

## Comparative Analysis of Two Different Apex Locator I-pex & Raypex-6 in Working Length Determination of Open Apex: An In Vitro Analysis

Dr. Jyoti Jain, Dr. Urvashi Ojha, Dr. Ankita Mehrotra, Dr. Afsana Begum

Corresponding Author: Dr. Urvashi Ojha

### Abstract:

**Background:** Open apex is often used to describe an exceptionally wide apical foramen, in which preparation of an apical stop is difficult. It may also be iatrogenic and the result of over instrumentation or root resection. In these type of cases success of endodontic treatment is depend upon correct determination of working length.

**Materials & method:** Twenty five freshly extracted single rooted human teeth were selected. Apical 3 mm of root cut from the apical tip to simulate the defect. A size 15 K-type stainless steel file was inserted into the canal until the file tip became visible at apical tip. After this samples were embedded up to the cemento-enamel junction in a plastic container containing freshly mixed alginate to simulate periodontium and determination of working length was done with I-Pex and Raypex-6.

**Result & Conclusion:** In determination of the actual WL, which was set at 0.00 to 0.5 mm short from the major foramen, the I-Pex was 40% whereas the raypex -6 was 52% accurate but if we set at 0.00 to 1 mm short from major foramen both are 60% accurate and in 40% cases file goes 0.5 to 1 mm beyond the major foramen.

**Keywords:** I-pex apex locator, Raypex-6 apex locator, Open apex, Working length

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### I. Introduction:

Success of endodontic treatment depends upon the complete removal of pulp tissue, necrotic materials and microorganisms. Accurate determination of working length is a key factor for complete cleaning, shaping and obturation of the root canal system. Working length has been defined as, "the distance from a coronal reference point to the point at which canal preparation and obturation should terminate. But dentist face great difficulty in determination of working length in wide or immature apices. The term open apex is often used to describe an exceptionally wide apical foramen, in which preparation of an apical stop is difficult. An open apex is found as a developmental stage in the permanent and primary dentition, as a sequel to pulp death following trauma or caries, or as a result of pathological or physiological resorption of primary teeth due to eruption of the permanent successor. It may also be iatrogenic or as a result of over instrumentation and root resection. The definition of open apex varies according to authors and is reflected by the minimum ISO size used to describe it: ISO 40 (Mente et al.2009), ISO 45 (Van Hassel & Natkin 1970), ISO 60 (Sarris et al.2008, ElAyouti et al.2009), ISO 80 (Friend 1966, Moore et al.2011) or ISO 100 (Andreasen & Andreasen 2000). Traditionally, the working length is determined by the radiograph when an instrument placed in the root canal but the major drawback associate with this method is:

1. Impossible to locate the position of the apical constriction or major foramen. <sup>[1-3]</sup>
2. It provides a two-dimensional image of a three-dimensional structure, which might affect the interpretation.
3. Superimposition of bony structures can hinder the identification of the radiographic apex of some teeth.

Cianconi et al have shown that electronic apex locators (EALs) provide a more accurate estimation of the WL than radiographs. <sup>[4]</sup>The I-Pex (NSK, Tochigi, Japan) is a fourth-generation apex locator. It measures the capacitance and resistance simultaneously to determine the location of the file tip in the canal. <sup>[5]</sup>Raypex-6 (VDW, Munich, Germany) is the last member of Raypex series. Moscoso et al. evaluating the performance of this new device and found that Raypex 6 is accurate 88.22% at  $\pm 0.5$  mm and 100% at  $\pm 1$ mm. <sup>[6]</sup> But there was no study which evaluated its performance in teeth with open apices. So the purpose of this study to compare the effectiveness of two different apex locator I-pex & Raypex-6 in working length determination of open apex.

## II. Materials & Method:

Twenty five freshly extracted single rooted human teeth with straight root canals were selected. All the extracted teeth were dipped in 5.25% sodium hypochlorite (NaOCl) for 6 h to remove the periodontal ligament and then stored in sterile 0.9% saline solution. All the extracted tooth carefully examined under magnifying glass for the presence of any fracture. After this apical 3 mm of root was cut from the apical tip to simulate the dopen apex defect. Standard access cavities were prepared and a notch is created on the incisal edge to achieve reproducible stable reference points. After the identification of the root canal orifice, Pulp tissues were extirpated using barbed broaches, without any attempt to enlarge the canal with the root canal instruments. After this canals were irrigated with 5 ml of 5.25% NaOCl using a syringe to remove the organic content of root canal system. To obtain the real length, a size 15 K-type stainless steel file was inserted into the canal until the file tip became visible at apical tip using a magnifying glass. This length was measured with a digital calliper to the accuracy of 0.01 mm; 0.5 mm was subtracted and recorded as the “Actual Length” (AL). The samples were then embedded up to the cemento-enamel junction in a plastic container containing freshly mixed alginate to simulate periodontium. All measurements were made within 2 hours with the alginate model kept sufficiently humid. For electronic measurement, a size 15 K-file connected to the EAL was used, with the lip electrode inserted into the alginate model. At first, canals were irrigated using 5.25% NaOCl and then cotton pellets held in tweezers were used to dry the tooth surface and eliminate excess irrigating solution. No attempt was made to dry the canal. Electronic measurements were obtained using the two EALs, I- Pex and Raypex 6. Both were used alternately and irrigation was performed between the uses of the apex locators. Measurements were considered as valid if the reading remained stable for at least 5 seconds. Measurements were repeated 3 times and the mean value was calculated and recorded for each sample and for each EAL. The recorded AL was compared with the values obtained with the EALs. The root canal lengths obtained by each method were recorded and were subjected to statistical analysis.

## III. Results:

**Table 1:**

Distance from actual working length	i-pex (n=25)		Raypex-6 (n=25)	
		%		%
-1 to -0.5	4	16%	2	8%
-0.49 to 0.00	10	40%	13	52%
0.01 to 0.5	3	12%	4	16%
0.51 to 1	8	32%	6	24%

(\*A negative value indicates a file position coronal to the actual WL.)

In determination of the actual working length, which was set at 0.00 to 0.5 mm short from the major foramen, the I- Pex was 40% whereas the Raypex -6 was 52% accurate but if we set at 0.00 to 1 mm short from major foramen both are 60% accurate and in 40% cases file goes 0.5 to 1 mm beyond the major foramen.

## IV. Discussion:

In this study, teeth that were extracted from adult patients for periodontal or orthodontic reasons were selected. Alginate was used as tooth-embedding media because its impedance values are similar to human tissues and thus it simulates the periodontal ligament.<sup>[7]</sup> Due to its colloidal consistency, it remains around the root and also shows a favourable electroconductive properties. NaOCl was used as an endodontic irrigant because in various previous studies, NaOCl can be safely used to determine the working length with the EALs.<sup>[8,9]</sup> In this study apical 3 mm of root cut from the apical tip to simulate the defect with open apex so that apical constriction was not used as a landmark because it was impossible to determine the working length in these type of cases.<sup>[10]</sup> In determination of the actual working length, which was set at 0.00 to 0.5 mm short from the major foramen, the I-Pex was 40% whereas the Raypex -6 was 52% accurate. In other previous studies i-pex apex locator was 72% accurate in determining the position of the actual WL when was set at 0.5 mm coronal to the major foramen in the cases of closed apex and raypex -6 was 80% but in the case of open apex when the apical diameter was more than 0.57 then the accuracy of raypex-6 was 50%.<sup>[11,12]</sup>

## V. Conclusion:

The accuracy of the EALs was evaluated in open apex cases and Raypex-6 was more correct determination of working length between the ranges of  $\pm 0.5$  mm comparison to I-pex.

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