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Endodontic Management Of Internal Resorptive Defect In Maxillary Central Incisor Using Biodentine; With 3 Years And 8 Months Evident Follow-Up.

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ABSTRACT

This case report demonstrates the benefits of utilizing Computed Tomography in the assessment and Biodentine in the management of perforating internal resorption of Maxillary right central incisor. In the follow-up, after 3 years and 8 months, the patient was clinically asymptomatic, and the sinus tract had disappeared. The radiographic examination and Cone Beam Computed Tomography indicated a periodontal bone repair.
Keywords: Perforating internal root resorption, Biodentine, Computed Tomography, 3 years 8 months follow-up

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INTRODUCTION

Internal inflammatory root resorption is an uncommon disorder which begins on the root canal surface characterised by progressive loss of tooth structure. It is caused by the transformation of normal pulp tissue into granulomatous tissue with giant cells which resorb the dentin [1]. Although the exact cause is unknown, chronic pulpal inflammation from bacterial invasion, trauma, and orthodontic treatment have been suggested as the cause in most cases [2, 3]. Diagnosis based on conventional and digital radiography has drawbacks as they only provide a two dimensional image of a three dimensional object. This might lead to misdiagnosis and incorrect treatment in the management of internal root resorption. The advent of Computed Tomography (CT) and Cone Beam Computed Tomography (CBCT) provides the greater appreciation of tooth and true nature of the lesion might be assessed, including root perforations and whether the lesion is amenable to surgical or non-surgical treatment [4-5]. The irregular confines of resorptive cavity pose technical difficulties for thorough debridement and obturation. This problem becomes even more evident when resorption is located in a region where access is difficult [6]. Andreasen has stated that an untreated internal resorption leads to premature loss of the tooth [7]. Hence, the treatment of choice to cease destructive process in the absence of concomitant external resorption is non-surgical root canal therapy [8]. Review of literature supports that Mineral Trioxide Aggregate (MTA) due to its higher biocompatibility and sealing ability promotes better healing of the peri-radicular tissues [1]. But it has a few drawbacks. A novel material Biodentine was made available in January 2011. The material claims to have beneficial properties such as excellent sealing ability, biocompatibility, good dimensional stability with added advantage of short setting time, improved mechanical strength, easy manipulation thereby fulfilling the drawbacks of MTA and therefore can be considered to be used as a suitable perforation repair material [9]. Till date, only a few studies have been reported in the literature about Biodentine as a perforation repair material. This paper reports a case of biodentine repair of a maxillary right central incisor with an inflammatory, perforating resorptive defect in the middle third of the root canal with the use of CT to enhance the radiographic diagnosis of internal resorption.

CASE REPORT

A 21-year-old male patient reported to the Department of Conservative and Endodontics with the chief complaint of a discoloured tooth in the upper front region of the jaw which he had noticed since 2 years. The patient gave a history of trauma in the front tooth region 10 years back associated with swelling in the attached gingiva. Patient's medical history was non-contributory.

Clinical examination revealed that the maxillary permanent right central incisor was sensitive to percussion and also showed mild mobility with normal probing depth. There was a buccal swelling on the maxillary vestibular region with a sinus tract (Figure 1). The tooth presented a negative response to pulp testing. The radiographic examination revealed a well-defined radiolucent area suggesting an internal root resorption at the middle third of the root canal as well as the presence of a perforated defect on the distal side of the root (Figure 2). Based on clinical and radiographic findings, the lesion was diagnosed as a perforating internal root resorption. A treatment plan was presented to the patient including nonsurgical root canal therapy and repair of the perforation with Biodentine.

Figure 1: Pre-operative clinical representation

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Figure 2: Pre-operative radiograph showing internal resorption in 11

3D accuitomo was used to evaluate the true information of resorptive lesion. The CT showed perforation around 4mm in height and 3mm in width in the labial cortical plate; and also the resorptive defect in tooth was around 6mm in height, 3mm in width, and oval shaped; and the perforated site was in the middle of the distal direction around 3mm in height and 3mm in width (Figures 3 and 4) .

Figure 3: CT Sagittal view showing perforation resorption on the labial side

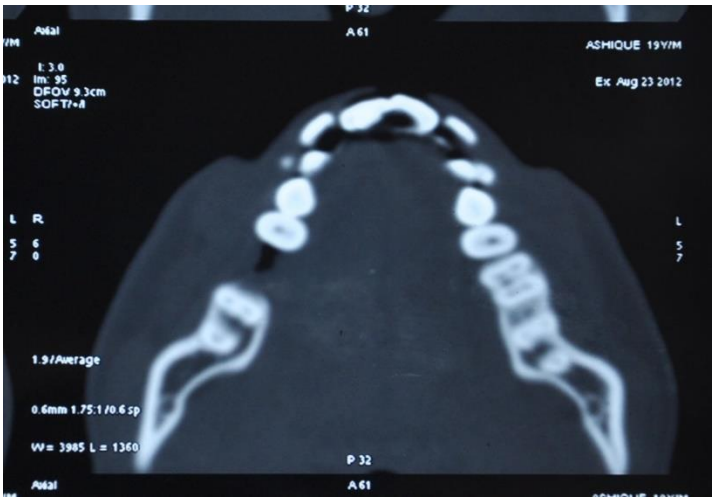

Figure 4: CT Axial view

After rubber dam isolation, conventional access cavity was performed. Working length determination was established using radiography (Figure 5). The root canal system was debrided thoroughly and biomechanically prepared using hand K files by the step back technique to size 55. Copious irrigation with 2.5% Sodium Hypochlorite solution was used throughout the procedure. A perforation of the distal wall seemed to be present and bleeding was consistently noted near that area when drying with paper points. The root canal was dressed with calcium hydroxide (Calform-RC®, Ammdent, Mohali, India) and temporarily sealed with Cavit (3M ESPE). After 4 weeks, the patient returned without symptoms and the sinus tract had disappeared. Calcium hydroxide dressing was removed with file and irrigation, and the canal was dried with paper points. Master cone was customized using roll cone technique extending up to 1mm from the WL with the aid of calibration ruler and then passively inserted into the root canal with a small amount of A H plus sealer (Dentsply, Germany) taking care to avoid extrusion into the resorbed area. The point was thermo-softened, partially removed and condensed during down packing stage of obturation using heat source from hand piece in conjunction with an appropriately sized electric heat plugger from Calamus Dual 3D obturation system (Dentsply Maillefer). Biodentine was then inserted with slight pressure into the resorptive area with the aid of amalgam carrier and Schilder pluggers after which periapical radiograph was taken to confirm the tight seal of perforation defect (Figure 6).

Figure 5: Working length determination

Figure 6: Immediate postoperative radiograph showing obturation with an apical seal of warm gutta percha followed by biodentine

After 2 months, the tooth was restored with composite resin (3M ESPE).The patient was re-examined periodically at 1 year and 2 years for post treatment observation.(Figure 7A-7B).

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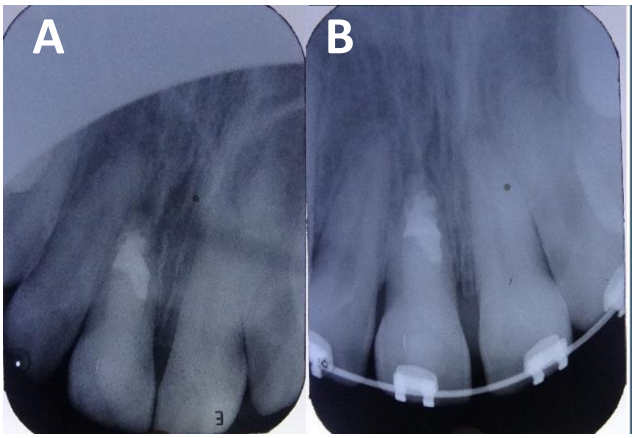

A) 1 year follow up radiograph
B) 2 year follow up radiograph showing periapical healing.

Figure 7

After 3years and 8 months the radiograph and CBCT showed adequate repair of the resorption, and the tooth remained asymptomatic (Figure 8A-8C). Orthodontic treatment was initiated in the patient 2 years after completion of the perforation repair procedure.

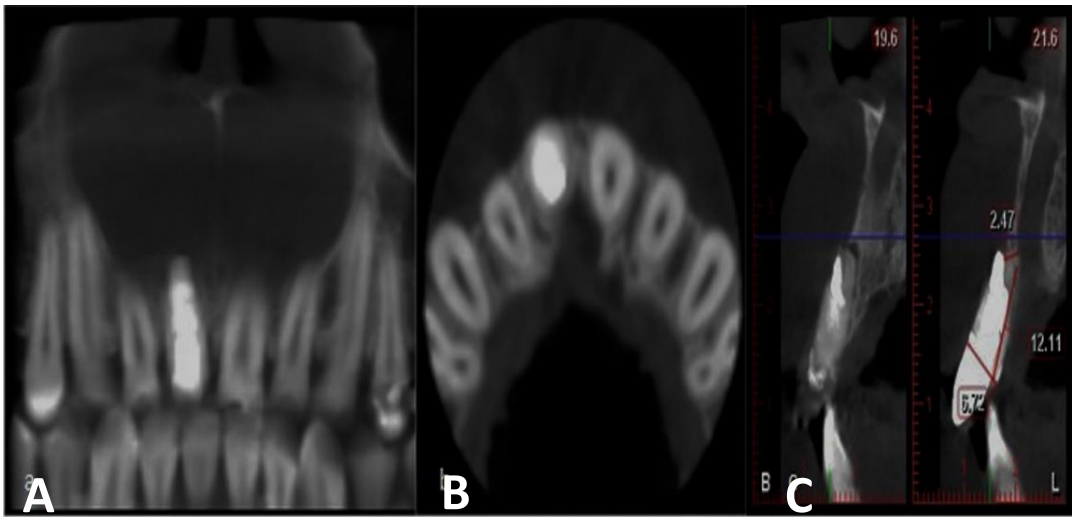

Figure 8: Postoperative CBCT images at 3 years and 8 months A) Coronal View B) Axial View at midroot level C) Sagittal view showing periapical tissue healing post-orthodontic treatment

DISCUSSION

Internal resorption is undoubtedly an endodontic challenge, especially if the resorption area is extensive. The vascular changes in the pulp subsequent to trauma, orthodontic tooth movement, chronic pulpitis, direct and indirect pulp capping and pulpotomy may lead to internal resorption [10].Circulatory changes produce active hyperaemia, which increases local oxygen tension, thereby lowering the pH. These collectively alter the metabolism of the pulp. Vascular changes attract numerous macrophages which eventually differentiate into osteoclasts. Multinucleated giant cells are also described in lacunae next to polymorphonuclear neutrophils. Finally, the connective tissue may undergo metaplasia to form granulation tissue.

Clinically, internal resorption is commonly an asymptomatic condition that is detected upon routine radiographs. When the lesion is symptomatic, it may appear like a small defect at the gingival margin or a pink coronal discoloration of the tooth crown [11, 12]. Internal resorption is seen as a radiolucent area around the pulpal cavity with smooth and well-defined margins and oval and round in shape [11-13]. Conventional intraoral periapical radiographs are routinely used to assess the root canal anatomy but owing to the inherent limitation of 2D images, they are not very helpful in the management of complicated cases. In these cases, CT and CBCT have proved to be useful diagnostic tools [4, 5].

CT is a technique of image acquisition that combines the use of x-rays and CT. The x-ray beams are directed from different angles to achieve axial section images to the object analysed. The CT scan has a superior diagnostic performance over conventional radiographic images as they provide a three-dimensional view. Failure of the traditional periapical radiographic examination to diagnose periapical lesions does not justify the routine use of CT examination in endodontic therapy because of exposure to high dose of radiation. But internal resorption defects with perforation may not be detectable using conventional radiographic techniques. Consideration of this should be made during diagnosis and treatment planning. It also provided additional relevant information on the location and nature of root resorptive defects when compared with that provided by conventional radiographic techniques [2, 13]. In the present case due to the unavailability of CBCT, the imaging technique opted for the diagnosis was CT.

During the debridement of the root canal system including the resorption defect complete elimination of the infection and the inflammatory granulation tissue is essential [11]. In the present case combined approach, involving both hand instrumentation and antibacterial irrigation was performed during the chemo-mechanical root canal preparation; which was then followed by intra-canal medicament with Calcium Hydroxide for the complete elimination of granulation tissue. To avoid the thinning of root canal wall, rotary files were not used; instead, we performed hand filing using step back technique which allows a controlled and directed canal preparation. Sodium Hypochlorite is the most commonly used irrigant during root canal treatment because of its tissue dissolving and broad antibacterial properties. It is crucial that the irrigation needle should remain loose inside the root canal during irrigation. This allows the backflow of irrigants thereby displacing the debris coronally while avoiding apical extrusion. Ultra sonic activation of irrigants should be viewed as an essential step in the disinfection of the internal resorption defect [3]. Chemo-mechanical debridement of the root canal space fails to consistently render the root canal system bacteria free. Thus, the disinfection of the inaccessible root resorption defects can be improved with the use of an intra-canal antibacterial medicament. Calcium hydroxide, with its antibacterial properties, has been shown to have a synergistic effect when used along with sodium hypochlorite to remove organic debris from the root canal [14-16]. It has been reported that Calcium Hydroxide when used as an intracanal medicament, reduces the inflammatory response and initiates prompt healing [16-18]. Because of its high pH, when placed in the root canal and the resorptive lacunae, Calcium hydroxide neutralizes the lactic acid from macrophages and osteoclasts. It arrests the osteoclasts activity and stimulates repair [19].

Since the root canal had an open apex it was difficult to get a tuck back with the normal gutta-percha points. In order to get the tight seal the roll cone technique seemed to be ideal in this case and once the apical seal was confirmed with the postoperative radiograph, only then the remaining resorptive defect was inserted with Biodentine.

Biodentine, known as “dentin in a capsule” is a biocompatible and bioactive dentin substitute which overcomes the drawbacks of Calcium Hydroxide and MTA [20]. The drawbacks of calcium hydroxide are: (a) poor bonding to dentine, (b) does not prevent microleakage in the long run, (c) the porosities of the new formed hard tissues may act as a portal of entry for microorganisms, and (d) material resorption and mechanical instability [20]. Good physical properties and the ability to stimulate tissue regeneration are the appreciable properties of Biodentine. It is new bioactive cement with dentin like mechanical properties which has a beneficial effect on living cells and acts in a biocompatible manner. The main component of the powder is a tricalcium silicate, with the addition of the powder of Calcium carbonate and Zirconium Oxide. The liquid is a solution of Calcium chloride with a water reducing agent. Advantages of this material are chemo-mechanical bonding with the tooth and composite, high compressive and flexural strength, low solubility, low setting time and better handling characteristics [21]. It can also induce the synthesis of dentin like matrix by human odontoblasts-like cells in the form of mineralization nodules that have the molecular characteristics of dentin [22]. This can also stimulate cell growth and induce hydroxyapatite (HA) formation on the surface of the material when exposed to the stimulated

body fluid. HA has shown to induce bone formation, growth and maintenance at the bone-material interface in vivo [23, 24].

The high pH of Biodentine during its setting reaction is responsible for its micro-mechanical adhesion. This high pH causes organic tissues to dissolve out of the dentin tubule. The alkaline environment at the boundary areas of contact between Biodentine and hard tooth substance opens a path through which the dentin substitute mass can enter the exposed opening of the dentin canaliculi. Therefore a micromechanical bond is created by means of numerous microscopic cones, creating a bacteria-tight seal [25].

Mineralization in the process of hard tissue healing is stimulated mainly by the alkaline effect and calcium ion release. Biodentine along with alkaline pH also has the ability to release calcium ions similar to that of MTA [26]. Han and Okiji compared the uptake of calcium and silicon released from MTA and Biodentine, when used as endodontic materials into root canal dentin and concluded that the elemental uptake into dentin was more prominent for Biodentine than for MTA [27].

The sealing properties of Biodentine are found to be superior to MTA [28]. A study conducted to check the sealing ability of MTA and Biodentine concluded that Biodentine had significantly less microleakage than MTA [9]. The reason was believed to be due to the formation of tag-like structures alongside an interfaced layer called the “mineral infiltration zone” where the alkaline caustic effect of Calcium silicate cements hydration products degrades the collagenous component of interfacial dentin. The formation of tag-like structures in the dentin was higher when compared to that of MTA [29].

The porosity and pore volume in set Biodentine, which was found to be less than MTA, attributed to its better sealing ability [30].But the porosity of Biodentine depends on the environmental conditions, the procedures like retrograde filling and perforation repair where there is continuous moist environment showed less porosity than with clinical conditions where moisture is not present [31]. The study conducted by Kokate and Pawar compared the microleakage of GIC, MTA and Biodentine used as a retrograde filling material and concluded that Biodentine exhibited the least microleakage when compared to the other materials used [28]. A study conducted by Pawar et al showed healing of the periapical lesion using Biodentine as retrofilling material with 18 months follow-up[32].The main difference between Biodentine and MTA is the absence of Calcium aluminates and Calcium sulphate in the formulation of Biodentine, which are known to decrease mechanical strength, as well as to reduce setting time [33]. The primary clinical advantage of Biodentine is its fast setting (between 12 and 15 min) when compared to MTA (170 min) [34] since a delayed setting time leads to an increased risk of partial material loss and alteration of the interface during the finishing phases of the procedure [35]. Calcium Chloride used as a setting accelerator decreases the setting time and also improves the handling properties [28].

CONCLUSION

Disadvantages of calcium hydroxide and MTA have given way for the use of Biodentine as a perforation repair material. Biodentine is a promising material demonstrating excellent biological properties and fast clinical setting time. As demonstrated by clinical, radiographic and CBCT examination after a follow-up of over 3 years and 8 months, this case gives optimal results and this might serve as an excellent alternative to MTA placement.

Ethical Statement

The work has been approved by the appropriate ethical committees related to the institution in which it was performed and the subjects gave informed consent to the work.

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