

# Accuracy of Paper Point Technique for Final Working Length Measurement after Canal Preparation

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## ABSTRACT

**Objective:** The aim this study was to check the accuracy of paper point technique for final working length measurement after canal preparation.

**Study Design:** Randomized controlled trial

**Place and Duration:** Study was performed in department of operative dentistry, Liaquat University of Medical & Health Sciences, Jamshoro for one year duration from January 2017 to December 2017.

**Methodology:** This study was performed on 78 patients divided equally into two groups. In one group working length was established by using electronic apex locator while in second group working length was established by using electronic apex locator with paper point technique. To check the working length master apical gutta percha point (GP point) was inserted into canal and radiograph were taken by paralleling angle technique.

**Results:** There were 34 (43.6%) males while 44 (56.4%) patients were females. Mean age of patients was 30.5±8.9 years. Mean tooth number was 28.8±11.0. Group A is concerned that was treated only with Electronic Apex Locator showed lesser number of acceptable length than group B. On the other hand, group B was treated with electronic apex locator and paper point technique showed higher acceptable length of respondents with a difference of 4 frequencies or 7% in excess. A less value of chi-square test showed relationship between observed and expected data; whereas, significance value indicated no significant difference between group A and B.

**Conclusion:** Paper point technique is as reliable as other techniques for final working length measurement.

**Key Words:** Electronic Apex Locator, Paper Point Technique, Endodontic Working Length

## INTRODUCTION

Endodontic working length (WL) is: "the length of root canal measured from coronal reference point to the point at which canal preparation and obturation should terminate".<sup>1,2</sup> Determination of accurate working length is crucial to get clinical excellence in endodontic therapy.<sup>3,4</sup> The aim of endodontic treatment is to remove the diseased tissues and prevent reinfection of root canal. A precise determination of working length helps the clinician to completely remove the diseased tissues and proper cleaning and shaping of root canal. Over preparation of canal may lead to tissue damage in peri-radicular area, persisting inflammatory responses and foreign body reactions and peri-radicular cyst formation.<sup>5</sup> Whereas; underestimation of working length may result in incomplete debridement of root canal, that ultimately lead to failure of root canal treatment.<sup>6,7,8</sup>

The anatomic or radiographic apex, the apical constriction also called the minor apical diameter or minor diameter and apical foramen also called major diameter are three important points described in the literature for establishment of an accurate working length.<sup>1</sup> Traditional methods to calculate the WL are periodontal sensitivity, tactile method, radiographic method (conventional and digital radiography) and use of electronic apex locator.<sup>9</sup> The most common method for determination of working length is the radiographic method. Besides having the benefits of direct observation of root canal system it serves as initial guide for determination of working length. However; there are many drawbacks of this method such as hazards of ionizing radiation, error in interpretation of image, 2-

dimensional image that lacks presentation of 3rd view and procedural sensitivity.<sup>9, 10</sup>

In 1918 Custer introduced use of electric current to establish working length.<sup>11</sup> Electronic apex locator (EAL) can be safely used in patients with gag reflex, mentally retarded patient and pregnant patients as well.<sup>12</sup> However; Electronic Apex Locators have their own limitations. As they functioned with direct current, any interference especially fluid may lead to inaccurate result. There may be electronic error due to low voltage as in case of repeated wrong readings.<sup>13</sup> Electronic Apex Locators does not accurately determine where the root canal terminate and extra-radicular structures (the Periodontal ligament, bone, cyst, granulation tissues) begin.<sup>14</sup> These devices are difficult to use in tooth with open apex.<sup>15</sup> Besides all these they have remained adjuncts to radiography.

Paper point technique (PPT) is well known in literature for working length. According to Rosenberg; "Paper point technique can provide more authentic details regarding the length and shape of root canal when compare to apex locator or digital radiograph as paper point can sometimes provide 3-dimensional details about location and slop of apical foramen."<sup>12</sup> To record WL by PPT we need a root canal free of its content and lack any moisture and vital tissues in periapical area. It could not assume that ppt is an alternate to other technique because it works as a part of other technique to establish WL. It needs initial WL measured formerly by some other method as EAL. PPT could be used to established final WL as an adjunct. Since preparation of canal and coronal flaring may alter the length of canal as measured initially a final WL is

needed before obturation to prepare apical 1/3rd of canal. PPT could be used to redefine WL and will helpful for adequate obturation. It is also mentioned in endodontic literature that paper point technique provides accurate measurement of root canal to within 0.25 mm.<sup>16,17</sup>

**MATERIALS AND METHODS**

This comparative/cross-sectional study was conducted at Department of Operative Dentistry, Liaquat University of Medical & Health Sciences Hospital, Jamshoro. The duration of this study was one year i.e from January 2017 to December 2017. Total 78 patients of either gender with single rooted teeth require root canal treatment were included. Patients were ages between 18-50 years. Teeth which are not suitable for conventional Root Canal treatment, teeth that lack apical patency, teeth with fractured root and root resorption, and multi rooted/Multi Canal teeth to avoid superimposition of canals were excluded. Informed consent has been taken from every patient.

After administration of local anesthesia containing 2% xylocaine with epinephrine 1:100,000 in 1.8 ml cartridge (Medicaine, made in Korea), isolation has been done with rubber dam. Access cavity preparation has been done with high speed hand piece. A sterile diamond round bur #02 and a tapered fissure bur # 02 (Alpha Dental Diamond Burs USA) has been used to serve this purpose. After obtaining straight line access, the cusp or incisal edges of teeth has been slightly flattened to obtain reference point for all measurements. The canal has been irrigated with saline solution (Searle, made in Pakistan) and pulp chamber were dried with sterile cotton pellet to eliminate excess moisture.

**Group A (Electronic apex locator):** The apex locator (Morta root Zx mini) was used as per manufacturer’s instructions. No # 15K file (MANI, INC made in Japan) was placed to estimated Working length according to preoperative radiograph. To check the WL by EAL a file was placed into root canal and advanced it until the green bar appear on screen. When file was pushed more apically then apex locator would show bar reading in apical zone (red bar). Measurement was considered valid when reading was observed stable for at least 5 seconds. The unstable measurements were considered when scale bars on the display screen were moving from one point to other. The stopper was positioned at the coronal reference point and x-ray has been taken. After that file has been removed and length from file tip to the stopper was measured with a millimeter endodontic scale.

After estimation of working length, coronal flaring was done and root canal was prepared by using hand K-files (MANI, INC made in Japan). After selection of master apical file cleaning and shaping was done by using step back technique. Recaptulation with small K-file #10 and irrigation with 2.5% sodium Hypochloride (Endo Wash, star international) was done at all times during instrumentation phase to ensure canal patency. Smear layer was removed by rinsing the canal with 17% EDTA (Ultradent) for 1 min.

After preparation of canal, master cone Gutta percha point (Meta Biomade) has been inserted and a master cone radiograph was taken using paralleling angle technique. We considered this measurement was as final Working length and recorded.

**Group B (EAL/PPT):** Proper application of Paper point technique needs initial working length measurement with an electronic apex locator. After estimation of WL by apex locator, root canal was prepared by same procedure as described above. After that root canal was dried with largest absorbent paper points (Meta Biomade, made in Korea), fitting 0.5 mm short to initial working length. Canal was considered dry when absorbent point will present with no moisture or color change

After that, final working length was determined by Paper point technique. A new absorbent point of lesser taper and size than the prepared canal was placed into the canal 2.0 mm short of initial Working length, removed and check for moisture. When we observed a paper point retrieve dry it was advanced into the canal in 0.5 mm length increments, paper point has been checked for wetness or color change between increments until moisture was appear at tip. The dry part of paper point was measured and considered as length of canal taken by PPT. For each measurement, we placed the paper points in canal only for 1 second. Dryness/ wetness has been checked visually under light.

Master cone gutta percha point (G.P Point) was inserted and radiograph has been taken by paralleling angle technique. This measurement was recorded as final working length and recorded.

The master cone radiographs were evaluated and graded as follow:

- Short (shorter than 2mm from radiographic apex).
- Acceptable (within 2mm from radiographic apex)
- Over (beyond the radiographic apex).

Root canal treatment was completed after that and tooth was restored with a suitable filling material.

Data was analyzed by using SPSS version 20. Chi square test was applied to analyze the data. Group B was treated with electronic apex locator and paper point technique showed higher acceptable length of respondents with a difference of 4 frequencies or 7% in excess. A less value of chi-square test (1.876) showed relationship between observed and expected data; whereas, significance value indicated no significant difference between group A and B.

**RESULTS**

Table 1:

	Variables		
	Gender	Age	Tooth Number
Mean	1.6	30.5	28.8
Standard Deviation	0.5	8.9	11.0
Std. Error Mean	0.1	1.0	1.2
Skewness	-0.3	0.4	-0.1
Kurtosis	-2.0	-1.0	-1.1
Range	1.0	30.0	34.0

The descriptive scores were examined before taking data into consideration for the testing of hypothesis. Age score indicated the highest prevalence of middle age people (i.e. 30.5 years) in sample size gathered from the treatment of root canal. Moderate level of left skewed was observed in the data of age whereas, no issue of skewness was found in other demographic factors. Moreover, Kurtosis score indicated no issue of flattened or sharpness at the peak of

data distribution. The high value of deviation showed volatility in the data of age and tooth number. Good level of ranges was observed in the data of age and tooth number that predicted the obtaining of good results from data. (TABLE 1)

Table No 2: Frequency Analysis of Demographics

Demographics	Categories	Frequencies
Gender	Male	34(43.6%)
	Female	44(56.4%)
	Total	78(100%)
Age Groups	18-21	15(19.2%)
	22-25	18(23%)
	26-29	3(3.8%)
	30-33	10(12.8%)
	34-37	14(17.9%)
	38-41	7(9%)
	42-45	7(9%)
	46-49	4(5.1%)
	Total	78(100%)

Frequencies of the demographic factors showed in above chart. Percentages were also mentioned adjacent to frequency values. Females were found more in observations that showed the more dental problems among women than men. This could be another reason that women are more willing to care their teeth than men in

current context. Age groups were constructed through numeric data of age and it provided the clear picture of prevalence of respondents in terms of age. Early age and middle age people are more willing to go for treatment of root canal. (Table 2)

Results revealed the significant findings in terms of working length in two groups. Both the variables were taken in rows and column. Rows indicated the categorical variable (treatment groups) with dichotomous categories i.e. Group A and Group B. Moreover, column contains categorical variable (working length) with three categories i.e. short length, over length and acceptable length. As the above table showed, both groups contained equal proportionate of respondents i.e. 39. Percentages were also mentioned adjacent to frequency values. As far as group A is concerned that was treated only with Electronic Apex Locator showed lesser number of acceptable length than group B. on the other hand, group B was treated with electronic apex locator and paper point technique showed higher acceptable length of respondents with a difference of 4 frequencies or 7% in excess. A less value of chi-square test showed relationship between observed and expected data; whereas, significance value indicated no significant difference between group A and B. (Table 3)

Table No 3: Chi-Square with Cross Tabulation of Working Length in Group A and B

		Working Length				Chi-Square	Sig. Value
		Short	Over	Acceptable	Total		
Group	A (EAL)	5(50%)	7(70%)	27(46.6%)	39(50%)	1.876	0.391
	B (EAL+PPT)	5(50%)	3(30%)	31(53.4%)	39(50%)		
Total		10(100%)	10(100%)	58(100%)	78(100%)		

## DISCUSSION

Determination of accurate working length is crucial to get clinical excellence in endodontic therapy.<sup>3,4</sup> The aim of endodontic treatment is to remove the diseased tissues and prevent reinfection of root canal. A precise determination of Working length helps the clinician to completely remove the diseased tissues and proper cleaning and shaping of root canal.

Traditional methods to calculate the WL are periodontal sensitivity, tactile method, radiographic method (conventional and digital radiography) and use of electronic apex locator.<sup>9</sup>

Another method of WL determination is PPT, claimed to be authentic and accurate. Despite of this claim only a few authorized scientific evaluations have been found in literature to support either claim. Therefore, the purpose of this in vivo study is to evaluate the accuracy of paper point technique for determination of final working length after canal preparation.

We use an in vivo approach to check the accuracies of both technique in locating the root apex because PPT requires a hydrated environment outside the canal.

In this study we use radiographic apex as apical reference point.<sup>18</sup> Radiographic apex is the only point that is reproducible

According to stringberg; "WL 1mm distance from radiographic apex is a standard for root canal treatment". WL 2-3 mm provide favorable prognosis and support tissue healing since a small wound is created. WL short of

radiographic apex is most commonly and universally accepted method.<sup>19</sup>

WL were recorded by EAL and PPT at two different point. Initially we used EAL to take WL after access preparation and hemostasis and before preparation of root canal. As it is commonly practiced in dentistry by most of dental professionals.

This study is performed by using a data consisting of 78 patients. Both gender has given equal chance to become the part of this research. Patients having disease in single rooted teeth included in the study. In addition to working length analysis, we also observed some secondary variables like patient's age, tooth number, and gender but all these variables have no effect on accuracy of WL taken by two different methods.

Before starting the research, we have done 6 cases EAL/PPT for practice session as recommended by previous study. We did not count these cases in statistical analysis.

data analysis is done in a total sample of 78 patients, divided equally into two groups. In group A WL has been measured by using EAL alone while in group B, WL has been measured by EAL plus PPT.

In first group we observed that most of the time EAL give acceptable readings i-e (27 out of 39 cases) in remaining cases we observed short and over readings 5 and 7 cases respectively.

In group B the ratio of acceptable WL is high (31 out of 39) like group A.

Remaining cases short and long WL has been observed (i-e 5 and 3 respectively).

As far as group A is concerned that was treated only with Electronic Apex Locator showed lesser number of acceptable length than group B. On the other hand, group B was treated with electronic apex locator and paper point technique showed higher acceptable length of respondents with a difference of 4 frequencies or 7% in excess. A less value of chi-square test showed relationship between observed and expected data; whereas, significance value indicated no significant difference between group A and B ( $P = 0.391$ ).

It seems difficult to contrast the findings of this research to the former studies since very few studies has been evaluating the PPT in vitro but no study has been found in literature that analyse PPT in clinical condition.

The results of the study performed by Marcos Arenal et al, IN 2009 match to the finding of our study.

Study performed by Marcose Arenal et al to evaluate the paper point technique for locating the apical foramen. The results of the study demonstrate that ppt is suitable for estimating apical foramen compared to EAL alone ( $p$  value  $< 0.00051$ )<sup>17</sup>.

In present study we found PPT acceptable but not better than EAL in term of significance value ( $p$  value  $> 0.05$ ). The reason for this difference may be that (1) in former study ppt is used to locate apical foramen while in our study radiographic apex is the apical landmark (2) length was measured by PPT to 0.25 mm readings while in our study, 0.5 mm. (3) that was an in vitro study.

The study performed by (Baggett et al.1996) supports result of our study. That study was performed with a same methodology, the paper point technique were examined before over children and found this technique useful in that age category (Baggett et al., 1996)<sup>20</sup>.

An attempt was done previously in order to measure the length through same instrument and found both instrument useful (Czerw et al., 1994)<sup>21</sup>

The study performed by (Guimarães et al. 2014) also comparable to the result of our study. Root zx (third generation of apex locator) has been used in that study similar to our study and find it accurate in 53.3%.<sup>22</sup>

**Possible sources of error:** In first group we observed that most of the time EAL give acceptable readings i-e (27 out of 39 cases) in remaining cases we observed short and over readings 5 and 7 cases respectively.

Result shows that in group B the ratio of acceptable WL is high (31 out of 39) like group A. Remaining cases short and long WL has been observed (i-e 5 and 3 respectively). It shows that PPT may be more helpful to prevent over extension of WL.

What could be the possible source of error in both methods. As root canal therapy is the multistep procedure, error in any step could lead to change in WL.

Since most of the step in clinical procedure remain same for both method we could assume that factors cause error affect both technique equally. Therefore these factors are not significantly affect the any method particularly.

## CONCLUSION

We found the PPT more accurate than EAL in a frequency of 4. But this difference is not considered significant in statistical

analysis ( $P$  value  $> 0.05$ ). Since the significance value is greater than 0.05 the difference between accuracies of two method is not considered significant. We found the ppt quite comparable to EAL, though not superior statistically. We could say that ppt is a reliable technique for WL measurement if use as adjunct for final WL measurement.

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