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# Limited field-of-view cone-beam computed tomography for resolving working length discrepancy between electronic apex locator and periapical radiography

**KEYWORDS**
Apical foramen;
Cone-beam computed tomography;
Endodontic;
Periapical radiograph;
Working length

Working length (WL) refers to the distance from a coronal reference point to the point at which canal preparation and obturation should terminate.[1–3] Ideally, this point is located at or near the apical foramen, approximately 0.5–1.0 mm short of the radiographic apex, to avoid over- or under-instrumentation.[1–3] Electronic apex locator (EAL) combined with periapical radiography is the most common method for working length determination. Studies have reported that the distance between the apical foramen and the anatomical root apex ranges from 0.20 to 3.80 mm.[4] Therefore, in clinical practice, complex cases may present with a significant discrepancy between the apical terminus determined by the EAL and the radiographic apex. In such cases, limited field-of-view cone-beam computed tomography (CBCT) can serve as a valuable supplemental diagnostic tool to ensure accurate WL determination.[5] This article presented a case in which CBCT was used to resolve a 3 mm discrepancy between the apical foramen and the radiographic apex.

A 50-year-old female patient presented with a chief complaint of chewing pain in the right maxillary canine region. Clinical examination revealed a deep wedge-shaped defect on the buccal cervical area of tooth 13. The tooth 13 was tender to percussion and palpation in the buccal apical region and showed no response to cold and electric pulp sensibility tests. A pre-operative periapical radiograph (Fig. 1A) showed no apparent periapical radiolucency associated with tooth 13. The tooth was diagnosed with pulp necrosis and symptomatic apical periodontitis. Root canal treatment was recommended, and written informed consent was obtained from the patient. After isolation with a rubber dam, an access cavity was prepared. Straight-line access to the middle third of the canal was achieved using nickel–titanium rotary files with a crown-down technique. A stainless-steel K-file was used to negotiate the canal. The WL was determined to be 22 mm from the cusp tip to the apical terminus using an EAL. A gutta-percha cone was then inserted into the canal to the determined WL, and a WL confirmation radiograph was taken (Fig. 1B). The radiograph showed the gutta-percha cone approximately 3 mm short of the radiographic apex. Due to the significant discrepancy between the apical terminus determined by EAL and the radiographic apex, a limited field-of-view CBCT scan was performed to further assess the WL. The sagittal CBCT image (Fig. 1C) revealed that the apical foramen was located approximately 3 mm short of the radiographic apex. The measured distance from the cusp to the apical foramen was approximately 22 mm. A three-dimensional

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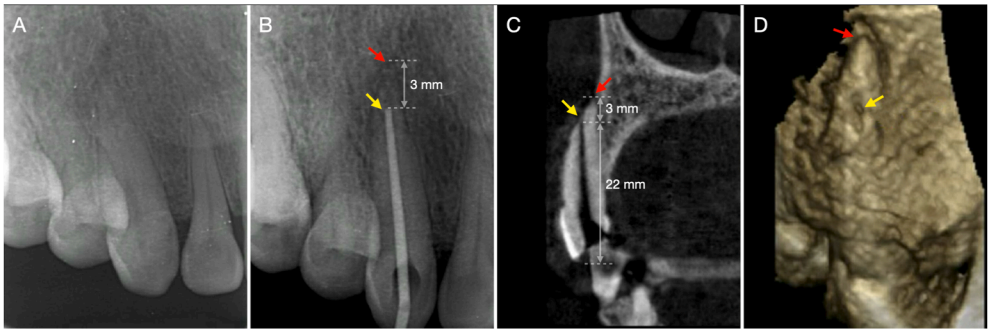


**Figure 1** (A) Pre-operative periapical radiograph. (B) Working length confirmation radiograph showing the gutta-percha cone (Yellow arrow: apical foramen by the apex locator) approximately 3 mm short of the apex (red arrow: radiographic apex). (C) Sagittal section of a cone-beam computed tomography (CBCT) image showing the apical foramen (yellow arrow) located approximately 3 mm short of the radiographic apex (red arrow). The distance from the cusp (reference point) to the apical foramen is approximately 22 mm. (D) Three-dimensional reconstruction of the CBCT image showing the relative position of the apical foramen (yellow arrow) and the radiographic apex (red arrow).

reconstruction of the CBCT scan (Fig. 1D) clearly demonstrated the spatial relationship between the apical foramen and the radiographic apex. Consequently, the WL was confirmed to be 22 mm. The root canal was instrumented, disinfected, and dried. Calcium hydroxide paste was placed as an intracanal medicament for two weeks. At the second appointment, the tooth was asymptomatic. The root canal was obturated using the warm vertical compaction technique. The access cavity and wedge-shaped cervical defect were restored with composite resin.

## Declaration of competing interest

The authors have no conflicts of interest relevant to this article to declare.

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## References

1. Wrbas KT, Nasiri K, Kiprova A. Accuracy of electronic apex locators during root canal therapy in dentistry. *J Dent Sci* 2025;20:2004—5.
2. Rangappa A, Arul B, Somasundaram J, Natanasabapathy V. The precision of radiographic and electronic working length estimation methods in endodontics: a systematic review of clinical studies. *Endodontology* 2024;36:307—14.
3. ElAyouti A, Connert T, Dummer P, Löst C. A critical analysis of research methods and experimental models to study working length determination and the performance of apex locators - a narrative review with recommendations for the future. *Int Endod J* 2022;55(Suppl 2):281—94.
4. Martos J, Ferrer-Luque CM, González-Rodríguez MP, Castro LA. Topographical evaluation of the major apical foramen in permanent human teeth. *Int Endod J* 2009;42:329—34.
5. Yılmaz F, Kamburoğlu K, Şenel B. Endodontic working length measurement using cone-beam computed tomographic images obtained at different voxel sizes and field of views, periapical radiography, and apex locator: a comparative ex vivo study. *J Endod* 2017;43:152—6.

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