. Overfilled and underfilled root canals reduce the success rate to about 76% and 68% respectively[1]. Therefore to obtain practical, effective, accurate, and reproducible results, the working length is calculated with great accuracy and precision every time it is taken.

Several methods and techniques are developed with time to determine the exact working length[1, 2]. Some of these methods are Ingle's method (preoperative radiographs), tactile sensation, electronic means (using apex locators), diagnostic radiographic method, patient response, and paper points[1]. Ingle's radiographic method is one of the most widely used methods for the determination of working length, because of its reliability and ease of use. However, there are some concerns of dentists with this technique[3]. Some of these are difficulty in accurately identifying apical constriction, different angulations of the radiographic image, observer bias in interpretation[2,3]. One of the biggest disadvantages of any radiographs is patient and the dental staff radiographic radiation exposure[1]. Electronic apex locators (EALs) are used to determine the working length of canals with more accuracy. But they too have limitations in conditions like root perforations, resorption, cracks, closed apices, constricted canals, conducting medium within the canal, size of the major terminus, etc. The electronic apex locator doesn't give any information about the anatomy/number of canals or periapical pathology that is why it will be prudent to use it in complement with radiographic methods. This is a reasonable reason, why the apex locator should not be considered as a substitute for radiographs but as a good tool that may help improve working length confirmation in dentistry[1]. The apex of the root has a specific resistance to an electrical current, which is calculated by using a pair of electrodes that are hooked into the lip and attached to an endodontic file. The electronic principle is relatively straightforward and is based on electrical resistance; when a circuit is complete (tissue is contacted by the edge of the file), resistance decreases noticeably, and the current suddenly begins to flow. A variety of devices signal this occurrence by a beep, a buzz, a flashing light, digital readouts, or a pointer on a dial[4]. Lately developed EALs calculate the resistance and capacitance at the same time by using different frequency[4,5]. IPEX II (NSK Inc., Kanuma, Japan) is multi-frequency EAL, introduced in the recent past. Nevertheless, not much data is available in the literature concerning its accuracy as compared with the conventional radiograph in the clinical setting. The results of this study will help clinicians to adopt the method, which is more accurate reliable and reproducible in the determination of working length in mandibular single canal teeth. The objective of this study was to compare the average working length calculated with conventional radiographs and an electronic apex locator (IPEX II) during the root canal treatment.

METHODOLOGY:

A cross-sectional study was done in the Department of Operative Dentistry, Sardar Begum Dental Hospital, Peshawar from February 2018 till March 2018. The total sample size was 30. A consecutive sampling technique was used in the collection of data. Inclusion criteria included all healthy patients aged between 18 to 60 years, with mature apex and clear radiographs visiting the department for root canal treatment for mandibular single were included in the study. Exclusion criteria included all patients having tooth attrition, calcifications, internal or external resorptions, teeth with perforation a medical condition that contraindicates patient safety for electric device usage, re-treatment, canals with separated instruments, or teeth with immature apex. Patients who declined to consent to be part of the study were also excluded from the study. Ethical approval and informed consent were taken before the start of the study. A complete dental examination and detailed history were recorded. The pre-operative radiograph was used for measuring the working length using Ingle's method. A graduated scale was used to measure the working length from the stable coronal reference point to the apex of the root (Reading 01). Onemillimeter was subtracted from the total length to compensate for radiographic image distortion and as the apical constriction, as it's 0.5-1.0 mm short of the radiographic apex in most of the cases. After administrating local anesthesia the treatment was started (lignocaine 36mg/ 1.8 ml, with epinephrine 1:100000). The access cavity was achieved using a high-speed handpiece with a round diamond bur. After achieving access cavity and thoroughly removal of caries electronic apex locator (IPEX II) was used to obtain working length. Initially, 10K file with double stoppers were connected to the IPEX II was used to determine the working length (Reading 2). Sodium hypochlorite (2.5% NaOCl) was used

as an irrigation liquid. The excess irrigating solution was dried up with cotton pellets; care was taken not to over-dry the canal or tooth surface. As per the instruction manual of IPEX II was used to determine working length. A flashing bar and a continuous sound tone indicated that the file has reached the area just beyond the apical foramen. The file was withdrawn back until an audible signal, and a flashing bar is observed which indicates that the file is now 0.5 mm short of the apical foramen. The stopper was adjusted to the coronal surface when the apex locator exhibited the specified reading. The file was removed from the canal and length from the stopper till the tip of the file was measured using a graduated scale in millimeters. The mean of three consecutive measurements was recorded to improve accuracy and removing biases in measurement. The working length of each tooth was first calculated from the conventional radiograph (Reading 01) and then with the electronic apex locator (Reading 02). Simple frequencies and percentages were calculated for qualitative variables like gender, mean and standard deviation were computed for quantitative variables like age, radiographic and electronic working length of a root canal. Paired t-test was used to assess the mean difference between radiographic and electronic working length. The level of significance incidence of postoperative pain or may also lead to was set with >0.05 at 95% confidence interval. SPSS version 20 was used to analyze the results. The level of significance was taken as 0.05.

RESULTS:

A total of 30 patients were included in the study. According to our inclusion criteria, all the patients were referred for RCT for various reasons. The mean ages of the participant were 45.33±5.16. The mean age of the patients was 39 years. 33% of the patients were male, and 66% were females. The mean working length calculated from radiographs was 22.25±1.29. The mean working length calculated by the electronic apex locator (IPEX II) was 22.17±1.28(Table 01) The mean difference between working length calculated by radiograph and electronic apex locator with 0.05% level of significance is -0.084mm, which is statistically insignificant. Table 02 shows that there is minimal or no difference between the working lengths recorded by both methods.

Table 1: Values of Working Length with Radiographs and Electronic Apex Locator (N=30)

	Min	Max	Mean	Standard Deviation	Standard error of mean
Radiographic Working Length	20.09	24.10	22.258	1.297	.236
Electronic Apex Locator Working Length	20.00	24.07	22.174	1.285	.234

Table 2: Mean Difference between Electronic and Radiographic Working Lengths

Electronic Apex Locator Radiographic Working Length	Mean	Standard Deviation	t-value	Sig P-value
	-0.084	0.372	1.242	0.224

DISCUSSION:

The accurate working length is a crucial factor for the success of endodontic therapy. Working length apical establishes the extent of canal preparation and apical stop. Failure to accurately determine the working length may lead to apical perforation, pushing out of debris and material may result in overfilling or may lead to under preparation or under treatment leads to postoperative pain and poor prognosis in the long run[6,7].In the present study two methods, conventional radiographic and electronic methods, for working length

determination were compared. The results of the current study showed that there was no significant difference between the working lengths recorded by both methods when it was done for lower anterior teeth with single canals. This comes in agreement with the study which shows that there was no difference in working length obtained from radiograph and electric device[9,10]. This shows the effectiveness of both methods. Another study done in vivo stated that reliable and similar results could be obtained by using conventional radiographs and electronic apex locator[12,13,14].These studies show that radiographs as the potential first choice for endodontic treatment planning and outcome assessment are equally efficient, especially when new scanners with lower radiation doses are used. On the other hand, some studies reported that the CBCT method is more accurate than the apex locator in determining the working length in primary teeth[15,16].While, another study reported that more cases determine satisfactory working length calculated by the electronic device, whereas fewer cases gave satisfactory results for conventional and digital radiographs as compared[17].Similarly, a clinical trial evaluates higher accuracy for electronic apex locator when compared to conventional radiographs was used[8,11]. In another study, showed that radiographs/CBCT was short in almost 50% of the cases while determining working length[18,19].The possible reasons for these variable results might be the quality of the radiograph unit, the expertise of the radiograph operator, the type of electronic apex locator, and the dentist‘s skills.

CONCLUSION:

The use of electronic devices for working length determination is gaining popularity day by day which lessens the problems associated with radiographic methods mainly radiation exposure and angulation. Nevertheless, the efficiency and equally precise results from radiographic measurements make it quite compatible with the electronic apex locators. Similarly, the improved and advanced types of radiographs lessen radiation exposure and its side effects. Electronic devices cannot replace the radiographs totally, but both can be used in combinations to improve the working length accuracy, reduce the number of radiographs, and increase the success and comfort of endodontic patients.

LIMITATIONS:

The sample size was small. It would be better if maxillary molars along with the Mandibular molars were added. Electronic devices cannot replace the radiographs totally. This study only provides preliminary data and further studies are required.

CONFLICT OF INTEREST: None

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REFERENCES:

1. Tabassum S, Khan SR. Failure of endodontic treatment: the usual suspects. Eur J Dent. 2016;10(1):144-7.
2. Abu Naeem FM, Abdelaziz SM, Ahmed GM. Accuracy of apex locators versus radiographic method in working length determination: a systematic review and meta-analysis. Int J Adv Res. 2017;5(11):506-18.
3. Nellamakkada K, Patil SS, Kakanur M, Kumar RS, Thakur R. A clinical evaluation of two electronic apex locators and conventional radiography in working length determination in primary molar and its influence on children's behavioral responses. J Indian Soc Pedod Prev Dent. 2020;38(2):158-63.
4. Rathore K, Tandon S, Sharma M, Kalia G, Shekhawat T, Chundawat Y. Comparison of accuracy of apex locator with tactile and conventional radiographic method for working length determination in primary and permanent teeth. Int J Clin Pediatr Dent. 2020;13(3):235-9.
5. Yılmaz F, Kamburoğlu K, Şenel B. Endodontic working length measurement using cone-beam computed tomographic images obtained at different voxel sizes and field of views, periapical radiography, and apex locator: a comparative ex vivo study. J Endod. 2017;43(1):152-6.
6. Gherlone E, Capparé P, Vinci R, Ferrini F, Gastaldi G, Crespi R. Conventional Versus Digital Impressions for" All-on-Four" Restorations. International Journal of Oral & Maxillofacial Implants. 2016 Mar 1;31(2).
7. Jafarzadeh H, Beyrami M, Forghani M. Evaluation of conventional radiography and an electronic apex locator in determining the working length in C-

shaped canals. Iran Endod J. 2017;12:60-3.
8. Permanand, Ali F, Channar KA, Memon AB. Comparison of radiographic & electronic working length measurement of the root canal in patients seen at Liaquat University of Medical and Health Sciences Jamshoro–Sindh. Pak Oral Dent J. 2016;36(4):641-44.
9. Faraj BM. Preoperative estimation of endodontic working length with cone-beam computed tomography and standardized paralleling technique in comparison to its real length. Biomed Res Int. 2020;10:1-8.
10. Rambabu T, Srikanth V, Saggan GS, Ganguru S, Gayatri C, Roja K. Comparison of tentative radiographic working length with and without grid versus electronic apex locator. Contemp Clin Dent. 2018;9(1):88-91.
11. Saraf PA, Ratnakar P, Patil TN, Penukonda R, Kamatagi L, Vanaki SS, et al. A comparative clinical evaluation of the accuracy of six apex locators with intraoral periapical radiograph in multirooted teeth: an in vivo study. J Conserv Dent. 2017;20:264-8.
12. Schell S, Judenhofer MS, Mannheim JG, Hülber JM, Löst C, Pichler BJ, et al. Validity of longitudinal sections for determining the apical constriction. Int Endod J. 2016;50(7):706-12.
13. Kqiku L, Städtler P. Radiographic versus electronic root canal working length determination. Indian J Dent Res. 2011;22:777-80.
14. Haupt F, Hülsmann M. Consistency of electronic measurements of endodontic working length when using multiple devices from the same manufacturer—an in vitro study. Clinical oral investigations. 2018 Dec;22(9):3107-12.
15. Segato AV, Piasecki L, Nuñovero MF, da Silva Neto UX, Westphalen VP, Gambarini G, Carneiro E. The accuracy of a new cone-beam computed tomographic software in the preoperative working length determination ex vivo. Journal of endodontics. 2018 Jun 1;44(6):1024-9.
16. Jarad FD, Albadri S, Gamble C, Burnside G, Fox K, Ashley JR, Peers G, Preston AJ. Working length determination in general dental practice: a randomised controlled trial. British dental journal. 2011 Dec;211(12):595-8.
17. Kqiku L, Städtler P. Radiographic versus electronic root canal working length determination. Indian Journal of Dental Research. 2011 Nov 1;22(6):777.
18. Vanitha S, Sherwood IA. Comparison of three different apex locators in determining the working length of mandibular first molar teeth with irreversible pulpitis compared with an intraoral periapical radiograph: A block randomized, controlled, clinical trial. Journal of investigative and clinical dentistry. 2019 Aug;10(3):e12408.
19. Ahmed HM. Anatomical challenges, electronic working length determination and current developments in root canal preparation of primary molar teeth. International endodontic journal. 2013 Nov;46(11):1011-22.

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