COMPARATIVE EVALUATION OF WORKING LENGTH WITH DIGITAL RADIOGRAPHY AND THIRD GENERATION ELECTRONIC APEX LOCATOR

1SAIMA NAWAB
2MUZAMMIL JAMIL AHMED RANA
3AHMED YAR

ABSTRACT

Precise working length determination is mandatory to accomplish the desired aim of root canal treatment. Advanced techniques of working length determination include digital radiography and electronic apex locator. The objective of the present study was to juxtapose the difference between the precision of working length taken by digital radiographs and third generation electronic apex locator and correspond it with directly measured root canal lengths after extraction of the same teeth.

The present comparative study was conducted at Armed Forces Institute of Dentistry, Rawalpindi from August 2014 to March 2016. Fifty human, maxillary and mandibular anterior teeth with closed apices which were planned for extraction were selected for the study. Working length determination for all teeth were initially done with the help of electronic apex locator and stable occlusal reference points were recorded followed by working length determination by directly observing digital radiograph on the displaying screen by three different clinicians. After extraction of teeth, actual working length of canals at apical constriction were determined under dental magnification loupes. The difference of two experimental termination points (digital radiographic and electronic apex locator) from ideal termination point (after extraction) was compared. Statistical analysis of data was undertaken by independent sample t-test (SPSS, version 20) and the results revealed no remarkable variation of radiographic and electronic working lengths from actual working length but electronic apex locator was slightly more accurate (58%) than digital radiographs (42%).

Key Words: Working length, apical constriction, electronic apex locator, digital radiographs.

INTRODUCTION

Working length is defined as “the interval from coronal point of reference to the apical point at which canal preparation and obturation should terminate.” For favorable outcome of endodontic therapy, proper cleaning, disinfection and obturation of root canal system is required and correct calculation of working length is one of the key steps in accomplishing the desired aim of endodontic therapy.

Appreciable dispute exists where to definitely stop the root canal preparation and obturation. On the basis of biologic and clinical principles, root canal instrumentation and obturation should not extend beyond the apical constriction which usually is 0.5-1.5mm coronal to apical foramen. The reason being apical constriction is the constricted part of the root canal near to anatomic apex having minimum blood supply where pulp and periodontal tissue concur. It also results in smallest wound site which is most favorable for healing.

In early days of endodontic treatment when radiographs had not yet been applied to dentistry, working length was calculated by various methods involving understanding of root canal anatomy and mean root canal lengths, pain perceived by the patient when endodontic instrument passes across apical foramen, tactical sensation felt in the apical part of the canal and use of paper points to identify bleeding point in utmost apical part of the canal. However all of these old methods could not account for precise working length calculation as they are not able to localize apical constriction, resulting in Postoperative pain either due to under obturation or overobturation.
Radiographs are very advantageous in root canal therapy as they offer an opportunity to examine root canal anatomy and periapical tissue. Radiographic method works on the logic that apical constriction is perhaps situated 0.5-1mm or in some cases 3mm short of the radiographic apex. Location of the radiographic apex can also vary from the anatomic apex due to inconstant root morphology and distortion of the radiographic image due to variation in radiographic technique, angulation, exposure and bigotry radiographic analysis. Accuracy of digital radiographic and conventional radiographic technique in terms of working length determination is same. However, digital radiographs allows for reduction in radiation dosage to the patient, radiographs are captured and saved in digital format and avoids the use of chemicals needed for image processing. It is also possible to adjust brightness and contrast of digital radiographs.

Electronic apex locators presently are being used to measure the working length and are an important appendage to radiographs. They are aimed to locate the apical constriction, cemento-enamel junction or the apical foramen. Electronic apex locators are beneficial in terms of ease of use, reduced procedure time, reduction in radiation exposure and number of radiographs in determining the working length. They are particularly useful in determining working length when the apical portion of the canal is obscured by anatomic structures, such as impacted teeth, tori, zygomatic arch, immoderate bone density, imbricated roots or shallow palatal vaults. Third generation apex locators are frequency dependent apex locators and the proportion between two frequencies is not affected even in the presence of electrolytes and pulp remnants. However, they do have some limitations like they do not work properly in presence of profuse bleeding, wide open apices, extensive periapical lesion, weak batteries and in teeth with metallic restorations.

The aim of the present study was to compare the diagnostic potency of Dentaport ZX apex locator with Vistascan mini plus digital radiographs in determination of working length in vivo and correlate it with directly observed working length under 3.5x dental magnification loupes in vitro.

**METHODOLOGY**

Present comparative study was conducted at Operative Dentistry Department, Armed Forces Institute of Dentistry, Rawalpindi from August 2014 to March 2016. This comparative study was conducted on fifty human permanent, maxillary and mandibular single rooted anterior teeth with closed apices, which were planned for extraction. Supernumerary teeth and teeth with resorbed roots, calcified canals, extensive periapical lesion and abnormal canal curvatures were excluded from the study.

After taking informed consent from the patient, a good quality, preoperative digital radiograph was taken, using paralleling long cone technique. After effective local anesthesia (Lidocaine hydrochloride 2% and epinephrine 1:100,000, Lignospan standard: septodont) and rubber dam isolation, access cavity was formed with round diamond bur (BR-40; Mani) and incisal edges or cusp tips were flattened using straight fissure bur (SF-12; Mani) to create flat, stable reference point. Canals were negotiated with No. 15 k file (Mani hand k file), pulpectomy was then carried out and canals irrigated with 3% sodium hypochlorite (BDH Lab. Poole, Bh151 TD, England) solution. Flaring of coronal part of canals were carried out using Gates drills (Mani gates drills,#1-6). After drying canals with paper points, No.15, 20 or 25 k files (Mani hand k files), which could easily be accommodated at the apex were inserted into canals and working length was taken by using electronic apex locator (Dentaport ZX (J. Morita Osaka, Japan) according to manufacturer’s instruction. After adjusting occlusal stops on reference points, length of the file was measured by using endodontic ring (ERR 030:Adam dental) and values were recorded as electronic working length.

Radiographic working lengths for all canals were then recorded by directly observing digital radiographs (Vistascan miniplus: Durr Dental) of teeth with file in place, by three different clinicians, on displaying screen. Same teeth were then extracted and retained in 5.25% NaOCl solution to remove residues of periodontal tissues. Same number of endodontic k file which was used previously was inserted in individual extracted teeth at the same reference point. Working length was then determined visually for each tooth when file tip was just visible at apical foramen using magnifying dental loupes (Flip-up, 3.5x, Philips). From this length 0.5mm was subtracted to obtain actual working length at apical constriction.

Conforming to method of working length determination, three equal groups were made each containing fifty teeth.

- **Group 1:** Electronic working length (EWL)
- **Group 2:** Radiographic working length (RWL)
- **Group 3:** Actual working length (AWL)

Data were statistically analyzed (SPSS, version 20) and independent sample t-test was enforced to analogize actual working length with length measured by digital radiographs and third generation electronic apex locator.
RESULTS

In present study, total number of single rooted teeth and canals were 50. For electronic method of working length determination, in 29/50 canals, working length was in coincident with actual working length. While for digital radiographic method, in 21/50 canals, working length was in coincident with actual working length. The accuracy of third generation electronic apex locator was 58% and digital radiographs was 42% in determination of working length at apical constriction. P value of less than 0.05 was considered significant. In present study P values for electronic apex locator and digital radiographs were greater than 0.05 which means that third generation electronic apex locator and digital radiographs do not have any significant difference in measuring the working length.

DISCUSSION

Present study was conducted to compare the precision of working length taken by third generation electronic apex locator and digital radiographs. Results demonstrated that there was no remarkable variation of electronic or radiographic working length from actual working length but third generation electronic apex locator was more accurate than digital radiograph in working length determination. Results of the present study are in accordance with various other studies that have collate electronic working length and digital radiography and judged the reliability of former technique in measuring working length to be indistinguishable or even better than that of digital radiography.\(^6,7,8\)

Saad and al-Nazhan proposed using apex locator in concomitance with digital radiovisiography to help minimize the amount of radiation.\(^5\) They only advocate proceeding digital radiograph with master cone inserted in canal, after having determined working length established electronically. According to study by Irfana et al, there was no significant difference between mean electronic working length (propex apex locator) and digital radiographic working length (RVG).\(^9\) Study by Tooba et al, revealed accuracy of third generation electronic apex locator was 65.2% and periapical radiographs 22% in determination of working length in permanent anterior teeth.\(^10\)

Ravanshad in his study concluded that in addition to reducing radiographic exposure, electronic apex locators are superior in reducing overestimation of root canal length.\(^11\) Qazi et al in their study compared the accuracy of 4th generation apex locator and periapical radiographs in determination of working length in anterior teeth and found that accuracy of electronic apex locator was 90%.\(^12\)

Cianconi et al in his study concluded that radiographic working length resulted in measurements beyond apical foramen in 19-28% of cases, regardless of an acceptable radiographic appearance.\(^6\) Another in vivo study by Sadaf et al concluded that radiographs do not always calculate the working length at minor constriction.\(^13\)

Pascon et al, recommended that working length taken by electronic apex locator should be confirmed by radiographs to decrease errors in working length determination.\(^14\) Benefits of combined methods are reduction in the number of radiographs required for working length determination, reduced procedure time, reduced radiation exposure to the patient, instead of determination of working length to the radiographic apex, apex locator are able to measure canal to apical constriction, cementodentinal junction or apical foramen and radiographs are advantageous to inspect root anatomy and can be documented in patients record. The present study had some limitations as only anterior teeth were considered and actual working length was calculated by assuming that apical constriction is located 0.5mm from the apical foramen. So, there may be the possibility of errors.

CONCLUSION

Although there is no remarkable difference between the radiographic method and electronic apex locator method in establishment of precise working length but both tendencies should be considered together. Both methods have their own benefits and constraints, but greater advantages of electronic apex locators have made them an authentic mean of working length determination for day to day endodontic applications.
REFERENCES


CONTRIBUTIONS BY AUTHORS

1 Saima Nawab: Title selection, Manuscript writing, study design, Data collection and analysis.

2 Muzammil Jamil Ahmed Rana: Clinical exam of the patients and drafting.

3 Ahmed Yar: Discussion and references.