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Dynamic navigation optimizes endodontic microsurgery in an anatomically challenging area

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Endodontic microsurgery (EMS) in the mandibular molar area can be more challenging due to limited access, buccal cortical bone thickness, complex root morphology, and proximity to the mandibular canal.[1] The introduction of guidance systems, either static or dynamic, led to breakthrough improvements in EMS by refining surgical procedures meanwhile reducing unintentional iatrogenic damage to critical structures.[2,3] Dynamic navigation provides real-time guidance and feedback during surgery, which is mainly used in implantology.[4] Though rarely documented, there are profound advantages of applying dynamic navigation in EMS.[5] Here, we presented a case of EMS with the assistance of dynamic navigation to share our experience.

A 41-year-old woman who experienced months of intermittent pain after endodontic retreatment at a local dental clinic was referred to our department for further opinion. Percussion and palpation tenderness of tooth 36 was noted, with a sinus tract tracing to its distobuccal root (Fig. 1A). A cone-beam computed tomography (CBCT) scan revealed extensive periapical bone resorptions around both the mesial and distobuccal roots of tooth 36 (Fig. 1B). After treatment plan discussion, the patient consented to undergo apical surgery with the aid of a dynamic navigation system. A preoperative CBCT scan was obtained with a thermoplastic clip (X-Clip, X-Nav Technologies, Lansdale, PA, USA) placing contralaterally to the surgical region (Fig. 1C). The image was imported into the dynamic navigation system (X-Guide, X-Nav Technologies) for access planning (Fig. 1D). After flap reflection, the distobuccal root was found directly exposed in a fenestrated bony defect, whereas the mesial root was still covered by intact buccal cortical bone. With the help of dynamic navigation, locating the mesial root apex was not a problem. By selecting an appropriate trephine bur, it was easy to create a bony window and perform root-end resection simultaneously (Fig. 1E, F, G, H, I and J). The rest steps of EMS were accomplished under a dental microscope (Fig. 1K). The buccal bone plate fragment was placed back to enhance the bony cavity. After series of follow-up appointments, the radiograph taken five months postoperatively showed significant bone healing at the periapical area of tooth 36 (Fig. 1L).

Applying dynamic navigation in the current case promoted accurate localization of the root tip and minimized the preparation time. It helped achieve ideal root-end resection without a bevel, which is usually difficult to achieve in freehand surgery but is essential for optimal outcome. Comparing to the static guidance, the dynamic navigation possesses the absolute advantage in EMS of posterior jaw due to its flexibility. Surgical procedures are more doable without a surgical stent in such limited operating space. It also enables the operator to amend the drilling path anytime during the surgery if the original design encounters difficulty. Furthermore, the intactly removed buccal cortical plate by a navigated trephine bur can be served as autograft to enhance post-operative healing. By thorough treatment planning, EMS with the aid of dynamic navigation, especially in anatomically challenging scenarios, is a promising procedure. It not only improves surgery accuracy and efficiency, which leads to elevated success rate, but can also accelerate healing by providing bony enhancement in certain situations.

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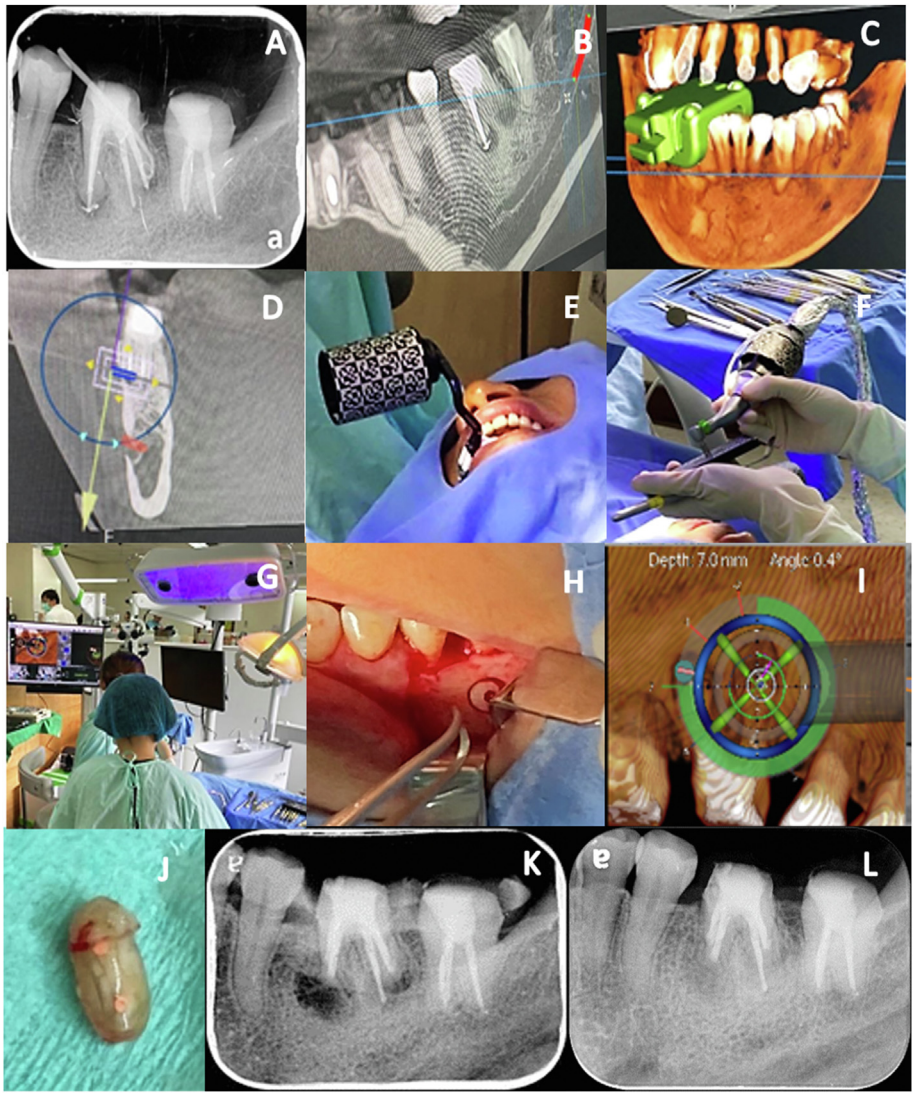

Figure 1 Clinical photographs of the surgery and radiographic images of the patient. (A) The pre-operative periapical film showed a sinus tract tracing to the distobuccal root of tooth 36. (B) Sagittal view of the CBCT image showed periapical radiolucency over both mesial and distobuccal roots. (C) The thermoplastic clip adaption on the contralateral arch to the surgical field was for positioning, and a pre-operative CBCT scan was acquired in full-arch mode. (D) Virtual access path designing in horizontal angulation (coronal view). (E) The cylinder tracer was attached to the customized thermoplastic clip. (F) Handpiece calibration was done with a calibrating plate to verify any deviation. (G) The surgery was performed with a Blue-OptiX sensor overhead to track the entire drilling procedure. (H) Creating a bony window with a 5.5 mm outer diameter trephine bur. (I) Real-time position of the drill was monitored on the screen. (J) Root-end resection was done at the same time when the trephine bur reached the target. (K) The post-operative radiograph right after the surgery. (L) The radiograph taken five months post-operatively showed a progress of healing. CBCT: cone-beam computed tomography. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

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Declaration of competing interest

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

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