Case Report

Non-surgical Endodontic Treatment for Dens Invaginatus Type III Using Cone Beam Computed Tomography and Dental Operating Microscope: A Case Report

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Abstract

Dens invaginatus is a morphological abnormality of the tooth in which the coronal tooth enamel and dentin fold inwards towards the pulp cavity. Dens invaginatus type III (Oehlers: 1957) is characterized by infolding of the enamel and dentin as far as the root apex. This report describes a case of surgical and non-surgical endodontic therapy for a maxillary lateral incisor with type III dens invaginatus, necrotic pulp, and an associated large periradicular lesion. The patient was a 16-year-old man. Periapical radiographs suggested the presence of an untreated area of invagination. Cone beam computed tomography (CBCT) was then used for three-dimensional observation of the morphological details of this area. The CBCT scans revealed invagination and its relationship with the pulp chamber. A dental operating microscope was used to access two primary root canals and the area of invagination. The root canals were then localized, negotiated, enlarged, and filled with calcium hydroxide. Two months later, the canal and invagination were obturated with core-based gutta-percha (FlexPoint Neo: FP core-carrier technique) and restored. Cone beam computed tomography and microscopic techniques allow even complicated cases of dens invaginatus to be diagnosed and treated using non-surgical root canal management.

Key words: Dens invaginatus — Cone beam computed tomography —
Dental operating microscope — Non-surgical treatment —
FP core-carrier technique

Introduction

Dens invaginatus is a morphological abnormality of the tooth in which the coronal tooth enamel and dentin fold inwards towards the pulp cavity. The prevalence of dens invaginatus varies considerably and is estimated to range between 0.25% and 10% depending on

the type of classification^{1,2,11)}. This anomaly arises most commonly in the maxillary lateral incisor and less frequently in the central incisors. The classification of dens invaginatus proposed by Oehlers (1957)⁸⁾ is probably the most clinically relevant, and is commonly used in clinical studies and case reports^{1–3,7,9–13)}. Dens invaginatus type III⁸⁾ is an anomaly

characterized by infolding of the enamel and dentin, sometimes as far as the root apex, but there is no immediate communication with the pulp. Dens invaginatus appears as an anomalous shape when viewed with conventional radiography^{1,6,7,11)}.

However, it is difficult to establish the three-dimensional morphological structure of the area of invagination. This report describes a case of a maxillary lateral incisor with type III dens invaginatus, necrotic pulp, and an associated large periradicular lesion. An overview of the feasibility of using cone beam computed tomography (CBCT) in the diagnosis and treatment planning and a dental operating microscope and the FlexPoint Neo (FP; Neo Dental Chemical Products, Tokyo, Japan) core-carrier obturation technique in the non-surgical endodontic management of a complex case of dens invaginatus is provided.

Case Report

A 16-year-old man was referred to our department at Tokyo Dental College Chiba Hospital by a general practitioner for evalua-

tion and root canal retreatment of the upper right lateral incisor because of a fistula that did not heal. Written informed consent was obtained for the use of the clinical records, including intraoral photographs, radiographs,

Fig. 1 Intraoral photograph taken at initial examination (a) Buccal view of upper lateral incisor showing peg-shaped microdont; (b) Palatal view showing temporary restoration after endodontic treatment.

Fig. 2 Periapical radiographs provided by referring general practitioner (a) Upper right lateral incisor showing dens invaginatus; only invaginated space was filled with gutta-percha; (b) Radiograph taken during retreatment showing medicated dressing in invaginated space.

and CBCT images, of this patient for this case report. The tooth appeared as a peg-shaped microdont from the buccal view (Fig. 1). Periodontal probing depth was less than 3 mm. The patient had undergone non-surgical endodontic treatment, surgical treatment (apicoectomy), and non-surgical retreatment for the lateral incisor prior to being referred to our department.

Periapical radiography (Fig. 2) showed that the tooth had Oehlers type III dens invaginatus with two primary root canals and a periapical lesion. Endodontic treatment had been performed for the invaginated space, which extending from the crown to the apex of the root. No such treatment had been

carried out for the two primary root canals, however.

To obtain a more accurate diagnosis, a CBCT scan (CB-Throne, Hitachi, Tokyo, Japan; 5×5 cm field of view; 120 kV; 15 mA; scanning time, 9.6 sec) of the tooth was performed (Fig. 3). Infolding of the enamel and dentin was clearly visible and distinct from the pulp chamber, and was divided into two distinct mesial/distal areas. At the middle level of the root, the area of invagination was lined with thin enamel, and the primary, circular root canals had almost been obliterated on the mesiopalatal and distobuccal sides. The two primary root canals were visible in slices of the apical area. The buccal root surface of

Fig. 3 CBCT images

(a) Three-dimensional computer graphics (3D-CG): Buccal view; (b) 3D-CG: Distobuccal view. (c) Coronal CBCT section of upper right incisor; (d) Sagittal CBCT section. (e) Panel of axial CBCT sections. From top to bottom, figures illustrate sections from root apex to dental neck. Two primary root canals and separate invaginated space can be seen.

the tooth was not covered by alveolar bone from the cervical line to the apex of the root. A stump showed evidence of an incomplete apicoectomy at the distal side of the root apex. Oehlers type III dens invaginatus associated with a periapical lesion was diagnosed based on these scans and three-dimensional reconstruction.

Clinical tests suggested that pulp necrosis had occurred due to rupture of the neurovascular bundle during curettage of the periapical lesion. Therefore, conservative root canal treatment of the primary root canals was initiated as the first stage of retreatment.

The tooth was isolated with a rubber dam and access gained to the narrow pulp chamber (Fig. 4) using a tapered, small-sized ultrasonic tip and a dental operating microscope (Carl Zeiss, Oberkochen, Germany). Two radicular access points were prepared in addition to the invaginated space in accordance with the CBCT images. A persistent exudate from the apical region into the regular root canal was noticed.

Radiographic assessment of the working length of the primary root canals and the invaginated space was performed (Fig. 5a). The canals were shaped to master apical size 40 (the primary root canals) and size 50 (the invaginated space), followed by stepback preparation. After canal irrigation with NaClO supported by the use of a spreader-shaped ultrasonic tip (Micro-endo file: #25/0.05, Mani, Utsunomiya, Japan), the root canals were dried, and no persistent exudate was observed. Ca(OH)₂ paste (Calvital, Neo Dental Chemical Products) was used as an intracanal dressing, and the access cavity was restored with temporary filling material (Cavition, GC, Tokyo, Japan).

On the day after the first treatment, swelling developed in the apical area, but all molimen disappeared. The Ca(OH)₂ paste was replaced 3 weeks later. After clinical signs and symptoms had resolved, the primary root canals and invaginated space were obturated on the third visit using the FP core-carrier technique^{4,5)}, in which a thermoplasticized gutta-percha root canal is used to fill the root

Fig. 4 Coronal view before pulp chamber was opened (a) Dark-stained dentin (arrowhead) provided clues to location of mesial pulp chamber. Asterisk marks orifice of invaginated space. (b) Postoperative view showing two prepared access cavities (arrowheads).

canal using a polypropylene obturation point (FP) as the core carrier.

FlexPoint Neo polypropylene cores were inserted into the root canals and the fit verified radiographically (Fig. 5b). After root canal sealer (Sealapex, SybronEndo, Glendora, USA) placement, the FP core-carrier coated with thermoplasticized gutta-percha was slowly inserted into each canal to the full working length. The surplus part of the core was removed and the filling material vertically compacted with root canal pluggers. The tooth was restored with temporary filling material. The immediate postoperative periapical radiograph (Fig. 5c, d) confirmed that the primary root canals and invaginated space

Fig. 5 Periapical radiographs taken during endodontic treatment

(a) Radiographic assessment of working length of mesial primary root canal and invaginated space. (b) Trial of polypropylene cores (mesial and buccal canal: #40, invaginated space: #50). (c) Verification of obturation of distobuccal primary root canal with core-based gutta-percha (FP core-carrier technique). (d) Post-operative periapical radiograph taken immediately after obturation of two primary root canals and invaginated space.

were successfully obturated.

Following treatment, the patient attended a different hospital for restoration of the tooth. The tooth remained asymptomatic at the postoperative one-year follow-up according to information obtained by telephone from the patient's family.

Discussion

Most clinical studies into dens invaginatus use the classification developed by Oehlers⁸⁾. Oehlers described three types: type I, an enamel invagination in the crown only; type II, an enamel-lined invagination that invades the root but remains confined within it as a blind sac and may communicate with the dental pulp; and type III, an invagination that extends from the crown to the apex and is penetrated by a second foramen laterally or apically on the root surface⁶⁾.

A retrospective study of prophylactic invagination treatment by Ridell *et al.*¹⁰⁾ reported that the most common type of tooth with dens invaginatus is the upper lateral incisor (85%), and that the prevalence of type III dens invaginatus is 3.3%.

In type III cases, the invagination penetrates through the root to the apical area, and has a second foramen in the apical or periodontal area, but there is no immediate communication with the pulp^{1,8,11)}. Alani and Bishop¹⁾ recommended that where "peri-invagination periodontitis" exists and the pulp remains healthy, all efforts should be aimed at preserving pulp health.

Tsurumachi¹²⁾ reported a case of type III dens invaginatus associated with a talon cusp involving a upper lateral incisor with significant peri-invagination periodontitis in which only the invagination was treated. Similar successful cases have been reported by many researchers^{6,7,11)}. In the present case, however, root canal treatment of the primary root canals was necessary given the presence of pulp necrosis caused by periapical endodontic surgery.

Conventional radiography plays an important role in evaluating the complex morphology of the root canal system, but it only provides two-dimensional representation of a three-dimensional structure²⁾. Non-surgical endodontic management can be achieved even in complicated cases of dens invaginatus by diagnosis and treatment planning using

CBCT scans^{1,3,9,11–13)} and microscopic treatment technique^{2,3,12)}. In the present case, the CBCT images revealed that the root canals and area of invagination had a highly complex morphology, indicating that appropriate management would require the use of a dental operating microscope.

Once preparation of the invaginated space is completed, filling with gutta-percha is acceptable. However, in this case, obtaining a three-dimensional seal of the root canal would have been difficult, because the form of the primary root canals was more complicated than a simple invaginated space. Therefore, care needed to be taken with the choice of the root canal filling method and filling technique.

Kato *et al.*⁵⁾ has devised a new thermoplasticized gutta-percha root canal filling technique using a polypropylene obturation point (FP) as the core carrier. In an earlier study⁴⁾, it was indicated that the FP core carrier method is effective for filling main and lateral canals. In the present case, the method was successfully used to fill complex root canals⁵⁾.

Cone beam computed tomography and microscopic techniques allow even complicated cases of dens invaginatus to be diagnosed and treated using non-surgical root canal management.

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