CASE REPORT/CLINICAL TECHNIQUES

Endodontic Retreatment Using Dynamic Navigation: A Case Report

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ABSTRACT

Introduction: Dynamic navigation systems are used in dental implantology to optimize the accuracy of dental implant placement. **Methods:** A 30-year-old man was seen at the endodontic clinic of the Universidad Autónoma de Yucatán for pain in the left maxillary lateral incisor. A previously treated tooth with symptomatic apical periodontitis was diagnosed. The patient accepted treatment, and after signing an informed consent form, minimally invasive coronal access was performed through a zirconia crown. Then a post removal was performed with an ultrasonic tip to 2 mm before the apical gutta-percha limit, and the removal of material was completed manually with a K-file. **Results:** This case report demonstrates the use of dynamic navigation to remove a post from under a zirconia crown for the retreatment of a failing root canal procedure. The removal of fiber posts from endodontically treated teeth can present a unique challenge for clinicians. Numerous techniques and instrument kits are recommended for the removal of fiber posts, but the risk of excessive root structure damage is a major concern because the ability to differentiate the color difference between peripheral dentin and a bonded fiber post can complicate the accuracy of the removal. **Conclusions:** The dynamic navigation system enabled minimally invasive removal of the fiber post with a high degree of accuracy, thus ensuring that there was no unnecessary removal of root structure. Dynamic navigation using real-time monitoring could reduce the attendant risk of iatrogenic errors in complex treatment cases. *(J Endod 2021;■:1–7.)*

KEY WORDS

Dynamic navigation; fiber post; minimally invasive access; retreatment

SIGNIFICANCE

Dynamic navigation allowed for the planning of a minimally invasive access path through a crown and the precise removal of a fiber post using real-time feedback from the instrument tip. This has not been reported in literature.

Retreatment or secondary treatment of a failing root canal is fraught with numerous challenges. Studies have reported that retreatment procedures have a lower success rate than primary treatment[1,2]. Surgical retreatment is a viable option, but certain issues must be taken into account in determining the treatment option of choice, such as wound healing impairment, infection, bleeding, maxillary sinus involvement, and damage to adjacent neurovascular structures[3,4]. The objective of nonsurgical retreatment is to re-enter the root canal system by removing canal obstructions such as posts and root-filling materials to identify and treat previously undetected canals, repair defects (pathologic and iatrogenic), and optimize sterilization before sealing the root canal space[5,6].

The presence of an intraradicular post leads to risk that is best mitigated by using a surgical operating microscope[7]. Metal posts can be readily removed with dedicated kits and ultrasonics[8]. Fiber posts have to be removed mechanically along the length of the post channel because they are bonded to the dentinal walls. Traditionally, fiber posts have been clear, so post removal requires great care because of the indistinct chromatic difference between the dentin and bonded post. The new generation of RTD fiber posts (RTD Dental, St Egreve, France) are color coded by size. This mitigates some of the concerns about deviation from the channel path, but the possibility of iatrogenesis may arise from the hybrid layer, which is a biocomposite containing dentin collagen and polymerized resin adhesive[9–11].

Dynamic surgical navigation has been shown to be an accurate method for executing cone-beam computed tomography (CBCT)–based computer-aided implant surgery[12] (Fig. 1). Greater experience level of the surgeon with dynamic navigation appears to improve accuracy outcomes in comparison with static guides and freehand navigation[13]. Computer-guided endodontic procedures have used 3-dimensional (3D) printed static systems for surgical procedures and endodontic access[14–16]. However, static guides are obstructive, they may have inaccuracies in their fabrication, and they require an

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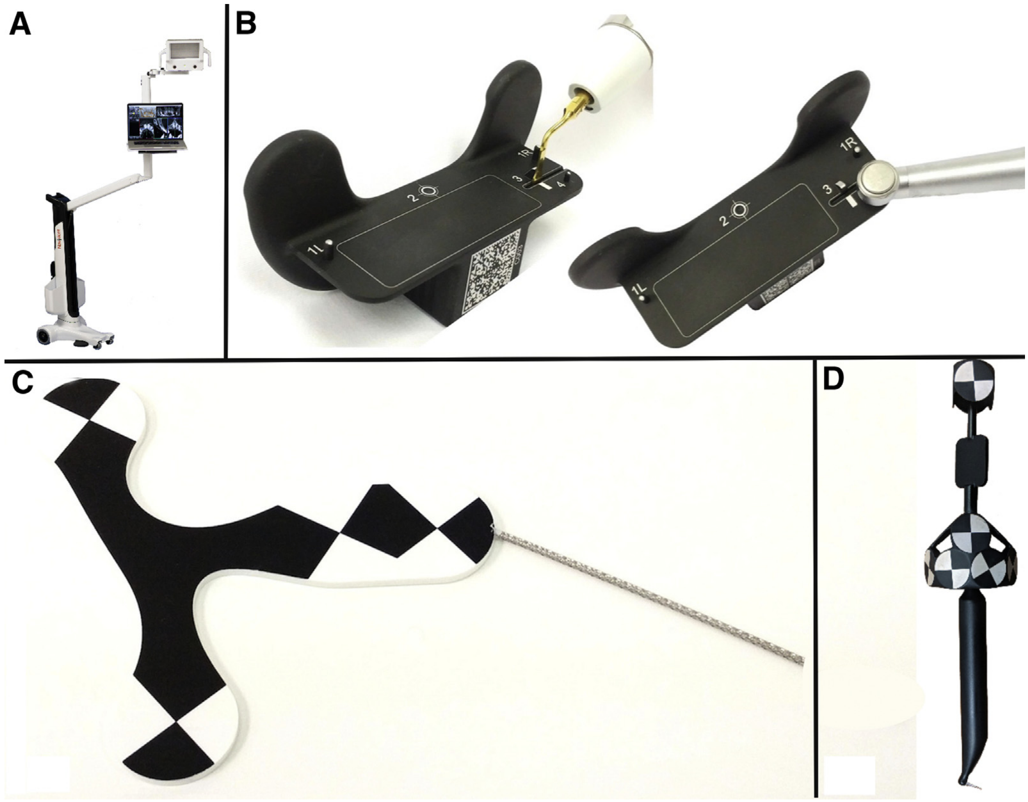

FIGURE 1 – (*a*) Navident dynamic navigation system: cart, micron tracker, laptop computer. (*b*) Calibrator: used for tracer tool, high- and low-speed handpieces (agnostic), burs, drills, ultrasonic tips, and piezo saws. (*c*) Jaw tracker: optical marker attached to the alveolus by screw plate for edentulous cases or to the teeth with composite or a PEEK U attachment secured with Blu-Mousse. (*d*) Tracer tool for trace registration that obviates the use of a stent.

increased length of surgical instrumentation to accommodate their bulk. The application of dynamic navigation for endodontics has not been fully explored. Thus, the present report details its use for the removal of a fiber post within the confines of a zirconia crown.

MATERIALS AND METHODS

A 30-year-old male patient reporting pain in the left maxillary lateral incisor was referred to the Graduate Endodontic Clinic of the Universidad Autónoma de Yucatán School of Dentistry. The tooth had been endodontically treated approximately 15 years prior. It supported a zirconium bridge extending from tooth #8 to tooth #10, which had been fabricated approximately 7 years earlier. Pain was evident on percussion and palpation, probe depths were within normal limits, and no response to thermal challenge was demonstrated.

Periapical pathology was evident radiographically, as was the presence of a fiber post (Fig. 2). The patient was advised about nonsurgical and surgical treatment options and their attendant risks. Because of a previous bad experience with apical surgery, he elected to undergo nonsurgical retreatment. After further consultation and the collection of a signed informed consent form, the patient agreed to proceed with the nonsurgical treatment option using dynamic navigation (Navident; ClaroNav, Toronto, Canada).

The dynamic navigation procedure has 3 parts. The first step is the importation of the patient's CBCT data set for planning the path through the zirconia crown and along the rectilinear path of the fiber post (Fig. 3*a*). Second, the registration is traced for mapping the patient's jaw onto the CBCT. A tracer tool is calibrated, and the teeth with the landmarks are "painted" by the tracer tool to register the jaw on the CBCT interface. Trace registration requires non-colinear landmarks to be placed on teeth in the maxilla and a jaw tracker to be attached to teeth in the arch (Fig. 3*b*). (Navident is currently the only software that does not require a stent.) The third step involves calibration of the handpiece and bur tip before initiating the procedure (Fig. 3*c*).

The system defaults to an accuracy check once the registration has been completed. The high-speed handpiece and a Great White Z GWZ 801-014 diamond bur for zirconia (SS White, Lakewood, NJ) were calibrated. The system provides 3D views of the tooth and the ability to monitor the location of the drill tip.

The coronal access (Fig. 3*d*) followed the plan displayed on the dedicated monitor. When the coronal extent of the fiber was revealed, a drill tag was placed on an ultrasonic handpiece, and an ED 7 ultrasound tip was calibrated (NSK, Tokyo, Japan). The ultrasonic tip was monitored as it moved through the fiber post following the pre-established path to 2 mm short of the apical extent (Fig. 4). The residual gutta-percha was removed with #15 K-file (Dentsply Maillefer, Ballaigues, Switzerland).

Drainage began upon achieving apical patency. Once the drainage subsided, the canal was irrigated with 5 mL of 6% sodium hypochlorite (Chlor-Extra; Vista Dental, Racine, WI) and saline solution. The canal instrumentation was performed with a Wave One Gold system large file (Black 45/.050; Denstply Maillefer). Calcium hydroxide was applied for a 7-day period. The coronal access was provisionally sealed with Cavit (3M ESPE AG Dental Products, Seefeld, Germany).

At the second appointment, the calcium hydroxide was removed using 6% sodium

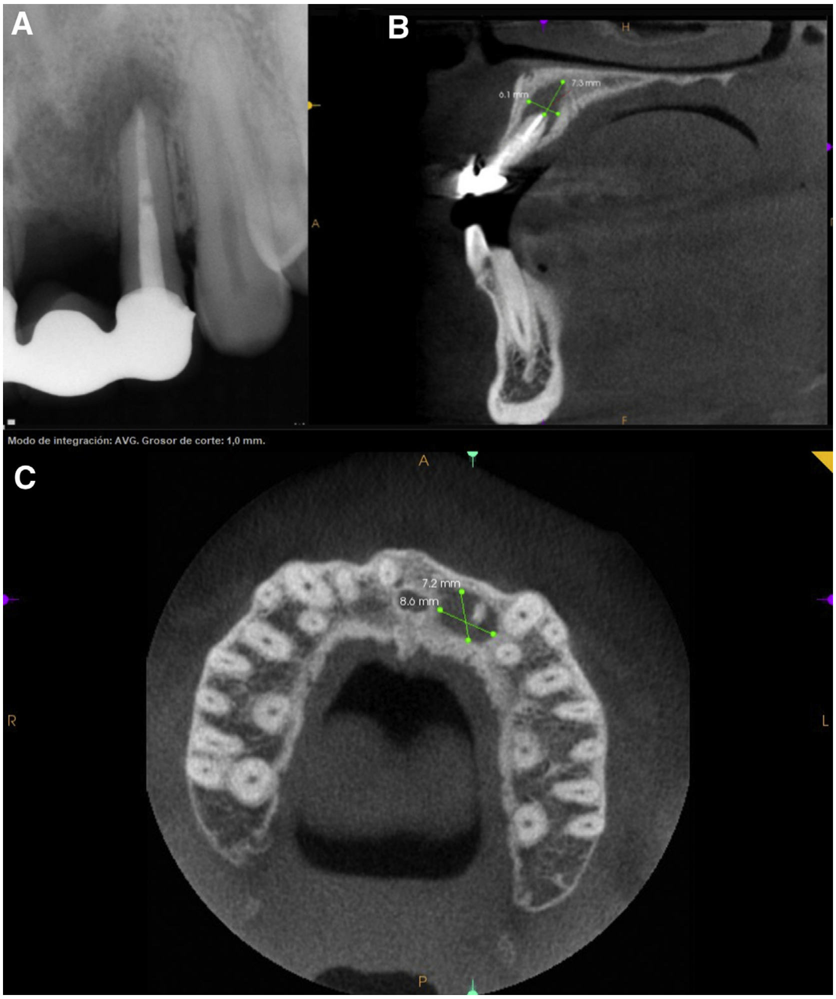

FIGURE 2 – (*a*) Preoperative 2D periapical radiograph showing a periradicular radiolucency about the apical third of the root. A fiber post is evident extending to mid-root. The root canal filling density deficit is apparent. (*b*) Sagittal CBCT slice. *Arrows* demonstrate the extent of the pathosis. (*c*) Axial CBCT slice demonstrating the extent of the pathosis.

hypochlorite, saline, and 17% EDTA (Smear Clear; SybronEndo, Orange, CA) for 1 minute. The canal was filled with gutta-percha and Sealapex sealer (SybronEndo) (Fig. 5*a*). The access preparation was sealed with a light-cured glass ionomer and a resin veneer. The patient was referred to the restorative dentistry department to reconstruct the post and core and to seal the access.

RESULTS

Dynamic navigation was used to develop a minimally invasive access cavity preparation through a zirconia crown and to remove a fiber post from the post channel. The real-time feedback capability enabled the preservation of the root structure without weakening the walls. The system has the advantage of allowing modification of the plan during the procedure, which is impossible when using static guides. As of 18 months after the end of treatment, the patient has been completely asymptomatic, and the periapical lesion is in remission (Fig. 5*b*–*d*).

DISCUSSION

To date, there have been no reports on the use of dynamic navigation to perform endodontic retreatment involving the removal of fiber posts, and there have not been been references regarding its use with ultrasonic tips. Dynamic navigation allows for modifications to the original plan during the procedure as a result of the ability to see the cutting tip in real time. This is a significant advantage in comparison with static guides, where no path modification is possible[17]. The use of the system has a learning curve because the clinician must look at a monitor rather than through the oculars of a microscope, but the learning period is short, and the procedure is remarkably easy to learn.

Gambarini et al[18] demonstrated that dynamic navigation offers many advantages in endodontic apical surgical procedures in comparison with static guides, particularly in the use of shorter surgical instrumention. Conservative endodontic access has been proposed to reduce the fracture risk in endodontically treated teeth[19,20]. A clinical case report by Nahmias[21] demonstrated the use of dynamic navigation for minimal access through a ceramic crown to identify a sclerotic root canal space that had metaphorsed to the apical third. Jain et al[22] showed that the use of high-speed drills with dynamic navigation can achieve minimally invasive access to cavities in locating highly difficult simulated calcified canals. They achieved a mean 2D horizontal deviation of 0.9 mm and a mean 3D deviation of 1.3 mm from the canal orifice, as well as a mean 3D angular deviation of 1.7. They concluded that the 2D deviation of 0.9 mm was relatively safe for deep endodontic-access cavity preparations.

Studies comparing the placement accuracy between freehand, static-guided, and computer-assisted surgery (dynamic navigation) have shown that dynamic navigation is more precise than the other modalities[13]. Adapting this technology to endodontics is a necessary paradigm shift for treating metamorphosed, sclerotic, and occult canals. In this case report, dynamic navigation allowed for the planning of a minimally invasive access path through a crown and the precise removal of a fiber post using real-time feedback from the instrument tip. The development of dedicated surgical navigation systems could assist in minimizing risk and in the prevention of iatrogenic errors in many if not all endodontic procedures.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

Jonathan Bardales-Alcocer: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Visualization, Writing - original draft, Writing - review & editing. **Marco Ramírez-Salomón:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Supervision, Validation, Visualization, Writing - original draft, Writing - review & editing. **Elma Vega-Lizama:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Visualization, Writing - original draft, Writing - review & editing. **María López-Villanueva:** Conceptualization, Formal

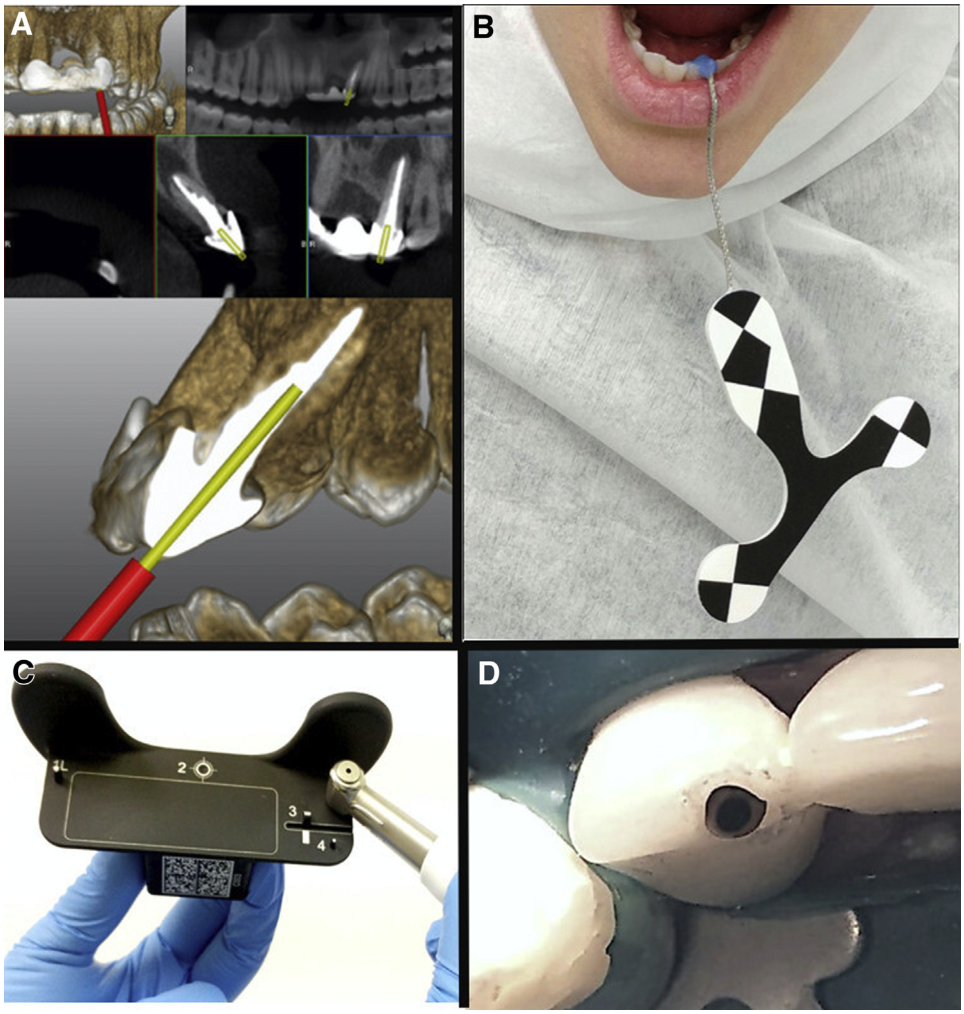

FIGURE 3 – (*a*) Path of the minimally invasive access through the zirconia crown is planned. (*b*) Jaw tracker (example) is attached to the teeth with composite. It is not bonded to natural teeth, relying on the undercuts to keep it stable. (*c*) Calibrator is used for the tracer tool, handpiece, burs, drills, and piezotome saws. It ensures that the distance from the optical marker to the tip of the instrument that engages the tooth is exact. This is further verified by an accuracy check after the calibration. (*d*) A minimally invasive access preparation was done through the zirconia crown. The accuracy of the removal of the fiber post is demonstrated.

analysis, Methodology, Validation, Visualization, Writing - review & editing. **Gabriel Alvarado-Cárdenas:** Conceptualization, Formal analysis, Methodology, Validation, Visualization, Writing - review & editing. **Kenneth S. Serota:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Supervision, Validation, Visualization, Writing - original draft, Writing - review & editing. **Jorgeraul Ramírez-Wong:** Conceptualization, Formal analysis, Methodology, Resources, Software, Validation, Visualization, Writing - review & editing.

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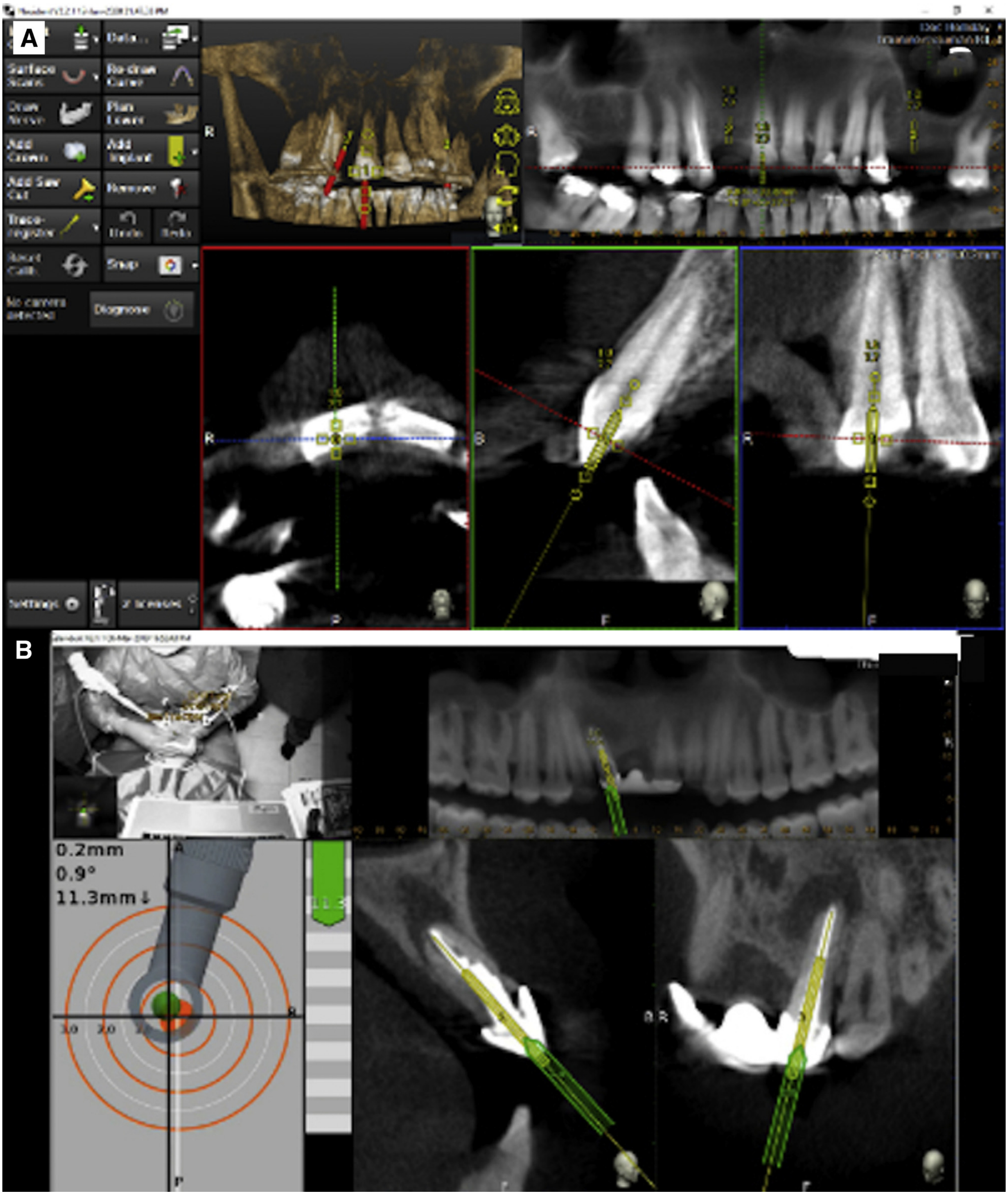

FIGURE 4 – (*a*) Navident software frames show 3D reconstruction, panoramic, axial, sagittal, and coronal images of the planned pathway for the ultrasonic tip. (*b*) Target (*grey background*) frame shows the horizontal distance from the target, the angle of the instrument, and the vertical (depth) distance as the ultrasonic tip is advanced. At any stage of the procedure, the planned path can be altered.

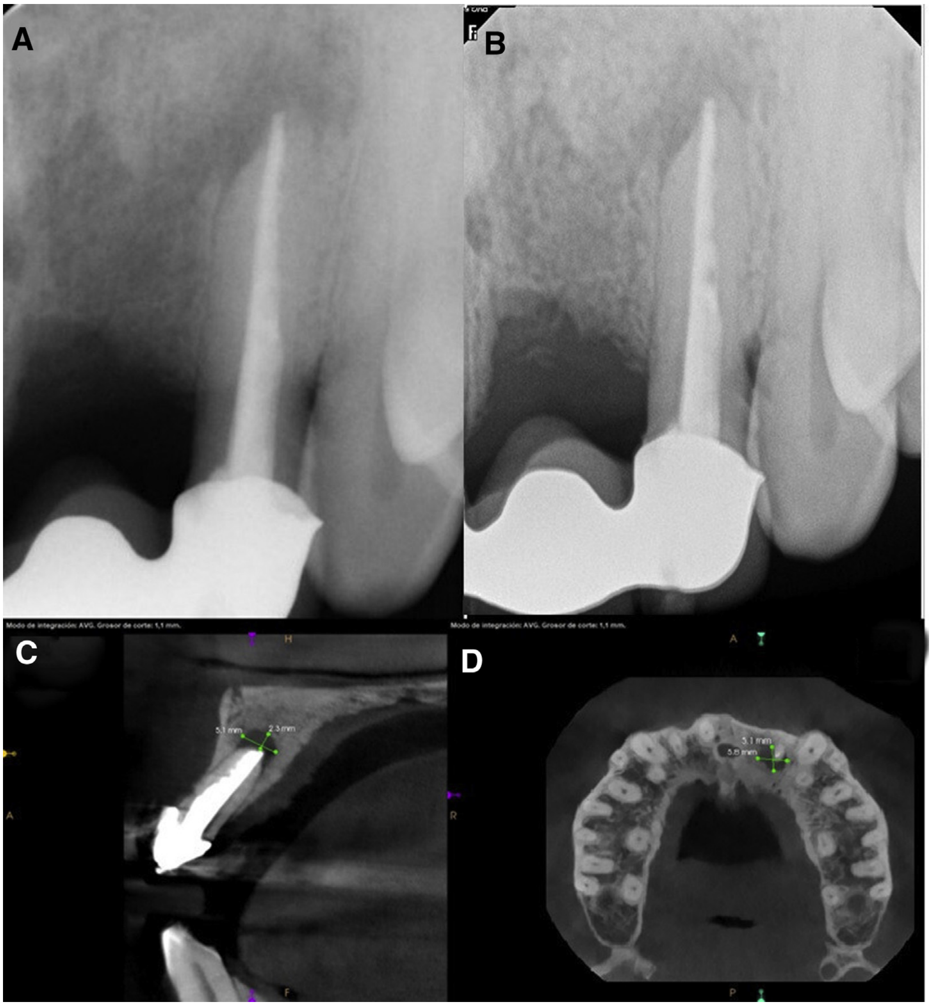

FIGURE 5 – (*a*) The immediate postoperative radiograph is shown; the fiber is removed, and the canal is obturated. (*b*) Reassessment 2D periapical radiograph taken 18 months after the retreatment procedure demonstrating significant osseous regeneration about the periradicular region. (*c*) Reassessment sagittal view CBCT taken 18 months after the retreatment procedure showing reduction in the size of the crypt. (*d*) Reassessment axial CBCT view taken 18 months after the retreatment procedure showing reduction in the size of the crypt.

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