INTRODUCTION

Virtually all elements of root canal therapy demand strict length control to ensure that neither the root canal system itself nor the periodontal ligament is damaged. Correct length measurements minimize the extrusion of potentially infected dentinal debris into the periapical area\(^1,2,3\). Traditionally, the periapical radiograph has been the primary method of canal length determination, but they expose the patient to ionizing radiation. They are merely two dimensional images of a three-dimensional object. Small areas of resorption especially on buccal or lingual aspects of the root are difficult to assess radiographically\(^4\). Interference of adjacent anatomic can often superimpose on the image of the root apices of molar teeth, resulting in interpretive error\(^5,6\). Furthermore, in children placement of large-sized sensor in their mouth is difficult and cause discomfort to them. All these factors together have stimulated the development of electronic root canal measuring devices also known as electronic apex locators (EALs)\(^7\).

Third generation devices are largely frequency-based. Certain third generational devices use a ratio algorithm between two electrical currents and are designed to make accurate readings regardless of fluid electrolytes being present within the canal\(^7,8,9,10\). Kobayashi and Suda \(^11\) have developed an EAL, the Root-ZX (J. Morita CO., Tustin, CA) that is based on the ratio method for measuring canal length. A study by A.C.V. Mello-Moura et al. concluded that Root ZX electronic apex locator performed best for the root canal length determination in primary teeth\(^12\). P.Nelson-Filho et al. found that the electronic apex locator accurately identify the working length in primary teeth regardless of presence or absence of root resorption\(^13\).

The present study is aimed to evaluate Dentaport Root ZX electronic apex locator, in vitro, for the accurate measurement of working length in primary molars with root resorption and to compare this to the working length measured by direct method.

METHODOLOGY

Thirty-two primary molars with the resorbed roots were obtained from the department of Oral and Maxillofacial Surgery at Islamic International Dental Hospital (IIDH) Islamabad. The teeth were not endodontically treated or calcified and the root length was not less than two-thirds of its full length. They were stored in 10% formalin and rinsed in saline solution before use. Each tooth was coded from number 1 to 32. A periapical radiograph of each tooth was taken to rule

ABSTRACT

For successful endodontic outcome, correct working length has to be determined. The third generation apex locators claim to be accurate regardless of physiologic root resorption. The objective of the study was to determine in vitro the accuracy of Dentaport ZX (third generation apex locator) in determining the working length of primary molars with root resorption.

Thirty-two extracted primary molars with root resorption were obtained for this study. After ascertaining the direct working length, Dentaport ZX was used to determine the working length of roots of primary molars with root resorption. The Dentaport ZX was 86.9% accurate in determining working length within ±0.0mm of coronal limit of resorbed primary molar root when compared with direct method. The accuracy of Dentaport ZX in measuring working length in primary molars was high and was not affected by physiologic root resorption.

Key Words: apex locator, working length, root canal, primary molar, physiologic root resorption.
out any previous endodontic treatment or morphological alteration. After standard access cavity preparation working length was determined both visually (direct method) and with Dentaport ZX electronic apex locator (EAL). Three readings were obtained, each after a 24 hour interval and average value was calculated.

For direct working length (DL) measurement a reference point was marked at the most coronal position of the crown using fine point marker. A K-file with silicone stop was introduced into the root canal until the tip was visible at the most coronal limit of root apex. At this point DL was calculated with the help of millimeter ruler. For electronic working length (EL) measurement the teeth were first fixed into saline-soaked sponge. The root canals were also flooded with saline. Excess saline from pulp chamber was removed using cotton pellets. The lip clip was attached to the sponge and the file holder to the metal shaft of the K-file (Mani) used to determine DL. The K-file was advanced in the canal until the display read “Apex”. A constant beep is heard at that point. If the reading was stable for at least 5 seconds the stop was adjusted against the same reference point used for DL. The EL is recorded with the help of millimeter ruler. The difference between EL and DL was recorded. The value within ±0.0mm was considered as a measurement of the accuracy of Dentaport ZX apex locator.

RESULTS

The frequency and percentages of electronic working length readings relative to DL are summarized in Table 1. In total the Dentaport ZX showed the accuracy as DL 86.9% of the time.

DISCUSSION

Establishment of correct working length is an important stage in root canal treatment because instrumentation beyond or too short of apex can adversely affect success. Historically, conventional radiography has been primary means for establishing working length in endodontic treatment but there are certain limitations to this technique. Therefore, an alternate method was developed, that uses electrical current for working length determination. EAL devices measure the constant resistance or impedance value between the patient’s oral mucosa and the periodontal ligament. In primary teeth without root resorption, the reading is maximized in the area of the apical constriction, as it is the site where the pulpal tissue meets the periodontal ligament. In primary teeth with root resorption the apical area keeps changing constantly, it is possible that the apical constriction is obliterated and apex is wide open. Therefore, it is reasonable to infer that inaccuracies may exist when EALs are used in cases of primary teeth with root resorption.

Working length measurement of primary teeth with or without root resorption has been carried out by using a number of EALs. The Dentaport ZX used in the present study is a third generation apex locator, and claims to be accurate in the presence of different canal conditions. The present study aimed to explore the effect of physiologic root resorption in primary molars on the accuracy of Dentaport ZX apex locator.

In this study sixty-one canals from the 32 teeth were measured for accurate working length determination by Dentaport ZX apex locator. The accuracy of Dentaport ZX apex locator was compared with direct method in terms of comparing the difference i.e. DL-EL. The results obtained are in accordance with the studies of Angwaravong and Panitvisai, Odabas et al, Leonardo et al, Pinhreiro et al, and Beltrame et al who reported high accuracy of EALs at different levels of root resorption.

In the present study the sample size was thirty two which is in agreement with Angwaravong and Panitvisai studies. Angwaravong and Panitvisai used thirty-three primary teeth in their in-vitro study and Odabas et al used twenty-eight primary teeth. Hence the results are very much comparable with the above mentioned studies.

The Root ZX and The Root ZX II (Morita) are the common EALs used in primary teeth. Related investigations of this brand did not follow a single criterion in determining the working length. For instance, Beltrame et al evaluated the working length at “0.0” mark i.e. Apex. Angwaravong and Panitvisai compared the Root ZX measurement meter readings at “0.5” bar and “Apex” and found that the error in locating the apical foramen was smaller at meter reading “Apex” than “0.5” bar. Odabas et al selected the “1” reading on the apex locator’s display. In the present study “0.0”

<table>
<thead>
<tr>
<th>TABLE 1: DIFFERENCE (EL-DL) IN MILLIMETERS</th>
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<td>Frequency</td>
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Accuracy of Electronic Apex Locator

mark i.e. Apex was selected as by Beltrame et al. and the results of their study were quite similar to our study. However, Kielbassa et al. study results were in contrast with our study.

A number of methods have been used to evaluate the accuracy of EALs e.g. its comparison with radiographic technique and, in other studies, EAL was used clinically and the actual lengths of canals were measured following extraction. In this study, the electronic working length was measured visually first and then with Dentaport ZX. This methodology is similar to that of Angwaraong and Panitvisai (2009). The overall accuracy of Dentaport ZX in this study compare well with those from other in vivo studies in which accuracies range from 80% to 100%.

The most significant limitation of this study is that it was done in vitro which allows us a well-controlled environment for the study and the clinical situations which offer multiple challenges cannot be taken into account. The small sample size did not include the anterior primary teeth. Increasing the number and types of teeth will give extremely valid and reliable statistical data. Secondly with the physiologic resorption the canals can begin to calcify thus accuracy of EALs in such cases was not established. Thirdly the histological sectioning of the teeth was not taken as “gold standard”. The actual working length was measured visually that can vary from one individual to the other.

CONCLUSION

It can be concluded that Dentaport ZX can measure the working length in primary molars with root resorption with high accuracy and therefore is a reliable alternative for conventional radiographic measurement of working length.

REFERENCES