Case Report

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Non Surgical Endodontic Treatment of Type II Dense Invaginatus

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ABSTRACT

Background: Dens in dente or Dense invaginatus is an anomaly of development resulting from deepening or invagination of the enamel organ into the dental papilla, which begins at the crown and often extends to the root, before the calcification of the dental tissues & affects most commonly maxillary incisors. Dense invaginatus can present in a variety of forms, knowledge of which can help in endodontic diagnosis & treatment. This article reports a case of type II dense invaginatus with a periradicular lesion in maxillary lateral incisor assessed thoroughly with three dimensional C-T scan & treated with non surgical approach. The use of contemporary endodontic techniques in the diagnosis, treatment planning and management of the case is highlighted in this article.

Keywords: Dens in dente, type II, dentistry.

INTRODUCTION

Developmental tooth disturbances pose a challenge to the clinician in diagnosis as well as treatment because of its complex crown and root canal morphology. One such rare developmental anomaly of teeth is dens invaginatus. Dens Invaginatus results from deepening or invagination of the enamel organ into the dental papilla prior to calcification of the dental tissues.[1] The incidence of dens invaginatus is between 0.3% to 10% in adults[2], with the maxillary lateral incisors being the most commonly affected.[1] As far as etiology for dens invaginatus is concerned, many theories have been proposed, including focal growth retardation[3], growth pressure of the dental arch[4], localized external pressure in certain areas of the tooth bud[5], infection, and trauma.[6]

Oehlers[7] classified dens invaginatus into 3 types on the basis of severity: type I, an enamel-lined minor form occurring within the confines of the crown not extending beyond the cement-enamel junction; type II, an enamel-lined form that invades the root but remains confined as a blind sac and might or might not communicate with the pulp; and type III, a form that penetrates through the root perforating at the apical area, showing a second foramen in the apical or in the periodontal area. The clinical appearance of dens invaginatus varies considerably. The crown of affected teeth can be of normal morphology but can also be associated with unusual forms like greater labiolingual diameter, peg-shaped, barrel-shaped, and conical and talons cusp[8,9].

In the past, techniques for management of the open apex in non-vital teeth were confined to custom fitting the filling material, paste fills and apical surgery[10]. Apexification with calcium hydroxide ($Ca(OH)_2$) is the most commonly advocated therapy for immature teeth with non-vital pulp. Whilst the advantages of calcium hydroxide lies in the fact that it has been widely studied and has shown success[11,12,13,14], the

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Fig 1: Preop Intraoral Photograph.

Fig 2: Preoperative Intra oral periapical radiograph.

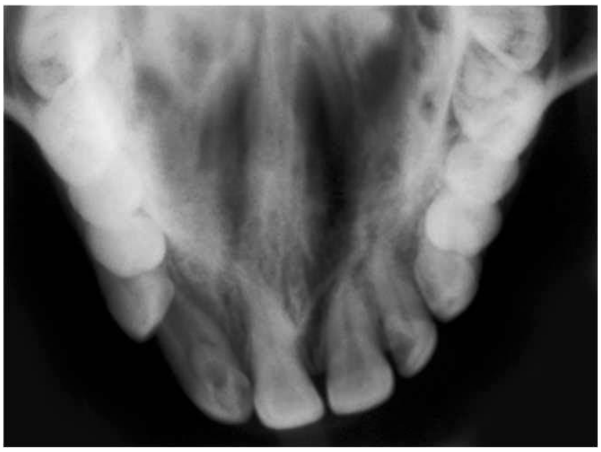

Fig 3: Preoperative Occlusal radiograph.

disadvantages are its prolonged treatment time, the need for multiple visits and radiographs[15,16]. One alternative to calcium hydroxide apexification is a single-step technique using an artificial apical barrier using Mineral Trioxide Aggregate(MTA).

Fig 4: Spiral computed tomography images.

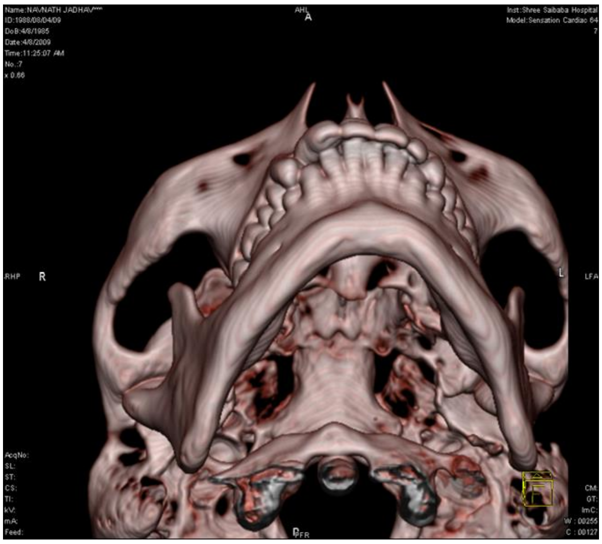

Fig 5: Spiral computed tomography images.

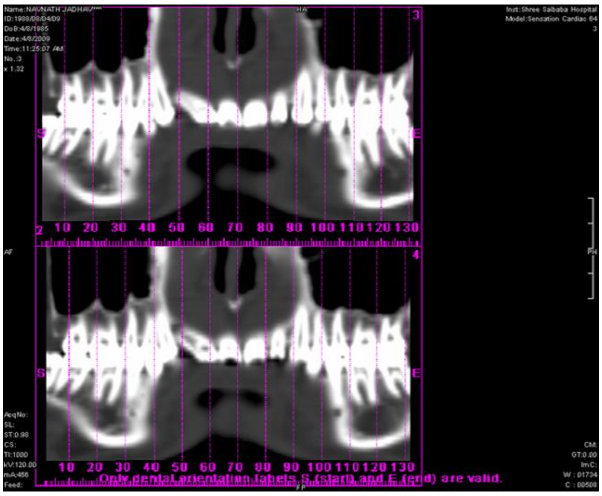

Fig 6: Spiral computed tomography images.

Fig 7: MTA Plug

Fig 8: Ribbond Insertion.

Fig 9: Ribbond Insertion.

Fig 10: IMM EDIATE POST OP.

Fig 11: Follow up 18 months.

Fig 12: Followup 24 Months.

Apexification using MTA has several advantages such as it neither gets resorbed, nor weakens the root canal dentin, and also sets in the wet environment[17,18] Sometimes the normal dental radiographs usually are not sufficient to aid in understanding the complicated morphology of the root canal system, as in the case of invaginated teeth. These problems might be overcome by using newer diagnostic methods such as spiral computed tomography (SCT) or volume acquisition CT, which can produce 3-dimensional (3D) images of individual teeth and the surrounding tissues.

This case report presents the management of dens invaginatus affecting the maxillary lateral incisor associated with an open opex (single step apical barrier placement using MTA and root reinforcement with ribbond) with the use of SCT as a diagnostic aid.

CASE REPORT

A 20 year old male patient presented to the department of conservative dentistry and endodontics with pain to hot and cold food in the right maxillary anterior region. On clinical examination, the maxillary right lateral incisor exhibited abnormal crown morphology. The tooth was wider labiopalatally. History of pain & swelling with the same tooth one month back & medication by a private practitioner.There was no previous history of trauma or any hereditary conditions. Medical history was noncontributory. All vital signs were found to be within normal limits. Oral examination revealed a normal set of dentition. The tooth was not sensitive to palpation or percussion. The tooth was non- reactive to an electric pulp tester (Parkell Electronics, Farmingdale, NY, USA) and a cold test (R C Ice, Prime Dental products, India). A clinical & radiographic diagnosis of necrotic pulp & chronic periapical abscess was established. On radiographic examination, the enamel-lined invagination could be identified extending from the crown to a varying distance into the root forming a pear-shaped radiolucent structure resembling a 'tooth within a tooth'., but it was not possible to recognize the complex structure of the pulp. Therefore, to ascertain the complex root canal anatomy of the tooth in a 3-dimensional (3D) manner, dental imaging with the help of Spiral Computed Tomography (SCT) was therefore planned. Informed consent from the patient was obtained, and a multislice SCT of the maxilla was performed using the dental software Dentascan (GE Healthcare, Milwaukee, WI). A 3D image of the maxilla was obtained. The involved tooth was focused and the morphology was obtained in transverse, axial, and sagittal sections of 0.5 mm thickness (Fig4,5), along with 3D reconstructed images (Fig6,7).

Management:

Local anaesthesia was administered and a rubber dam was applied. Endodontic access cavity was done on the occlusal surface using a No. 2 round bur and EX 24 bur (non end cutting tapered fissure; Mani, Tochigi, Japan). The internal hard tissue was removed under the operating microscope with ultrasonic endodontic tips sizes 2–4 (ProUltraTM 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 with the aid of an operating microscope (Carl Zeiss). The canal was instrumented lightly with K files (Mani, Japan) with the aim of cleaning the root canal walls of debris. The canal was thoroughly debrided with a copious irrigation of sodium hypochlorite (3%) and saline (0.9%) coupled with passive ultrasonic agitation (Irrisafe, Satellec, France) to ensure complete removal of the necrotic pulp tissue. The canal was dried with sterile paper points and Calcium hydroxide (Ultracal XS, Ultradent, South Jordan, and UT) was placed as an intracanal medicament and the access cavity was temporized with Cavit G (3M ESPE; Germany). The patient was recalled after 1 week.

After 1 week, the tooth was asymptomatic. At this appointment it was decided to use MTA as an apical barrier. Informed consent of the patient was obtained in writing after thoroughly explaining the clinical procedures, risks involved and clarifying all questions raised by the patient. The root canal was flushed with 1% sodium hypochlorite followed by normal saline. The canal was dried with absorbent paper points (DENTSPLY, Tulsa Dental). Mineral trioxide aggregate was introduced into the canal and compacted using schilders pluggers (DENTSPLY Caulk, Milford, DE). A radiograph was exposed to confirm adequate placement of MTA to form an apical stop approximately 3-4 mm thick (Fig 8). The blunt end of a large paper point was moistened with water and left in the canal to promote setting. A cotton pellet was placed in the chamber and the access cavity was sealed with temporary filling material IRM (Caulk/DENTSPLY, Milford, DE).

After 2 days, the patient remained asymptomatic and the tooth was isolated and accessed as before. A hand plugger was lightly tapped against the MTA plug to confirm a hardened set. The length of the pulp space from coronal to the MTA was measured. This length was doubled and length of the fiber was measured. Two pieces of fiber were then cut with special scissors. Ribbon pieces (Ribbond Reinforcement Ribbon, Ribbon, Scottle, WA, USA) were coated with bonding agent (Scotchbond 1,3M Dental products, St.Paul, MN, USA) and excess was blotted out. The ribbons were folded in a V shape and the inside of Vs was coated with dual cure resin (Panavia F, Kuraray). The first piece of ribbon was then placed in the post space in a facio lingual orientation (Fig9). A second V of ribbon was then placed at right angles to the first ribbon piece (Fig 10). The ribbons were condensed below the cervical part of the tooth and a small drop of dual cure resin was then placed between the ribbons. Then the core build up was done with composite resin (3M ESPE, St paul, USA) (Fig11)and cured. The patient was followed up for a period of 14 months (fig 12).

DISCUSSION

Teeth with dens invaginatus pose challenges for root canal treatment because of their anatomical complexity. Managing invaginated immature tooth with necrotic pulp is further complicated by thin root walls and open apices associated with these teeth. Treatment decisions for teeth with dens invaginatus should be based on a thorough preoperative evaluation of the severity and complexity of the invagination. To identify the type of invagination, a thorough preoperative radiographic evaluation, often with radiographs taken at different angles, is important. Radiographic examination is an essential component of the management of endodontic problems. It underpins all aspects of endodontic treatment from diagnosis and treatment planning to assessing outcome. The amount of information gained from conventional film and digitally captured periapical radiographs is limited by the fact that the 3D anatomy of the area being radiographed is compressed into a 2-dimensional image. As a result of superimposition, periapical radiographs reveal limited aspects of the 3D anatomy. In addition, there might also be geometric distortion of the anatomic structures being imaged[19]. These problems can be addressed by the use of SCT, which can produce 3D images of individual teeth and aid in better understanding of the root canal morphology. In this specific case, an SCT could confirm the complicated morphology of the root canal system of the invaginated tooth. This technique seems to have the potential to visualize the topography of root canals and offer new perspectives for dental imaging of special clinical cases. SCT has been used successfully in clinical dentistry for the confirmatory diagnosis of morphologic aberrations in the root canal anatomy[20,21,22], and it might provide a better, more accurate, and faster diagnostic method in 3 dimensions.

Many treatment regimens have been suggested such as conventional root canal treatment[23], combined root canal–surgical treatment[24], intentional replantation[25] and extraction[26]. 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[10]. Non-surgical endodontic treatment should be attempted first regardless of the size of the periradicular lesion.

Type II invaginations, as presented here, are often difficult to treat as the root canal system is complex, and the invagination prevents access to perform proper cleaning and shaping necessary for infection control. When communication also exists between the invagination and the main root canal, early pulp necrosis may occur soon after eruption, often before root end closure[27]. This should also be considered during treatment planning, as the tooth is immature and may be prone to fracture.

Treatment in these cases also relies on an apexogenesis/apexification procedure and a restorative treatment plan that considers fracture risk and fracture resistance[28].

Calcium hydroxide has been the first choice material for apexification, with repeated changes over the course of 5-20 months to induce the formation of a calcific barrier[29]. The unpredictable and often lengthy course of this treatment modality presents challenges, including the vulnerability of the temporary coronal restoration to re-infection[30]. Moreover, the treatment requires a high level of patient compliance. For these reasons, one visit apexification has been suggested[31].

Mineral Trioxide Aggregate (MTA), introduced by Torabinejad and colleagues at Loma Linda University has shown promising results[32]. MTA has demonstrated minimal leakage of dye and bacteria in comparison with other restorative materials[33]. MTA, a bio-compatible material, can be used to create a physical barrier that also helps in formation of bone and periodontium around its interface[34]. With the use of MTA, the potential for fractures of immature teeth with thin roots is reduced because a bonded core can be placed immediately within the root canal.

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[35]. Favorable clinical results with resin reinforcement and dowel and cores in structurally weakened teeth have been reported by some clinicians[36]. Ribbond material is composed of preimpregnated, silanized, plasma treated, leno-woven, ultra high molecular weight polyethylene fibers. Leno-weave is a special pattern of crosslinked, locked-stitched threads which increase the durability, stability and shear strength of the fabric. The open and lacelike architecture of the lenowoven. Ribbon allows it to adapt closely to the contours of the teeth[37].

Ribbond fibers are translucent and assume the color of the resin to which they are added. Ribbond fibers easily absorb water because of the 'gas-plasma' treatment to which they are exposed. This treatment reduces the fibers superficial tension, ensuring a good chemical bond to composite materials[38]. The leno-weave of Ribbond reportedly resists shifting and sliding under tension more than a plain weave, minimizing crack propagation[39]. This occurs by reducing the coalescence of microcracks within the resin matrix into cracks that could lead to failure of the restorative complex. This composite reinforcement fiber network provides an efficient transfer of stress within the internal frame work by absorbing the stresses that are applied to the restorative complex and redirecting those forces along the long axis of the remaining root structure, thereby minimizing the risk of root fracture[40].

CONCLUSION

This case report demonstrates a predictable and successful solution toward the nonsurgical endodontic management of a invaginated immature maxillary lateral incisor, adopting innovative new treatment strategies in the most conservative way. The Oehlers type II dens invaginatus presents a complex root canal system that impairs proper cleaning, shaping and asepsis. Completely debriding the infected canal is the key to the success of this case. The removal of the invaginated mass of hard tissue in the canal with the aid of operating microscope and ultrasonic instruments made a difficult and challenging task very easily achievable. The combination of MTA as an apical barrier and Ribbond to reinforce the immature tooth could be considered as a good option for treating invaginated teeth with open apices. However, controlled clinical trials are necessary to investigate the predictability of the outcome of the technique. This report also highlights the use of SCT as a diagnostic tool to a great effect in understanding the complex root canal anatomy, thus helping a great deal in rendering successful endodontic therapy.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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