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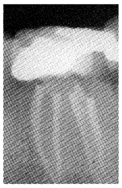

CASE REPORT

Contemporary treatment of class II dens invaginatus

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Abstract

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Aim To present the nonsurgical management of a tooth with class II dens invaginatus with an open apex utilizing contemporary techniques.

Summary Root canal treatment of teeth with complex root canal anatomy such as dens invaginatus can be problematic because infected pulpal tissues may remain in inaccessible areas of the canal system. The cleaning and debridement of such root canal systems are therefore challenging and may sometimes be considered impossible. An immature apical root-end development is another challenge in root canal treatment especially in controlling the apical extent of the filling material and achieving an apical seal. When difficulties in cleaning and filling combine, management options may include surgical intervention or extraction. This article reports the nonsurgical endodontic treatment of a case of an open apex and dens invaginatus utilizing the operating microscope, endodontic ultrasonic instruments and mineral trioxide aggregate.

Key learning point

- Teeth with class II dens evaginatus and an open apex may be managed successfully with contemporary nonsurgical materials and techniques.

Keywords: dens invaginatus, dental operating microscope, mineral trioxide aggregate apexification.

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Introduction

Dens invaginatus is a developmental anomaly resulting from the invagination of the enamel organ into the dental papilla during the soft tissue stage of development. As the hard tissues are formed, the invaginated enamel organ produces a small tooth within the future pulp chamber. In the severe type of dens invaginatus, there is a folding of

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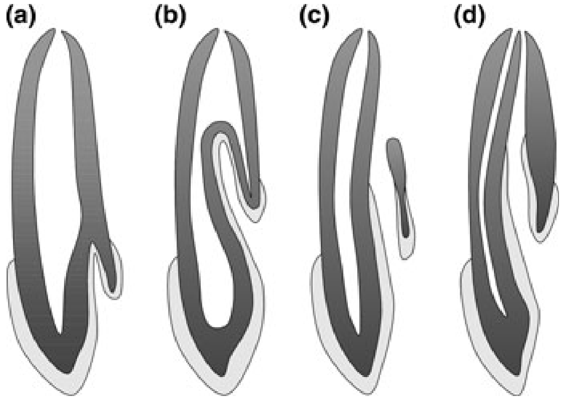

Figure 1 Classification of dens invaginatus. Adapted from **Oehlers (1957)** class I (a); class II (b, c); class III (d).

Hertwig's sheath into the developing root. This invaginated epithelial organ then produces enamel and dentine within the root (Bhaskar 1986). The aetiology remains controversial, and although many hypotheses have been proposed, none has been proven or widely accepted. Its prevalence ranges from 0.04% to 10% (Hovland & Block 1977), with the maxillary lateral incisor the most commonly affected tooth. Dens invaginatus can be classified according to its severity, with the most commonly accepted classification of Oehlers (1957) describing three classes: class I invagination is limited to the crown, class II invagination invades part of the root and class III invagination invades the entire root (Fig. 1).

Teeth with dens invaginatus pose challenges for root canal treatment because of their anatomical complexity. Many treatment regimens have been suggested such as conventional root canal treatment (Hovland & Block 1977), combined root canal–surgical treatment (Benenati 1994), intentional replantation (Lindner *et al.* 1995) and extraction (Rotstein *et al.* 1987). However, extraction and intentional replantation are usually the last resort. Surgical approaches are avoided when possible, due to the inability to completely clean the entire canal and issues of patient comfort. Additionally, surgical intervention may pose the challenge of producing an apical seal in a thin, fragile and irregular apical root end. The delicate root canal walls of the root-end preparation may fracture during compaction of root-end materials (Rafter 2005).

Nonsurgical root canal treatment has been considered impractical with class II and III dens invaginatus because of the challenge in adequately cleaning the root canal without the removal of dens. In the past, the removal of the dens was considered unfeasible (Lindner *et al.* 1995), but the technological advancements of operating microscopes and ultrasonic instruments have now made this option possible (Girsch & McClammy 2002). Outcome studies for the treatment of teeth with dens invaginatus are, however, unavailable due to the rarity of the condition.

Open root apices also present a challenge especially in controlling the apical extent of the root filling. Traditionally, this situation has been managed by apexification with long-term calcium hydroxide medication. As the calcium ions in the apical barrier do not come from the calcium hydroxide itself, but from the blood stream (Sciaky & Pisanti 1960, Pisanti & Sciaky 1964), the mechanism of action of calcium hydroxide during the induction of an apical barrier remains controversial. Even though calcium hydroxide apexification often results in favourable outcomes (Kerekes *et al.* 1980, Cvek 1992), it possesses some disadvantages including variability of treatment time (3 months to 2 years), difficulties with patient follow-up and delayed treatment (Cvek 1972, Kleier & Barr 1991, Sheehy & Roberts 1997, Finucane & Kinirons 1999). This also makes the treatment less predictable in terms of total time required for its completion. A relatively recent addition to the endodontic armamentarium is mineral trioxide aggregate (MTA), which has added an extra clinical treatment option for the management of wide apices (Witherspoon & Ham 2001, Giuliani *et al.* 2002). MTA is a highly biocompatible material with many favourable properties and clinical uses (Torabinejad *et al.* 1997). This material can be used in a single step to create an artificial apical barrier against which the root canal filling can be compacted.

The following case report presents a nonsurgical root canal treatment utilizing the operating microscope and ultrasonic instruments on a maxillary right canine that exhibited class II dens invaginatus and an open apex.

Case report

An 18-year-old female patient presented to the casualty department of The Royal Dental Hospital of Melbourne, Australia with a history of pain and swelling in the maxillary right anterior region. After initial examination, the patient was referred to the endodontic department for consultation and further management. She reported throbbing pain and swelling about a week before, but at the time of examination, there were no symptoms. Clinical examination revealed the maxillary right canine (tooth 13) to be unusually wide in its mesio-distal dimension, and the tooth appeared sound without any restorations. There was no evidence of a swelling or sinus tract; however, the tooth was slightly tender to percussion. The labial mucosa related to the 13 was tender to palpation. The tooth was nonresponsive to CO_2 stimulation, whilst the adjacent teeth responded normally. Periodontal probing was within normal limits. Radiographic examination revealed immature root development, an apical radiolucency of approximately 4 mm in diameter and an anomalous internal structure consistent with class II dens invaginatus (Fig. 2). A diagnosis of pulp necrosis with chronic apical periodontitis was made. The contralateral canine was also checked for clinical and radiographic signs of the same abnormality, but there were none.

The treatment plan presented to, and accepted by, the patient was to perform removal of the dens and infected necrotic pulp tissue, followed by MTA apexification.

Endodontic treatment was initiated with the aid of an operating microscope (Möller Denta 300; Möller-Wedel GmbH, Wedel, Germany). After rubber dam isolation and gaining access into the pulp chamber, two distinctly separate areas of pulp tissue were found. A central component was surrounded by internal hard tissue; the lateral component appeared to form a C-shape extending from the mid-labial towards the mesial and palatal surfaces. The internal hard tissue was removed under the operating microscope with ultrasonic endodontic tips sizes 2–4 (ProUltra™ Endo Coated instrument; Dentsply Tulsa Dental, Tulsa, OK, USA) at power setting 4 of the ultrasonic unit (Satelec P5; Dentsply Tulsa Dental) in a brushing motion working from an apical to coronal direction. Pulp burs were also used to assist in the removal of the dens (Fig. 3). Radiographs were taken to confirm the centrality of the ultrasonic tips and pulp burs (Fig. 4). The dens was thus removed completely, allowing working length assessment (Fig. 5) and total removal of pulpal tissue. The canal was initially debrided with large nickel–titanium rotary instruments up to size 90 (ProFile®; Dentsply Tulsa Dental). The master apical size of 130 was achieved using K-files (SybronEndo, Orange, CA, USA). The canal was irrigated with 1% sodium hypochlorite and dressed with calcium hydroxide paste (Pulpdent Corp., Watertown, MA, USA). The access cavity was temporarily sealed with Cavit (ESPE, Dental AG, Norristown, PA, USA) and Fuji IX (Kerr Corp., Orange, CA, USA). The patient missed the appointment 1 week later, but returned after 6 weeks, having remained free

Figure 2 Preoperative radiograph.

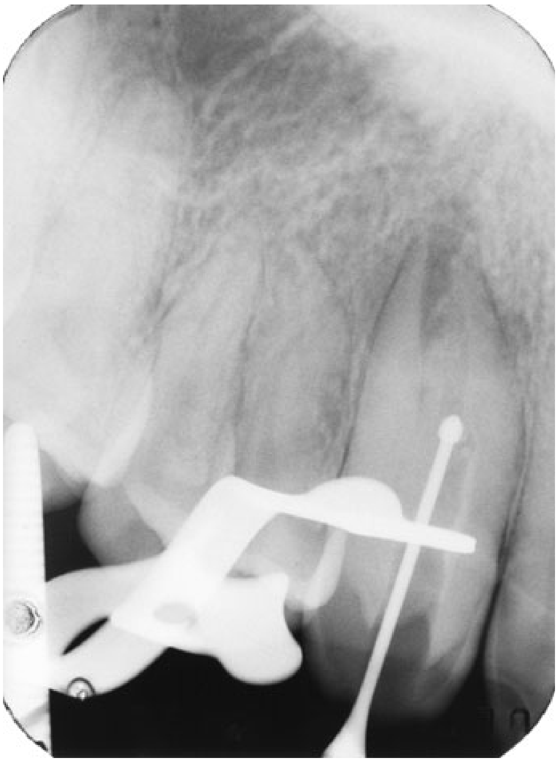

Figure 3 Dens removal with pulp bur.

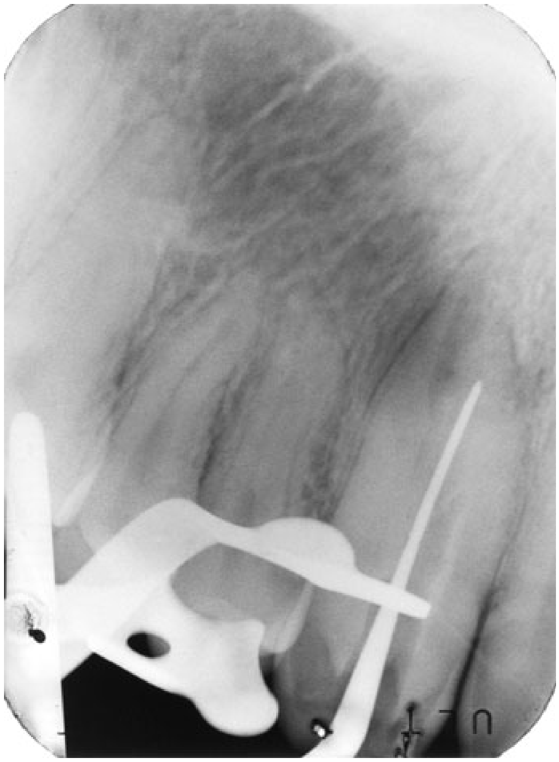

Figure 4 Dens removal with ultrasonic instruments (ProUltra™ Endo Coated Instrument Nos 2–4).

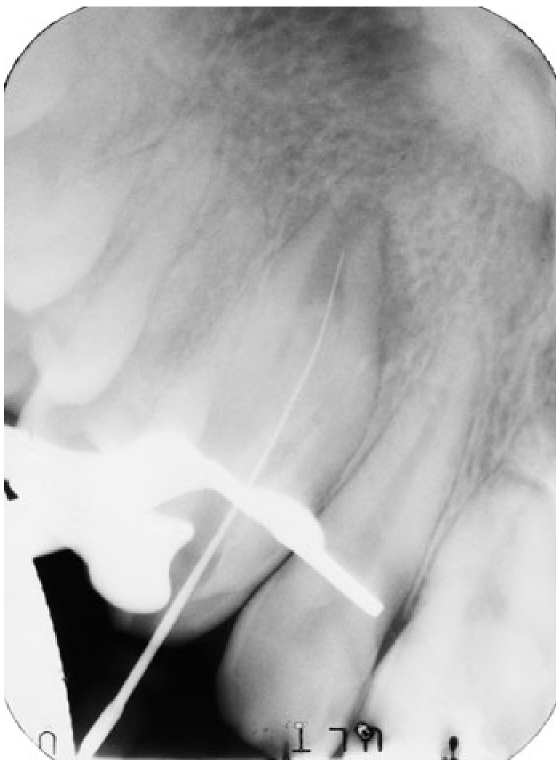

Figure 5 Estimated working length.

Figure 6 The placement of mineral trioxide aggregate apical barrier.

of any symptoms. At this second appointment, the tooth was not tender to percussion and the soft tissues in the area were not tender to palpation. MTA apexification was therefore commenced.

After rubber dam placement, the canal was irrigated with 1% sodium hypochlorite and dried with paper points. The apical barrier was checked with paper points to determine if an external matrix of calcium sulphate was necessary against which to compact the MTA (ProRoot MTA; Dentsply Tulsa Dental). As there was a reasonably firm soft tissue barrier at the apex, MTA alone was carefully compacted by hand into the root canal incrementally with a 5/7 endodontic hand plugger (Dentsply Tulsa Dental) to create an artificial apical barrier of some 4-mm thickness (Fig. 6). A moist cotton pellet was then placed in contact with the MTA to encourage setting and the canal sealed with Cavit. The following day, the cotton pellet was removed; the coronal portion of the canal was cleaned, dried and filled with thermoplasticized gutta-percha (Obtura-Spartan Corp., Fenton, MO, USA) and AH-26 sealer (DeTrey Dentsply, Konstanz, Germany) (Fig. 7). The access cavity was restored with Fuji IX and composite resin.

At 1-year review, the patient reported no symptoms. The tooth was not tender to percussion and the labial mucosa related to the area was not tender to palpation. The radiograph showed reduction in size of the apical radiolucency (Fig. 8). The patient will be recalled annually for long-term follow-up.

Discussion

The vast majority of the literature concerning dens invaginatus consists of case reports, which lie low in the hierarchy of evidence (Greenhalgh 2006). Several treatment options

Figure 7 Completed treatment.

Figure 8 One-year review radiograph.

have been presented in case reports and evidence for a best treatment option for dens invaginatus is lacking. The case presented here represents only one treatment approach, which may not be necessarily appropriate in all such clinical scenarios.

In teeth with dens invaginatus with immature root development, a large amount of dentine has to be removed to ensure adequate cleaning. Unfortunately, this may lead to increased fracture susceptibility of the delicate root-end walls. Several methods have been proposed to strengthen the root (Katebzadeh *et al.* 1998, Lertchirakarn *et al.* 2002). Most of these involve bonding a material to the root dentine in the canals. However, it has been shown that such a bond can break down over time (Kitasako *et al.* 2001, 2002). Thus, long-term reduction of fracture susceptibility utilizing bonding techniques must be questionable. In the current case, the dentine wall appeared to be reasonably thick, so fracture was not a major concern.

Conclusions

Historically, nonsurgical root canal treatment of teeth with severe dens invaginatus was deemed impractical. Treatment options were then limited, e.g. surgical intervention or extraction. The dramatic improvements in an endodontic armamentarium make possible the conservative treatment of such anomalies. This case report has shown that class II dens invaginatus with an open apex can be treated nonsurgically with an aid of the operating microscope, ultrasonic endodontic instruments and a relatively new material (MTA).

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