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Comparison between Conventional Radiography, Radiovisiography and Raypex 5 Electronic Apexlocator in Determining the Root Canal Length in Posterior Teeth- An Invitro Study

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ABSTRACT

Background: The determination of working length and its maintenance during cleaning and shaping procedures is a key factor for successful endodontic treatment. The aim of this in- vitro study was to evaluate the utility and accuracy of Raypex5 electronic apex locator in determining the working length in comparison to conventional radiography and radiovisiography in posterior teeth. **Methods:** In this study sixty extracted mandibular first and second molars were used. Diagnostic images were obtained both by conventional radiography and radiovisiography (RVG) and tentative working length was obtained and recorded. After access opening actual root canal length was determined by both conventional radiography and RVG and recorded. Four blinded observers determined the working length in all samples with Raypex5 electronic apex locator. Then at that length file position was checked using RVG. **Results:** All the data collected was statistically analyzed using one way analysis of variance (ANOVA), Cronbach's alpha reability analysis and student paired t-test. **Conclusion:** In this study it was found that Electronic apexlocator Raypex 92 %, RVG 74% and conventional radiograph was 70% accurate in measuring root canal length in posterior teeth.

Keywords: Apical foramen, Minor constriction, Major Constriction, Root canal length Electronic apex locator Raypex5.

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INTRODUCTION

The determination of the working length and its maintenance during cleaning and shaping procedures is a key factor for successful endodontic treatment. This determines how far into the canal the instruments are advanced and worked within the root canal.[1] It will limit the depth to which the canal filling may be placed. It will also affect the degree of pain and discomfort the patient will feel following the appointment.[2] Therefore, the procedure for establishment of working length should be performed with skill, using techniques that have been proven to give valuable and accurate results and by methods that are practical and efficacious. Superior results are obtained in endodontic treatments when instrumentation and filling are done up to correct working length.[3]

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Traditionally, there have been numerous techniques employed in working length determination including average tooth length, tactile perception, paper points, conventional radiography, computed radiovisiography and various generations of apex locators.[4] But here the question is how reliable and accurate these methods are in calibrating the exact working length. With the introduction of newer technologies and equipments to measure working length, it becomes important to verify the ability and accuracy of these devices as they are rapidly gaining acceptance in everyday clinical practice in endodontics. The requirements of a method for determining the working length of the tooth are- it must be accurate, it must be easily and readily performed, and it must be easily confirmed and reproducible.

Radiographic method described by INGLE is one of the most common and reliable methods used in determining the working length. However, it is well known that the apical foramen seen on the radiograph may be, but usually is not, the real end of the canal, and this cannot be distinguished with a two dimensional image. Accuracy is difficult to

achieve because the apical constriction cannot be identified, and variability in techniques, angulations and exposure distort this image and lead to error due to laterally situated foramina.[4,5] In addition there is a radiation hazard both to patients and dental personnel. Observer's bias in radiographic interpretation may lead to error. It is difficult to take radiographs in patients with restricted mouth openings and patients with gag reflex.

The use of apex locators in working length determination is in its revolutionary phase. Everyday claims of so called newer generations of apex locators are being published in the literature. Raypex5 is a fourth generation apex locator which utilizes voltage difference and operates on the principal that impedance measurement not only differs between two electrodes, depending on the frequencies used, but also differs greatly between at an apical constriction region.

Electronic apex locators have advantages of no radiation exposure to patient, more economic and requires less time in determining the working length of the tooth. Computed radiovisiography have advantages of speed acquisition, reduced patient irradiation, the possibility of editing the image without distortion, and eliminates chemical wastes and hazards and quality of detail similar to conventional radiology.[1,5]

The purpose of this in vitro comparative study was to determine the accuracy and precision in measuring the root canal length using conventional radiography, radiovisiography and fourth generation electronic apexlocator Raypex5 in posterior teeth.

MATERIALS & METHODS

Sixty first and second mandibular molars with mature apices were used in this study. Similar to G.Nayak, S. Dahiya et al,[6] study the specimens were directly positioned on geometrically standardized, graduated support equipped with a horizontal goniometer. X- cone position was standardized with the use of paralleling XCP rinn and wooden stand and the specimens were kept at a constant distance both from X-ray film (10mm) and X-ray cone of RVG Unit 50mm. Tooth localization was referenced to calibrated graphsheet, to allow X-Ray Cone positioning parallel to the paper lines. After these standardization preoperative X-ray images with conventional (Kodak, Rochester, NY, USA) size zero and RVG (eva with proimage, DENT.X, Elmsford, NY, USA) having sensor of same size as that of IOPA film, were obtained. On the sensor, 10mm premeasured metal wire was fixed with the help of cellotape for giving precaliberation measurements of digitized images. Digital vernier caliper (Sankin, Mitutoyo Co., Kanagawa, Japan) with accuracy to the nearest 0.01mm was in turn used to obtain measurements of each specimen from all preoperative X-ray images by viewing them on viewer's box. Maximum preoperative root length of both conventional and digitized images was recorded by measuring the distance between the incisal edge and the radiographic apex.

Access preparation was done and canals were located. Actual canal length was calculated by inserting a #15K- File 25mm into the canal until the file tip was just visible at the level of apical foramen, under 2.5X-420 magnifying loupes. (Galilean Loupes, Lifecare Medical Equipments Co., Ltd., Zhejiang, China). Rubber stopper was adjusted at this length, file was removed and its length was measured with digital vernier caliper to the nearest 0.01mm.

Electronic measurement of root canal length was calculated for each specimen using Raypex5 apex locator by four blinded observers. In order to reproduce clinical conditions involved in the electronic measurement of root canal length, each specimen was mounted in alginate.[7] Each canal was irrigated with 3% sodium hypochlorite and size 15 k-file attached to the instrumental clip was inserted into the root canal till the red mark was visible on the screen of apex locator. Point at which red mark indicated the position of the apical foramen, at this point rubber stopper was adjusted to the reference level, file was taken out and its length was measured with the help of digital vernier caliper. The tooth was demounted and file was reinserted with rubber stopper adjusted at the measured electronic length. The tooth was again mounted on the adjustable jig and radiographic images with file were taken by conventional radiograph and RVG. Now the position of the file at its tip was noted and recorded similarly as done before. If it was at the apex it was recorded as "*", if file tip is 0.5mn beyond the apex it was designated as "+" and if it was 0.5mm short of apex it was designated as " -". Measurements with+-0.5mm of the apical foramen were considered acceptable.[8,9]

RESULTS

All the results were tabulated and data were analysed using the one-way analysis of variance (ANOVA). Mean of root canal length obtained by four blinded observer was taken. Results of the blinded observer's were compared using Cronbach's alpha-reliability test. No significant difference was found in results of blinded observer's. Comparison between different groups was done using student pair-test. Statistical significance was considered to be $p \leq 0.05$. Wilcoxen sign rank test was used to see the position of the file with respect to apical foramen. On comparison between Raypex5, conventional and digital radiography there was a significant difference noted. In terms of percentage Raypex5 was found to be 92% accurate, RVG was 74% and conventional radiograph was 70% accurate in locating apical foramen with acceptable range

lying in ±0.5mm. The statistical analysis was carried out with SPSS version 11.5 software (SPSS Inc., Chicago, USA).

DISCUSSION

Establishment of correct working length is an important stage in root canal treatment, because sufficient evidence suggests that instrumentation either beyond or too short of apex can adversely affect its success.[10] Various school of thought exist for the termination of root canal working length. Kuttler[5] stated that the narrowest diameter of the apical foramen was located at the cementodentinal junction (CDJ), which is usually found about 0.5mm from the external surface of the root or radiographic apex. However CDJ is a histological term and microscope is needed to find it. Clinically this is not practical. In this sense, we considered the apical foramen to be an appropriate reference and moreover no well-defined apical constriction has been clearly confirmed in all root canals.[6]

Radiography is the traditional and essential method but at the same time it may not be able to differentiate between radiographic apex and anatomic apex as the two may not coincide in all cases.[11] Mandibular multirooted teeth were selected in this study because the degree of apical foramen deviation is more in posterior teeth. It has also been reported that as the curvature in the apical third increases, the chances for erroneous radiographic working length also increases. Similarly, experience accumulated over the years clearly confirms the reliability of EALs. Various studies have reported the accuracy of Electronic apex locator to be as high as 80 to 95%, on contrarary some have even found radiographic method more accurate.[12-16] Now EAL have come a long way and have become an essential component of armamentarium of endodontic due their high accuracy rate which is further more significant in curved canals. In anteriors or teeth with straight canals even radiographic methods have good results but in curved canals its results vary to greater range.

According to manufacturer, Raypex5 apex locator is fourth generation, based on the principal that impedance measurement not only differs between two electrodes depending on the frequencies used, but also differs greatly between at an apical constriction region. This device uses two frequencies 400 HZ and 8KHz, produced by a variable frequency generator but only one frequency at a time6. In this study Raypex5 is found to be 92% accurate in comparison to conventional radiograph and RVG which were 70% and 74% accurate in posterior teeth with error range of ±0.5mm. In similar study in anterior teeth by Nayak G,[6] it reported 90% accuracy of Raypex5. Shiva Sadeghi and M Abolghasemi also used Raypex5 to determine working length in anterior teeth and reported accuracy upto 70% and 50% accuracy rate of conventional radiograph respectively.[4] Another study by Chopra et al,[17] reported 75.93% accuracy for determining working length in anterior teeth with Raypex5 apexlocator. A Saraf et al,[18] reported the accuracy of six different apexlocator in multirooted teeth with accuracy of 95.6% with Raypex6 and 97.8% with RootZX II.

CONCLUSION

In this in vitro study Raypex5 was found to be more accurate than conventional radiograpgy and RVG in measuring working length and in locating apical foramen in posterior (mandibular molars) teeth.

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