Endodontic Management of a Maxillary Lateral Incisor with 4 Root Canals and a Dens Invaginatus Tract

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Abstract

Dens invaginatus (DI) is associated with complex internal anatomy. This article represents a maxillary lateral incisor with 5 root canals including DI. The treatment was planned and performed using cone-beam computed tomographic (CBCT) imaging. After clinical and radiographic evaluations, tooth #7 was diagnosed with DI and pulp necrosis with symptomatic apical periodontitis. Periapical radiographs of the tooth showed 2 roots and complex internal anatomy. CBCT evaluation revealed tooth #7 had 5 separate canals (4 root canals and 1 DI canal extending through the root to the periodontal ligament), communication between DI and the root canal system, and severe and multiple curvatures of the palatal canals. Root canal treatment was completed in 2 visits. Modified access openings were required to safely treat the dilacerated palatal canals. At the 6-month re-evaluation, the patient reported he had remained asymptomatic and his tooth had remained functional since the treatment was completed. Clinical examination showed tooth #7 had no sensitivity to percussion or palpation, probe depths within normal limits (≤3 mm), and no mobility. Radiographic assessment of the tooth showed significant osseous healing of the preoperative lesion. Three-dimensional imaging is a valuable tool for endodontic management of teeth with complex internal anatomy. Three-dimensional imaging is recommended for evaluating and treatment planning cases with DI. *(J Endod 2015;41:1167–1171)*

Key Words

3-dimensional imaging, cone-beam computed tomographic imaging, dens invaginatus, dental operating microscope, root canal anatomy

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The purpose of endodontic treatment is to remove all potential sources of infection from the root canal system; these include remnants of pulp tissue, microorganisms, and their by-products. Accurate knowledge of the internal anatomy of teeth is essential before endodontic procedures can be performed proficiently. Studies have shown that failure of root canal treatment can be caused by complex internal anatomy preventing adequate removal of bacterial biofilm from the root canal system (1).

Incorporation of the dental operating microscope and cone-beam computed tomographic (CBCT) imaging into clinical endodontic practice has increased the knowledge and awareness of clinicians regarding anatomic complexities. Studies have shown that the use of magnification significantly enhances the quality of the access cavity preparation (2) and increases the number of located and negotiated canals in molar teeth (3–5).

CBCT imaging allows for 3-dimensional (3D) evaluation of the external and internal anatomy (6). Comparison of CBCT images of extracted teeth with routine 2-dimensional radiographic images of the same specimens revealed that CBCT images consistently resulted in a greater number of root canals identified (7).

A comparison of CBCT reconstructed images with histologic sections as a validation showed a strong correlation between these 2 (8). In addition, studies have shown that the combined use of magnification and CBCT images significantly facilitates locating and negotiating the root canals in maxillary molars (9). A recent clinical study on the effect of CBCT images on treatment planning by endodontists showed 3D imaging provided information that changed the treatment plan in the majority (62%) of the cases (10).

Dens invaginatus (DI) is a developmental anomaly resulting in invagination of the enamel organ into the dental papilla before mineralization of the tooth structure. DI is not an unusual finding in permanent teeth, specifically in maxillary lateral incisors. Several studies have evaluated the prevalence of DI in different populations. A clinical and radiographic examination of 739 Swedish 7-year olds showed a 6.8% prevalence of DI (11). An examination of 1660 panoramic radiographs obtained from a Jordanian population revealed a 2.95% prevalence of DI (12). Ninety percent of these reported DI cases were maxillary lateral incisors. A number of teeth with DI become infected because of oral communication through the invagination (13) and require either endodontic treatment or extraction. Endodontic treatment of a tooth with DI is considered a potentially complicated procedure. A survey of 307 Flemish dentists showed that if a tooth with DI needs endodontic treatment 38.4% of them will refer the patient to a specialist (14).

There are several classifications for DI based on different criteria and standards. However, the following classification by Oehlers (15) is the most popular:

1. *Type 1:* This is an enamel-lined invagination that is minimal, confined within the crown, and does not extend beyond the cementoenamel junction.
2. *Type 2:* The enamel-lined invagination invades into the root but remains within a blind sac. However, there may be communication with the pulp.
3. *Type 3A:* There is usually no communication with the pulp, which lies compressed within the wall around the invagination process. The invagination may appear to be completely lined by enamel, but more often a portion of it is lined by cementum instead. The invagination communicates with the periodontal ligament with a "laterally located" foramen.

4. *Type 3B:* The anatomy of the invagination and pulp are similar to type 3A. The invagination communicates with the periodontal ligament with an "apically located" foramen.

In both type 3 lesions, any communication between the oral cavity and the invaginatus foramen can lead to an inflammatory response within the periodontal tissues. The disease is called *peri-invagination* periodontitis by some authors (13) and requires the cleaning and sealing of the communication to promote healing.

This article presents the endodontic management of a case of type 3B DI in a maxillary lateral incisor with 4 other canals. The internal anatomy was unusually complex and required the use of CBCT imaging for diagnosis and planning modified access openings to reach the otherwise inaccessible palatal canals.

Case Report

A 16-year-old male was referred with a history of repeated swelling in the area of tooth #7. The reason for referral, as stated by his general dentist, was complex root canal anatomy. The medical history of the patient was noncontributory. Clinical evaluations revealed that tooth #7 was mildly sensitive to percussion and palpation. There was no intraoral or extraoral swelling at the time of evaluation. The periodontal condition of tooth #7 was within normal limits (probing ≤3 mm and normal mobility). Tooth #7 did not respond to cold tests using Endo Ice (Hygenic, Akron, OH) or the electric pulp test (Analytic Technology, Redmond, WA). Tooth #7 had a wide labiopalatal dimension with a prominent palatal cusp on the cingulum and a pitlike invagination in its center (Fig. 1*A*). There were no visible caries or previous restorations in this tooth. Radiographic evaluation of the tooth showed 2 roots (mesial and distal), a possible presence of more than 1 canal in each root, and an enamel-walled space in the center of the tooth, indicating DI (Fig. 2*A*). Also, there was a large lucency periapical to the DI. The diagnosis for tooth #7 was DI type 3B and pulp necrosis with symptomatic apical periodontitis.

Because the preoperative radiographs revealed complex anatomy, a CBCT scan was taken (Kodak 9000 3D; Carestream Health, Trophy, France) (Fig. 3*A–H*). 3D evaluation of tooth #7 showed a DI canal in the middle (Fig. 3*F–H*) and a complex root canal system surrounding the DI in the crown. Coronal slices showed the presence of 4 separate canals: mesial labial (ML), mesial palatal (MP) (Fig. 3*C*), distal labial (DL), and distal palatal (DP) (Fig. 3*D*). The CBCT image also showed abrupt palatal curvature of both mesial and distal roots (Fig. 3*A–E*). The axial cross sections showed the presence of a possible communication between DI and the root canal system (Fig. 3*G*).

After clinical and radiographic examination and diagnosis, root canal treatment was planned for tooth #7. The patient's legal guardian gave oral and written informed consent. Complete local anesthesia was provided with 36 mg lidocaine and 0.018 mg epinephrine (Novocol Pharmaceutical, Cambridge, Ontario, Canada). After rubber dam isolation, the access cavities were prepared using a 331 carbide bur (SS White, Piscataway, NJ). Based on the CBCT findings, the labial and palatal canals required specifically angled approaches. Separate conservative access openings were made under magnification (Dental Operating Microscope; Zeiss Proergo, Prescott's, Inc, Monument, CO), which provided straight-line access to each canal. Because the palatal canals exited at right angles to the root trunk (Fig. 3*C–E*), a standard access into the palatal surface would have created acute angles for the files to negotiate. At the first appointment, the DI canal was accessed and treated (Fig. 1*B*) and then the labial canals (Fig. 1*C*). At the second appointment, the palatal canals were accessed and treated (Figs. 1*D* and 2*B*). The access to the DP canal was made directly palatal and parallel to the DI and their openings converged. A separate opening was prepared to access the MP canal (Fig. 1*D*). Root canal instrumentation was performed using nickel-titanium hand files (Dentsply Tulsa Dental, Tulsa, OK) to master apical file size #25 in the MP and DP canals, #30 in the ML and DL, and #50 in the DI. Root canals were irrigated with NaOCl 5.25% during and after instrumentation. After completion of the root canal preparation in the DI, ML, and DL in the first visit, all 3 canals were obturated by a combination of cold lateral condensation and vertical compaction of gutta-percha and Roth's 801 Elite sealer (Roth International Ltd, Chicago, IL). The access cavities were temporarily restored with Cavit (3M ESPE, St Paul, MN). The patient returned asymptomatic 7 days later. After local anesthesia and rubber dam isolation, the palatal canals were accessed (as previously described), instrumented, and obturated (Figs. 1*D* and 2*B*). The access openings were temporized with Cavit. The patient was referred to his general dentist for permanent restoration. Two weeks later, the patient's guardian was contacted by phone and confirmed the patient's tooth was asymptomatic and the permanent restoration had been scheduled.

The patient returned asymptomatic at the 6-month re-evaluation. Tooth #7 was functional and had no sensitivity to percussion or palpation. The tooth had been restored permanently with composite resin. The probe depths were within normal limits (≤3 mm). The

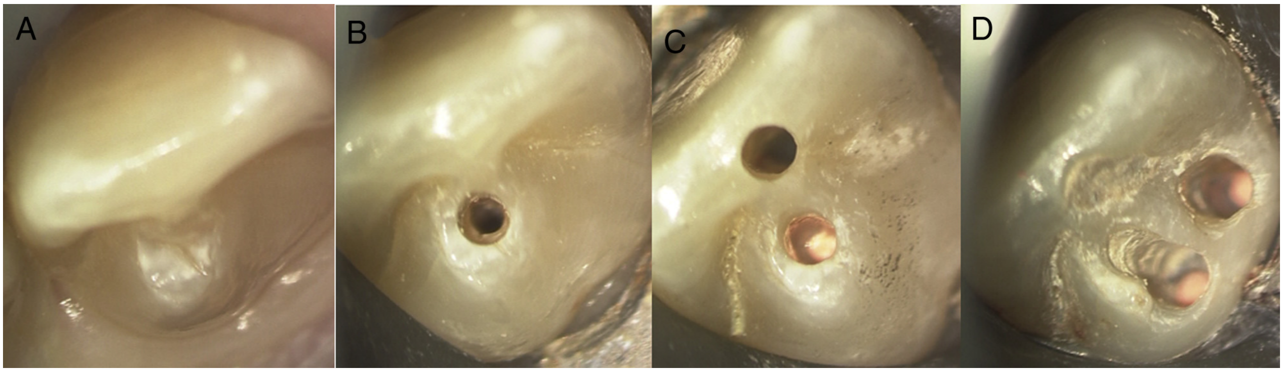

Figure 1. (*A*) A clinical view of the crown of tooth #7. Please note the wide labiopalatal dimension of the crown and the presence of a palatal cusp with an invagination in its center. (*B*) Access opening to the DI canal. (*C*) Initial entry to the labial canals. (*D*) Access openings to the palatal canals (second appointment). Access to the DP canal was made directly palatal to the DI opening, causing the 2 openings to converge. Note the access openings to the DI and labial canals are temporized with Cavit.