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# Apex locators in detecting lateral canals, extent of perforating internal root resorption and open apex

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**Abstract**
**Aim:** The present study compared the accuracy of Root ZX mini and CanalPro in determination of working length in open apex, location of lateral canals at different levels and determination of extent of perforating internal root resorption.
**Methods:** Seventy-five decoronated single rooted teeth with single canal were divided into three groups- simulated lateral canals at 3, 5 and 8 mm from the apex, simulated perforating internal root resorption and simulated open apex. Actual length was measured by visual method and electronic length of samples embedded in alginate model.
**Results:** The accuracy of both the apex locators in EL determination was significantly higher in apical lateral canals compared to middle and coronal canals and in apical extent of internal resorption as compared to coronal extent ($P<0.05$).
**Conclusion:** Both EAL's are accurate in working length determination in simulated clinical scenarios.

**Keywords:** Apex locators, lateral canals, open apex, perforating internal root resorption

## Introduction

Proper working length (WL) determination is a precursor for success in root canal treatment. An adequate apical limit ensures shaping procedures to be confined within the canal limits without injuries to periapical tissues [1]. The Root ZX mini a fifth-generation electronic apex locator (EAL) calculates the root canal length by ratio method [2]. Sixth generation apex locator CanalPro (Coltene-Whaledent) which uses multiple frequencies which are alternated, thus eliminating noise and the need for signal filtering.
Arnaldo S et al. [3] in his study showed that the accuracy of EALs is reduced slightly by the presence of accessory canals. This study has been designed to compare the accuracy of Canal Pro and Root ZX mini in WL determination in open apex, in location of lateral canals at different levels and location and determination of extent of perforating internal root resorption.

## Material and Methods

The present study was conducted in the department of conservative and endodontics, GMC Rajouri (J & K). Seventy-five freshly extracted human teeth with single root and single canal, extracted due to periodontal reasons, were chosen for the study. Samples with incomplete root development, fractures or root resorption were excluded. Access opening was performed with round bur #06 (SS White burs Inc., New Jersey, USA). Preflaring of the canals was done with ProTaper Sx and S1 (Dentsply Maillefer, Ballaigues, Switzerland). The samples were then randomly divided into three groups with 25 samples each.

1. In group O (n=25), immature open apices were simulated by resecting the apical 3 mm of the roots using double diamond disc and creating irregular differences between dentinal-wall lengths of 2-3 mm. Enlargement of root canals was done to a size #80 K file followed by instrumentation using Peeso reamers sequentially from #1 to #3, with each Peeso reamer passing 1 mm beyond the apex to increase the apical width to 1.3 mm in diameter.
2. In group L (n=25), simulation of lateral canals was done by subjecting the samples to tooth decalcification procedure by suspending the samples in nitric acid (5%) for 24h which it was washed under running tap water for three min. Lateral canals were then created under 8 X magnification by # 06 to # 15 K file.
3. In group I (n=25), artificial internal resorptive cavities were created by sectioning the root horizontally from the apex at 7 mm with a diamond disk. Semi-circular cavities with a diameter of 2 mm were formed around the root canal space periphery of each section forming a communication of 1 mm with external surface of root. Then the root halves were repositioned using minimal amount of cyanoacrylate glue on the dentine surface around the cavities. Canal patency was maintained by introducing a # 15 K file into the root canal which prevented glue from flowing in the canal.

The actual length (AL) in all the samples was measured by direct visual examination under operating microscope and use of digital Vernier Caliper. The samples were subsequently embedded in an alginate model and electronic length (EL) was determined. Values were acknowledged only if the reading was stable for at least 5 seconds. The procedure was repeated three times for each tooth. The mean value was calculated and recorded for each sample.

## Statistical Analysis

The tabulated data was subjected to "t" test using statistical package for social sciences (SPSS Inc., Chicago, IL, USA) version 24 for windows. $P<0.05$ was considered statistically significant.

## Results

No statistically significant difference was observed between

CanalPro and Root ZX mini (P > 0.05) in all the groups in Table 1.

**Table 1:** Inter and intra comparison between CanalPro and Root ZX mini for different groups

| Groups | Mean±SD (Difference B/W Canal pro & ROOT ZX MINI | p value (Intra-comparison) |
|---|---|---|
| Open Group | .05±.43 | 0.94 |
| L C Group | -.18±.39 | 0.59 |
| L M Group | .26±.39 | 0.17 |
| L A Group | .09±.46 | 0.79 |
| I C Group | -.11±.50 | 0.69 |
| I A Group | -.06±.51 | 0.88 |
| Pair of Groups | Canal PRO (p value: Inter-comparison) | Root ZX MINI. (p value: Inter-comparison) |
| LA & LC | 0.003* | <0.01* |
| LA & LM | 0.001* | 0.09 |
| LC & LM | 0.003* | 0.002* |
| IA & IC | 0.003* | <0.01* |

*: statistically significant

## Discussion

In this study no statistically, significant difference was observed between the two apex locators in all groups which show that both EAL have equal accuracy for all the conditions evaluated in this study. The results are in contrast with study by Alothmani OS [4] in which CanalPro showed higher accuracy than Root ZX mini however, the clinical conditions for which the apex locators were tested was different from this study.

Our study shows 100% accuracy at ± 1 mm tolerance in open apex however at ± 0.5 mm, it is lesser when compared to mature apex. ElAyouti et al. [5] found that the accuracy of Root ZX and Raypex reduced with increasing apical diameter. Aydin et al. [6] found Root ZX presented with an accuracy of 50% (within ± 0.5 mm) and 85% (within ± 1 mm) in teeth with immature apices, both the values being lower than in our study.

The results show that both the EAL's can be used reliably to predict the apical and coronal extent of perforating IRR (at tolerance level of ± 1 mm). There was a statistically significant difference between location of apical and coronal extent of IRR by both the apex locators. The reason may be the relative level of perforation with respect to apical and coronal extent and also due to preflaring by greater taper instruments, which leads to better adaptation of the file at the apical extent thus forming a better contact with dentinal wall and a better accuracy of apex locator.

Accuracy in EL determination was significantly more at apical third than middle third and coronal third (only at ± 0.5 mm tolerance level). Due to the preflaring of root canal with greater taper instruments, the initial file will have a better adaptation at apical third wall of root canal.

## Conclusion

It can be concluded from the results of the present study that CanalPro and Root ZX mini are able to determine apical extent of perforating IRR significantly better as compared to coronal extent and locate lateral canals at apical third significantly better than middle and coronal third of root canal.

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