Successful Nonsurgical Endodontic Outcome of a Severely Affected Permanent Maxillary Canine with Dens Invaginatus Oehlers Type 3

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Abstract

Introduction: The morphogenic complexities of dens invaginatus (DI) Oehlers type 3 in maxillary canines offer significant endodontic challenges. **Methods:** A case report is provided of a 14-year-old female patient who presented with an anomalous-looking permanent maxillary canine associated with a sinus tract. Pulp testing revealed a normal response on the distal aspect of the tooth, whereas the mesial segment tested nonresponsive. A radiolucent lesion was seen on the mesiolateral radicular area adjacent to the severely distended pulp chamber. A gutta-percha point inserted into the sinus tract traced to this same region. The diagnosis was normal pulp coincident with DI Oehlers type 3 with pulp necrosis and chronic apical abscess. **Results:** Despite a concerted effort to limit the root canal therapy to only the necrotic canal, its proximity to the normal canal obviated this possibility, entailing endodontic treatment of the entire root canal system. The necrotic pulp space was subjected to sustained irrigation with 5.25% sodium hypochlorite and then completed with 17% ethylenediaminetetraacetic acid. A bolus of gutta-percha was used to create an apical barrier, and then the remainder of the enlarged pulp space was obturated with injectable thermoplasticized gutta-percha. At a 4.5-year recall, there was no clinical and radiographic evidence of infection. **Conclusions:** Endodontic success was accomplished with meticulous efforts of disinfection. Thermoplasticized gutta-percha can offer utility for obturation of anatomically complicated pulp spaces. The use of the dental operating microscope is an invaluable aid for discernment of the intricacies of teeth affected with DI type 3 variant and can enhance clinical outcomes. *(J Endod 2014;40:1702–1707)*

Key Words

Cuspid, dens invaginatus, disinfection, endodontics, root canal obturation

Dens invaginatus (DI) refers to a congenital infolding of a tooth-like structure within a tooth. The widespread classification of DI, originally described by Oehlers (1) in 1957, designated 3 subtypes, which are based on the extent of apical migration of an enamel-lined invagination. Type 1 is distinguished by the ingression of this malformation solely within the clinical crown. In type 2, there is extension of the invagination apical to the cementoenamel junction, terminating as a blind sac within the root canal system but not to the periodontal ligament. The type 3 variant is characterized by the extension of the invagination to the apical region, with subsequent exiting out of the root and terminating with communication to the periapex.

The reported incidence of DI is diverse, ranging from 0.04% to 10%, which is based on the heterogeneity of the subpopulations studied and methodologies of investigators (2). DI occurs most frequently with permanent maxillary lateral incisors, whereas maxillary canine involvement is extremely rare and found in only 0.002% of the total number of teeth evaluated in radiographic surveys (3, 4). Far fewer examples of mandibular canines affected with DI have been reported (5, 6). The clinical significance of DI is the increased risk of oral microbial contamination through the coronal aspect of the invagination, leading to infection of the root canal system. The orifice of the DI is typically quite diminutive and could be easily overlooked on clinical examination. Affected patients often present signs/symptoms of oral infection, namely a draining sinus tract, pain, or swelling. On occasion, patients are asymptomatic and the discovery of the infected DI is simply an incidental radiographic finding (7).

Various treatment modalities have been implemented for DI, such as prophylactic sealing of the invagination to prevent caries and pulpal contamination, nonsurgical endodontic therapy, apical curettage and retrograde filling, orthograde retreatment, intentional replantation, or extraction (2). An array of endodontic difficulties can be encountered with management of DI, particularly with Oehlers type 3, and include inadequacies with biomechanical cleaning and three-dimensional obturation of the dysmorphic root architecture and the frequent lack of an apical and/or periradicular canal constriction, leading to potentially excessive overextension of the filling material.

A paucity of cases of successful endodontic treatment involving permanent maxillary canines DI Oehlers type 3 has been reported. A PubMed search, which was restricted to the English language literature from 1970 to 2014, has yielded only 7 documented cases with favorable treatment outcomes, with follow-up assessments as long as

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http://dx.doi.org/10.1016/j.joen.2014.06.008

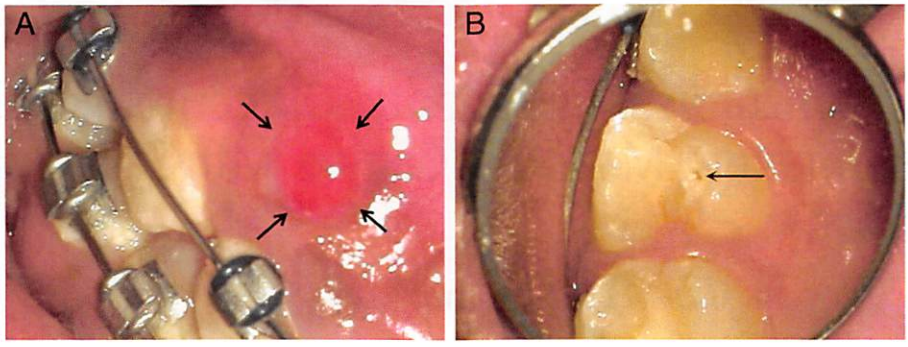

Figure 1. Preoperative clinical views. (*A*) Draining sinus tract stoma between the canine and lateral incisor (*arrows*). (*B*) Occlusal view showing conspicuous palatal cusp-like structure with an orifice (*arrow*).

24 months (2, 8–13). Here we provide the successful case of nonsurgical endodontic therapy on a maxillary canine severely affected with DI type 3.

Case Report

In 1999, a 14-year-old female patient who was undergoing orthodontic therapy was referred by a family friend to a private practice limited to endodontics (M.J.R., Washington, DC) for evaluation of discomfort of recent onset in the maxillary region. The medical history was noncontributory and the patient was not taking any current medications. On oral examination, the radicular labial mucosa at the mesiolateral aspect of the permanent maxillary right canine was slightly edematous and associated with a patent sinus tract. The clinical crown exhibited unusual morphologic features, with a pronounced palatal cusp comparable to the anatomy of the adjacent first premolar, and an enamel pit was noted along the labial incline of this palatal structure (Fig. 1). The tooth was noncarious and periodontal probing depths were normal. The remainder of the dentition was unremarkable and there was no apparent family history of congenital dental abnormalities.

Radiographically, the periapical radiograph demonstrated an aberrant root canal system, with an expansive, funnel-shaped pulp chamber in the middle-to-mesial aspect suggesting a somewhat enlarged portal of exit located along the lateral radicular aspect. A narrower, sinusoidal root canal system was observed along the distal aspect, exiting at the apex of the root. In addition, a pronounced radiolucent lesion was evident in the mesiolateral radicular bone, whereas the distoapical bone appeared normal. A gutta-percha point that was inserted into the sinus tract traced to the area of rarefaction (Fig. 2). The affected tooth was not sensitive to percussion but was tender to palpation along the mesiolabial mucosa overlying the radiolucency. Vitality testing was conducted with a pencil of ice and applied to the mesial and distal labial surfaces; the mesial was nonresponsive, and the distal manifested a normal response to cold. The diagnosis was normal pulp in the main canal and DI Oehlers type 3 with pulp necrosis and chronic apical abscess. Written parental consent was obtained before initiation of endodontic therapy and notably addressed all of the available treatment options and their associated risks, benefits, and challenges. A prior evaluation by another endodontist had prompted the recommendation of an extraction.

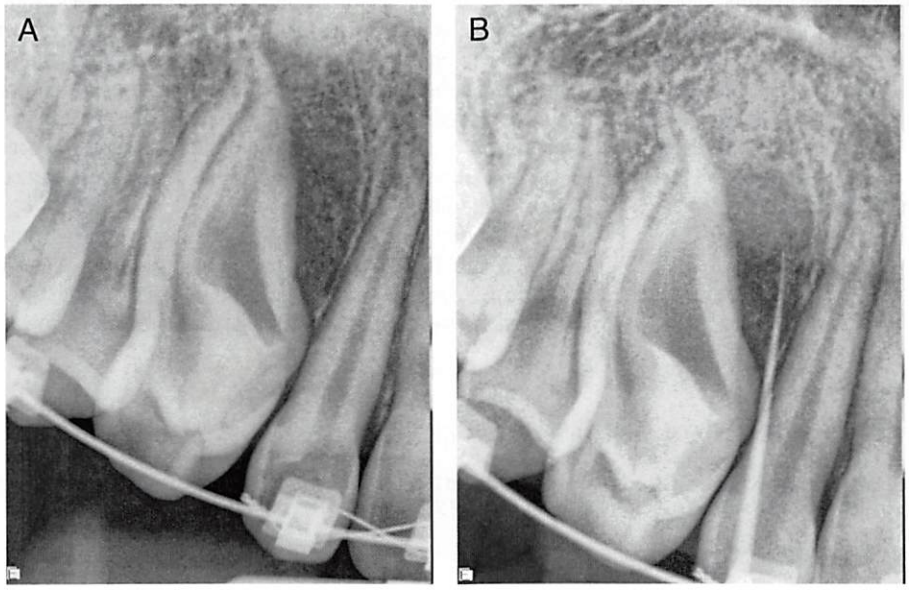

Figure 2. Preoperative radiographic findings. (*A*) Aberrant root canal system with mesial radicular radiolucency. (*B*) Gutta-percha point tracing to mesiolateral rarefaction.

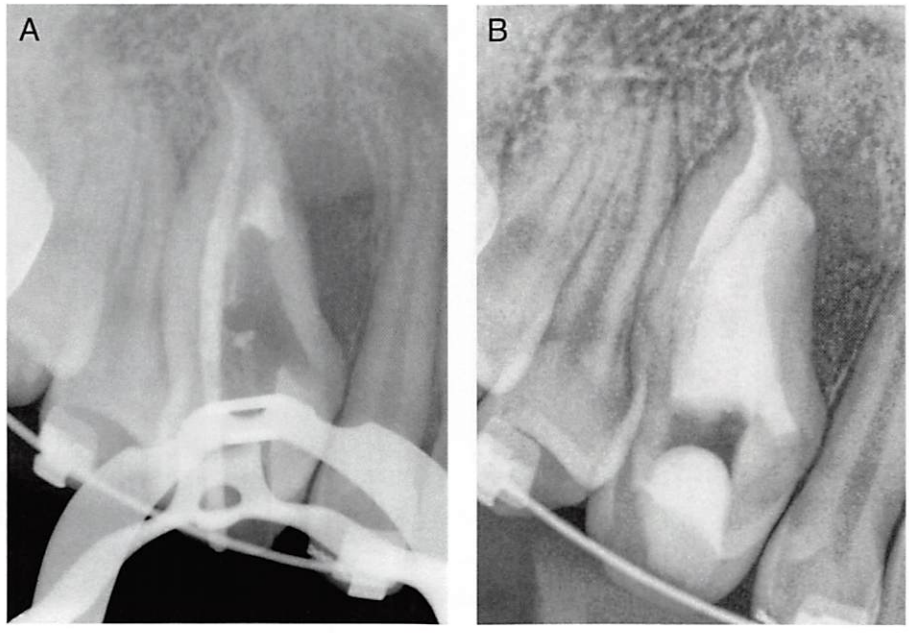

Figure 3. Gutta-percha placement. (*A*) Bolus of gutta-percha successfully delivered to seal apical foramen of DI. Master gutta-percha cone seated in the distal canal and verifying the cut shape. (*B*) Immediate completion of obturation.

Local anesthesia was achieved with labial infiltration of 3.6 mL 2% lidocaine with 1:100,000 epinephrine (Xylocaine; AstraZeneca, Dentsply, York, PA). Under rubber dam isolation, the entire endodontic procedure was performed while using a dental operating microscope (G4; Global Surgical Corp, St Louis, MO). Entrance into the large pulp chamber of the invagination via an occlusal access revealed the presence of a putrescent slurry of necrotic debris. An electronic apex locator (Root ZX; J Morita Corp, Tustin, CA) established the working length and was verified radiographically. To maximize proper disinfection, 5.25% sodium hypochlorite (NaOCl) was infused into the dilated pulp space, remaining for 8–10 minutes and repeatedly replenished with a fresh solution for an estimated period of 1.5 hours, and followed with a final rinse with 17% ethylenediaminetetraacetic acid (EDTA). The walls of the canal were dried with sterile paper points and then dabbed with coarse paper points coated with Kerr Pulp Canal Sealer EWT (Kerr Corp, Romulus, MI). While aided with the dental operating microscope, a bolus of thermoplasticized injectable gutta-percha (Obtura; Obtura Corp, Spartan USA, Fenton, MO), heated to 150°F, was delivered apically and carefully positioned against the portal of exit with use of Schilder pluggers (Dentsply Maillefer, Ballaigues, Switzerland). Serial radiographs were exposed to visualize the apical migration of the gutta-percha plug, to confirm its satisfactory adaptation, and to verify the lack of extrusion beyond the apical foramen. The remainder of the root canal system was then obturated with thermoplasticized gutta-percha, heated to 150°F.

Despite a concerted effort to restrict the endodontic procedure to include only the necrotic portion of the tooth, the need for adequate unroofing of the dens invaginatus led to an unavoidable exposure of the normal distal pulp, necessitating its extirpation and root canal treatment. The working length was also ascertained with an electronic apex locator and with radiographic confirmation. A stainless steel hand file size #15 (Dentsply Maillefer) was used to achieve a smooth and reproducible glide path. A final shape was created to a size #25 0.06 taper with a nickel-titanium rotary file (ProFile; Dentsply Tulsa Dental Products, Tulsa, OK), synchronized with copious irrigation with 5.25% NaOCl. A final rinse with 17% EDTA was performed and the canal was dried with paper points. After tug-back with a nonstandardized medium-size gutta-percha point coated with root canal sealer, the apical portion of the root canal system was obturated by using a heating element (The System B Heat Source; SybronEndo, Orange, CA) and pluggers by using the vertical condensation technique, as described by Schilder (14). This root canal system was also backfilled with thermoplasticized gutta-percha (Obtura). A dry, sterile cotton pellet was placed into the access opening, and the tooth was temporized with Cavit (3M ESPE, St Paul, MN). The proper occlusion was then verified. The postoperative radiograph revealed obturation of the unusual root canal system (Fig. 3).

The patient was advised to take 400 mg ibuprofen (every 6 hours as needed for pain) at discharge. Antibiotics were not deemed necessary because of the absence of signs/symptoms of systemic involvement in the immunocompetent patient. The patient was then referred back to her attending dentist and the access opening was

Figure 4. Occlusal view of tooth restored with composite resin.

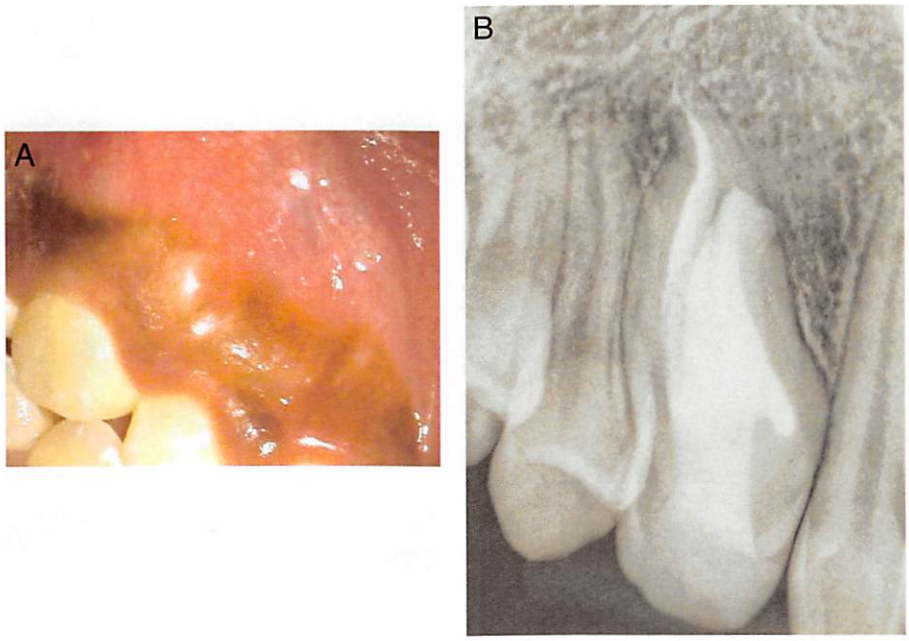

Figure 5. A 4.5-year recall. (*A*) No evidence of sinus tract or edema. (*B*) Radiograph demonstrating complete osseous healing.

restored with a composite resin (Fig. 4). At a 4.5-year recall appointment, the patient was asymptomatic, without evidence of a sinus tract, and radiographic assessment demonstrated complete resolution of the radicular infection (Fig. 5). The patient has since relocated and was lost to follow-up.

Discussion

The featured patient presented with a permanent maxillary canine with DI Oehlers type 3 associated with pulp necrosis and chronic apical abscess. The onset of oral discomfort and the evidence of a sinus tract prompted endodontic intervention. Adhering to the fundamental principles of root canal therapy, the aforementioned treatment consisted of the thorough removal of organic pulp debris and the establishment of a hermetic sealing of the root canal system (14). Disinfection of the DI was attributed to the sustained irrigation of 5.25% NaOCl and a final rinse with 17% EDTA, owing to their antibacterial activity and reduction of endodontic biofilms. Minimal hand/rotary instrumentation was warranted in the DI because of the lack of need to shape the root canal system and the inherent risk of further weakening an already structurally compromised tooth.

Obturation of the overly dilated DI was accomplished with meticulous, incremental efforts to seal its apical terminus with the bolus of gutta-percha concurrent with use of a dental operating microscope and sequential radiographs. There is universal agreement that obturating the maximum amount of the root canal system anatomy is a desired goal of endodontic therapy, and thermosoftened compaction with gutta-percha represents an optimal technique, particularly because of its capacity of adapting to an eccentric-shaped pulp canal space, as seen in our case (15). Failure to provide a sound apical plug can lead to overextension of thermoplasticized gutta-percha into the contiguous soft tissues and possibly the maxillary sinus (16).

As far as could be ascertained, this report represents only the eighth documented patient who underwent successful endodontic therapy on a permanent maxillary canine with DI Oehlers type 3, as cited by PubMed from 1970 to 2014 (Table 1). An additional literature search was conducted from the bibliographies of culled references. Of note, of these 8 identified cases, ours is apparently the first published account that used thermoplasticized gutta-percha. Four other cases involved the use of gutta-percha cones (2, 9–11). Singular cases were obturated with gutta-percha in the main canal and a silver point in the DI (8), gutta-percha in the main canal and mineral trioxide aggregate (MTA) in the DI (12), or MTA only within the DI (13). Cases that had appeared in non–peer-reviewed on-line newsletters were excluded from this compilation of successful outcomes. Beltes (18) reported favorable results with thermoplasticized gutta-percha for obturation of a maxillary canine with DI Oehlers type 2.

The preservation of the normal pulp in cases of DI Oehlers type 3 is desirable but often unavoidable because of the proximity of the main canal to the infected invaginated pulp space, as seen in our case with the exuberant root canal system. In fact, 75% (6 of 8) of affected cases (including the featured patient) received endodontic therapy of the entire root canal system (2, 8, 9, 11, 12). Interestingly, the attending clinicians were able to preserve the integrity of the normal pulp in the main canal of 2 less severe cases of affected canines with DI type 3 (10, 13). One other case described by Sousa Neto et al (19) involved only surgical management of a DI type 3 canine with "apicocurettage and retrofilling to close the canal". Although the authors had not specifically acknowledged failure, a 15-year follow-up examination disclosed severe clinical and radiographic bone loss. As such, this case was excluded from our table of successful cases. Stamfelj et al (20) published a case of a maxillary canine with DI type 3, which was morphologically comparable to our case; however, endodontic therapy was not performed, and the tooth was subsequently extracted.

It should be pointed out that our featured patient was treated 15 years ago. The patient presented with a DI with a completely mature apex, obviating the consideration for apexogenesis with $Ca(OH)_2$, which was in vogue at that time (21), and its use continues to remain relevant (22). Contemporarily, the attending clinician has an array of advancements for endodontic cases such as various sonic and ultrasonic agitation systems, which serve to maximize root canal system disinfection (23). Use of these devices would have greatly reduced

TABLE 1. Cases of Successful Endodontic Treatment of Maxillary Canines with DI Oehlers Type 3 Malformation*

Case no.	Patient age (y)/ gender	Clinical signs/ symptoms	Preoperative pulp diagnosis	Preoperative periapical diagnosis	Treatment	Outcome	Reference
1	13/F	"Pointing sinus"	Normal pulp	Chronic apical abscess	DI: silver point MC: gutta-percha Next day: apicoectomy and retrograde amalgam	Sinus healed	8
2	30/F	Draining sinus tract, extreme thermal sensitivity	MC: symptomatic, irreversible pulpitis DI: pulp necrosis	Chronic apical abscess	Instrumentation and gutta-percha, retrofill with amalgam At 11 mo: retrograde amalgam in "vacant root space"	7 mo: recurrence of sinus tract 12 mo: postoperative healing "uneventful"	9
3	16/F	Throbbing pain	MC: normal pulp DI: pulp necrosis	Chronic apical abscess	DI: instrumentation, irrigation with 5.25% NaOCl, Cavit At 3 wk: gutta-percha	12 mo: RG: resolution, MC: normal pulp	10
4	18/F	None	Pulp necrosis	Chronic apical abscess	Instrumentation, irrigation with 2% NaOCl, H_2O, 2% chlorhexidine, ultrasonic irrigation with NaOCl, flushed with 15% EDTA and H_2O $Ca(OH)_2$, sealed with GIC At 3 wk: $Ca(OH)_2$ removed, gutta-percha	24 mo: RG: resolution	11
5	13/F	Spontaneous pain, hyperemic mucosa	Pulp necrosis	Symptomatic apical periodontitis	Instrumentation, irrigation with 2.25% NaOCl $Ca(OH)_2$, Cavit At 2 wk: gutta-percha	18 mo: asymptomatic RG: resolution	2
6	12/M	Sinus tract	MC: normal pulp DI: pulp necrosis	Chronic apical abscess	MC and DI: instrumentation, irrigation with 0.5% NaOCl, $Ca(OH)_2$, Cavit At 1 wk: irrigation with 0.5% NaOCl, $Ca(OH)_2$ replaced, Cavit. At 1 wk: $Ca(OH)_2$ removed. DI: $Ca(OH)_2$ plug and MTA MC: gutta-percha	18 mo: sinus tract healed RG: resolution	12
7	13/F	Pain, swelling	MC: normal pulp DI: pulp necrosis	Acute apical abscess	DI: instrumentation, irrigation with 4.2% NaOCl, $Ca(OH)_2$, Cavit At 3 wk: irrigation with 4.2% NaOCl, flushed with 17% EDTA, passive ultrasonic irrigation with 4.2% NaOCl MTA	12 mo: asymptomatic RG: resolution	13
8	14/F	Sinus tract, edematous mucosa	MC: normal pulp DI: pulp necrosis	Chronic apical abscess	MC: instrumentation, irrigation with 5.25% NaOCl, 17% EDTA, gutta-percha master cone, WTI gutta-percha DI: NaOCl replenished every 8–10 min for 1.5 h, flushed with 17% EDTA, bolus of gutta-percha, WTI gutta-percha	4.5 y: sinus tract healed RG: resolution	Present case

GIC, glass ionomer cement; MC, main canal; RG, radiographic; WTI, warm thermoplasticized injectable.

*Some of the case diagnoses were amended to conform to current terminology adopted in 2009 by the American Association of Endodontists (17).