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To compare the effects of different solvents on the accuracy of different apex locator

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Abstract

Aim: To compare the effects of different solvents on the accuracy of different apex locator.

Materials and Methodology : 60 single rooted teeth without caries were selected, teeth were decoronated till CEJ to obtain a flat reference point. Actual working length was determined using no.15 K-file and optical microscope followed by determination of working length using respective apex locator with the help of alginate model. Biomechanical preparation was done till f 2 and canals were obturated followed by retreatment. The gutta percha were removed from the canal with the help of H-file and solvents. 2 different solvents were used. Working length was determined with no.30 k file using respective apex locator.

Results: the results showed that there is no significant difference in working length determination by 3 different apex locators during pretreatment and re-treatment. **Conclusion:** Within the limitation of study it can be concluded that solvents does not have any effect on the working of apex locators.

Keywords: apex locator, re-treatment, solvent, working length.

Introduction

The key to success of endodontic therapy is proper cleaning, shaping and obturation(1,2) . However failure do occur in some cases because of persistant infection or complexities of root canal anatomy which cannot be properly cleaned or obturated (3,4). This failure requires re-treatment which can be either non-surgical or surgical (Torabinajad 2009). Need for retreatment can be assessed by clinical signs & symptoms along with radiographic evidence of periapical bone destruction (5). However, most common cause for endodontic failure is incomplete debridement of root canal. Endodontic failure due to loss of working length has shown to reduce the success rate to 60%(6). Chugal et al showed that for every 1mm loss of working length in teeth with apical periodontitis, failure rate increases by 14%, these failure requires complete removal of primary root canal filling material (7,8). Various methods are available for removal of filling material from canal such as H-file, gutta percha solvent, GG drill, protaper universal retreatment instrument, M-two retreatment files, ultrasonic tips & soft tissue laser (9). The use of hand instrument without or with solvent is most commonly employed for retreatment. According to

Stabhouz and Friedman, the use of solvents is essential for removal of filling material from dentinal tubules and ramifications, as it makes the biomechanical preparation easy which helps in deeper penetration of irrigant and intracanal medicament. Various solvents used for removal of filling material are RC solve, Endosolve E, Endosolve R, Resosolv, Guttasolve. After removal of primary filling material determination of accurate working length is important to avoid pushing of endodontic file, retreatment solution or canal content beyond apical constriction (10). For working length determination radiograph should be used in conjugation with electronic working length determination device because apical constriction cannot be determined accurately on radiograph despite of various techniques and angulations (11). But, electronic working length determination devices are not always correct because it work's on the principal of change in impedence which can be altered by pulp electrical conductivity, apical foramen size, presence or absence of canal irrigating solution, gutta percha solvents, residual gutta percha points and sealer(12,13). Thus, the aim of this study is to compare the effects of different solvents on the accuracy of three different apex locator.

Materials & Methodology

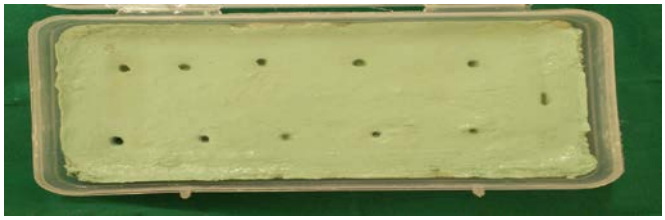
Sample Preparation

Sixty single-rooted human teeth without caries or restoration that had been extracted for periodontal reasons were stored in saline. Teeth were examined carefully at 4X magnification to check the complete formation of the apical foramen and were replaced in the event of finding any radicular fracture or immature apex. Teeth with wide and narrow apical foramen were also replaced. To determine the root canal anatomy, radiographic images were taken from mesiodistal and buccolingual directions, and teeth with more than one canal or calcified canals and any internal and external resorption of the root were replaced with new teeth. The crowns of teeth were sectioned till CEJ with diamond disk to facilitate canal access and establish a flat reference point. Actual working length was established with the help of no.15 k file until its tip was visible at apical foramen using optical microscope, the silicon stopper was adjusted at cervical limit & then the file was removed and the length was measured with the help of endodontic scaler. After determination of actual working length electronic working length was determined with the respective apex locator by embedding roots of teeth into alginate model till CEJ, the lip clip is also embedded into model. Teeth were divided into 3 groups based on the type of apex locator used. In this study Root ZX mini, Propex pixi II and apex id was used. Canal was subsequently instrumented with hand protaper system sx, s1, s2, f1 and f2. F2 was master apical file for all roots. The root canal was irrigated with 2.5% of NaOCL. Canals were obturated by lateral compaction using f-2 as master gutta percha and Pulp Canal Sealer™. Lateral compaction was achieved in each canal using a finger spreader and approximately 4 accessory gutta-percha cones.

Teeth divide into 3 groups (N=20) according to apex locator used and 2 sub groups according to solvent used.

Alginate Model Preparation

A plastic box was taken into which a layer of wet cotton is laid down followed by a layer of alginate again a layer of wet cotton and a layer of alginate. Then 10 punch holes were made on the top layer of alginate and a groove for engaging lip clip. This model can be used for more than 45 days without refrigeration.



Alginate model

The root canal filling was then removed with the help of no.25 H-file and gutta-percha solvents using .5ml of gutta-percha solvent. In this study 2 different gutta-percha solvents were used i.e Endosolve E and RC Solve. So, the 3 groups were further divided into 2 sub-groups based on the type of solvent. Hence, the groups were-

Group 1 – apex id + RC solve

Group 2 – apex id + Endosolve E

Group 3 – propex pixi II + RC solve

Group 4 – propex pixi II + Endosolve E

Group 5 – root ZX + RC solve

Group 6 – root ZX + Endosolve E

The roots of teeth were then embedded into alginate model till CEJ along with the lip clip placed in longitudinal groove. Gutta-percha solvent was then injected into the root canal and the softened apical gutta-percha was penetrated by no.20 K- file. Biomechanical preparation was done till f3 protaper file and working length was determined with no 30 k file using respective electronic apex locator.

Comparison between electronic apex working length and radiographic working length was made & accuracy was determined.

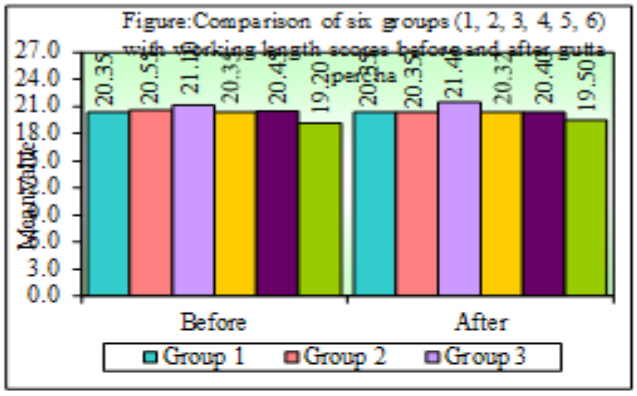
Results

The results showed that there was no difference in working length determination by the 3 different apex locator. Intragroup comparison was done was ONE way ANOVA in which there was no significant difference in p value of group (table 1).

The difference in working length before root canal treatment and after re-treatment was calculated. The accuracy of EAL in determining working length after retreatment ranged from 0 to -.2. The mean and standard deviation are shown in table 2. The p value of ANOVA showed insignificant difference in working length before gutta percha removal and after removal of gutta percha.

Table 1: Comparison of six groups (1, 2, 3, 4, 5, 6) with radiographic working length scores by one way ANOVA

Groups	Mean	SD	SE
Group 1	20.56	2.55	0.81
Group 2	20.75	3.23	1.02
Group 3	21.27	3.81	1.20
Group 4	20.52	2.87	0.91
Group 5	20.62	1.79	0.57
Group 6	19.35	1.97	0.62
F-value	0.5121		
P-value	0.7659		



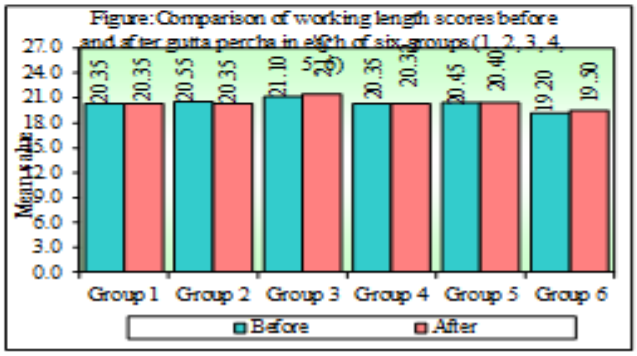


Table 2: Comparison of six groups (1, 2, 3, 4, 5, 6) with working length scores before and after gutta percha by one way ANOVA.

Groups	Before			After			Changes from before to after		
	Mean	SD	SE	Mean	SD	SE	Mean	SD	SE
Group 1	20.35	2.52	0.80	20.35	2.06	0.65	0.00	0.91	0.29
Group 2	20.55	3.27	1.03	20.35	3.22	1.02	-0.20	0.35	0.11
Group 3	21.10	3.73	1.18	21.45	3.65	1.16	0.35	0.41	0.13
Group 4	20.35	2.96	0.94	20.32	3.14	0.99	-0.03	0.50	0.16
Group 5	20.45	1.69	0.53	20.40	2.02	0.64	-0.05	0.64	0.20
Group 6	19.20	1.92	0.61	19.50	2.04	0.65	0.30	0.42	0.13
F-value	0.5013			0.5010			1.4197		
P-value	0.7739			0.7741			0.2320		

Discussion

Working length is defined as the distance between a reference point from coronal portion to a point at which canal instrumentation and filling should terminate (11). Accurate determination of root canal length from coronal reference point to apical foramen is critical (13). At apical foramen cemento-dentinal junction (CDJ) or minor constriction is the landmark that anatomically and histologically determines where pulp ends and periodontal ligament begins (14). Instrumentation and obturation short of CDJ may leave undebrided bacteria in this critical space. These bacteria have potential to contribute to subsequent failure of endodontic treatment. On the contrary a long measurement causing instrument past CDJ will damage the natural anatomy of root end, making it difficult to obtain an apical seal and maintain root canal filling within the tooth (Stein and Carum, Kaufmann). Historically radiograph has been the primary method for working length determination. However, radiograph have inherent limitations i.e it produces 2 dimensional image of a 3dimensional object. This is further complicated by superimposition of anatomic structures such as zygomatic arch or adjacent root. Variation in root end morphology have been studied in works of Kuttler in 1955, green in 1956 and Dummer et al in 1984 showed that radiographic interpretation cannot be depended alone for working length determination and that electronic determination is necessary. Electronic apex locator works on the principle that a constant electrical resistance of approximately 6.5 kilo ohm exists between periodontal ligament and oral mucous membrane in vivo (14). In in-vitro studies alginate is used as embedding medium to simulate periodontal ligament as electrical resistance of alginate is same as that of periodontal ligament (13). In in-vitro studies apex locator makes the use of electro conductive material in which teeth are embedded thus allowing closure of circuit, simulating the clinical situation (15). Different material has been used as embedding medium such as 2% agar by N Ahmas etal in 1987, gelatine proposed by Donelly in 1993, alginate by Kaufmannn and Katz in 1993 and also simply saline solution proposed by Ushiyarain 1983. Alginate is composed of potassium alginate, calcium sulphate, magnesium oxide, iron oxide, pyrophosphate tetrasodium and diatomite. The diatomite act as load to increase the resistance and stiffness of alginate gel, producing a firm, smooth-textured surface that is not sticky. Despite its firm consistency alginate remain as gel, which possibly allow the ions to circulate. Good results are obtained with alginate as it has good electroconductive property, remains around the tooth, simulating the periodontal ligament with its colloidal consistency, easy achievement and preparation combined with its low cost made it medium of choice (16).

In present study crown of teeth were sectioned to establish a steady reference point for measurement.

Removal of filling material is an important phase in root canal re-treatment because it requires chemico-mechanical instrumentation and re-disinfection of root canal system (17,18). Hence, it is necessary to completely debride the root canal filling material from canal to eliminate the remaining necrotic tissue. In orthograde retreatment cases use of solvent is recommended to facilitate removal of gutta-percha by softening (18). In this study RC Solve and Endosolve E were used. Endosolve E was designed to be zincoxide /eugenol based sealer solvent containing

tetrachloroethylene. It helps to remove zinc oxide based sealer. RC solve is a gutta-percha and zincoxide eugenol cement solvent. It has controlled penetration to avoid apex seal. It contains orange oil which can initially present as an essential oil as disintegrating solvent of zincoxide eugenol sealer (19, 20). Since different gutta-percha solvent has different chemical structure with different properties they may have valueable accuracy in determining the working length (8). But in this study there is no significant change in working length with the use of apex locator. In this study 3 different apex locator were used Propex Pixi, Root zx mini and Apex id. Propex pixi and Apex id is a multi-frequency based electronic root canal length measurement devices differs from root zx mini in terms of number of sine wave frequencies used. The calculation of impedence is based on the energy of the signal in contrast to amplitude of the signal which is used by root zx mini (9). In root ZX mini the ratio method works on the principle that two electric currents with different sine wave frequencies will have measurable impedances that can be measured and compared as a ratio regardless of the type of electrolyte in the canal. The capacitance of a root canal increases significantly at the apical constriction, and the quotient of the impedances reduces rapidly as the apical constriction is reached. Kobayashi & Suda (1994) showed that the ratio of different frequencies have definitive values, and that the ratio rate of change did not change with different electrolytes in the canal

(14). These is because a change in the electrolyte material, which is a change in dielectric constant (e of equation 3), will influence equally the numerator and denominator of equation 8, and hence the final ratio will still remain constant (21). Elelctrically conductive fluid such as sodium hypochlorite is the most commonly reported impediment to accurate reading with earlier generation apex locator (22). However, a study by Anthony Meares suggested that new generation apex locator are not adversely influenced by presence of sodium hypochlorite (23). Thus all the 3 of electronic root canal length measurement devices works independently of canal contents. The result of present study showed that there was no significant difference of different endodontic solvent on accuracy of electronic root canal length measurement devices. However in this study retreatment was done with the help of solvent and H-file which have less effect on apical constriction as compared to retreatment files which shows more aggressive cutting for which further evaluation is required.

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