# Determination of the Accurate Tooth Length and Apical Constriction Measurements by different Methods in Mandibular Premolar Teeth

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*Abstract--- During this study the accurate teeth length, and the accurate apical constriction measurement was determined in lower premolar teeth in 43 lower premolar teeth in sample of Iraqi patients who attended to privet dental clinic for root canal treatment in their mandibular premolar teeth, all these teeth were examined by ZX mini apex locator and digital radiography, all samples were recorded on the monitor of MAYRAY (Xpod) sensor imaging system, the electronic working length was determined by the ZX mini apex locator, the patients are examined by bisecting angle periodical digital radiographic machine (CSN digital radiographic machine).And the measurement were applied on the monitor of MYRAY (Xpod) sensor imaging system, then the formula of direct fit was applied to obtain the coefficient factor of shortness and elongation of the radiographic image for each tooth, the distance mean of apical constriction to the apical end of tooth end (radiographic apex) was found 1.26 mm the largest distance the was 1.88 mm and the smallest distance was 0.69 mm. The mean of the lower premolar teeth length was found 20.92 mm with rang (18.48- 23.74) mm. The measurements were carried out by the aid of ZX mini apex locator and MYRAY (Xpod) sensor imaging system. It can be concluded that the using ZX mini with the MAYRAY imaging system during root canal therapy have accurate determination of working length and the distance between the apical constriction and radiographic apex measurements, in addition to the importance of the combination of the EWLs with the digital imaging system in determination of accurate working length and reduction of unnecessary radiation exposure to the patient.*

*Keywords--- ZX Mini Apex Locator, MYRAY (Xpod) Sensor Imaging System, Mandibular Premolar Teeth.*

## I. INTRODUCTION

The key of success of any root canal treatment is the determination of accurate working length; the working length is the distance from the referring point in the crown to the point of the end of canal preparation and obturation, at the cementoenamel junction or the apical constriction (AC) to which the termination of the root canal filling is still required. Which varies in different races, and the AC is an appropriate terminus location in root canal treatment (1), Nawab et al 2016 reported that the root canal instrumentation and obturation should not extend beyond the apical constriction which is usually is 0.5-1.5 mm coronal to apical foramen(2).

The ideal working limit as determined by the clinicians (usually located at the apical constriction) and the apical foramen proper, which may be 0.5 to 1mm, depending on the clinical criterion (3) ,the root canal instrumentation and obstruction should not extend beyond the apical constriction which is usually 0.5-1.5 mm coronal to apical foramen (2) others studies were stated that the apical constriction (AC) is suggested as the end point of root canal treatment (4). While others reported that the apical constriction (AC) located 0.5 -1.0mmcoronal to the apical

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foramen (5),but in some cases 3mm short of the radiographic apex (2),Furthermorethe preparation and filling should end 1mm coronal to the radiographic apex of the root (6),the accepted place for the apical constriction is between 0.5 to 1mm from the radiographic apex.

There are variations in the relationship from that point of reference which result in errors of instrumentation, and that obviously influence the position of endodontic filling (7) the achieving of working length by subtraction of 1 mm from radiographic apex can be provide shorter or longer working length in comparison to exact working length. (8) Palud et al reported that the EALs display the distance between file tip and the radiographic apex from 0.1mm to 1.5 mm. (9)

The clinical methods used in the determination of working length(WL) include the tactile sensation, radiography, and the use of apex locater (EAL) devices. Tactile sensation is not a reliable method in determination of actual working length and need to highly experienced dentist to depend on this method. Manual tactile sensation, being the oldest and most common technique in working length determination, requires a learning curve to achieve expertise (10),Shanmugaraj et al (11) reported that the tactile perception because of the simplicity of the technique and its virtual effectiveness are factors that motivate a few clinicians in endodontic practice to still follow this technique, but this technique is in general inaccurate in root canals with immature apex, excessive curvature and if the canal is constricted throughout its length.

The digital radiographs allows for reduction in radiation dosage to the patient, radiographs are captured and saved in digital format and avoid the use of chemicals needed for image processing (2) Radiographs are advantageous as the information they furnish, cannot be obtained from any other source and its value is not diminished by a critical appraisal of its limitations (12).

The use of EALs for WL determination has increased considerably due to their improvement and introduction of the latest generation of EALs, becoming an important adjunct in root canal treatment (13).

The apex locator can potentially replace, in many instances, the classic radiographic method for tooth length determination and that the correct use of calibrated apex locator would prevent the need for further diagnostic radiographs for working length determination (14). The electronic working length were superior to radiographs in reducing the overestimation of root canal length, using an EALs as an aid to endodontic therapy could also potentially reduce the number of diagnostic radiographs required for WL determination (15), Ebrahim et al (16) reported that the use of electronic apex locator in combination with the radiograph is greater precision in the determination of root canal length.

The development of EAL has enabled more accurate measurement of the root canal length, several studies have reported the accuracy of these devices along with their specific potential (17), Jafarzadeh et al (18) reported that the Root ZX mini apex locator reduce the risk of over instrumentation of root canal length in these canals.

In this study the EAL measurement were invested in the determination of the accurate tooth length with the depending on the measurements that taken from the monitor screen of the MAY RAY imaging device that I used in the privet clinic. Also measurement of the distance from the apical constriction to the radiographic apex of the tooth

(AAC) was obtained by extracting the elongation and the shortening factors for each tooth in the sample treated.

## II. MATERIALS AND METHODS

Present study included 43 patients were examined and selected for root canal therapy attended to private clinic for the treatment lower premolar teeth, all cases had selected vital and with chronic and acute pulpitis the non-vital were excluded during this study.

All patients anesthetized with inferior dental block anesthesialidocaine 2% with epinephrine 1:100000, each patients tooth is isolated by the use of rubber dam and fixed by clamp to the affected tooth

Cavity preparation were done, using high speed turbine with round diamond bur and water spray of the turbine for cavity coolant, removal of total caries and the pulp chamber opened for each patient's tooth, a 15 K file (Densplay Maillefer, Ballaigues, Switzerland) inserted in the canal until the patency of the canal is felt, the tooth irrigated by normal saline 5% and the use of 30 G x 25mm disposable needles were used also, air spray subjected to the coronal pulp, to reduce the fluid inside the cavity, followed by insertion of 20 K fileinside, the file were advanced in the canal the lip clip was placed in the corner of the patients mouth and the file holder was attached to the shaft of the file, until the signal indicated the proximity of the file end from the apical constriction or the end of the canal and patency felt by the fingers after that K file were removed from the canal, the silicon stopper was fixed to the file by the use of light cure bond, the measurement was carried from the silicon stopper to the end of the K file by root canal ruler , and the EWL is determined by the use of ZX mini (J. Morita Corp, Tokyo, Japan), with the use of gentle tactile sensation and the ZX mini alarm was starter then the tooth was x-rayed by the use of CSN digital x-ray machine(Italy) and MYRAY sensor(Italy). Measurements were repeated twice by another operator for each patient for assurance the correct findings.

The technique used in this study was bisecting angle technique in spite of the errors in the vertical angulation because of the size of the sensor and the discomfort of the patients during exposure to radiation and position of the patient during the examination for all these reasons there will be either elongation or shortening in the image of the tooth, The MYRAY imaging device have a screen monitor and one of its options is the ruler that cans measure the radiographic image, the WL on the radiographic image and called radiographic working length (RWL), and the size and measurement of the apical constriction to the radiographic apex is called radiographic apical constriction (RAC), and the whole radiographic tooth length called (RTL).

During this study the electronic working length(EWL) and the radiographic working length(RWL) were invested to determine the actual tooth length(ATL) and the distance between the apical constriction and the radiographic apex (AAC) (figure1).

All the patients are radiographed using bisecting angel intraoral radiography the difference in the vertical angulations are taken in the consideration, and by using a mathematical equation in which the radiographic working length measurement divided on the electronic working length this will result in a figure representing shortening and elongating factor, and the radiographic tooth length is divided by this factor so the resulted figure will represent the accurate tooth length this is for each radiographic image, according to the mathematical equation below:

$$\frac{\text{Radiographic Working Length (RWL)}}{\text{Electronic Working Length (EWL)}} = \frac{\text{Rdiographic Tooth Length (RTL)}}{\text{Accurate Tooth Length (ATL)}}$$

And this will be equal to the mathematical equation $\dfrac{\text{Radiographic ApicalConstriction (RAC)}}{\text{Accurate Apical Constriction (AAC)}}$

These mathematical equation known value which is the AWL and so by using the formula for exponential proportion the unknown value becomes known, and this mathematical equation have used also for the determination of the distance from apical constriction to the radiographic apex.

And then we used the mathematical equation for direct proportion to determine and explore the value of tooth length and apical constriction.
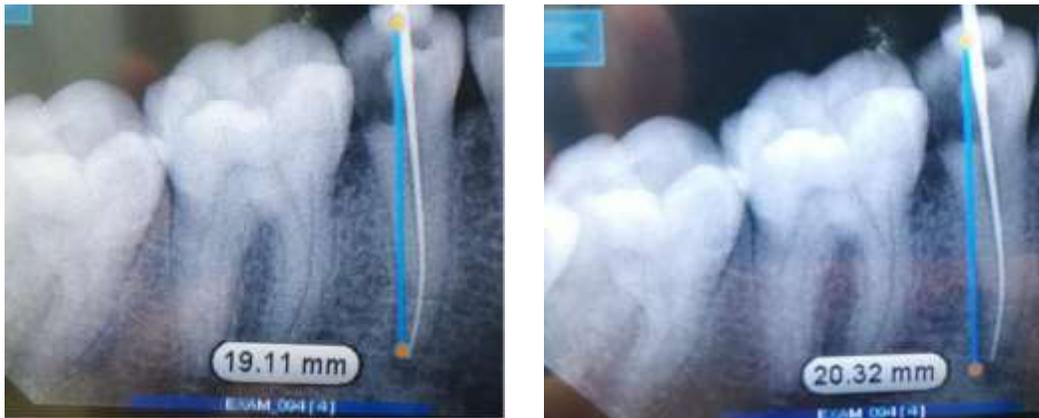


Figure 1: Detection Working Teeth Length Using Radiology

## III. RESULTS

This study depend essentially readings of apex locator (ZX mini) for determination working length in the teeth indicated for the root canal treatment, these teeth are 43 lower first and second premolar teeth, the ZX mini which is poses the reliability of accurate reading for the EWL, and at the same time the teeth are radiographed by digital x-ray machine (CSN), the image of each tooth appear on the MYRAY(Xpod) monitor screen, then the image was investigated for the measurement of the radiographic working length.

And by applying the mathematical equation the readings for the accurate tooth length, and apical constriction to apical foramen distance. the mean for the distance of apical constriction to the apical end of tooth (AAC) was 1.26 mm the largest distance the was 1.88 mm and the smallest distance was 0.69 mm.

The mean of the lower premolar teeth accurate length (ATL) was found 20.92 mm average between 18.48- 23.74 mm. All results in Tables 1, 2, 3 and 4 were subjected to the statistical analysis of the SSPS program, version 20 as the statistical factors were extracted, which are Pearson Lab and the value of F and T A + B.

The results of the statistical analysis refer to Table 1 and RWL as the value of r reached 0.677 and with a significant level (P 0.000) this means that the lower the reading, EWL the value of the reading RWL Vice versa. It is also possible to extract the value including RWL Using the equation at the end of the table.

Table 1: Electronic Working Length (EWL) and Radiographic Working Length (RWL)

| No. | EWLX) | RWL(Y) | Ratio(Y/X) |
|---|---|---|---|
| 1 | 20.5 | 23.65 | 1.153659 |
| 2 | 20 | 19.76 | 0.988 |
| 3 | 20.5 | 23.33 | 1.138049 |
| 4 | 19 | 18.14 | 0.954737 |
| 5 | 19 | 19.35 | 1.018421 |
| 6 | 21.5 | 20.13 | 0.936279 |
| 7 | 20 | 18.09 | 0.9045 |
| 8 | 21 | 18.68 | 0.889524 |
| 9 | 21 | 16.88 | 0.80381 |
| 10 | 20 | 20.6 | 1.03 |
| 11 | 18 | 19.03 | 1.057222 |
| 12 | 20 | 25.42 | 1.271 |
| 13 | 19 | 20.6 | 1.084211 |
| 14 | 23 | 28.05 | 1.219565 |
| 15 | 18 | 18.46 | 1.025556 |
| 16 | 21.5 | 24.7 | 1.148837 |
| 17 | 20.5 | 23.6 | 1.15122 |
| 18 | 18 | 17 | 0.944444 |
| 19 | 18.5 | 19.19 | 1.037297 |
| 20 | 20 | 21.6 | 1.08 |
| 21 | 21 | 23.6 | 1.12381 |
| 22 | 19.5 | 17.6 | 0.902564 |
| 23 | 18.5 | 18.46 | 0.997838 |
| 24 | 20.5 | 23.12 | 1.127805 |
| 25 | 18.5 | 19.38 | 1.047568 |
| 26 | 20 | 22.21 | 1.1105 |
| 27 | 17.5 | 18.95 | 1.082857 |
| 28 | 19.5 | 21.99 | 1.127692 |
| 29 | 20 | 21.36 | 1.068 |
| 30 | 21 | 22.49 | 1.070952 |
| 31 | 18.5 | 20.73 | 1.120541 |
| 32 | 17.5 | 16.94 | 0.968 |
| 33 | 16.5 | 17.04 | 1.032727 |
| 34 | 20 | 22.48 | 1.124 |
| 35 | 21 | 21.04 | 1.001905 |
| 36 | 20.5 | 21.66 | 1.056585 |
| 37 | 19.5 | 21.98 | 1.127179 |
| 38 | 18.5 | 20.78 | 1.123243 |
| 39 | 20 | 19.74 | 0.987 |
| 40 | 20 | 21.36 | 1.068 |
| 41 | 18 | 19.04 | 1.057778 |
| 42 | 20 | 21.3 | 1.065 |
| 43 | 21 | 24.01 | 1.143333 |
| **Statistical Factor** | | **The Factor value** | **Significant level** |
| **Pearson Correlation (r)** | | 0.677 | 0.000 |
| **F** | | 34.631 | 0.000 |
| **T** | | 5.885 | 0.000 |
| **RWL(Expected)** | | -4.812+(1.3007*X) | |

Also, the results in Table 2 found that the correlation between ATL and RTL was statistically significant and direct, as the value of the Pearson correlation coefficient r was 0.507 and the level of significance (P 0.001) and this means any increase in the reading of ATL Accompanied by an increase of RTL vice versa. As the average values for RTL and ATL readings were (22.217 and 20.957), respectively. Through the table, can be expected that the ATL

value detected if the RTL value is determined by the following formula: = 14.99 + (0.2685 * X).

Table 2: Accurate Tooth Length (ATL) and Radiographic Tooth Length (RTL)

| No. | RTL(X) | ATL(Y) | Ratio(X/Y) |
|---|---|---|---|
| 1 | 24.59 | 21.31 | 1.153918 |
| 2 | 22.33 | 21.57 | 1.035234 |
| 3 | 27.78 | 21.7 | 1.280184 |
| 4 | 19.7 | 20.61 | 0.955847 |
| 5 | 21.25 | 20.88 | 1.01772 |
| 6 | 23.3 | 22.64 | 1.029152 |
| 7 | 19.14 | 21.16 | 0.904537 |
| 8 | 19.88 | 22.34 | 0.889884 |
| 9 | 18.12 | 22.53 | 0.804261 |
| 10 | 21.77 | 21.2 | 1.026887 |
| 11 | 20.32 | 19.22 | 1.057232 |
| 12 | 27.08 | 21.3 | 1.271362 |
| 13 | 21.8 | 20.11 | 1.084038 |
| 14 | 28.94 | 23.74 | 1.21904 |
| 15 | 19.82 | 19.08 | 1.038784 |
| 16 | 26.3 | 22.9 | 1.148472 |
| 17 | 25.6 | 22.2 | 1.153153 |
| 18 | 18.7 | 19.59 | 0.954569 |
| 19 | 20.37 | 19.71 | 1.033486 |
| 20 | 23.04 | 21.33 | 1.080169 |
| 21 | 25.4 | 22.6 | 1.123894 |
| 22 | 18.9 | 20.9 | 0.904306 |
| 23 | 19.57 | 19.17 | 1.020866 |
| 24 | 24 | 21.28 | 1.12782 |
| 25 | 20.05 | 19.19 | 1.044815 |
| 26 | 23.38 | 21.05 | 1.110689 |
| 27 | 20.19 | 18.64 | 1.083155 |
| 28 | 23.15 | 20.53 | 1.127618 |
| 29 | 23.19 | 21.72 | 1.06768 |
| 30 | 22.42 | 22.8 | 0.983333 |
| 31 | 21.51 | 19.19 | 1.120896 |
| 32 | 17.89 | 18.48 | 0.968074 |
| 33 | 18 | 21.07 | 0.854295 |
| 34 | 23.68 | 17.5 | 1.353143 |
| 35 | 22.39 | 22.35 | 1.00179 |
| 36 | 23.42 | 22.17 | 1.056382 |
| 37 | 23.46 | 20.82 | 1.126801 |
| 38 | 21.98 | 19.57 | 1.123148 |
| 39 | 20.93 | 21.16 | 0.98913 |
| 40 | 22.92 | 21.47 | 1.067536 |
| 41 | 20.83 | 19.7 | 1.05736 |
| 42 | 23.2 | 22.77 | 1.018884 |
| 43 | 25.05 | 21.91 | 1.143314 |
| **Mean** | **22.217** | **20.957** | **0.9527** |
| **Max value** | **28.94** | **23.74** | **1.243377** |
| **Min value** | **17.89** | **17.5** | **0.73902** |
| **Statistical Factor** | | **The Factor value** | **Significant level** |
| **Pearson Correlation (r)** | | **0.506** | **0.001** |
| **F** | | **14.175** | **0.001** |
| **T** | | **3.765** | **0.001** |
| **ATL(Expected)** | | **14.99+(0.2685*X)** | |

In Table 3 AAC using an equation which is the division of RAC by the ratio factor Ratio Factor and this last

parameter is extracted either by dividing the EWL On RWL or divide by ATL On RTL After the statistical analysis of the results in this table, it was found that there was a very high direct relationship between RAC and AAC as the value of the Pearson correlation coefficient r was 0.916, and with a significant level (P 0.000), this means that any increase or decrease in RAC is accompanied by an increase or decrease in AAC Respectively, the value of AAC can also be expected. By RAC according to the predictive equation at the end of Table 3.

Table 3: Radiographic Apical Constriction (RAC) and Accurate Apical Constriction (AAC)

| No. | RAC(X) | AAC(Y) =(X/Ratio Factor) | Ratio Factor |
|------|--------|--------------------------|--------------|
| 1 | 0.94 | 0.814799 | 1.153918 |
| 2 | 1.57 | 1.589069 | 1.035234 |
| 3 | 1.45 | 1.274111 | 1.280184 |
| 4 | 1.53 | 1.602536 | 0.955847 |
| 5 | 1.9 | 1.865633 | 1.01772 |
| 6 | 1.17 | 1.249627 | 1.029152 |
| 7 | 1.05 | 1.160862 | 0.904537 |
| 8 | 1.2 | 1.349036 | 0.889884 |
| 9 | 1.24 | 1.542654 | 0.804261 |
| 10 | 1.17 | 1.135922 | 1.026887 |
| 11 | 1.29 | 1.220179 | 1.057232 |
| 12 | 1.66 | 1.306058 | 1.271362 |
| 13 | 1.2 | 1.106796 | 1.084038 |
| 14 | 0.89 | 0.729768 | 1.21904 |
| 15 | 1.36 | 1.326111 | 1.038784 |
| 16 | 1.6 | 1.392713 | 1.148472 |
| 17 | 2 | 1.737288 | 1.153153 |
| 18 | 1.7 | 1.8 | 0.954569 |
| 19 | 1.18 | 1.137572 | 1.033486 |
| 20 | 1.44 | 1.333333 | 1.080169 |
| 21 | 1.8 | 1.601695 | 1.123894 |
| 22 | 1.3 | 1.440341 | 0.904306 |
| 23 | 1.11 | 1.112405 | 1.020866 |
| 24 | 0.88 | 0.780277 | 1.12782 |
| 25 | 0.67 | 0.639577 | 1.044815 |
| 26 | 1.17 | 1.053579 | 1.110689 |
| 27 | 1.24 | 1.145119 | 1.083155 |
| 28 | 1.16 | 1.028649 | 1.127618 |
| 29 | 1.83 | 1.713483 | 1.06768 |
| 30 | 1.93 | 1.802134 | 0.983333 |
| 31 | 0.78 | 0.696093 | 1.120896 |
| 32 | 0.95 | 0.981405 | 0.968074 |
| 33 | 1.02 | 0.987676 | 0.854295 |
| 34 | 1.2 | 1.067616 | 1.353143 |
| 35 | 1.35 | 1.347433 | 1.00179 |
| 36 | 1.76 | 1.665743 | 1.056382 |
| 37 | 1.48 | 1.313012 | 1.126801 |
| 38 | 1.2 | 1.068335 | 1.123148 |
| 39 | 1.14 | 1.155015 | 0.98913 |
| 40 | 1.56 | 1.460674 | 1.067536 |
| 41 | 1.74 | 1.644958 | 1.05736 |
| 42 | 1.4 | 1.314554 | 1.018884 |
| 43 | 1.44 | 1.259475 | 1.143314 |
| **Statistical Factor** | **The Factor value** | **Significant level** | |
| **Pearson Correlation (r)** | 0.916 | 0.000 | |
| **F** | 213.153 | 0.000 | |
| **T** | 14.600 | 0.000 | |
| **AAC(Expected)** | -0.07441+(0.123909 * X) | | |

The results in Table 4 indicate that there is an inverse correlation relationship between the relative factor Ratio

Factor, which is shown how to extract it and the value of AAC as the value of the correlation coefficient r is -0.335, this means that the increase in the relative factor Ratio Factor is accompanied by a decrease in the value of AAC and at a significant level (P 0.028).

Table 4: Ratio Factor (r)and Accurate apical constriction (AAC)

| No. | Ratio Factor (X) | AAC(Y) | |
|---|---|---|---|
| 1 | 1.153918 | 0.814799 | |
| 2 | 1.035234 | 1.589069 | |
| 3 | 1.280184 | 1.274111 | |
| 4 | 0.955847 | 1.602536 | |
| 5 | 1.01772 | 1.865633 | |
| 6 | 1.029152 | 1.249627 | |
| 7 | 0.904537 | 1.160862 | |
| 8 | 0.889884 | 1.349036 | |
| 9 | 0.804261 | 1.542654 | |
| 10 | 1.026887 | 1.135922 | |
| 11 | 1.057232 | 1.220179 | |
| 12 | 1.271362 | 1.306058 | |
| 13 | 1.084038 | 1.106796 | |
| 14 | 1.21904 | 0.729768 | |
| 15 | 1.038784 | 1.326111 | |
| 16 | 1.148472 | 1.392713 | |
| 17 | 1.153153 | 1.737288 | |
| 18 | 0.954569 | 1.8 | |
| 19 | 1.033486 | 1.137572 | |
| 20 | 1.080169 | 1.333333 | |
| 21 | 1.123894 | 1.601695 | |
| 22 | 0.904306 | 1.440341 | |
| 23 | 1.020866 | 1.112405 | |
| 24 | 1.12782 | 0.780277 | |
| 25 | 1.044815 | 0.639577 | |
| 26 | 1.110689 | 1.053579 | |
| 27 | 1.083155 | 1.145119 | |
| 28 | 1.127618 | 1.028649 | |
| 29 | 1.06768 | 1.713483 | |
| 30 | 0.983333 | 1.802134 | |
| 31 | 1.120896 | 0.696093 | |
| 32 | 0.968074 | 0.981405 | |
| 33 | 0.854295 | 0.987676 | |
| 34 | 1.353143 | 1.067616 | |
| 35 | 1.00179 | 1.347433 | |
| 36 | 1.056382 | 1.665743 | |
| 37 | 1.126801 | 1.313012 | |
| 38 | 1.123148 | 1.068335 | |
| 39 | 0.98913 | 1.155015 | |
| 40 | 1.067536 | 1.460674 | |
| 41 | 1.05736 | 1.644958 | |
| 42 | 1.018884 | 1.314554 | |
| 43 | 1.143314 | 1.259475 | |
| Statistical Factor | | The Factor value | Significant level |
| Pearson Correlation (r) | | - 0.335 | 0.028 |
| F | | 5.175 | 0.028 |
| T | | - 2.275 | 0.028 |
| AAC (Expected) | | 0.07441+(-0.93805 * X) | |

## IV. DISCUSSION

Radiographic method used in dentistry since the past 120 years for the diagnosis and evaluation of the teeth condition in diseased and healthy status, but till now there are no studies or researches deals with the measurements of total tooth length radiographic images.

The reliability of radiographic examination for the determination for certain measurements is the dentists concern, there no researches describe the use of periapical radiography in the determination of teeth length, or the measurements of the apical constriction to the apical foramen specially the bisecting angle technique, this is because of the shortening, elongation, and distortion due to the vertical angulation errors.

In this study the bisecting angle periapical radiography was used in determination of tooth length and the measurements of apical constriction to the apical foramen in spite of the presence of image shortening and elongation due to the difference in the vertical angulation , all the researches about the measurements and the determination of the working length used the paralleling periapical radiography , so that the radiographic sensor was putted in close contract with the examined teeth and the supporting structures during the radiographing of the examined teeth. When determining the working length of the root canal by the radiographic method, the tolerance of vertical angle alteration can allow the clinician to obtain a working length with minimal vertical distortion avoiding errors in determining the working length. (19)

Yilidirim et al., used a 10 and 15 K file to determine the actual tooth length, and the file inserted into the canal, until the tip of the file can be seen from the major apical foramen (20) Abdulhaleem and Mohammed used an electronic caliper to measure the accurate tooth length in an extracted lower first premolar teeth, the mean of teeth length was found 19.59-24.07 mm and the mean for the teeth length was found 21.59 mm (21).

The ZX mini apex locator is used for the determination of EWL because it presents the higher precision and reliability in the measurements, and because it can determine the location of the apical foramen and apical constriction.

During the recent study the value of(r) reached 0.677 and with a significant level (value P = 0.000) this means that the lower the reading, EWL the value of the reading RWL Vice versa. It is also possible to calculate the value including RWL using the equation at the end of the table (1). All studies about the use of periapical radiography choose the paralleling technique rather than bisecting angle technique, to ovoid the elongation, shortening or use of extracted teeth in these researches. In the recent study the bisecting angle technique was preferred because the MYRAY sensor is in close contact to the premolar teeth examined and radiographic measurements was extracted depending on the measurements of apex locator and the radiographic working length and the elongation and the shortening of the image were invested. The mean value for the ATL was found 20.957 mm and range between 17.5-23.74 mm. Pishipati (22) reported that the radiographic working length determination was performed with Ingles method. A# 15 K file with I mm less length than the tooth length (safety factor), as noted from preoperative radiograph, was kept in the root canal and radiograph was taken. On the radiograph the difference between the end of the file and the apex was measured. This amount was added or subtracted to the original measured length. From

this adjusted length of tooth, 1 mm was subtracted to confirm with cementodentinal junction this value was registered as radiographic length (RL).

Also, the results in after statistically analyzing it were found that the correlation between (ATL) and (RTL) The relationship was statistically significant and direct, as the value of the Pearson correlation coefficient(r) was 0.507 and the level of significance (P value = 0.001) and this means any increase in the reading of (ATL) Accompanied by an increase of RTL vice Table (2).

But as (AAC) using an equation which is the division of RAC by the ratio factor Ratio and this last parameter is extracted either by dividing the RWL On EWL or divide by RTL On ATL After the statistical analysis of the results in this table, it was found that there was a very high direct relationship between RAC and AAC as the value of the Pearson correlation coefficient r was 0.916, and with a significant level (P value = 0.000), this means that any increase or decrease in RAC is accompanied by an increase or decrease in AAC Respectively, the value of AAC can also be expected. By RAC according to the predictive equation at the end of (Table 3).A study reported that the distance of apical constriction to apical foramen ranged from 0.4-1.5 mm, and the mean was found 0.864 mm this because that these teeth are extracted for orthodontic reasons from young adult and teenager patients, while in the recent study the age of the patients examined reach to over 50 years, the distance was ranged from 0.69-1.88 mm and the mean was 1.26 mm (21). The endodontic treatment using the electronic apex locator is quite comparable, if not superior to radiographic length measurement regarding the rates of acceptable and short cases (7).

There is an inverse correlation relationship between the relative factor Ratio Factor, which is shown how to extract it and the value of AAC as the value of the correlation coefficient r is -0.335, this means that the increase in the relative factor Ratio Factor is accompanied by a decrease in the value of AAC and at a significant level (P 0.028) (Table 4).The mean for accurate apical constriction for the whole sample was 1.26 mm and ranged between 0.69 mm to 1.88 mm, this represent the distance between the file tip and the radiographic apex. It is important to emphasize that these values are related to the radiographic apex and not to apical foramen. The apical foramen may be located 1 or 2 mm or 3 mm and even 3.4 mm away from the radiographic apex (9).

For the determination of tooth length, root canal length should be obtained, the root canal length and the measurements of the apical constriction to the anatomic apex are still the tough task and the subject for several controversies but are the basis for successful endodontic treatment.

The tooth length of an individual in the same race will be more or less same but varies in different races, thus knowing the tooth length, working length is helpful for the clinicians in treatment procedures and reduce the chances of failure of the treatment.

## V. CONCLUSION

According to all the results the use of ZX mini with the MAYRAY imaging system during root canal therapy is accurate determination the working length and the distance between the apical constriction and radiographic apex measurements in addition to the importance of the combination of the EWLs with the digital imaging system in determination of accurate working length and reduction of unnecessary radiation exposure to the patient.

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