Case Report

Management options for dens invaginatus: Case series report

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ABSTRACT

Dens invaginatus (DI) is a developmental defect with invagination of enamel organ into the dental papilla before calcification of dental tissues. This report intends to emphasize the significance of early detection and management options when DI is evident, and will explore the extensive pulpal and periapical pathosis that is often accompany a nontreated DI.

Keywords: Bioactive cements, cone beam computed tomography, dens invaginatus, thermoplasticized obturation, ultrasonic irrigation activation

INTRODUCTION

Dens invaginatus (DI) is a developmental anomaly that results in the invagination of enamel organ into the dental papilla before calcification of dental tissues. Historical scientific literature is replete with numerous terminologies describing the conditions, such as “dens in dente” (Busch 1857), “dilated composite odontome” (Hunter 1951), and “gestant anomaly” (Colby 1956). Of the various terminologies representing this condition, “DI” is the most appropriate term describing the infolding of the outer enamel layer into the inner dentine with the formation of a pocket or dead space. Literature reports indicate that DI is not an uncommon anomaly, but one that can be very easily overlooked. A study by Patil and Doni reports the prevalence of DI in a North Indian population as 2.4%. This result, however, is from a radiographic observation, which may not have identified the presence of this anomaly in the radiographs that were reviewed. Furthermore, patients in whom there are no symptoms with these teeth having DI rarely seek treatment. This may have led to an underestimated prevalence rate.

The presence of invagination increases risk of caries, pulpal pathosis, and periodontal inflammation, with its presence often complicating both the nonsurgical and surgical endodontic intervention. This article aims to highlight the importance of early identification and treatment intervention and will clarify the extensive pulpal and periapical pathosis that is often associated with the presence of nontreated DI and its management.

CASE REPORTS

Case 1

A 25-year-old male patient reported with chief complaint of decay in the palatal aspect of maxillary incisors. Radiograph identified the presence of DI in his maxillary right and left central and lateral incisors [Figure 1a and b]. On clinical examination, the DI was completely confined within the palatal enamel Oehlers’ type I with evidence of demineralization [Figure 1c]. This lesion was minimally...
prepared and restored with a flowable composite restoration (Anabond Restofill N Flo, Anabond Stedman Pharma Research Pvt. Ltd., India).

**Case 2**

A 13-year-old male reported with chief complaint of a pit on the palatal surface of the maxillary right lateral incisor, which was determined to represent a DI. On clinical examination, there was evidence of active demineralization and cavitation [Figure 2a]. The cone beam computed tomography (CBCT) Machine Kodak CS 8100 3D (Carestream Dental, USA) was used for image acquisition with an exposure of 80 kV, 5 mA, 19.96 s and a voxel size of 90 μm for all the CBCT recordings in this report. The CBCT showed that the invagination was confined to enamel – Oehlers’ type I [Figure 2b]. The contralateral tooth was examined both clinically and in CBCT but showed no structural invagination [Figure 2a and b]. The importance of contralateral tooth examination for DI has been highlighted by Hülsmann.[9] The lesion was restored with a flowable composite.

**Case 3**

A 14-year-old male reported with swelling and pain in relation to the maxillary left anterior quadrant and was referred with provisional diagnosis of trauma from occlusion, leading to a periapical abscess [Figure 3a]. On examination of maxillary left anterior teeth, there was no evidence of decay or history trauma. Intraoral examination of maxillary left incisors and canine revealed the presence of small invagination on the palatal aspect of maxillary left lateral incisors, which was difficult to detect without magnification; no demineralization was evident. A CBCT revealed a DI – Oehlers’ type I, in the maxillary left lateral incisor with periapical bone destruction extending to the maxillary left canine [Figure 3b]. The contralateral maxillary lateral incisor also had a DI – Oehlers’ type I [Figure 3c]. In operating microscope (Labomed Prima, USA) at ×1 invagination, a dens was clearly visible in both maxillary laterals [Figure 3d]. In all the cases in this series, operating microscope Labomed Prima, USA, was used. Pulp sensibility test [Cold test (Endofrost, Roeko, Switzerland)] gave no response in maxillary left lateral. The diagnosis of DI – Oehlers’ type I with necrotic pulp with periapical abscess was made. Treatment was root canal treatment for maxillary left lateral with access preparation extending to include the DI groove [Figure 3e]. Flowable composite restoration was placed in the maxillary right lateral [Figure 3f]. Once the root canal treatment was completed, the swelling due to the abscess resolved [Figure 3g and h].

**Case 4**

A 17-year-old female patient presented with a chief complaint of pain in the right maxillary central incisors. On clinical examination, there was no evidence of decay and history of trauma to the tooth. A periapical radiolucency was evident on the maxillary right central and enamel invagination present in both the right maxillary central and laterals in radiograph [Figure 4a]. A CBCT indicated the presence of bone loss over the root apex of maxillary right central with intact labial and palatal cortical plates [Figure 4b]. The CBCT also showed the maxillary right central and both the laterals having DI-Oehlers’ type I [Figure 4c and d]. Cold pulp sensibility testing gave no response on maxillary right central. Root canal treatment was planned for the right maxillary central. Clinically, the palatal aspect of the right maxillary central did not show any evidence of enamel invagination or demineralization in magnification and also on methylene blue staining [Figure 4e and f]. Access preparation was done involving the invagination in the maxillary right central [Figure 4g and h]. Root canal space was obturated using thermoplasticized Gutta-Percha (Super Endo Alpha II and beta, B and L Biotech, Korea), and the invagination was restored through the access preparation with flowable composite under magnification [Figure 4i and j]. Maxillary lateral incisor invagination showed evidence of demineralization and was restored [Figure 4k and l].

**Case 5**

A 28-year-old male reported for treatment with chief complaint of the fractured incisor. On clinical examination, a horizontal crown root fracture from the cervical third of the crown in the maxillary right upper central incisor was identified [Figure 5a]. The patient was advised to have root canal treatment and reattachment of the fractured [Figure 5b]. On further examination of the patient’s maxillary incisors, a malformed left lateral incisor with small invagination close to the incisal edge with no evidence of demineralization and the tooth was nonresponsive to cold sensibility testing [Figure 5c and d]. Methylene blue staining was used, which gave an indication of the location of the invagination [Figure 5e]. A radiograph showed the presence of a lesion over the root apex [Figure 5f]. A CBCT identified an enamel lined invagination (Oehlers’ type II) with the canal morphology being of C-shaped due to the invagination; also, extensive periapical bone loss over the root apex of maxillary left lateral incisor with palatal cortical plate erosion was evident [Figure 5g]. The treatment plan included root canal treatment for maxillary left lateral followed by root-end surgery or decompression. The patient opted for root canal treatment and surgery. Root canal treatment was completed using ultrasonic activation (Ultra X, Orickam Co., India) of the irrigating solution to enhance cleaning, followed by canal obturation using Biodentine (Septodont, France) as a sealer with thermoplasticized gutta-percha technique [Figure 5h].
Since the enamel lined invagination was not involved in the access preparation, it was prepared separately and was shaped using nickel-titanium rotary files (Aurum Pro, Meta Biomed, Korea) [Figure 5i]. This complemented with ultrasonic activation with 3% sodium hypochlorite (Parcan, Septodont, France), followed by thermoplastic obturation [Figure 5j]. Access preparations were restored with composites. Charisma Smart, Kulzer, Germany composite was used for all the cases as a restorative material to seal the access in the present report. Apical root resection and curettage
was performed using papilla preservation flap design and a root-end filling of Biodentine was placed followed by bone grafting (Bio-Oss-Geistlich, Switzerland) and PRF was used as a bone fill [Figure 5k and l]. This case highlighted the complications that can exist when the tooth is malformed and has an invagination.\(^1\) The contralateral maxillary lateral did not exhibit any invagination [Figure 5m].

**Case 6**

A 20-year-old female patient presented with complaints of pain in her maxillary anterior teeth. On examination, it was determined that she had a discontinued root canal treatment of her right maxillary lateral incisor. Clinically, the maxillary right lateral had been restored with temporary cement; in addition, there was an enamel invagination in the maxillary left lateral incisor with no evidence of demineralization [Figure 6a]; a radiograph verified these observations [Figure 6b and c]. A CBCT confirmed the presence of enamel-lined invagination (Oehlers’ type II) in both the maxillary laterals [Figure 6d and e]. Furthermore, the maxillary right lateral coronal root canal space was encroached by the invagination, open apex, and periapical lesion. There was no response to cold testing on this tooth. This tooth was planned for root canal treatment and a composite restoration of the enamel invagination. On access opening under the operating microscope, it was evident that access preparation had missed the enamel invagination. The absence of demineralization indicated the need for a separate restoration [Figure 6f and g]. Root canal treatment was completed with ultrasonic activation of the sodium hypochlorite irrigation solution and with biodentine apical plug and thermoplastic obturation [Figure 6h]. The enamel invagination was cleaned using sodium hypochlorite with ultrasonic activation followed by a flowable composite restoration [Figure 6i]. Depth of the preparation was confirmed with a radiograph using 6% taper gutta-percha (Diadent Group, Korea) placed inside the preparation [Figure 6h].
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Case 7
A 23-year-old male patient reported with chief complaint of palatal surface decay on his maxillary right central incisor [Figure 7a]. On clinical examination, there was cavitated active demineralization evident in his right maxillary central, which was not responding to cold sensibility test. Radiograph
revealed periapical rarefaction in the right maxillary central and enamel invagination in all the maxillary central and lateral incisors. Clinical examination of the palatal surface of his other maxillary incisors also detected the presence of DI with active demineralization. CBCT observation also showed the presence of enamel invagination (Oehlers’ type I) in maxillary incisors and demineralization in the right maxillary central incisor extending into the pulp space and the invagination [Figure 7b-d]. Right maxillary central was taken up for root canal treatment and the access preparation was extended to include the invagination because of the extent of demineralization [Figure 7e]. Biodentine apical plug and thermoplastic obturation of the canal space was done because of the wide root canal space and lack of apical constriction. Flowable composite restoration was completed for the other maxillary incisors [Figure 7f].

DISCUSSION

All the cases presented here depict the importance of early detection and intervention of DI, along with recognizing this condition and the pathological and treatment ramifications of its presence. Susceptibility of DI for caries occurrence is dependent on the individuals’ caries risk, but the risk of pulpal necrosis and periapical lesion development is high when this dead space is not treated at an early stage as evidenced from cases where there was no evidence of demineralization in the groove. Younger age groups are likely to be at the greater risk posed by this condition, as evident from the age groups of the present cases. A greater understanding of this aberration associated with pulpal and periapical disease that the current recommendations suggest the preventive sealing. A retrospective study of prophylactic invagination sealing in pediatric patients reveals a success rate of 88.7% and their findings suggest a close follow-up program.[7] As suggested by Alani and Bishop[6] when both the invagination and root canal require treatment, consideration has to be given as whether they both are to be treated separately or their anatomy be unified. In case numbers 3, 4, and 7, the invagination was included in the access preparation as it was very close to the coronal pulp chamber and its path near the region of traditional access. Whereas, in case numbers 5 and 6, the location of the invagination and its path was located distant from the access location and extending the access to reach the invagination would have unnecessarily weakened the tooth structure. Except for two cases (case numbers 2 and 5) in this report, all the other patients had the bilateral occurrence of DI in maxillary lateral incisors. However, only one among these bilateral teeth in every patient had pulpal or periapical pathosis, the reason for this occurrence could not be ascertained. Furthermore, all the patients in the current report, sort for the management of DI only after they had developed symptoms in the concerned teeth and were not aware of the presence of invagination on their contralateral asymptomatic healthy teeth. A 5-year case report of the management of infected root canal in maxillary lateral incisor teeth with dens invagination with large periapical lesion exhibited excellent healing when root canal space was obturated with bioactive cement and the invagination being restored.[6] Many other case reports have advocated the use of bioactive cements in infected root canals with dens invagination to promote better healing.[8-11]

Modern magnification has enabled the identification and restoration of the invagination in a minimalistic manner. CBCT imaging enhanced the detection of the invagination by detailing its course and its proximity to pulp and root canal space. It would be impossible to manage the invagination...
and root canal space separately, using a periapical radiograph alone without this supportive information. Importance of the three-dimensional imaging in the management of DI has been highlighted earlier. A great deal of scientific advancements have taken place in diagnosing and treatment approaches for DI, as can be evidenced from the article published in 1998. Novel treatment strategies have been made possible with the usage of CBCT imaging.

When the root canal space is involved, management of the tooth should be with CBCT imaging and under the operating microscope. Infected root canal spaces with periapical tissue involvement will require the use of ultrasonic activation of irrigation solution and bioactive cements as either apical plug or as root canal sealer. Furthermore, the use of thermoplasticized gutta-percha is recommended when the extension of invagination is beyond the cementoenamel junction, as seen in Oehlers’ type II, and where the invagination and root canal are going to be managed separately. In this latter situation, invagination would have encroached into the root canal, making the obturation with cold compaction difficult.

CONCLUSIONS
This report highlights the wide variations in clinical presentation and anatomy of the dens invagination. Maxillary lateral incisors are associated with dens invagination in higher prevalence as seen in this case report and have also been reported in earlier literature. DI has also been rarely reported in other teeth such as canines, premolars, and molars. Even deciduous teeth may be affected with DI. The overriding objective in the management of dens invagination should be of early detection and sealing it to prevent further damage to the pulp and periapical tissues.

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Declaration of patient consent
The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest
There are no conflicts of interest.

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