



ISSN Print: 2394-7489
ISSN Online: 2394-7497
IJADS 2018; 4(1): 151-153
© 2018 IJADS
www.oraljournal.com
Received: 27-11-2017
Accepted: 28-12-2017

Dr. Syed Shahbaz
Department of Oral Medicine &
Radiology, Al-Badar Dental
College, Gulbarga, Karnataka,
India

Dr. Shailendra Mashalkar
Professor & Head, Department
of Conservative & Endodontics,
Al-Badar Dental College,
Gulbarga, Karnataka, India

Working length determination of root canal in permanent single rooted tooth: An *in vitro* comparative study

Dr. Syed Shahbaz and Dr. Shailendra Mashalkar

Abstract

Background: An accurate and a reproducible working length is an important factor in root canal treatment (RCT). The success rate of conventional RCT has been correlated with the length of the final root canal filling. There are various methods of determining the working length. The determination of correct working length is one of the keys to success in endodontic therapy.

Objective: The objective of this study was to compare the working length determination done using three methods, namely, radiovisiography (Kodak RVG 5100) and conventional radiography (Satelac, Acteon X-mind), apex locator (Root ZX mini, MORITA).

Methodology: In this research, to determine the working length, 40 single-rooted teeth (mandibular first premolars) were selected and each tooth was subjected to all the three methods of the working length determination. This was compared with the actual working length measured utilizing ground sections of the individual teeth.

Results: The results revealed that all the three methods located the apex nearly as accurately as the actual root canal length obtained by histological ground sectioning, and among three methods apex locator being the closest to the actual root canal length.

Conclusion: The study concludes that all the three techniques are equally effective in determining working length.

Keywords: Working length, Radiography, RVG, Apex locator.

Introduction

An accurate working length determination of root canal during endodontic treatment is very essential. It makes endodontic treatment easier for an operator to remove necrotic tissue and prepare canals precisely. Various methods have been used to establish correct working length. These include use of conventional or digital radiography, tactile method and moisture on paper point. All of these methods have their limitations. Radiographs are subjected to distortion and magnification. It comprises accurate location of root apices. They are technique sensitive in exposure and interpretation. They also provide a two dimensional image of a three dimensional structure which may not represent real position of apical region. Furthermore, in many cases with conventional radiography, it is difficult to establish the actual length of the canal with a two dimensional image [1, 2, 3, 4].

In recent years, new imaging techniques have been developed with the aim of improving the clarity of the image while reducing the radiation dose. Among them is the radiovisiography (RVG), which is the most recently introduced method and is fast gaining widespread popularity. The advantage of RVG is that there is a 60% radiation dose reduction and production of an instant image which can be enhanced and modified [5, 6, 7, 8].

It becomes even more difficult to establish correct working length with radiography when root canal system is superimposed radiographically by anatomic structures. In such cases, electronic method using apex locator is very useful [9]. With advent in technology, a new method of establishing working length with electronic apex locator was introduced by Sunada in 1962. Since then, different generation of electronic apex locators have been developed to measure root canal length with superior accuracy [10]. Electronic apex locators give reliable results when apical foramen does not coincide with the anatomic root apex.

The cemento-dentinal junction (CDJ), where the pulp and periodontal tissue meet is

Correspondence

Dr. Shailendra Mashalkar
Professor & Head, Department
of Conservative & Endodontics,
Al-Badar Dental College,
Gulbarga, Karnataka, India

considered as physiological limit for working length, biomechanical preparation and obturation in endodontic treatment. This landmark cannot be precisely determined radiographically and has been claimed to be determined by modern electronic apex locators with more than 90% accuracy [11, 12]. The present article intends to compare the diagnostic efficacy of three methods, namely apex locator, conventional radiography (IOPA-R) and radiovisiography (RVG) in determining the working length in root canal systems *in vitro*.

Methodology

A total number of 40 single rooted mandibular premolars extracted for orthodontic purpose were collected. The study was obtained ethical clearance from institutional ethical committee. The materials and techniques tested in this study are apex locator (Root ZX mini, MORITA), radiovisiography unit (Kodak RVG 5100), X-ray unit (Satelac, Acteon X-mind), X-ray film (E Speed, Kodak). The teeth were screened and X-rays were taken. If any of the following were noted, then those teeth were excluded in the study: Incompletely formed apex, evident root fracture, Dilacerated root & Pulpal calcification.

Teeth were cleaned from any residual tissues and cleaned with water and stored in 10% formalin solution. Conventional access cavity preparation was carried out on all teeth using diamond burs, high speed hand piece and water coolant. The cusps of teeth were flattened using a high speed hand piece to establish a surface level to serve as a stable and equal platform for all measurements. Pulp chamber wall was smoothed and root canal orifices were identified. Canals were irrigated with 2.5% sodium hypochlorite. Care was taken to maintain the standardization between samples while recording working length measurement in all the three techniques, namely apex locator, conventional radiography and radiovisiography.

Length determination by conventional radiography and RVG:

A table on which geometric angulation was available was used for keeping the tooth for radiography, so that the angulation of the X-ray remained the same for all the samples. Tooth positioner and paralleling technique were used for standardization during exposure with radiography and RVG. A constant distance of 3 inches was maintained between the cone head of the X-ray unit and the tooth positioner during radiographical and radiovisiographical methods for all the samples. Keeping tooth and file arrangement in the tooth positioner, which was described earlier, the conventional radiographic images of canal length measurement were obtained and working length was calculated as 1 mm short from the radiological apex. Radiovisiographic image was also taken using the same standard equipment and working length

was calculated using the parameters of this system. Readings were noted as working length according to the radiographic method and the radiovisiographic method respectively.

Length determination by apex locator:

The same sample was evaluated for length determination by electronic method. The labial clip was fixed with the edge of saline bath in contact with fluid all the time. The apex locator was turned on and no. 15 K file was advanced into the root canal just beyond the foramen. As the instrument moved apically, the digital display indicated the distance from the tip of the file to the apical constriction in the tenth of a millimeter. The unit's cable was clipped in to metal shank after removing 15 no K file. The apex locator gave out signal in 3 ways, a digital display reading -0, a pulsing audition, a flashing light. When the locator signaled the apical region; the rubber stop was adjusted at the same reference point. Length was measured and recorded. 1 mm was subtracted from that and the file was stabilized in canal using cyanoacrylate material within the chamber opening. The same procedure was followed for the rest of the samples.

Determination of actual length:

To know the correct position of the DCJ, the tooth was selectively ground sectioned in two different planes. This allowed elimination of the hard tissue which had prevented direct visualization of the most apical position of the root canal. By this method of ground sectioning, it is possible to observe the relationship between the file tip and the anatomical apex. Utilizing the research microscope, the DCJ was observed and the distance between the file tip and DCJ was measured and the actual working length of root canal was measured and recorded.

The actual working length found was compared with the working length obtained using the apex locator, conventional radiograph and RVG for individual root canal of tooth.

Results

The data thus obtained were tabulated. Statistical analysis was performed using ANOVA test and Students' t test, with a p-value of 0.05 was considered as statistically significant, all the statistical analysis was done by SPSS software 20.0 version, Chicago USA.

Our study showed that there was no statistically significant difference between the groups in the determination of working length with an F value of 0.0512031 ($p > 0.05$). It implies that the root canal length determination in all the groups were similar. There is no statistically significant difference between the four groups as well as within the groups in locating the apex indicating that all the three methods are equally competent in locating the apex [Table 1].

Table 1: Four groups compared by ANOVA test

SV	SS	df	MS	F	p-value	Significance
Between groups	0.283609	4	0.08245	0.0512031	>0.05	NS
Within groups	297.3516	137	2.37234			
Total	297.641209	141				

NS: Non Significance

Discussion

Ideal length determination at the onset of treatment initiation ensures thorough cleaning and shaping and obturation. However, locating the appropriate apical position has always been a challenge in clinical endodontics. For successful endodontic treatment, establishing a correct working length is an important element. Numerous studies have been done to

evaluate the accuracy of working length of root canal during endodontic treatment. Apical constriction is an ideal spot for working length determination. It is a narrowest spot of root canal having lowest diameter of blood vessels, also known as minor diameter of the canal [13].

There are various methods for determining working length, but none of these are ideal, so as to be considered as the

perfect method. Each method has got its own advantages and disadvantages. The usual methods followed are apex locators, radiography and RVG. While using radiographic method in most cases the DCJ does not coincide with the point 1 mm short from the radiographic apex because of cementum deposition. Also, it simply provides reliable information on the location of the radiographic apex. The anatomical apex may or may not coincide with the apical foramen. In most of the cases the foramen deviates from the long axis of the tooth. The mean distance between the anatomical apex and the foramina is generally 0.5 to 1.0 mm. Considering that the apical foramen frequently does not coincide with the radiological apex, positioning of the file at the radiological apex will often lead to under- or over-instrumentation [5, 14, 15]. In recent years, electrical devices have been developed for determining the length of the tooth without resorting to radiography. This method helps to reduce the treatment time and the radiation dose. RVG is the most recent and upcoming method of measuring working length. Their advantages over conventional radiographs are the speed of image acquisition, reduced patient radiation dosage and the possibility of image editing [5, 7, 8].

In our study, the methods that were used to determine working length were apex locator, RVG and conventional radiography. All the three techniques showed equal efficiency in determining accurate working length. Out of these three methods, the apex locator was closer to the accurate value but, was not statistically significant than the other two methods. The worst prognosis for root canal treatment is under-or over-instrumentation or filling short or beyond the apical constriction. The best prognosis for root canal treatment is adequate instrumentation and homogeneous obturation till the apical constriction. So, combining proper usage of instruments with the knowledge, skill and experience of the operator will determine the outcome of each technique.

Conclusion

The conventional X-ray, though accurate, has the disadvantages of increased radiation and being time consuming. The RVG overcomes these by reducing the radiation and time requirement and also eliminating processing variables. The apex locator, however, completely eliminates radiation and has the advantage of time and convenient chairside access. To conclude, all the three methods located the apex nearly as accurately as the actual root canal length obtained by histological ground sectioning, and among three methods apex locator being the closest to the actual root canal length.

Acknowledgement

Authors acknowledge the immense help received from the scholars whose articles are cited and included in references of this manuscript. The authors are also grateful to authors/editors/publishers of all those articles, journal and books from where this article has been reviewed and discussed.

References

1. Goldberg F, Marroquin BB, Frajllich S, Dreyer C. *In vitro* evaluation of the ability of three apex locators to determine the working length during retreatment. *J Endod.* 2005; 31:676-8.
2. Stein TJ, Corcoran JF. Radiographic working length revisited. *Oral Surg Oral Med Oral Pathol.* 1992; 74:796-800.
3. Seidberg BH, Alibrandi BV, Fine H, Logue B. Clinical

- investigation of measuring working lengths of root canals with an electronic device and with digital-tactile sense. *J Am Dent Assoc.* 1975; 90:379-87.
4. Ruddle CJ. Cleaning and shaping root canal systems. In: Cohen S, Burns RC, editors. *Pathways of the Pulp.* 8th ed. St. Louis, MO: Mosby, 2002, 231-91.
5. Martinez-Lozano MA, Forner-Navarro L, Sanchez-Cortex JL, Llana-Puy. Methodological considerations in the determination of working length. *Int Endod J.* 2001; 34:371-76.
6. Duran-Sindreau F. Comparison of *in vivo* and *in vitro* readings when testing the accuracy of the root ZX apex locator. *Journal of Endod.* 2012; 38(2):236-39.
7. Neena IE. Comparison of digital radiography and apex locator with the conventional method in root length determination of primary teeth. *J Indian Soc Pedod Prev Dent.* 2011; 29:300-04.
8. Griffiths BM, Brown JE, Hyatt AT, Linney AD. Comparison of three imaging techniques for assessing endodontic working length. *Int Endod J.* 1992; 25:279-87.
9. Custer LE. Exact method of locating apical foramen. *J Natl Dent Assoc.* 1918; 65:815-9.
10. Sunada I. New method for measuring the length of the root canal. *J Dent Res.* 1962; 41:375-87.
11. Ricucci D, Langeland K. Apical limit of root canal instrumentation and obturation, part 2. A histological study. *Int Endod J.* 1998; 31:394-409.
12. Bernardes RA, Duarte MA, Vasconcelos BC, Moraes IG, Bernardineli N, Garcia RB *et al.* Evaluation of precision of length determination with 3 electronic apex locators: Root ZX, elements diagnostic unit and apex locator, and RomiAPEX D-30. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2007; 104:91-4.
13. Green D. Stereomicroscopic study of 700 root apices of maxillary and mandibular posterior teeth. *Oral Surg Oral Med Oral Pathol.* 1960; 13:728-33.
14. Brown R, Hadley JN, Chambers DW. An evaluation of ektaspeed plus film versus ultraspeed film of endodontic working length determination. *J Endod.* 1998; 24(1):54-56.
15. Brunton PA, Abdeen D, Macfarlane TV. The effect of an apex locator on exposure to radiation during endodontic therapy. *J Endod.* 2002; 28(7):524-26.