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Clinical management of dens invaginatus in a maxillary lateral incisor with the aid of cone-beam computed tomography – a case report

CASE REPORT

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Abstract – This report describes non-surgical endodontic treatment of Oehlers' type III dens invaginatus in a maxillary lateral incisor with the aid of postobturation cone-beam computed tomography (CBCT). The endodontic treatment was initiated with the aid of a surgical operating microscope, and two canals, one of which represented the invagination, were instrumented, irrigated under passive ultrasonic activation and obturated with the lateral condensation technique. As postobturation periapical radiographs suggested the presence of untereated and/or unfilled areas in the root canal and invagination, CBCT was taken to assess the possibility of further treatment. The CBCT scans demonstrated inaccessible and unfilled canal and invagination areas because of complex internal morphology characterized by (i) C- or ring-shaped cross-sectional canal configuration with constrictions at different points in different root levels and (ii) a prominent intraradicular cavity that was communicated with the enamel-lined invagination and opened into the apical periodontium. Thus, it was judged that further endodontic treatment was not feasible. A 14-month follow-up revealed a satisfactory clinical and radiographic outcome, suggesting that the chemomechanical debridement may have sufficed to induce periapical healing. CBCT greatly helped the decision of avoiding further intervention that could have been difficult to negotiate.

Introduction

Cone-beam computed tomography (CBCT) has recently been introduced to the field of endodontics (1). Studies have revealed that three-dimensional images obtained by CBCT are more sensitive than periapical radiographs in detecting extra canals (2) and vertical root fractures (3, 4), and assessing post-treatment periapical lesions (5–7). Thus, CBCT is now considered as a useful tool for various complex endodontic conditions such as detection of root canal system anomalies, diagnosis of difficult-to-detect pathologies including trauma-related injuries, assessment of endodontic treatment complications, and presurgical case planning (8). Dens invaginatus is a developmental anomaly resulting from epithelial invagination of the tooth crown before occurrence of calcification. Its reported prevalence ranges from 0.3% to 10% of teeth, and the maxillary lateral incisor is most commonly affected (9). Dens invaginatus is classified into three types according to the extension level of the invagination (10): type I represents an enamel invagination confined within the tooth crown; type II is an enamel-lined form that invades the root as a blind sac and may communicate with the pulp; and type III is a severe form where the invagination extends beyond the cementoenamel junction and exhibiting a second foramen into the lateral periodontal ligament or the periapical tissue. Teeth affected by dens invaginatus are associated with an increased risk of pulp disease and its sequela, i.e., pulp necrosis and apical periodontitis, because the invagination allows entry of bacterial irritants and may communicate with the pulp space directly and/or through a thin enamel and dentin layer that may be developmentally deficient. Also, type III lesion may cause apical periodontitis without pulpal involvement.

Endodontic treatment of teeth affected by dens invaginatus and pulpal/periapical diseases may be highly complex or sometimes impossible because of aberrant anatomy. However, various treatment options including non-surgical endodontic treatment of the true canal and/or invagination, endodontic surgery, and their combinations have been reported to treat those cases (11–13). The success may still be dependent greatly on the internal morphology of the affected tooth that is highly variable and may be difficult to recognize under clinical setting.

We here present a case of dens invaginatus in a maxillary lateral incisor in which non-surgical endodontic treatment was performed and postobturation CBCT was taken to assess the possibility of further treatment. The CBCT greatly helped the decision of avoiding further intervention that could have been infeasible because of complex internal morphology with inaccessible areas.

Case report

A 12-year-old male patient who did not have any problems in his medical history was referred to the Clinic of Endodontics of Tokyo Medical and Dental University Hospital for endodontic treatment of his maxillary left lateral incisor because of unusual anatomy of the tooth. He suffered from swelling associated with the tooth. The occlusion was normal with no missing teeth. Clinical examination revealed swelling and a sinus tract in the labial region of the maxillary left lateral incisor, which was also sensitive to percussion. However, the clinical crown had no caries or restoration, and its morphology appeared normal and not different from that of the maxillary right lateral incisor (Fig. 1). The tooth did not respond to electric pulp vitality test using an Analytic Pulp Tester (Analytic Technology Corp., Richmond, VA, USA.) and thermal test using Pulper (GC Corporation, Tokyo, Japan), although adjacent teeth all responded within normal limits. Probing depths around the tooth were 2 mm or less. Initial periapical radiographic examination revealed that the maxillary left lateral incisor showed an abnormal morphology with an invagination that appeared narrow and enamel lined to the mid-root level (Fig. 1). A radiolucency of 15 mm in diameter was clearly detected at the apical area of the maxillary left lateral incisor. A diagnosis of dens invaginatus (Oehlers' type III) with pulp necrosis and chronic apical periodontitis was established Endodontic treatment was performed on the maxillary left lateral incisor (Fig. 2a). Without local anesthesia, rubber dam was applied on the tooth, and endodontic access was performed with a tapered safe-ended diamond point (F102R; Shofu, Kyoto, Japan). Using an endodontic explorer and a size 15 K file (Zipperer; Roydent Dental Products, Johnson City, TN, USA) with the aid of an operating microscope (Carl Zeiss, Göttingen, Germany), two orifices were identified (Fig. 2b). The two canals were negotiated, and working length was established with an electronic apex locator (Root ZX; J Morita Co., Kyoto, Japan). The primary canal was prepared by a crown-down technique, using Taper 0.04 ProFile Series 29 instruments (Dentsply/Maillefer, York, PA, USA) rotated with an endodontic handpiece with built-in apex locator (TriAuto ZX; Morita). The invagination was instrumented with stainless steel hand K files, Gates Gridden burs followed by ProFile instruments to 0.04 taper. During the instrumentation, the canals were irrigated with copious amount of 5.0% sodium hypochlorite. The irrigation was supported by the use of a spreader-shaped ultrasonic tip (ST21; Osada, Tokyo, Japan) that was activated by an ultrasonic unit (Enac; Osada) at a power setting of 2 for about 3 min. The tip was centered in the canal to minimize contact with the canal walls (passive activation). Following the final irrigation with 15% ethylenediaminetetraacetic acid and then sodium hypochlorite, the canals were dressed with calcium hydroxide paste (Calcipex II; Nippon Shika Yakuhin, Shimonoseki, Japan) and the access was sealed with temporary filling material (Caviton; GC Corporation). Calcium hydroxide was then replaced twice at 3-week intervals, and the swelling and sinus tract were resolved. Final obturation of the root canals was performed with gutta-percha cones using the standard cold lateral condensation technique and a zinc oxide non-eugenol sealer (Canals-N; Showa Yakuhin Kako, Tokyo, Japan), and the access was sealed with Caviton. Postobturation periapical radiographs revealed possible presence of untreated and/or unfilled areas in the root canal and invagination (Fig. 3a,b). Thus, dental CBCT

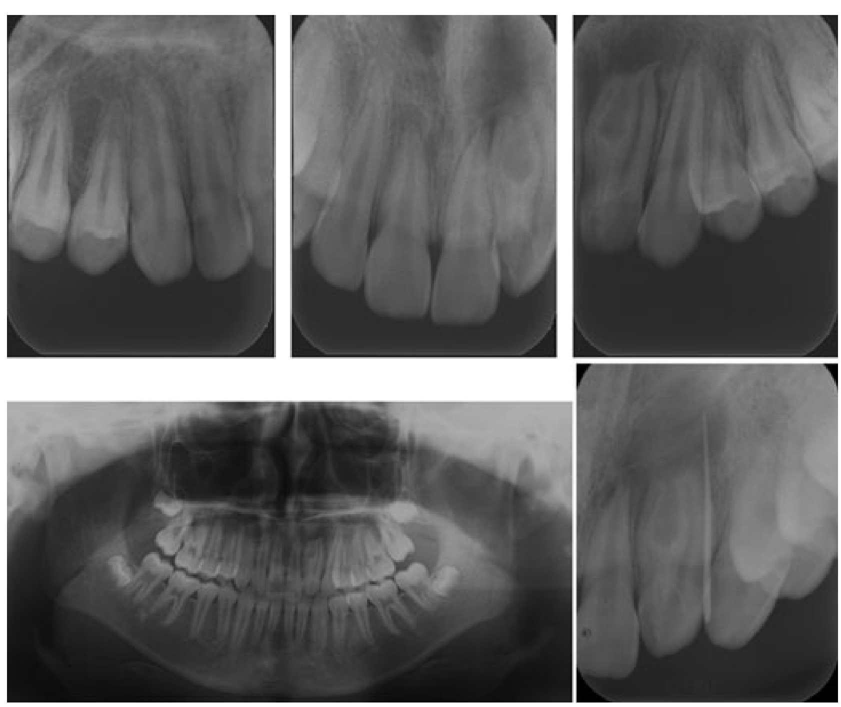

Fig. 1. Preoperative radiographs and pantomograph for diagnosis. The maxillary left lateral incisor showed dens invaginatus with a periapical radiolucency.

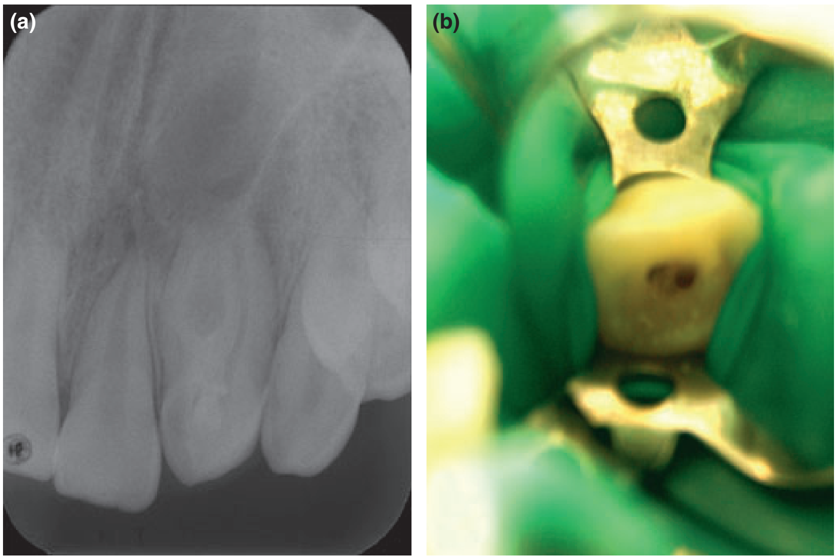

Fig. 2. (a) A radiograph of the maxillary left lateral incisor during treatment, showing a radiolucency. (b) Access opening showing two root canal orifices.

(Finecube; Yoshida Dental, Tokyo, Japan) was further taken to examine whether further orthograde and/or surgical endodontic treatment to improve the condition was feasible. The CBCT images showed a highly complex morphology of the root canal and invagination (Fig. 3c). The canal showed a thin C- or ring-shaped cross-sectional configuration with several constrictions at different points in different levels along the root, and only the distal area of the canal was occupied by the root canal filling material. Moreover, in the apical portion of the dilated root, the invagination was communicated with a prominent 'intraradicular cavity' that was not enamel lined and opened into the apical periodontium through a relatively large 'pseudoforamen'. The intraradicular cavity was poorly occupied by the root canal filling material. However, no communication between the root canal and the cavity was detected. Based on these morphological features, it was judged that non-surgical retreatment to improve the condition was not feasible. Because clinical signs and symptoms had been improved, surgical endodontic treatment was not carried out, and the crown was restored with light-cured resin composite, and the decision to observe the tooth periodically was made.

At the 14-month follow-up appointment, the tooth remained asymptomatic, and the control periapical radiograph revealed complete resolution of periapical radiolucency of the maxillary left lateral incisor (Fig. 4a–c).

Discussion

Cone-beam computed tomography is a useful tool for the management of complex endodontic problems, because it enables us to acquire three-dimensional information on the morphology of root canals, teeth, and surrounding tissues under radiation doses lower than the conventional CT (1, 2, 14). Some reports have described that CT scans are useful in the clinical management of teeth affected by dens invaginatus, because they clearly depict the type and extent of the invagination (14–16). In the present case, we used postobturation CBCT to assess the possibility of further treatment, because conventional periapical radiographs suggested the presence of untreated and/or unfilled areas. The CBCT scans demonstrated inaccessible and unfilled canal and invagination areas. Thus, the postobturation CBCT greatly helped the decision of avoiding further intervention that could have been infeasible because of complex internal morphology with inaccessible areas.

Treatment of teeth affected by type III invagination with pulp necrosis and periapical pathosis is usually challenging to the clinician, and different treatment options may be applied depending on the morphological complexity, including non-surgical endodontic treatment of the root canal and the invagination (17, 18), a combined endodontic and surgical treatment (13, 19–21), intentional replantation (22), or extraction (23). In this case, non-surgical endodontic treatment was carried out in an attempt to debride the canal space as much as possible, based on the widely accepted concept that non-surgical endodontic treatment should be constituted first and that surgical treatment is the second option only when the non-surgical treatment has failed. Postobturation CBCT images of the present case clearly showed a complex cross-sectional canal configuration, i.e., thin, C- or ring-shaped with several constrictions. Such configuration has been described schematically (24) and using CT scans of extracted teeth (9). In the present case, the position of canal constrictions differed at different levels along the root, indicating that a significant portion of the canal was inaccessible. One approach to achieve entire debridement could be to remove the invagination that inhibits complete cleaning and shaping (25), although such an approach may result in a great loss of tooth structure and be feasible only for invagination types I and II.

Another prominent morphological feature of the present case was the presence of non-enamel-lined

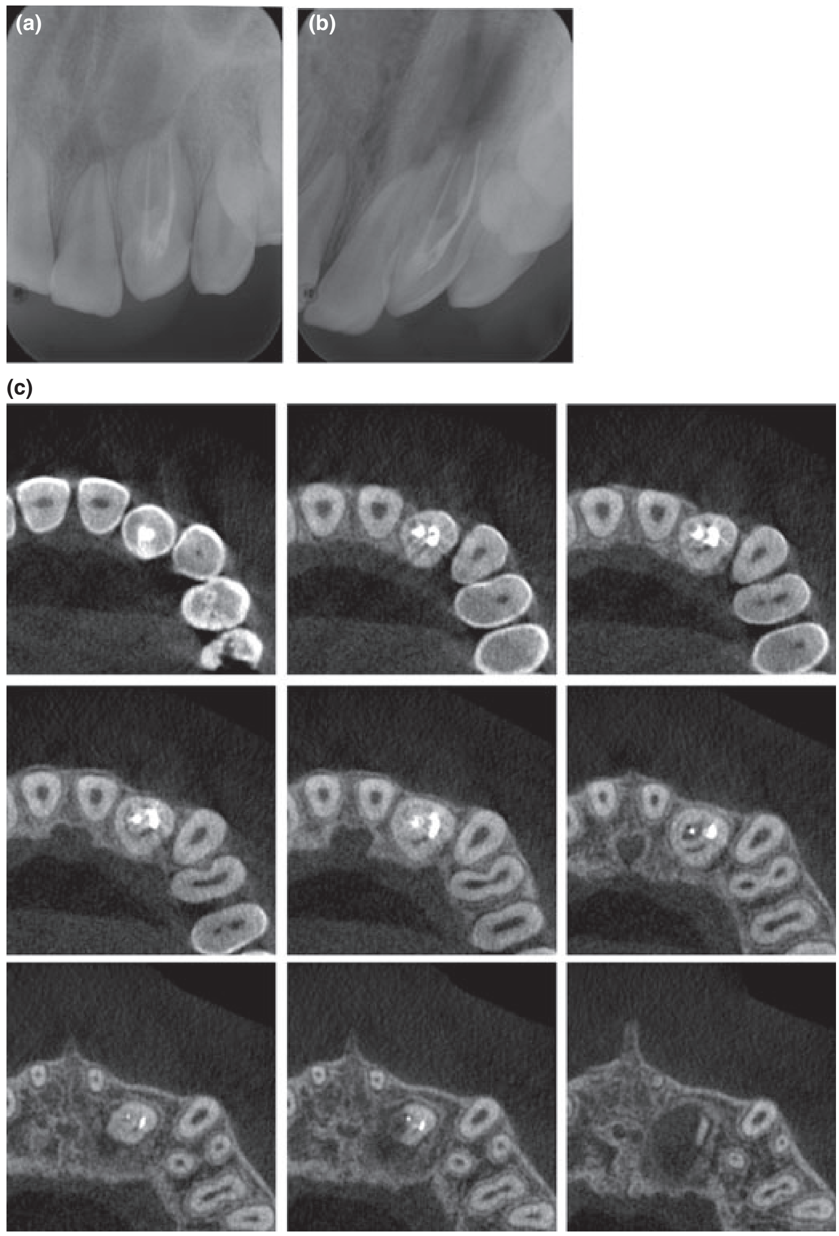

Fig. 3. Postobturation periapical radiographs (a, b) and dental cone-beam computed tomography axial sections (c). The CBCT images showed a highly complex morphology of the root canal and invagination.

intraradicular cavity that communicated with the enamel-lined invagination and opened into the apical periodontium as a relatively large 'pseudoforamen'. Although histological features of such structure have not yet been fully understood, some reports have demonstrated that it is lined by the cementum (26, 27). It has also been reported in a particular tooth that the cavity contained all components of the attachment apparatus (27). Thus, it is conceivable that, in certain cases, endodontic treatment is required only within the coronal channel (invagination).When the cavity contains necrotic tissues, orthograde debridement and filling may be compromised, and apical surgery may be indicated when the non-surgical treatment is not successful. In the present case, no communication between the intraradicular cavity and root canal was detected based on the CT examination, which could have favored the good prognosis.

Passive ultrasonic irrigation technique was used during the instrumentation, because activated irrigants are more effective to remove affected dentin debris (22, 24, 28)and considered suitable for the endodontic treatment of non-circular canals as those in teeth affected by dens invaginatus (23). This procedure could have facilitated the debridement of the canal space that was not accessible. The healing of periapical pathosis at the 14-month follow-up suggests that the chemomechanical debridement performed in this case may have sufficed to induce periapical healing, although this does not guarantee long-term success and longer follow-up seems necessary.

In conclusion, this case shows that the complex morphology of dens invaginatus is still a challenge in conducting instrumentation and obturation properly, as described in the previous reports (29, 30), and indicates

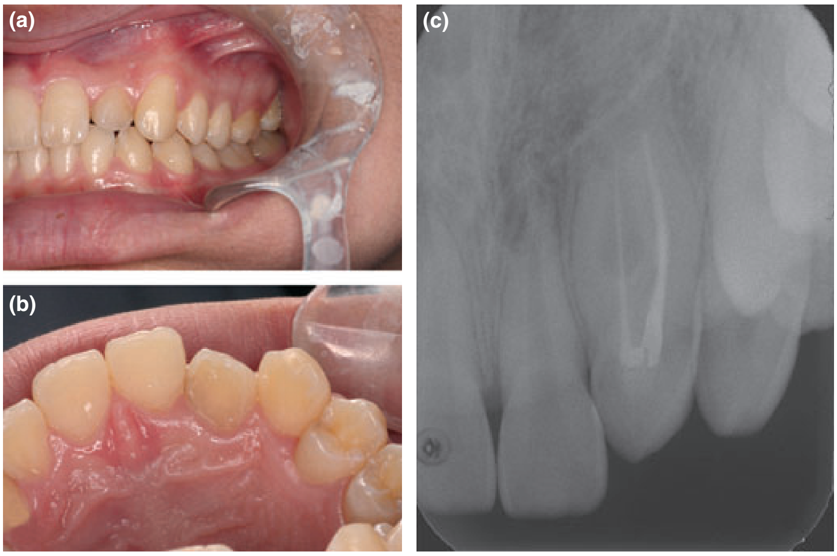

Fig. 4. Intra-oral views (a, b) and a radiograph (c) at the 14-month follow-up appointment, showing complete resolution of periapical radiolucency of the maxillary left lateral incisor.

that CBCT is useful in the assessment of the feasibility in the treatment of dens invaginatus.

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