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Diagnosing perforations using apex locators

Yosef Nahmias revisits the subject of apex locators to describe a technique for diagnosis of perforations of the canal wall or pulpal floor

One of the more perplexing problems in endodontics is the unforeseen perforation of the canal wall or floor of the pulp chamber. These are sometimes difficult to diagnose due to location, film angulation, lack of hemorrhage, and/or subjective symptoms.

About 20 years ago, I described a technique using apex locators in order to determine the existence of a perforation (Nahmias et al, 1983). Back then, few dentists were familiar with the use of these devices. Now that technology has taken over our practices, apex locators have become an important part of our armamentarium. That is the reason why I have decided to revisit this subject.

This article will describe a technique for the diagnosis of perforations of the root canal wall or pulpal floor with the use of an apex locator.

Apex locators can be used to determine if the perforation communicates with the periodontal membrane. This is based on Sunada's (Sunada, 1962) findings that the electrical resistance between the mucous membrane and the periodontium can be considered to have a constant relationship. It can be supposed that the electrical resistance between the oral mucous membrane

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and the periodontal membrane would register a constant value. Older apex locators worked under this principle (impedance method) (Kobayashi, 1997). Newer apex locators that work under different principles (gradient method, ratio method) essentially do the same. Once the measuring probe (a file or a reamer) touches the periodontal ligament the apex locator will indicate that the apex has been reached.

When clinical inspection and radiographic evidence are inconclusive in determining whether the root or pulpal floor is perforated, the apex locator should be used in the following manner. A no 10 file, connected to the device, is inserted into the suspected perforation. A dramatic increase in the electrical resistance will be noticed immediately if a true perforation is present (Figure 1).

This is in direct contrast to the gradual

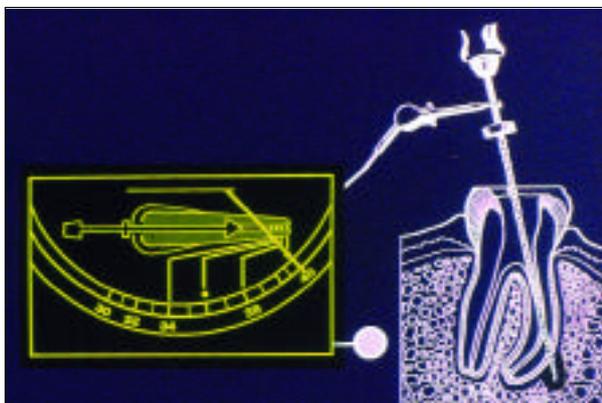
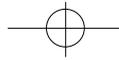


Figure 1: Apex locator's analog readout shows a dramatic increase in the electrical resistance that is indicative of a perforation



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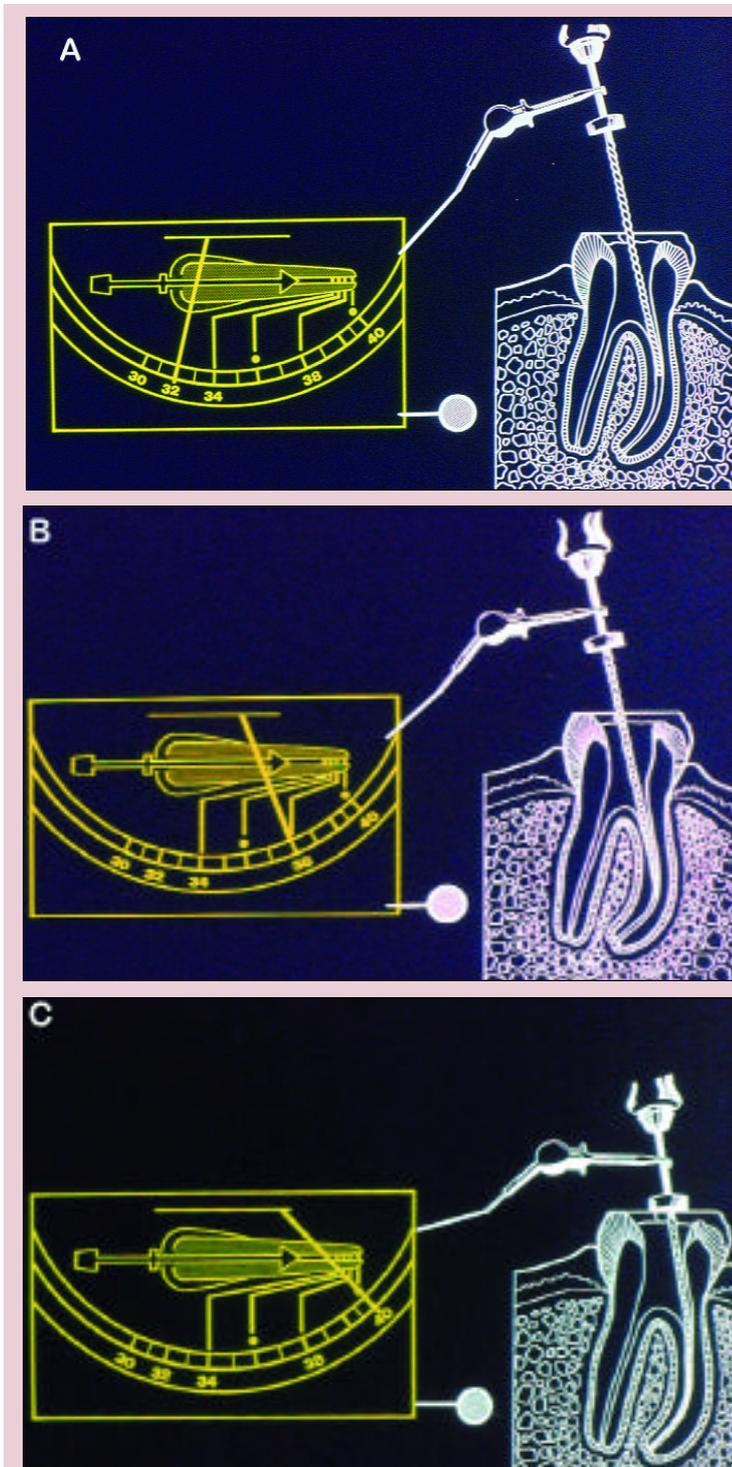


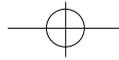
Figure 2: Typical 'in canal' reading. The file is introduced in the canal (A) the analog readout shows little increase of the electrical resistance. As the file advances (B) a gradual increase is noted. The device (C) indicates that the apical foramen has been reached

increase in the electrical resistance obtained while negotiating an intact root canal system (Figure 2). Experience in the use of the apex locator will allow the clinician to recognise the difference immediately. If in doubt, wash the area thoroughly and dry the site with paper points and repeat the test. A period of familiarisation is required for the inexperienced operator to learn the language of the machine. All apex locators have equivalent capabilities.

Case study

A 53-year-old patient was undergoing conventional root canal therapy for tooth no 45 which was suspected to have sustained an iatrogenic perforation (Figure 3). There was no clear-cut evidence to substantiate this clinical impression.

A no 10 file connected to an apex locator was inserted into the buccal canal. A gradual increase in the electrical resistance was observed, and when the apical foramen was reached the apex locator gave us a reading indicating it. The canal length was determined to be 15mm. When the file was inserted in the lingual canal, the apex locator indicated that the foramen had been reached as soon as the file was inserted into the canal opening. This confirmed the clinical impression that a perforation was present in the root canal system. The character and location of the defect precluded a surgical correction. The tooth was extracted, and



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the perforation was visually verified. I have to add that this case was treated previous to the use of MTA. Nowadays this perforation could have been repaired by using this material!

Case two

A 35-year-old patient presented with a recently completed root canal treatment and a post cemented in the distal root. It was suspected that the post had perforated the middle area of the root. Radiographs failed to provide a definite answer (Figure 4). No other clinical signs or symptoms were present. It was decided to connect one of the electrodes of the apex locator to the post in order to demonstrate a communication with the periodontal membrane. The apex locator registered a typical 'in canal' reading. This and evidence of total healing after 1 year confirmed the accuracy of the reading with the apex locator (Figure 5).

Case three

A 75-year-old patient required endodontic treatment on an upper bicuspid that had been recently crowned. The radiograph revealed that the canals appeared to be calcified (Figure 6).

Endodontic therapy was started using the surgical microscope. The access opening was made through the crown and the tooth was transilluminated in order to find the orifices into the canals. A white dot was seen at high magnification.

A no 8 file was introduced into what appeared to be a canal and it was connected to one of the electrodes of an apex locator (Figure 7). The device registered an 'in

canal' reading. A second canal was found using the same technique. A radiograph was taken to confirm the working length and the location of the canals (Figure 8).

Conclusion

The only way I know to prevent a perforation

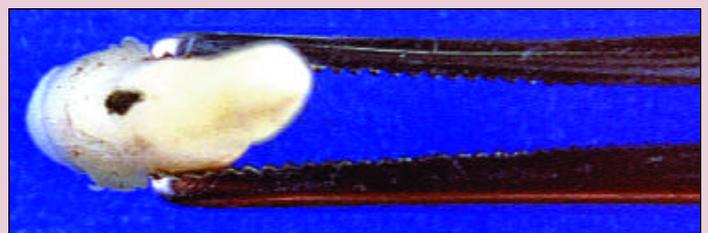
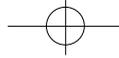


Figure 3: Preoperative radiograph (A) indicates a possible type IV canal (one main canal breaching into two separate ones). Radiograph of 10 file (B) in the lingual canal. Note how the file follows the curvature of the root thus appearing to be inside of the canal. The extracted tooth (C) confirms iatrogenic perforation of the root



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Figure 4:
Radiograph showing suspected post perforation. Note periapical pathology

100% is by not doing any endodontics! All of us who like doing endodontics take this risk on a daily basis. Careful examination and thorough knowledge of the internal and external anatomy of each tooth can prevent disas-



Figure 5: One year recall radiograph confirming the apex locator finding of no perforation. Note intact lamina dura and total healing of preexisting periradicular lesion

can we tell, if these dots are canals or perforations? If we are able to determine that a perforation has occurred we can proceed to repairing it immediately and thus increase the chances of repair dramatically. Materials such as MTA can be used quite predictably in situations like this one. However, the success of a perforation repair depends on the size of the defect and how quickly the defect is sealed. Prompt diagnosis is paramount. The use of an apex locator in this scenario can be extremely advantageous. 

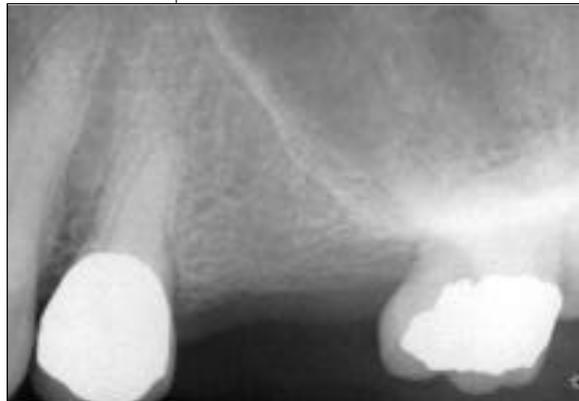


Figure 6:
Radiograph showing calcified canals

ters from happening. Techniques that utilise high magnification, transillumination, dyes and ultrasonics can be extremely useful. However, sometimes we can encounter situations where all the anatomical landmarks are gone and the only thing that we can see is a small red or white dot. The question is, how

References

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- Sunada I (1962). New method for measuring the length of the root canal. *J Dent Res* 41:375-387

Figure 8:
Radiographs confirms that the canals were successfully located

Figure 7: A file is inserted into the canal that is attached to one of the electrodes of an apex locator

