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CLINICAL ARTICLE

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Endodontic treatment of dens evaginatus by performing a splint guided access cavity

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Abstract

Aim: Dens evaginatus (DE) is described as an unusual dental malformation. Tooth structure variations attached to this anatomical disturbance complicates the performance of a conservative access cavity for a conventional root canal treatment. Author's purpose is to describe the treatment of a type V DE by using splits as guides to perform access cavity.

Clinical considerations: This clinical case shows a root canal treatment of a type V DE diagnosed by using a cone beam computed tomography (CBCT). Access cavity was planned through an osseointegrated implant planning software and guided by a stereolithographied split. After endodontic treatment, tooth was sculpted for placing a veneer, processed by a chair-side system in a single session.

Conclusions: CBCT is an effective method for obtaining internal anatomical information of teeth with anatomical malformations. The osseointegrated implant planning software is an effective method for planning root canal treatment and designing stereolithograped splits (for performing minimally invasive access cavities).

CLINICAL SIGNIFICANCE

Stereolithographed splints allow performing a guided and conservative access cavity of teeth affected by dental malformations whereas digital technology allows us to esthetically reconstruct a tooth in a single session.

KEYWORDS
dens evaginatus, guided endodontics, chairside system

1 | INTRODUCTION

Dens evaginatus (DE), which includes malformations such as interstitial cusp, tuberculated premolar, odontoma of the axial core type, evaginated odontoma, occlusal enamel pearl, occlusal anomalous tubercle, supernumerary cusp, and Leong's premolar, is defined as an unusual dental malformation arising during the odontogenesis process.[1]

Dens evaginatus is thought to originate from an abnormal proliferation and folding of the inner portion of the enamel epithelium and subjacent ectomesenchymal cells of dental papilla into the stellate reticulum of the enamel organ during the bell stage of tooth formation. The resulting formation is defined as a tubercle, or supplemental solid elevation on some portion of the crown surface.[2,3]

In the literature, dens evaginatus is defined as an uncommon developmental aberration of a tooth, that results in the formation of a supernumerary tubercle extending from the occlusal aspect of an otherwise normal tooth.[4]

This unusual tooth surface anomaly contains a prolongation of pulpal tissue covered by a thin layer of enamel and dentin. The presence of pulp inside the tubercle has major clinical importance and helps us to distinguish from supplementary cuspids, such as Carabelli's cuspid,

FIGURE 1 Visual examination of dens evaginatus on tooth 2.1

which contains no pulp.[2,5] Some authors have reported that a pulpal extension can reach 70% of the tubercle, which can lead to a pulpal horn exposure due to a tubercle fracture or wear in enamel and dentine caused by occlusal erosion or brushing friction.[6]

Dens evaginatus is predominant in Asians (including the Malays, Chinese, Thai, Japanese, Filipinos and the indigenous populations) with ranges of prevalence from 0.5 to 4.3%, depending on the studied population.[2,4,7]

Dens evaginatus can affect any tooth, however it is more associated with premolars. Generally, the distribution is bilateral and symmetrical, with a slight predilection toward women.[8] Dens evaginatus has also been reported on canines and incisors, but its presence is low on anterior teeth.[5,9]

Dens evaginatus is more common on occlusal surfaces of the posterior teeth and can also be present on the anterior teeth, on their lingual surface.[2] Generally, it appears as an enamel covered projection on the occlusal surface of premolars.[10]

Periapical lesions on radiographs may be indistinguishable from or misinterpreted as developing dental follicles. Diagnosis and treatment may be delayed and severe toothache or infection may occur as there is no obvious etiology for pulpitis such as caries or trauma. Immature root development in a young patient makes managing the affected teeth problematic. For this reason, radiographic examination is a key diagnostic tool that provides essential information about the internal anatomy of the affected tooth.[11] The literature highlights cone-beam computed tomography (CBCT) as a useful radiologic technique because it allows for the interpretation of different planes and provides the clinician with a 3-dimensional (3-D) image.[11,12]

Levitan and Himmel suggest six categories to determine the treatment for teeth with DE: type I (normal pulp and mature apex), type II (normal pulp and immature apex), type III (inflamed pulp and mature apex), type IV (inflamed pulp and immature apex), type V (necrotic pulp and mature apex) and type VI (necrotic pulp and immature apex).[2]

In this clinical case, we describe the endodontic treatment of a case of type V DE diagnosed using CBCT. We planned the access cavity by using guided implant placement software and splint guides fabricated using stereolithography, since this approach has been used successfully before.

2 | CASE REPORT

A 16-year-old caucasian girl came to the clinic with a fistulous lesion located on the apical third of her central superior incisor. During clinical examination a tubercle was observed on the medial gingival third and on the medial buccal tooth surface (Figure 1).

Diagnosis tests revealed an apical chronic supurative periodontitis on tooth 2.1 and a root canal treatment was recommended. It is worth noting the importance of the radiographical examination for diagnosing type V DE (Figure 2A,B).

With the goal of understanding the internal anatomy of the affected tooth, a complementary radiographic examination was performed with CBCT (White Fox, Acteón Medico-Dental Iberia S.A.U, Satelec, Merignac, France), with exposure parameters of 105.0 kVp, 8.0 mA, 7.20 s and a field of view of 6 × 6 mm. Sagittal cuts evidenced the presence of pulpal tissue inside the buccal tubercle (Figure 3). The unusual of cameral access justified the need for a splint to guide the access cavity to the radicular canal of DE. The design of the splints was aided by the osseointegrated implants planning software SIMPLANT® (Dentsply Implants, Hasselt, Belgium) (Figure 4A-C). A 3D printer (ProJet® 6000. 3D Systems©, Rock Hill, SC, USA) was used to generate the splint, made by stereolithography and processed in a medical-use resin, except for the stainless steel cylinder that guided the drilling. The length and diameter of the guide cylinder were 5 mm and 1.3 mm, respectively. A dental diamond bur (Ref: 882 314 012, Komet Medical, Lemgo, Germany) was chosen, featuring a 1.2 mm diameter cutting surface and a total length of 14 mm. To guarantee access to the pulpar tissue, a drilling depth was determined based on the radiographical examination, which was established as 12 mm for the buccal access cavity.

Infiltrative anesthesia was took place before realizing the access cavity. A buccal access cavity was made for a pulpal camera using the splint guide (Figures 5A,B). Next, a rubber dam (Hygenic® dental dam, Coltene® Whaledent Grouppe, Altstätten, Switzerland) was used to achieve total isolation, and the working length was determined with an electronic apex locator (Root ZX®, Morita, Tokyo, Japan). Root canals were prepared with Protaper Next® (Denstply Maillefer®, Ballaigues, Switzerland) system, up to the X3 file; afterwards, an apical calibration was done to determine the real canal diameter. Canals were irrigated with 5.25% sodium hypochlorite during the cleaning and shaping, and

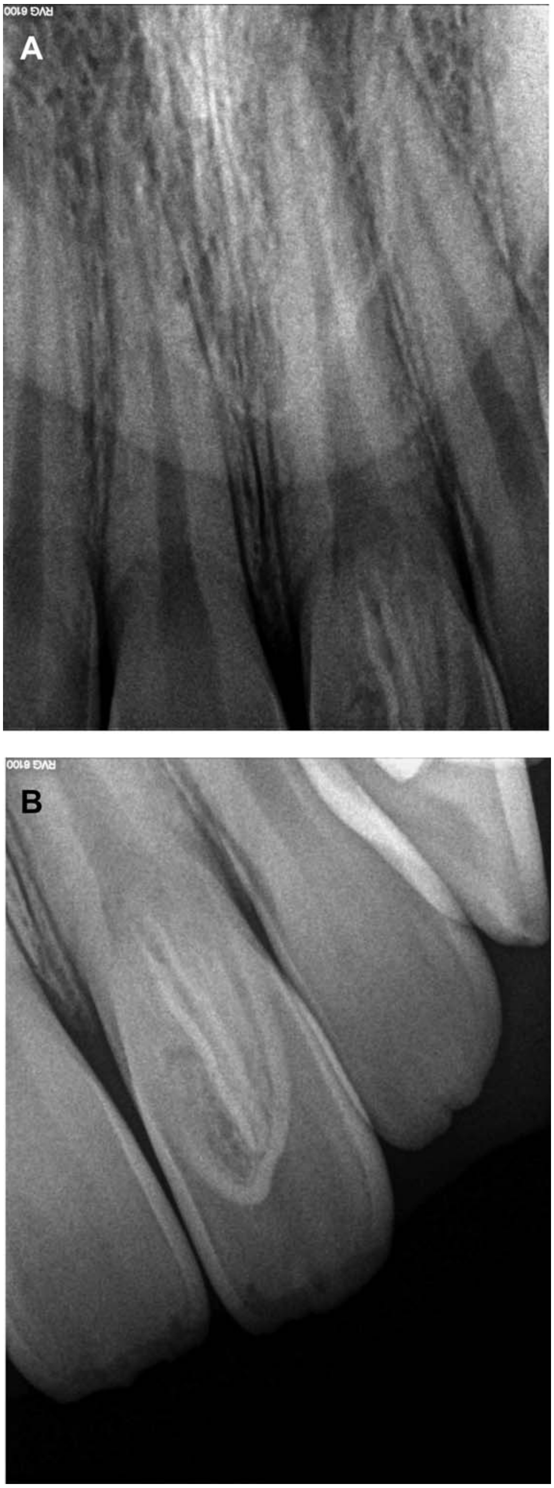

FIGURE 2 (A and B) Intraoral periapical radiographical examination of dens evaginatus on tooth 2.1

they were ultrasonically activated with an Irri-S® (VDW, Munich, Germany) points, to potentiate contact between the irrigant solution and the root canal surface. After drying the root canal with sterile paper points (Dentsply Maillefer, Ballaigues, Switzerland), the root canals were filled using a warm vertical condensation technique (Elements®, Sybron Endo, Orange, USA) and an epoxy resin cement (AH Plus®, Dentsply DeTrey, Konstanz, Germany) (Figure 6).

Buccal defect restoration was performed with a veneer done on a Lava Ultimate® (3M Espe, Seefeld, Germany) block. Lava Ultimate Resin Nano Ceramic (RNC) blocks are innovative new CAD/CAM materials that allows for superior esthetic results using simple steps. The blocks are made of nano-ceramic particles embedded in a highly cured resin matrix. Composite materials can be used to characterize and adjust the resin nano-ceramic restorations after milling but in this case, the characterization was made finally by the cement. The milled RNC restorations can be individualized intra-orally or extra-orally, either before or after insertion. The sculpting and etching were done in the same session after taking digital impressions with the 3M True Definition® (3M Espe, Seefeld, Germany) intraoral scanner and the posterior block wasmilled using a Roland Easy Shape DXW-4® (Roland DG Corporation, Japan) milling machine. The etching and make-up was performed with RelyX Veneer Cement® (3M Espe, Seefeld, Germany) (Figure 7).

Finally, follow-ups were scheduled to evaluate the case evolution and a control CBCT was perfomed after one year, which revealed the recovery and disappearance of the periapical lesion associated with dens evaginatus (Figures 8A,B).

3 | DISCUSSION

Early detection of dens evaginatus is important to prevent vitality loss and to consider alternatives such as esthetical restorations or veneers with or without root canal treatment. The problems associated with DE may include compromised esthetics, occlusal interference, displacement of the affected tooth, risk of caries, pulpar necrosis, periodontal problems and periapical pathosis. The structural variations associated with this anatomical alteration make it difficult to perform conventional root canal treatment, leading these teeth to require new therapeutic procedures. Early diagnosis and treatment of DE are required to prevent complications, by sealing communications between the DE and the external surface, to prevent bacterial contamination of the DE.[13–15] In this case, pulp necrosis might have occurred by the buccal wearing.

Pulp exposition can occur when the evagination is worn or fractured, leading to pulp necrosis.[16,17] In this case, probably due to severe attrition or a fracture, the enamel surface of the nodule became worn, causing a communication of the dentin-pulp complex and, consequently, pulp necrosis.

The incidence of DE is predominant in Asians, but it can also be found in Caucasians, as observed in this case.[10]

The therapeutic prognosis of this anatomic disorder has been closely associated with technical advances in radiology. The introduction of radiologic techniques such as CBCT has allowed clinicians to obtain better information about the internal anatomy of these teeth,[18] and better information allows for more predictable treatment plans.[19]

Guided splints are an adjuvant method for locating root canals. However, they have a number of limitations, such as inaccuracy, high economic cost, long therapeutic time and associated complications.

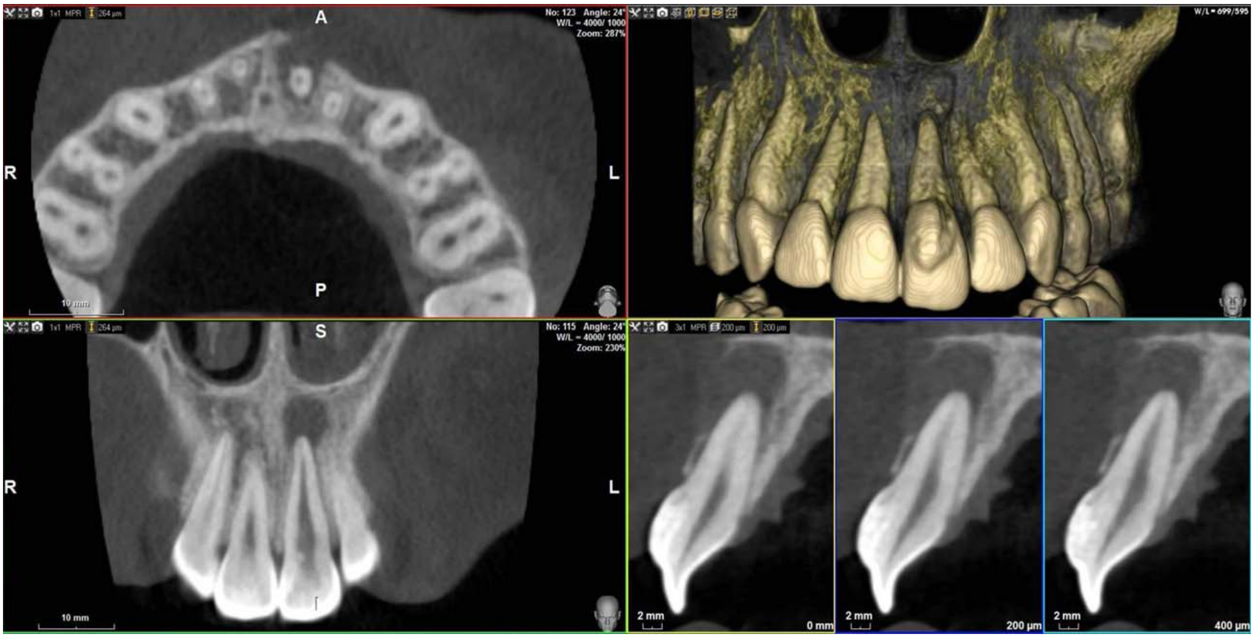

FIGURE 3 Cone-beam computed tomographic (CBCT) radiographical examination of dens evaginatus on tooth 2.1. CBCT sagittal cross-section shows a periapical lesion and the presence of the dens evaginatus. A: Buccal. I: Incisal. mm: Millimeter. P: Palatal. S: Apical

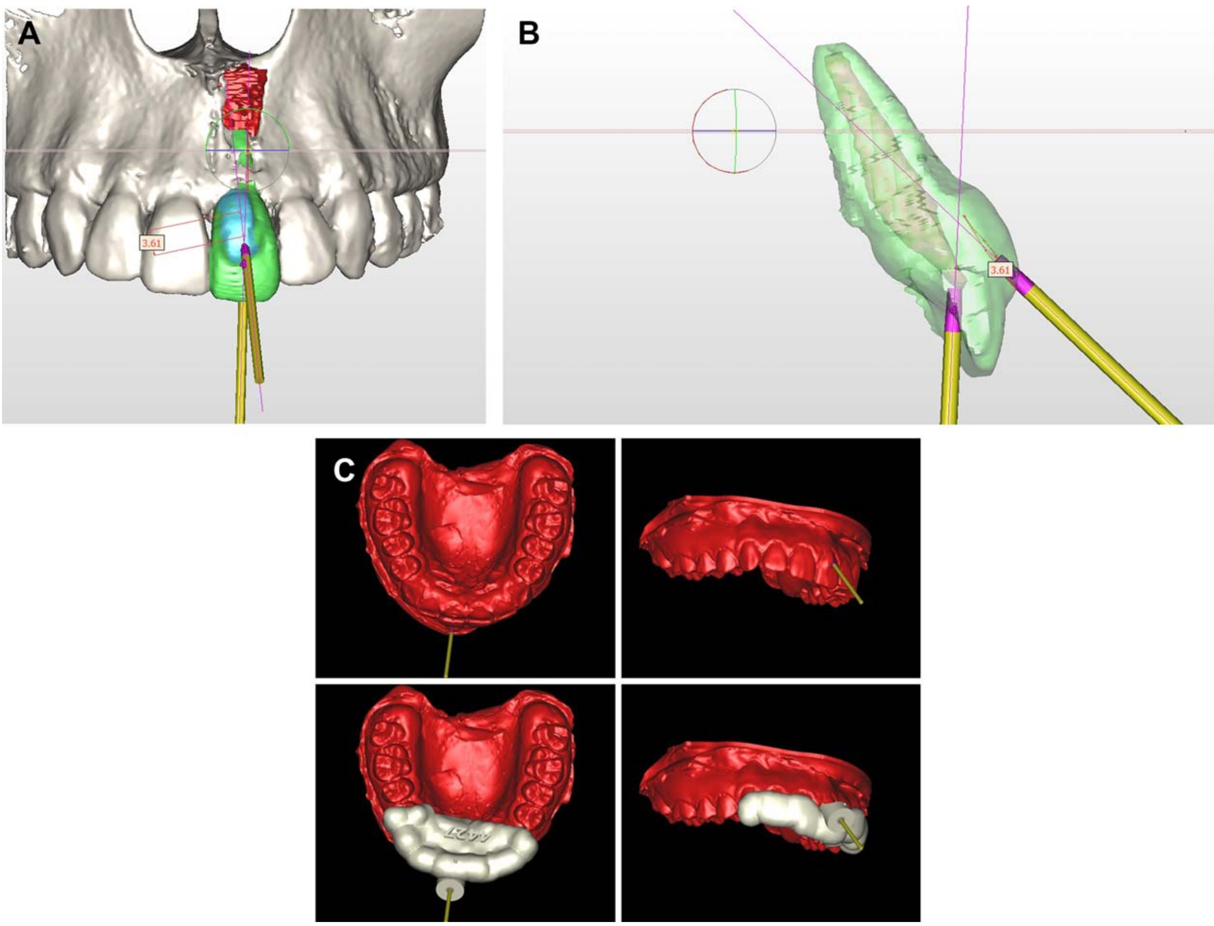

FIGURE 4 (A) Tridimensional reconstruction of vector direction that represents the cavity access path of dens evaginatus and tooth 2.1. Coronal view. (B) Tridimensional reconstruction of vector direction that represents the cavity access path of Dens Evaginatus and tooth 2.1. Sagittal view. (C) Tridimensional reconstruction of the design of the splints for guided endodontic treatment

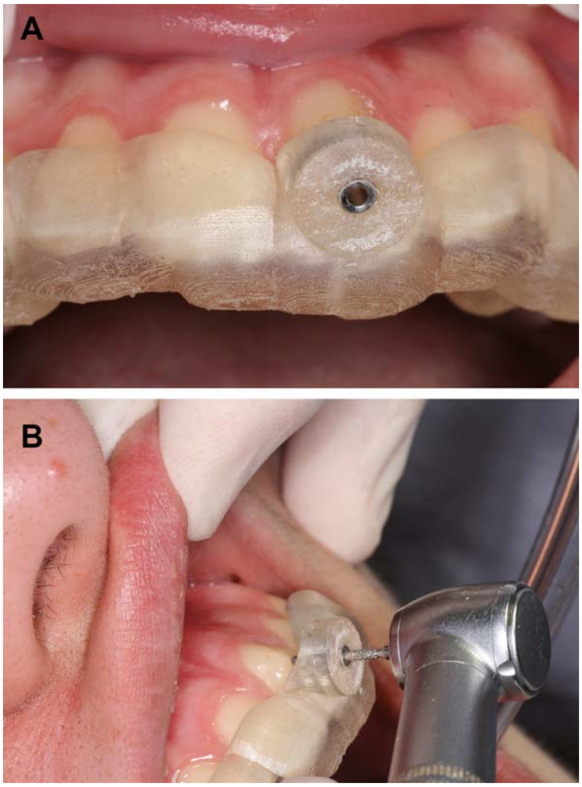

FIGURE 5 (A) Stereolithographied splint for performing guided endodontic treatment. (B) Positioning of the cavity access drill on stereolithographed splint

FIGURE 6 Final radiographs of the root canal treatment on 2.1 with dens evaginatus

FIGURE 7 Reconstruction of buccal defect on 2.1 with a Lava Ultimate Resin Nano Ceramic veneer, processed with a chair-side system during the same session

Few adverse effects have been documented such as the separation of the cylinder guide from the splint as well as the splint's fracture.[20] A root canal treatment with conventional access cavity was proposed as alternative therapy, previously informing to the patient of the associated risk.

Several authors have proven the accuracy of these splints in the field of oral implant dentistry, relating presurgical planning to postsurgical outcomes. They found a 0.99 mm horizontal deviation (ranging from 0.0 to 6.5 mm) at the level of the implant platform of the osseointegrated implants, a 1.24 mm horizontal deflection (ranging from 0.0 to 6.9 mm) at the osseointegrated implant apex and an average angle deviation of 3.81° (ranging from 0.0° to 24.0°) to the longitudinal osseointegrated implant axis.[20,21] Buchgreitz et al. evaluated ex vivo the accuracy of a preparation procedure planned for teeth with root canal obliteration using a guide rail concept based on CBCT scan merged with an optical surface scan and the mean distance between the drill path and the target was significantly lower than 0.7 mm[22] and Zehnder et al. concluded that deviations of planned and prepared access cavities were low with means ranging from 0.16 to 0.21 mm for different aspects at the base of the bur and 0.17–0.47 mm at the tip of the bur and the mean of angle deviation was 1.81°.[23] In the field of endodontics, the use of guided splints assisted by CBCT has been documented for treating dens invaginatus[24] and teeth with root canal calcification and apical pathology[25]; this lack of precision can make it difficult to locate the root canals and may lead to unexpected complications.

The values defining the accuracy of guided splints depend on various factors, such as the type of support, type of study, techniques used to fabricate the splint, planning software, discrepancy between the drill and cylinder guide, degree of wear of the drill and number of guides used.[20,21]

The restorations done by the chairside system add value to our endodontic treatments, because they allow us to restore esthetical defects in a single session. Compound CAD-CAM materials such as resin-based nanoceramics might be preferable for chairside treatments

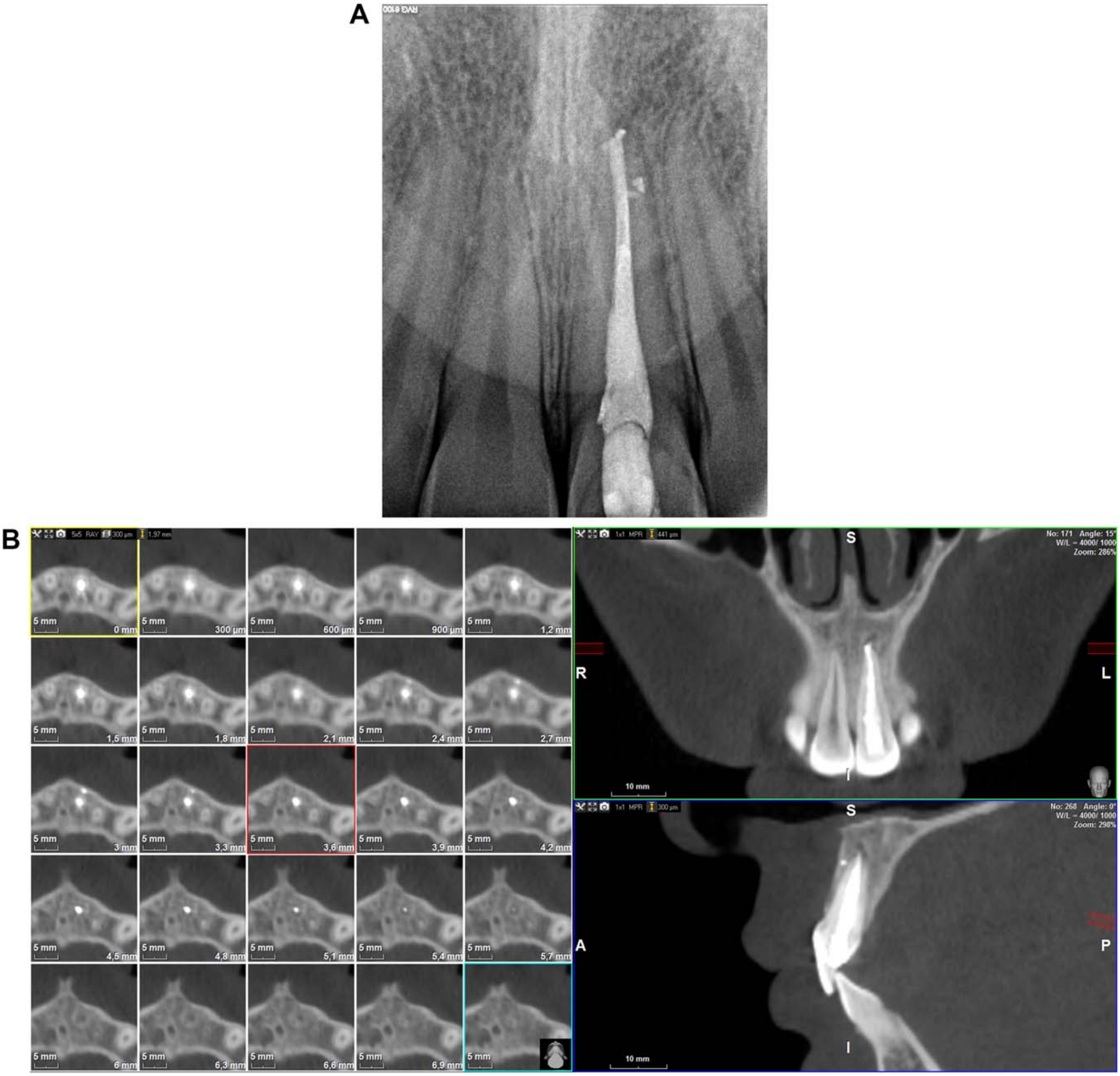

FIGURE 8 (A) 1-year follow-up intraoral radiograph. (B) 1-year follow-up CBCT sagittal, axial and coronal cross-sections

because of their rapid post-processing protocol. Furthermore, several studies have demonstrated their advantages,[26] although certain aspects could be improved.[27]

4 | CONCLUSIONS

This clinical case led to the following conclusions:

1. CBCT was a useful diagnostic method for revealing the internal anatomy of a tooth with anatomic malformations.
2. Virtual osseointegrated implant planning software was an effective method for planning the root canal treatment and for designing stereolithographed splints.
3. Stereolithographed splints allowed us to create a guided and conservative access cavity on teeth affected by malformation. Nevertheless, exactly locating the root canal ultimately depends on the skill and experience of the clinician.

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CONFLICT OF INTERESTS

None of the authors has declared any conflict of interest or financial disclosures

DISCLOSURE

The authors do not have any financial interest in any of the companies whose products are included in this article.

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