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Evaluation and Comparision of Working Length Determination Using Four Different Apexlocaters

[1]Dr. Gyan Prakash, Department of Conservative And Endodontics, Vyas dental college, Jodhpur

[2]Dr. Nitin Mirdha, Department of Conservative And Endodontics, Vyas dental college, Jodhpur

[3]Dr. Roopa Babannavar, Department of Conservative And Endodontics, Bapuji dental college, Davengeree

[4]Dr. Chinmay Vyas, Department of Conservative And Endodontics, Yogita dental college, Khed

[5]Dr. Bhupesh Gandhi, Department of conservative and endodontics, Surendra dental college & research institute, Shree Ganganagar

[6]Dr. Surabhi Ghosh, Department of conservative and endodontics,Yogita Dental College, Khed

Corresponding Author: Dr. Gyan Prakash, Department of Conservative And Endodontics, Vyas dental college, Jodhpur

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Abstract

The removal of all pulp tissue, necrotic material and microorganisms from the root canal is essential for endodontic success. Although radiography is the most commonly used diagnostic aid in endodontics, it is only able to provide reliable information on the location of the radiographic apex. The anatomical apex may or may not coincide with the apical foramen.

The development of the electronic apex locator has helped make the assessment of working length more accurate. This *in vivo* study was performed for comparison of working length determination with four different apex locators (Propex II, Root Zx mini, I Pex, Apex ID) and it was observed that no statistically significant differences were observed among the results of all the four apex locators and it can be said that the use of EALs is a reliable method for determining root canal length.

Introduction

Electronic apex locators (EALs) have been used for over 20 years for locating the canal terminus. The operation mode of EALs has evolved over the years, from measurement of electrical resistance with direct current, alternating current or high frequency current, to measurement of voltage gradients and calculation of the ratio between impedances.[1] Accordingly, early generation EALs signal the contact of an intracanal probe with the periodontal ligament at the minor foramen[2], whereas later generation EALs signal the point of the narrowest diameter of the canal at the apical constriction.[3] Depending on the method of assessment, the accuracy of canal length measurement by various EALs is in the range of 80-94%, as shown in vitro[4,5] and in clinical evaluation.[6,7]

Electronic apex locators (EALs) reduce the number of radiographs required, and are recommended to complement and assist radiographic methods of working length determination. Moreover, they can indicate cases where the apical foramen is some distance from the radiographic apex and might be helpful in detecting root canal perforations.[8]

The EAL of Sunada (1962) used continuous wave current that gives a polarization effect on the electrodes, thus negatively affecting their performance.

This led to the development of EALs supplied by alternating current (Inoue 1973). These second generation EALs are characterized by a single frequency of alternating current to detect changes in the canal impedance.

Despite considerable developments over the years, the major disadvantage with these EALs is related to the fact that the canal needs to be reasonably free of electrically conductive material in order to achieve an accurate reading (Ushijama 1983, Ushijama et al. 1988, Fouad & Krell 1989). The third generation of dual frequency EALs has attempted to overcome or minimize this problem; in fact these devices are also based on alternating current, but they operate on the principle that the impedance difference between electrodes depends on the signal frequencies used.

The latest generation apex locators are based on the new multi-frequency principle, and are thought to be able to overcome previous drawbacks; however studies need to be conducted to evaluate the accuracy of the new generation apex locators.

Therefore the aim of the study was the comparison of working length determination with four different apex locators (Propex II, Root Zx mini, I Pex, ApexID).

Material and Method

60 teeth, scheduled for extractions due to periodontal disease or orthodontic reasons were selected. Informed consent was obtained from each patient under a study protocol approved by an ethical committee from the Jodhpur national university. A standardized periapical radiograph was taken for each tooth to allow proper selection.

After administration of local anaesthesia and isolation under rubber dam, the cusps were flattened with a tapered diamond bur using a high-speed handpiece under water irrigation to obtain fixed reference points if a flat reference point was not available. A conventional endodontic access was prepared using the access preparation kit to obtain a straight line access to the root canal. The cervical bulge of dentin was removed by using 2-4 Gates-Glidden drills in a low speed handpiece with canals irrigated by 5 % sodium hypochlorite. Glide path was achieved using 10 k file and 17% EDTA.

15 teeth were allotted under each group:

Group 1- teeth whose working length was determined by Propex II

Group 2- teeth whose working length was determined by Root Zx mini (J morita)

Group 3- teeth whose working length was determined by I pex (NSK)

Group 4- teeth whose working length was determined by Apex ID (Sybronendo)

A 15 no k file was used for the working length determination. The file was attached to the apex locator and working length was determined following manufacturer's instructions for all groups. Once the apex was detected by apex locators, silicon stop of the file was adjusted to the reference point and fixed to the shaft in place using cyanoacrylate glue. Now the working length was reverified through the apex locator and the glass-ionomer cement was manipulated and carried by using plastic filling instrument. The file was fixed in the tooth by applying to 2-3 mm thick layer of glass-ionomer cement. The cement was allowed to set for at least 5 minutes.

The tooth was then extracted. The extracted teeth were stored in 5% sodium hypochlorite for 15 min and then stored in 0.2% thymol solution to remove any remaining organic tissue from the root.

After a short rinse in tap water, the teeth were dehydrated by immersing them in 80% ethyl alcohol for 24 hours, followed by a 90% and 100% alcohol immersion for 1

hour periods. A final immersion in methyl salicylate for 4-6 hours rendered the teeth transparent.

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Electronic working length determination was done with the help of four different apex locators. The file with which working length was determined was fixed in the root canal and the teeth were extracted, cleaned and evaluated under stereomicroscope.

Result

Fisher's exact test and Pearson Chi- Square test were performed to statistically analyze qualitative data.

The expected count for the file at the anatomic apical foramen was 9 for each group, was 4.5 for files protruding beyond the apical foramen and was 1.5 for the files short of the apical foramen.

The Pearson Chi-Square statistic revealed the value of 5.111. After calculating the probability value (P) associated with the obtained Chi- square statistic of 5.111, the result showed P= 0.530, which suggested that there was no significant difference between all the four apex locators used in this study. A *P*-value of < 0.05 is considered statistically significant.

	Root Zx mini n=15 %		Propex II n=15 %		I pex n=15 %		Apex ID n=15 %	
At the anatomic apical foramen	10	66.6	7	46.6	8	53.3	11	73
Protruding beyond the apical foramen	4	26.6	7	46.6	4	26.6	3	20
Short of the apical foramen	1	6.6	1	6.6	3	20	1	6.6

Discussion

A number of methods have been used to evaluate electronic root canal length measuring instruments.[9,10] Many clinical studies have determined the accuracy of the EALs with radiographic techniques[11], whereas, in other studies, instruments were used clinically and following tooth extraction, the actual lengths of canals were measured.[12]

The present in vivo study was performed to evaluate the accuracy of four EALs under authentic clinical conditions. Several earlier investigations used radiographic lengths as a reference.[13,14] Exact determination of the position of the file tip or the actual root canal length is only possible if the teeth are histologically examined after extraction.[15] Modern apex locators are able to determine an area between the minor and major apical foramen by measuring the impedance between the file tip and the canal with different frequencies and enables tooth length measurements in the presence of electrical conductive media in the root canals.[12]

In the present study, the results obtained from the root canal length determinations using the 4 EALs are in agreement with those in the literature. Propex II located the apical foramen precisely in 7 teeth out of 15 teeth. (46.6%) which was in agreement with previous reports on the accuracy of the Propex II.[16]

The Root Zx mini device located the apical foramen precisely in 10 teeth (66.6%). The endodontic file protruded beyond the foramen in 4 teeth (26.6%) and was short of the apical foramen in 1 tooth (6.6%). The Root Zx

mini has been object of numerous ex vivo and in vivo studies (Gordon and Chandler 2004, Kim and Lee 2004).

The results of the present study are in agreement with previous in vivo studies evaluating the accuracy of EALs in determining the apical constriction.[17, 18, 19]

The I pex located the apical foramen precisely in 8 teeth (53.3%). The endodontic file protruded beyond the foramen in 4 teeth (26.6%) and was short of the apical foramen in 3 teeth (20%). The accuracy of the electronic measurements with the Ipex was similar to that reported by other authors using various EALs.[20] The results of present study was in agreement with previous reports on the accuracy of the I pex.[21, 22]

The Apex ID located the apical foramen precisely in 11 teeth (73%). The endodontic file protruded beyond the foramen in 3 teeth (20%) and was short of the apical foramen in 1 tooth (6.6%). The present study showed the accuracy of 73% that was not in agreement with other study[23] that showed accuracy of 93%.

Our results support the claims made by the manufacturers and results obtained in other investigations that the accuracy of the EALs lies approximately between 50-88%. Our analysis also suggested that if a tolerance of 0.5 mm was given, the accuracy would increase considerably between 69.6-91.2% which has been reported in other studies also.[12, 24]

These findings raise the question of whether the WL should be established at the point where the EAL indicates the apical foramen or at some distance coronal to that point.

Under the conditions of this study, no statistically significant differences were observed among all the four apex locators and it can be said that the use of EALs is a reliable method for determining root canal length. However further in vivo studies need to be done to substantiate the accuracy of EALs in modern endodontic therapy

Conclusion

This study concluded that no statistically differences were observed among all the four apex locators and it can be said that the use of EALs is a reliable method for determining root canal length. It is advocated to use electronic apex locators as an adjunct to radiography and should not encourage its use as an alternative due to its various shortcomings such as inability to visualize root curvature, root length and extra canals. While apex locators currently lack the capacity to be a single baseline entity in endodontic treatment, radiography must be supplemented with apex locators to deliver the best possible endodontic care to the patients. Nevertheless, further researches need to be conducted to study the role of EALs.

References

1. Sunada I. New method for measuring the length of the root canal. Journal of Dental Research 1962; 41: 375–87.
2. Kobayashi C. Electronic canal length measurement. Oral Surgery, Oral Medicine and Oral Pathology 1995; 79: 226-31.
3. Inoue N. An audiometric method for determining the length of root canals. Journal of the Canadian Dental Association 1973; 39: 630-6.
4. Ushiyama J. New principle and method for measuring the root canal length. Journal of Endodontics 1983; 9: 97-104.
5. Fouad Af, Krell Kv .An in vitro comparison of five root canal length measuring instruments. Journal of Endodontics 1989; 15: 573-7.
6. Saito T, Yamashita Y. Electronic determination of root canal length by a newly developed measuring

device — Influences of the diameter of apical foramen, the size of K-file and root canal irrigants. Dentistry in Japan 1990; 27: 65-72.

7. Fouad Af, Krell Kv. Mckendry Dj, Koorbusch Gf, Olson Ra. A clinical evaluation of five electronic root canal length measuring instruments. Journal of Endodontics 1990; 16: 446-449.
8. Gordon MP, Chandler NP. Electronic apex locators. International Endodontic Journal 2004; 37: 425–37.
9. A Erdemir, A U Eldeniz, T Esener. The influence of irrigating solutions on the accuracy of the electronic apexlocator facility in the TriAuto ZX handpiece. International Endodontic Journal 2007; 40: 391-97.
10. Busch LR, Chiat LR, Goldstein LG, Held SA, Rosenberg PA. Determination of the accuracy of the Sono-Explorer for establishing endodontic measurement control. Journal of Endodontics 1976; 2: 295–297.
11. O'Neill LJ. A clinical evaluation of electronic root canal measurement. Oral Surgery, Oral Medicine and Oral Pathology 1974; 38: 469–473.
12. G. Plotino, N.M. Grande, L.Brigante, B. Lesti, F.Somma. Ex vivo accuracy of three electronic apex locators: Root Zx, Elements Diagnostic Unit and Apex Locator and Propex. International Endodontic Journal 2006; 39: 408-414.
13. K. T. Wrbas, A. A. Ziegler, M. J. Altenburger & J. F. Schirrmeister. In vivo comparison of working length determination with two electronic apex locators. International Endodontic Journal 2007; 40: 133–138.
14. Frank AL, Torabinejad M. An in vivo evaluation of endex electronic apex locator. Journal of Endodontics 1993; 19: 177–9.
15. Kim E, Lee SJ. Electronic apex locator. Dental Clinics of North America 2004; 48: 35–54.
16. W.Fan, B.Fan and M.W.Fan. Evaluation of the accuracy of three electronicapex locators using glass tubules. International Endodontic Journal 2006; 39: 127-135.
17. F.Somma, R.Castagnola, C.Lajolo and L.Marigo. In vivo accuracyof three electronic root canal length measurement devices: Dentaport ZX, Raypex 5 and Propex II. International Endodontic Journal 2012; 45: 552-556.
18. A. Elayouti, I. Kimionis, A. L. Chu and C.Lost. Determining the apical terminus of root-end resected teeth using three modern apex locators: a comparative ex vivo study. International Endodontic Journal 2005; 38: 827-833.
19. Chris siu, J. Gordon Marshall and J.Craig. An in vivo comparison of the root zx II, the Apex NRG XFR, and Mini Apex locator by using rotary nickel-titanium files. Journal of endodontics 2009; 35: 962-965.
20. Tselnik M. An evaluation of root zx and elements diagnostic apex locators. Journal of endodontics 2005; 31: 507-9.
21. Saito T, Yamashita Y. Electronic determination of root canal length by a newly developed measuring device — Influences of the diameter of apical foramen, the size of K-file and root canal irrigants. Dentistry in Japan 1990; 27: 65-72.
22. Eva K. Stober, Fernando Duran- Sindreu, Montse Mercade and Miguel Roig. An evaluation of Root ZX and Ipex apex locators: An in vivo study. Journal of endodontics 2011; 37: 608-610.
23. P. Nelson- Filho, P.C. Romualdo, R,A,B.Silva and L.A.B. Silva. Accuracy of the ipex multi-frequency electronic apex locator in primary molars: an ex vivo study. International Endodontic Journal 2011; 44: 303-306.

24. Bruno Carvalho de Vasconcelos, Rebeca Dibe Verissimo Chaves et al. Ex vivo evaluation of the accuracy of electronic foramen locators in root canals with an obstructed apical foramen. Journal of endodontics 2015; 41: 1551-1554.