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A Successful Non-surgical Management of a Type II Dens Invaginatus with Antimicrobial Photodynamic Therapy: A Case Report

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Endodontic therapy of dens invaginatus (DI) anomalies is challenging due to difficult access, inadequate cleaning and shaping, and incomplete disinfection of its complicated root canal system. The present case report describes the treatment of tooth #10 with tooth discomfort, intermittent pus discharge, and localized swelling. Sinus tract, mobility, and probing grade 1 were observed. The tooth was tender on palpation and percussion with negative responses to pulp sensibility tests. Radiographic assessments revealed an atypical structure of pulpal anatomy, probably dens invaginatus, associated with a large periapical lesion and severe root curvature. Cone-beam computed tomography confirmed the presence of DI type II. Finally, the diagnosis of pulp necrosis with chronic apical abscess of tooth #10 was made. Combining antimicrobial photodynamic therapy as an adjunctive treatment with different irrigation techniques were effective in nonsurgical endodontic management of the complicated DI type II in a maxillary lateral incisor with a large periradicular lesion and severe root curvature. Six-month and one-year recall radiographic images revealed asymptomatic tooth and progressive osseous healing.

Keywords: Cone-beam Computed Tomography; Dens Invaginatus; Disinfection; Endodontics; Photodynamic Therapy

Introduction

Dens Invaginatus (DI), also known as dens in dent, commonly occurs in maxillary lateral incisors (85%). Previous studies reported successful treatment protocols of DI Classes II and III in maxillary lateral incisor [1-3]. Type II (29.5%) of DI Oehler's classification is described as enamel-lined invagination, which invades apically beyond the external cemento-enamel junction but remains in the root canal confined to the crown. Root canal therapy of DI type II is challenging due to difficult access, probable inadequate cleaning and shaping, and incomplete disinfection of its complex root canal system [4-6].

Some studies reported a positive influence of photodynamic therapy (PDT) on decreasing microbial load up to 91-100 % during root canal therapy, This effect was especially against drug-resistance bacteria like *Enterococcus faecalis (E. faecalis)* which is common in endodontic treatment failures [7-9].

This case report aimed to present the efficacy of antimicrobial PDT as an adjunctive treatment in a successful non-surgical endodontic management of a DI type II in a maxillary lateral incisor with a large periradicular lesion and severe root curvature.

Case Report

A 30-year-old male patient was referred to the Endodontics Department of Shahid Behehsti University to evaluate and treat the left maxillary lateral incisor (tooth #10). The patient's chief complaint was tooth discomfort, intermittent pus discharge, and swelling localized in the interior part of the face. His medical history was non-contributory.

Intra-oral examination revealed a sinus tract, mobility grade 1 by using miller classification, and probing grade 1. The tooth was tender in palpation and percussion evaluation. Also, it showed a negative response to cold test (Endo Ice; Maquira, PR, Brazil) as

well as electric pulp test (SybronEndo, CA, USA). The tooth crown had a restoration but was free from caries and tooth discoloration (Figure 1A). Radiographic assessments using periapical (PA) image and panoramic view (OPG) revealed an atypical structure of pulpal anatomy, probably dens invaginatus, associated with a large periapical lesion and severe root curvature (Figures 1B and 1C). Cone-beam computed tomography (CBCT) was carried out using NewTom VGi (QR Verona, Verona, Italy) with exposure factors of 110 kV, 1-20 mA, 75-150 µm voxel, 6 cm^2 field of view [10], and approximately one min reconstruction time (Figures 1D, 1E, 1F, and 1G). Finally, the presence of DI type II was confirmed. Tracing with gutta-percha was done, and the diagnosis of pulp necrosis with chronic apical abscess of the left maxillary lateral incisor was made. Treatment options were debated with the patient, and informed consent was obtained following the treatment decision of non-surgical endodontic management with a fair prognosis.

First session

Local anesthesia of Lidocaine 2% plus epinephrine 1:80000 (Darou Pakhsh Co., Tehran, Iran) was administered through an infiltration technique. First, the abscess drainage was performed, the fluid was obtained through fine needle aspiration (FNA), and sent for pathologic examination. Then, following the rubber dam setting, two access cavities were prepared; one in dens in dent (mesial canal) and the other in the main canal (distal canal) (Figure 1H).

An apex locator Root ZX II (J Morita, Tokyo, Japan) was used with the aid of a #15 K-file (Mani Co, Tokyo, Japan) to estimate the working length (WL) followed by radiographic evaluation. The WL of the mesial canal (dens in dent canal) and distal canal (main one) were measured at 13 mm and 24 mm, respectively (Figure 1I). The canals were successfully enlarged manually to fit master K-file sizes #60 for dens in the dent canal and #15 for the main canal. Root canal instrumentation was carried out through the crown-down preparation technique. The irrigation was copiously performed with 2.5% sodium hypochlorite (NaOCl), chlorhexidine (CHX), 17% Ethylenediaminetetraacetic acid (EDTA) solution, and normal saline. An ultrasonic Ultra-X with a blue tip (Eighteeth; Medical Technology Co., Changzhou, China) was used for passive activation of NaOCl according to the manufacturer's recommendation (Figure 1J). To a better physical contact with the walls of the tooth canal system, efficient cleaning of the root canal surfaces, and better activation of NaOCl, an XP-Endo® Finisher file (FKG Dentaire, La-Chaux-de-Fonds, Switzerland) was used with supplementary sonic irrigation of a size 15, 02 taper tip of Endoactivator (Dentsply Sirona, Ballaigues, Switzerland).

For PDT, Methylene blue (Sigma, St. Louis, MO, USA) with a concentration of 25 g/mL (67 M) was applied as the photosensitizer (PS) inside the root canal for two min. The root canal was irradiated by an infrared light-emitting diode (LED) with a wavelength of 630 nm and 2000 mW/cm2 intensity (Figure 1K). Both canal spaces were dried with paper points, filled with calcium hydroxide (CH) paste (Golchai, Tehran, Iran), and then temporarily sealed with Coltosol for one week.

Second session (after seven days)

Microscopic description of FNA aspiration reported no atypical cells. In clinical examination, the tooth was asymptomatic without any sign of the sinus tract.

Chemical irrigation and PDT were performed again, and root canals dried completely. ProRoot mineral trioxide aggregate (MTA; Dentsply, Tulsa, OK, USA) was placed in the apical third and middle area of main canal using ultrasonic Ultra-X. Then the remained parts of the canals were filled with thermo-plasticized gutta-percha. At the end of the session, a new PA radiograph revealed complete root filling (Figure 1L). Finally, a permanent restoration was done with light-cured composite resin (3M ESPE, Seefeld, Germany).

A six-month (Figure 1M) and one-year (Figure 1N) recall radiographic images revealed progressive osseous healing. One-year clinical findings showed asymptomatic teeth, no sensitivity to percussion and palpation, no mobility, no attachment loss or recession, but complete healing of the sinus tract (Figure 1O).

Discussion

Efficient cleaning and shaping of the root canal in DI type II is described as an endodontic challenge considering the complicated anatomy [11-13]. Therefore, we combined various irrigation and disinfection techniques, including PDT, to ensure complete disinfection of the root canal system. CBCT was used due to their several advantages to confirm the presence and the type of DI [14, 15]. Capar *et al.* [16] reported that the prevalence of DI in rendered OPG images was less than in CBCT scans (3% compared with 10.7%).

The XP-Endo® Finisher file was used to improve the surface contacts because the 3-mm arc shape of the third apical part of the instrument enables it to increase contact and enhances the root cleanness [17, 18].

Ultrasonic Ultra-X with the blue tip was used for passive activation of NaOCl, which is reported to improve canal irrigation. Also, 17% EDTA as a chelator material is useful in smear layer removal. Previous studies implicated an enhancement

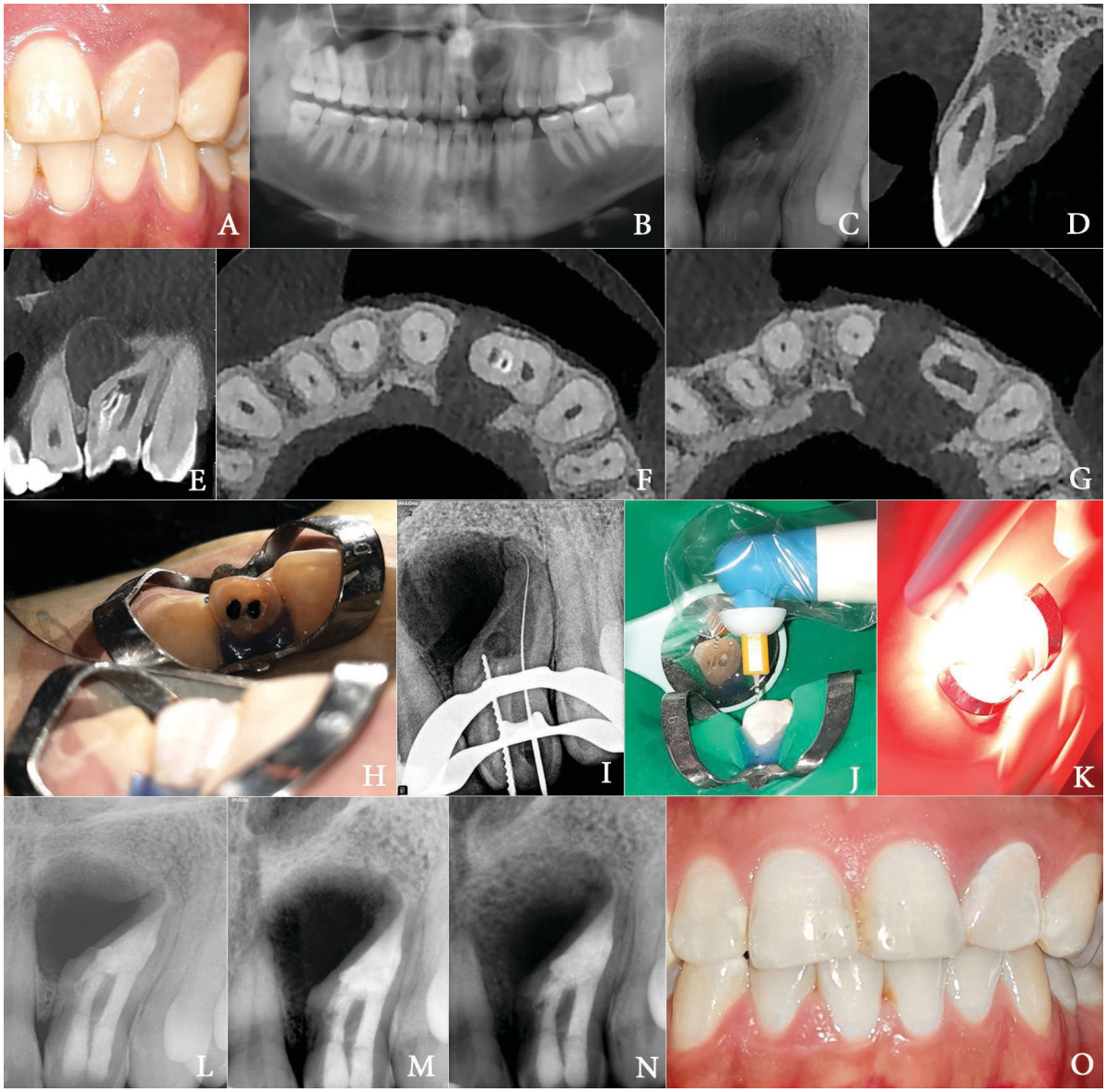

Figure 1. Treatment of tooth #10. *A*) Preoperative Photograph; *B*) Preoperative panoramic view; *C*) Preoperative periapical radiograph; *D, E*) CBCT images (sagittal sections); *F, G*) CBCT images (axial sections); *H*) Access Cavity using diamond bur and ultrasonic tip with methylene blue; *I*) Instrumentation; *J*) Supplementary sonic irrigation of a size 15, o2 taper tip of Endoactivator to NaOCl activation; *K*) Photodynamic therapy; *L*) Filling of the main canal and invagination; *M*) Clinical view following composite filling; *N*) Six-month follow-up; *O*) One-year Follow-up

in disinfection and eradication of *Enterococcus (E.) faecalis* following ultrasonic activation on PDT or simultaneous application of PDT with 2.5% NaOCl [19, 20]. During PDT, as an adjuvant method in irrigation and disinfection, a nontoxic, photosensitizing agent named photosensitizer (PS) is localized in tissues and activated by light with a particular wavelength to produce singlet oxygen and free radicals. These products are cytotoxic to cells of the target tissue. Several gram-positive and gram-negative oral bacteria are susceptible to red light following sensitization with cationic PS, including methylene blue [21, 22]. Soukos *et al.* [23] reported a 97% decrease in *E. faecalis* biofilm following 25 g/mL methylene blue and subsequent illumination with light.

ProRoot MTA was placed in the apical third and middle area due to its expression of osteopontin, a bone mineralization marker, antibacterial activity, and higher push-out bond strength values [24, 25]. Favorable obturation techniques in complicated tooth structures are thermoplastic and warm gutta-percha obturation methods. Therefore thermoplastic gutta-percha was used to fill the irregular root canal structure.

Conclusion

This case report presents a successful endodontic treatment of a lateral incisor, combining PDT and different irrigation techniques during non-surgical management of a complicated DI type II associated with a large periapical lesion and severe root curvature.

Conflict of Interest: 'None declared'.

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