Bull Tokyo Dent Coll (2015) 56(3): 169–175

Case Report

Microscopic Endodontics in Infected Root Canal with Calcified Structure: A Case Report

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Received 19 January, 2015/Accepted for publication 23 April, 2015

Abstract

Calcium deposited within a root canal due to exogenous stimuli may hamper root canal treatment. In endodontic treatment, an operating microscope allows the conditions within the root canal to be directly viewed and evaluated. This report describes a case in which an operating microscope was used to facilitate the excision of a calcified structure from within a root canal at an early stage in the treatment of an infection. An 18-year-old man was referred to our clinic due to suspected chronic suppurative apical periodontitis of the right maxillary central incisor. Periapical radiography confirmed the presence of a radioopaque structure inside the root canal that was likely to pose an obstacle to endodontic treatment. After opening the pulp chamber, an operating microscope was used to directly confirm the presence of the calcified structure in the root canal, which was removed using an ultrasonic tip. The infected root canal was treated using calcium hydroxide. Two months later, closure of the apical foramen as a result of calcification of the apical foramen was confirmed and the root canal filled. Using an operating microscope to directly view a structure posing an obstacle to root canal treatment made it possible to perform an excision while avoiding risks such as canal perforation.

Key words: Endodontics — Root canal treatment — Calcified structure — Operating microscope — Calcium hydroxide

Introduction

Calcified structures, as in tertiary dentin, may form on the root canal wall in vital teeth in response to exogenous stimuli such as dental caries. This can lead to narrowing of the pulp chamber and root canal[1,2]. Generalized gingival recession due to aging or periodontal disease may also cause the formation of dentin in the pulp chamber or on the wall of the root canal in multiple teeth. Dentin deposition on the root canal wall induces stenosis of the pulp chamber and root canal, which may hamper endodontic treatment.

Mechanical preparation and chemical irrigation are considered the most crucial elements in sterilizing an infected root canal. The success of this procedure may be compromised,

Fig. 1 Buccal view of right maxillary central incisor area showing fistula in labial apical gingiva

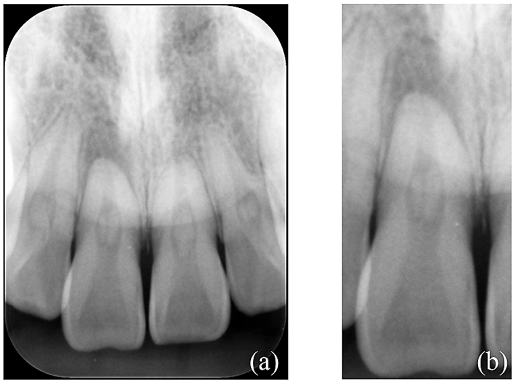

Fig. 2 Periapical radiographs obtained at first visit
(a) Radiopaque structure was observed in root canal in all four teeth in image field; (b) Close-up view of right maxillary central incisor area.

however, if access to the root canal is hindered by the formation of calcified structures that obstruct insertion of endodontic instruments. In such cases, mechanical removal of the calcified structure can help ensure access for instruments used to widen the root canal. Removing such depositions, however, can be difficult, depending on their size and location. Moreover, removal poses the danger of accidents such as perforation of the root canal wall if an attempt is made to remove the obstruction forcibly without a clear view of the field of operation. In this respect, recent studies have noted the effectiveness of using an operating microscope to obtain such a view in endodontic treatment[8,10].

Here, we describe a case in which a calcified structure inside an infected root canal posing a potential obstruction to endodontic treatment was safely removed using an operating microscope and ultrasonic instrumentation, allowing subsequent treatment of the root canal.

Case Report

An 18-year-old man was referred to the Tokyo Dental College Suidobashi Hospital by his general practitioner for treatment of suspected chronic suppurative apical periodontitis and dens invaginatus of the right maxillary central incisor. The patient's history revealed that he had had a fall at the age of 13 years, which had resulted in strong impact to the right maxillary central incisor area. The pain, however, had quickly subsided and no treatment was given. Currently, although the patient complained of no spontaneous pain, there was mild pain on vertical percussion. Examination revealed no particular abnormalities on the tooth crown surface, except for a small chip in the enamel on the incisal edge. A fistula was observed in the labial apical gingiva (Fig. 1). Electrical testing of the dental pulp revealed that the tooth was non-vital. There was no mobility, and the periodontal pocket depth was 2 mm. Periapical radiographs showed radiolucency in the apical area. This lesion was believed to be due to apical periodontitis as this radiolucent area extended into the alveolar bone. Moreover, a radiopaque structure was observed in the central part of the root canal, and this structure was seen in all four of the teeth in the image field (from the right maxillary lateral incisor to the left maxillary lateral incisor) (Fig. 2a). The radiopaque structure seen in the root canal of the right maxillary central incisor consisted of a mesial and distal section, with the former larger than the latter. The density of this structure was the same as that of dentin on the root canal wall, suggesting that it was also formed of calcium. The structure was separate from the mesial and distal walls, and the mesiodistal width of the root canal at this point appeared to be greater than that of the other regions (Fig. 2b).

Based on the above findings, the diagnosis was chronic suppurative apical periodontitis of the right maxillary central incisor. The treatment plan called for root canal treatment of the infected root canal.

However, the following two problems had to be considered when planning treatment:

1. The structure in the root canal was believed to comprise hard tissue, which would hinder insertion of the instruments needed to treat the root canal and prevent adequate sterilization. It was also thought that it would not be possible to tightly fill the root canal, which would also prevent the treatment objectives being reached.

2. It was thought that if the injury suffered by the patient at the age of 13 years had caused necrosis of the pulp, the apex formation would have been compromised. Moreover, because apical periodontitis was also present concurrently, it was anticipated that the diameter of the apical foramen would be large.

With respect to the first problem, it was decided to directly confirm and remove the structure using an operating microscope, after first enlarging the pulp chamber. The second problem would be addressed by applying calcium hydroxide.

To remove the calcium deposit inside the root canal, the pulp chamber was enlarged and an operating microscope used to determine whether or not it had adhered to the wall, and if it had, the location of the adhesion site. As the patient was young, and both the patient himself and his parents expressed a wish to minimize any exposure to radiation, cone beam computed tomography (CBCT) was not performed at the time of the first visit. It was decided that imaging would be done only if removal of the root canal obstruction was judged to be impossible using only an operating microscope, and if the patient and his parents consented.

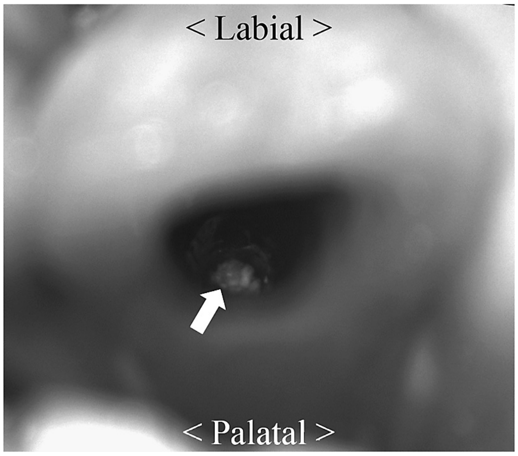

Fig. 3 Inner wall of root canal viewed using operating microscope

Structure observed on root canal wall (arrow).

The tooth was isolated using a rubber dam and the pulp chamber opened in the usual manner by using an air turbine handpiece and diamond point (#201R, Shofu, Kyoto, Japan). The inside of the root canal was observed using an operating microscope (Carl Zeiss, Oberkochen, Germany). The structure in the root canal had the same hue as the dentin on the root canal wall. It consisted of a mesial and a distal section, each of which was contiguous with the root canal wall, but only on the palatal side. At all other locations, there was a gap between the calcified structure and the root canal wall (Fig. 3). On examination with a stainless steel file, it exhibited the same degree of hardness as dentin. The inside of the root canal was irrigated thoroughly with a 10% sodium hypochlorite solution and 3% aqueous hydrogen peroxide and dried with a paper point. Calcium hydroxide paste (Calvital, Neo Dental Chemical Products, Tokyo, Japan) was then placed in the root canal opening and the cavity sealed with a hydraulic temporary sealing material (Caviton, GC, Tokyo, Japan).

At the second visit to our clinic, two weeks later, there was no pain on percussion and

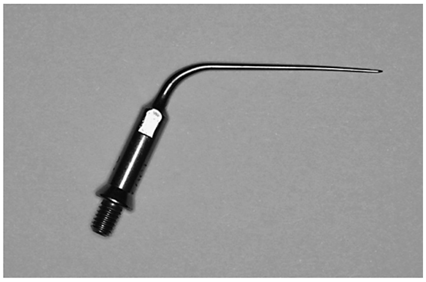

Fig. 4 Osada No. 1309 ultrasonic tip

Fig. 5 Radiographic assessment of working length
Working length was set at 20 mm and master apical size at point was set at #60.

the fistula had disappeared. The tooth was isolated using a rubber dam, the temporary sealing material and calcium hydroxide paste removed, and the inside of the root canal irrigated thoroughly with 10% sodium hypochlorite solution and 3% aqueous hydrogen peroxide. After confirming the presence of the calcified structure in the root canal with the operating microscope, an ultrasonic tip (No. 1309, Osada Electric Co., Ltd., Tokyo, Japan) was used to apply vibration to the point of contact between the structure and the root canal wall (Fig. 4). After vibration had been applied continuously for approximately 2 minutes, the structure separated from the root canal wall, and was washed out from the inside of the root canal with water. The inside of the root canal was dried with a paper point. The operating microscope was used to confirm that the calcified structure had been removed from the inside of the root canal. The apical opening was wide, allowing easy access with a #50 file. It was not possible to insert a #55 file, however, suggesting that the diameter of the apical opening was within the range of 0.50 to 0.55 mm. The root canal length was measured with an electronic apex locator, and the working length was set at 20 mm, which was 0.5 mm shorter than the root canal length (Fig. 5). The master apical size at that point was set at #60. The inside of the root canal was thoroughly washed with 10% sodium hypochlorite solution and 3% aqueous hydrogen peroxide. A calcium hydroxide paste was then applied in the root canal and the cavity sealed with a hydraulic temporary sealing material.

At the third visit to our clinic, two weeks after the second visit, there was no pain on percussion, and the fistula had not recurred. The tooth was isolated using a rubber dam and the temporary sealing material and calcium hydroxide paste removed. The inside of the root canal was then washed with 10% sodium hypochlorite solution and 3% aqueous hydrogen peroxide and dried with a paper point. Fresh calcium hydroxide paste was then applied and the cavity sealed with a hydraulic temporary sealing material.

At the fourth visit to our clinic, two months later, there was still no pain on percussion, and the fistula had not recurred. The temporary sealing material and calcium hydroxide paste were removed and the inside of the root canal washed with 10% sodium hypochlorite solution and 3% aqueous hydrogen peroxide. The inside of the root canal was then dried with a paper point and the apical foramen area observed with the operating microscope. A white-colored structure was observed. Percussion with a file confirmed that it comprised

Fig. 6 Post-operative periapical radiograph obtained immediately after root canal filling

Apexification was observed in apical foramen area.

hard tissue. To encourage the formation of additional hard tissue, fresh calcium hydroxide paste was applied and the cavity sealed with a hydraulic temporary sealing material.

At the fifth visit to our clinic, two months later, there was still no pain on percussion, and the fistula had not re-formed. It was confirmed that the apical foramen had been closed off by hard tissue. Based on the above findings, the decision was made to fill the root canal. The temporary sealing material and calcium hydroxide paste were removed and the inside of the root canal washed with 10% sodium hypochlorite solution and 3% aqueous hydrogen peroxide. The inside of the root canal was then dried with a paper point and the root canal filled using a magnesium oxide-based sealer (MGO sealer, Neo Dental Chemical Products) and a gutta percha point, using the lateral condensation method. The cavity was then closed using hydraulic temporary sealing material (Fig. 6).

Two weeks later, there was still no pain on percussion and the fistula had not recurred, so the cavity created by enlarging the pulp chamber was closed using composite resin and treatment concluded.

Discussion

Operating microscopes are being increasingly used for endodontic treatment[8,10]. The indirect lighting from dental chairs may not be sufficient to allow a clear view of the inside of a root canal. Therefore, in the absence of an operating microscope, the only way that the condition of the root canal may be evaluated is by relying on radiographs or tactile stimulation from inserting a file or some other instrument. This is a major concern: it would be extremely dangerous to remove something from within the root canal without a full understanding of the conditions that applied as it could lead to accidents such as root canal perforation. In the present case, an operating microscope was used to obtain a detailed picture of the situation deep inside the root canal. This allowed immediate detection of the structure to be removed and an understanding that it was only contiguous with the root canal wall on the palatal side. This made it possible to limit excision with the ultrasonic tip to the smallest possible area, thereby retaining most of the unaffected surrounding area. Thus, the risk of perforating the root canal wall was adequately reduced.

Some studies have noted that preoperative CBCT images are effective in identifying the relationship between a given structure in the root canal and the root canal wall[5,6]. One drawback of CBCT, however, is that it uses X-rays, so exposing the patient to radiation is unavoidable. In the present case, the patient was only 18 years old, and both the patient himself and his parents wanted to minimize exposure to radiation. Therefore, it was decided to use an operating microscope to examine the inside of the root canal first and only resort to CBCT later if it could not be avoided. It was found that the operating microscope alone was sufficient to allow clear observation of the inside of the root canal, making it possible to directly evaluate the attachment between the structure to be excised and the root canal wall. This eliminated any obstacles to the procedure and obviated the need to resort to CBCT to obtain additional information preoperatively. Numerous reports have described the efficacy of CBCT in diagnosis, but the patient is exposed to approximately 0.1 mSv of radiation with each CBCT scan[7]. Each dental X-ray is estimated to subject the patient to 0.01–0.03 mSv of radiation, while panoramic X-rays expose the patient to a dose of 0.03 mSv[4]. On the other hand, CBCT involves even heavier doses of radiation than these imaging methods. The International Commission on Radiological Protection (ICRP) recommends a maximum exposure limit of normally approximately 1 mSv per year from CTs, X-rays, or radiological exposure at nuclear power plant sites. This indicates that dental practitioners need to minimize the amount of radiation to which patients are exposed in the course of dental tests and treatment.

In the present case, infection inside the root canal was suspected as there was some evidence of apical periodontitis. Treating an infected root canal involves mechanically removing any infected material, using an agent such as sodium hypochlorite to irrigate the site, and finally applying an antiseptic agent inside the root canal. In cases such as that described here, however, these steps may be hindered by structures protruding from the inside of the wall of the canal, making it impossible to achieve adequate sterilization.

Also, because the diameter of the apical foramen was somewhat large in the present case, a calcium hydroxide paste was applied inside the root canal in order to biologically close the apical opening. Calcium hydroxide applied to the apical area acts as a cement[3,9]. It is ineffective, however, unless it comes into direct contact with the periodontal tissue of the apical area. Therefore, calcium hydroxide introduced through the opening of the root canal has to be delivered to the apical area with great precision. However, if the path to the target area is obstructed by some kind of structure, this can be extremely difficult, or even impossible to achieve.

Taken together, this indicates that any structure interfering with access to the root canal must be carefully removed at the very earliest stage of treatment when dealing with an infected root canal. In the present case, removing such a structure allowed adequate sterilization of the root canal and precise application of calcium hydroxide to the apical foramen area. As a result, formation of new hard tissue was observed in the apical foramen area at two months after initiation of root canal treatment. Biological closure of the apical foramen before filling of the root canal is the ideal treatment configuration, suggesting that the maximum degree of stability can be expected.

In the present case, the use of an operating microscope proved to be effective in allowing safe removal of potential impediments to treatment located within the root canal.

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