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CASE REPORT

TWO CASE REPORTS DESCRIBING THE NON-SURGICAL MANAGEMENT OF EXTERNAL ROOT RESORPTION WITH BIOACTIVE MATERIAL

Saikat Chatterjee*, Ipsita Maity, Paromita Mazumdar and Priti Desai

Department of Conservative Dentistry & Endodontics, Guru Nanak Institute of Dental Sciences & Research, Kolkata-114.India

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A B S T R A C T

External root resorption (ERR) is a lytic process occurring in the cementum, or cementum and dentin of the roots of teeth. Here two case reports of the inflammatory ERR in mandibular molars has been discussed .In both the cases the chief complaint was pain.The alkalinity and sustained calcium hydroxide release exhibited by MTA was considered for using to treat EER, followed by permanent prosthesis. The clinical and radiographic follow-up after one month three month and six month revealed that treated teeth were functional, the progression of the ERR had ceased, the resorptive area was replaced with newly formed bone and periapical radiolucency was healed.

INTRODUCTION

Root resorption is defined as "Resorption initiated in the periodontium and initially affecting the external surfaces of a tooth; may be further classified as surface, inflammatory or replacement, or by location as cervical, lateral or apical; may or may not invade the dental pulp space".(**Glossary of Endodontic Terms**)ora clinical condition associated with either a physiologic or a pathologic process resulting in the loss of dentin, cementum or bone.[1]

Root resorption is broadly classified into two types – internal and external resorption[2]. External root resorption (ERR) may be physiological or pathological. Physiological root resorption is a process encountered during the exfoliation of primary dentition. ERR of permanent teeth is a multifactorial process and usually has a pathologic basis[3]. From a clinical and applied perspective, ERR may be divided into three categories: 1) progressive inflammatory resorption; 2) cervical resorption; and 3) replacement resorption [4]

Several hypotheses have been suggested regarding the pathophysiology of root resorption. According to Kheirieh S *et al* the remnants of Hertwig's epithelial root sheath (HERS) surround the tooth root, like a net impart,which is resistant to resorption and subsequent ankylosis[5].On the other hand Hasegawa *et al*. showed that the protective role of HERS had not been established.

Corresponding author:* **Saikat Chatterjee
Department of Conservative Dentistry & Endodontics, Guru Nanak Institute of Dental Sciences & Research, Kolkata-114.India

However, they revealed that HERS cells, by producing specific matrix proteins including osteopontin, ameloblastin and bone morphogenic proteins (BMPs) play an important role in cemental repair subsequent to resorption[6].Hatakeyama J *et al* stated that the absence of some intrinsic factors in cementum and predentin such as amelogenin or osteoprotegerin (OPG) [a member of tumor necrosis factor (TNF) superfamily], which act as the inhibitors of resorptive cells.OPG is a decoy receptor by binding to the receptor activator of nuclear factor κB ligand (RANKL). Binding to OPG reduces RANKL concentration and thereby inhibits its ability to bind to receptor activator of nucleic factor κB (RANK) receptors on the surface of osteoclast precursors (circulating monocytes) and stimulate osteoclast production[7]

According to Witherspoon DE *et al* the intermediate cementum is the innermost layer of cementum which creates a barrier between the dentinal tubules and the periodontal ligament. Under normal conditions, this barrier does not allow irritants such as bacterial by-products to pass from an infected pulp space to stimulate an inflammatory response in the adjacent periodontal ligament. If the intermediate cementum is lost or damaged, pro-inflammatory mediators may diffuse from an infected pulp space into the periodontal ligament, setting up an inflammatory response and subsequent external inflammatory root resorption[8].Clinically in initial stage teeth with external resorption may be detected only in radiographs.However, as the process progresses the teeth may become symptomatic and periradicular abscess may develop with increasing tooth mobility.

Although Intra Oral Periapical Radiograpy or extra oral radiograph like OPG is essential for provisional diagnosis of periradicular lesion but does not provide a true extent, location, or the portal of entry of a resorptive lesion because of their 2D representation. CBCT has been shown to help the clinician in offering an accurate prognosis on the basis of the extent of the resorptive lesion[9].CBCT image gives detailed information three dimensionally. Therefore, studies on root resorption using CBCT demonstrated improved accuracy and sensitivity in comparison with those using 2D data.[10]The following case reports will describe the diagnosis and management of inflammatory root resorption.

Case Report:1

A 21-year-old male patient reported to department of Conservative Dentistry and Endodontics, Guru Nanak Institute of Dental Sciences and Research,West Bengal with a chief complaint of pain involving lower left back tooth region for the last one week. The pain was intermittent, localised in nature and aggravated when the patient chew food at that side.Pain subsided after taking analgesic. Patients' medical history was not contributory. Clinical examinations revealed secondary caries in#36.Periodontal status was normal.#36 had given no response during pulp sensitivity test with ethyl chloride spray but for confirmation of the result Electric pulp test was carried out. Response of the tooth #36 in both the tests indicated that the tooth was nonvital. IOPA radiograph showed pulpal involvement with caries in #36, with radiolucency at furcation area which extended up tothe apex of mesial root**[Fig:1A]**.Apex of both the mesial and distal roots of the tooth exhibited radiolucency approx.(6mmX4mm) with ill define margin. Provisional diagnosis of root resorption was established. For definitive diagnosis CBCT of #36 was advised.

CBCT of #36 revealed a) coronal restoration with secondary caries, b) External root resorption seen upto middle 3rd of mesial root (6.2mmX4.3mm) and apical 3rd of distal root (3.9mm), c) Also there was a dehiscence bony defect of the buccal cortical plate in relation to the involved tooth. [**Fig :1B,C,D**]It was planned for orthograde MTA obturation of the canals followed by post endodontic restoration.

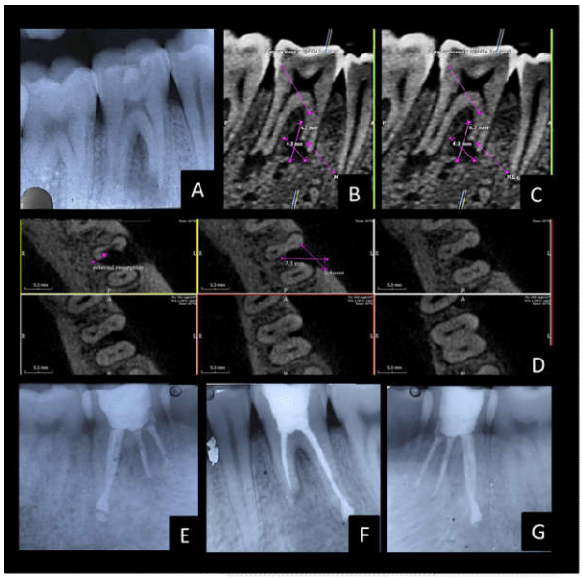


Figure 1 A)IOPA radiograph showed pulpal involvement with caries in #36. B),C) CBCT showed true extent of bone loss vertically in #36. D)CBCT showed true extent of bone loss horizontally in #36. E)After 1 month post-operative IOPA of #36. F)After 3 months post-operative IOPA of #36. G)After 6 months post-operative IOPA of #36

Rubber dam isolation was done on the tooth#36 .Pre-existing composite resin restoration was removed and access cavity preparation was done. Round Carbide Burs ISO Ø 010 and 014 was used first to penetrate into the pulp chamber in order to remove the whole pulp chamber roof including all pulp horns. Pulp chamber walls were finished by Endo-Z FG Bur ISO 016.Working length of the tooth was determined by apex locator Canal Pro (COLTENE) . Result was confirmed by IOPA radiograph with 20º mesiodistal shifting of the x-ray tube head using#15K file. Canals were shaped with the help of Protaper universal hand file (Dentsply, Tulsa dental specialities, Ballaigues, Switzerland) up to F2 and irrigation was done with 1ml of 2.5% of sodium hypochloriteafter each instrumentation, (Vishal dentocare Pvt. Ltd., Ahmedabad, Gujarat, India) with 30-gauge side vented needle (KerrHawe Irrigation Probe; KerrHawe SA, Bioggio, Switzerland). This was followed by irrigation with normal saline to remove any remnants of hypochlorite, latter canals were dried with absorbent points. Calcium hydroxide (R C Cal, Prime Dental products, Kalher, Thane) as an intracanal medicament was placed in canals for one week to arrest the inflammatory process by neutralizing the acidic environment of the pulp and periradicular tissue and ultimately disinfect the area after that temporary restoration with IRM (Dentsply) was done.

After one week, temporary restoration was removed with #4 round diamond bur , canals were irrigated with 5mL of 2.5% sodium hypochlorite (NaOCl) and 5 mL of 17% of ethylenediaminetetraacetic acid for removing the Ca(OH)2 dressing and then all the canals were flushed with 2% Chlorhexidine followed by normal saline and dried.

A piece of Abgel (absorbable gelatin sponge) was cut in a square shaped & placed in the apical end,as a apical stop at the root apices and working length was rechecked by #15 K file. MTA, pro-Root MTA (Dentsply, Tulsa Switzerland) was manipulated according to manufacture instructions.All the four canals were obturated with MTA, material was placed in the canal orifices with MTA carrier and then condensed vertically with finger pluggers. After completion of obturation postendodontic restoration of the access cavity was done with light cure composite resin.

The patient was recalled after 1 month**[Fig1:E],**3 months**[Fig1:F]** and 6 months**[Fig1:G]**for clinical and radiographic follow up. Clinical examination of tooth #36 was functional without tenderness to percussion or palpation. Intraoral periapical radiograph showed regression in the size of periapical radiolucency with sign of osseous repair.

Case Report:2

A 27-year-old male patient presented to department of Conservative Dentistry and Endodontics, Guru Nanak Institute of Dental Sciences and Research,West Bengal with a chief complaint of pain involving lower right back tooth region for the last two weeks. The pain was intermittent, localised in nature and aggravated when the patient chew hard food.Pain was subsided after taking analgesic. Patients' medical history was not significant.

Clinical examinations revealed carious #46 with no mobility. Vitality test and confirmation of the result were done similarly as described in the previous case. Response of the tooth #46 in both the tests indicated that the tooth was nonvital.

IOPA radiograph showed pulpal involvement with caries in #46 with periapical radiolucency involving the mesial root **[Fig:2A]**. Root apex of the mesial root appeared ill define in IOPA radiograph. For confirmation and to determine the true extent of the lesion CBCT is always advisable but because of the economic condition of the patient CBCT was not done.

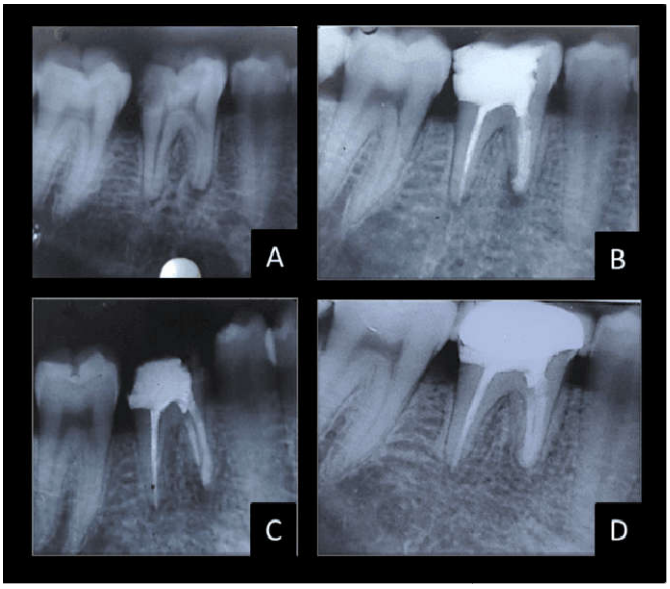


Figure 2 A)IOPA radiograph showed pulpal involvement with caries in #46 with periapical radiolucency involving the mesial root. B)After 1 month post-operative IOPA of #46. C)After 3 months post-operative IOPA of #46. D)After 6 months post-operative IOPA of #46.

Table 1 Preoperative and Post-operative (after 1 month,3 months and 6 months)clinical follow up and radiographic follow up

CLINICAL FOLLOW UP		Pain	Palpation	Swelling	Presence of sinus	Mobility	Tender on Percussion
Pre-operative	Case 1	Present	NAD	—	—	—	+ve
	Case2	Present	NAD	—	–	–	+ve
After 1 month	Case1	—	NAD	—	—	—	-ve
	Case 2	—	NAD	—	—	—	-ve
After 3 months	Case 1	—	NAD	—	—	—	-ve
	Case 2	—	NAD	—	—	—	-ve
After 6 months	Case 1	—	NAD	—	—	—	-ve
	Case 2	—	NAD	—	—	—	-ve

RADIOGRAPHIC FOLLOW UP		PAI score
Preoperative	Case 1	5
	Case 2	5
After 1 month	Case 1	3
	Case 2	3
After 3 months	Case 1	2
	Case2	2
After 6 months	Case 1	1
	Case 2	1

Isolation, access cavity preparation, working length determination, irrigation protocol and shaping of the canals were done similarly as the previous case.

Calcium hydroxide (R C Cal, Prime Dental products, Kalher, Thane) as an intracanal medicament was placed in canalsfor one week after that temporary restoration with zinc oxide eugenol cement was done.

After one week, temporary restoration was removed with #4 round diamond bur , canals were irrigated with 5 ml of 2.5% sodium hypochlorite (NaOCl) and 5 ml of 17% of ethylenediaminetetraacetic acid for removing the Ca(OH)2 dressing and then all the canals were flushed with 2% Chlorhexidine followed by normal saline and dried. A piece of Abgel (absorbable gelatin sponge) placed in the apical end as a apical stop at the root apices was done similarly like previous case. MTA, pro-Root MTA (Dentsply, Tulsa Switzerland) was manipulated according to manufacture instructions. All the root canals were obturated with MTA same way like before mentioned. After completion of obturation postendodontic restoration of the access cavity with light cure composite resin was done.

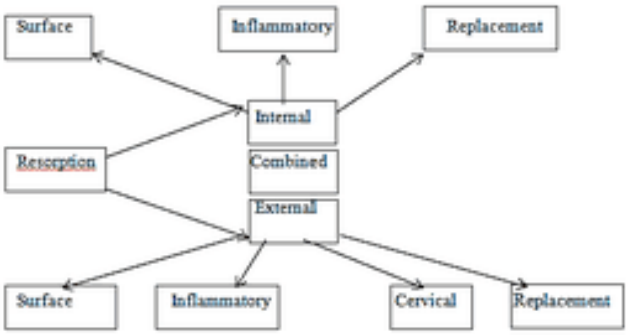
The patient was recalled after 1 month[Fig 2:B],3 months[Fig2:C]and 6 months[Fig2:D] for clinical and radiographic follow up. On clinical examination the tooth #36 was found functional without sensitivity to percussion or palpation. Intraoral periapical radiograph showed regression in the size of periapical radiolucency with signs of osseous repair.

DISCUSSION

Root resorption is a clinical entity which should be diagnosed early and managed effectively**.**

Usually the hard tissues (dentin, cementum, and enamel) of permanent teeth do not undergo resorption. When resorption of permanent teeth is observed, it is usually the result of some pathological condition like trauma;chronic inflammation of the pulp, periodontal tissues or both; or induced pressure in the periodontal ligament associated with orthodontic tooth movement, tumors. Resorptive lesions can be most simply classified as external or internal. In the former the lesion occurs on the external aspect of the root. In the latter the lesion occurs inside the root canal and/or pulp chamber.

Caries or mechanical trauma will elicit an inflammatory process within the pulpal tissue.In both the cases presented here caries was the causative agent.In the first case secondary caries was detected under a composite resin restoration in #36, and in the second case primary caries involved in #46.In both the cases caries was responsible for theinflammation of pulpal tissue and production of nonspecific inflammatory mediators. If there is damage to the protective predentine layer osteoclasts may bind to the dentine. In the presence of such inflammation osteoclastic activity increases resulting in resorption.[11]



Schematic classification based upon Andreasen's descriptions of resorption[12]

Many a times, External Root Resorption is difficult to predict and diagnose[13]because in its initial stage external root resorption is asymptomatic. This pathologic condition is difficult to treat also because apical architecture of the root canals are lost so it is very difficult to achieve a proper apical seal .Successful management of resorptive lesions starts with an early diagnosis. A thorough history, clinical assessments , along with radiographic evaluation are essential.

Conventional radiographic techniques have been shown to reveal limited information on the true extent and nature of the resorptive lesion. Thus, CBCT has become an important diagnostic tool for the detection of resorption because it provides 3D imaging.[14]The ability to assess an area of interest

in 3dimensions eliminates the superimposition that is inherent in conventional radiographic imaging[15] .CBCT technology provides the clinician with the ability to observe an area in 3different planes (axial, sagittal, and coronal) and thus acquire 3-D information. The axial and sagittal views are of particular value, and they are not seen with conventional periapical radiography[16].

Studies on Root Resorption using CBCT demonstrated improved accuracy and sensitivity in comparison with those using 2D data. Wang demonstrated that CBCT accurately measured the extent of root resorption, and it was more accurate and reliable 3D investigation for external root resorption[17].Another significant advantage of CBCT in root resorption studies is that it could be used in vivo, compared with Micro CT.

A CBCT scan was requested for both the cases described in this study. In case 1, the use of CBCT helped to determine the position and true extent of the lesion in relation to the root and ultimately, the restorability of the tooth but in case 2, CBCT was not done because of the patient's economic condition. So, we had proceeded to the treatment only based on the findings of IOPA radiograph.

These infection induced resorptions can vary widely in complexity but will generally respond favorably to therapy aimed primarily at removing the infective agent. Additional impetus to resorption control can be provided by the use of anti-clastic therapeutic agents such as calcium hydroxide, ProRoot MTA (Dentsply Tulsa Dental, Johnson City, Tennessee, USA), or Ledermix Paste (Lederle Pharmaceuticals Wolfratshausen Germany) can also be used to stimulate hard tissue formation on resorbed root surfaces.[18]

Calcium hydroxide as an intracanal medicament is widely used and it is also beneficial for external root resorption because of its strong antibacterial effect.It also removes the various inflammatory cytokines such as tumor necrosis factor-α (TNF-α), interleukins (IL)-1α, IL-β, IL-6, IL-11, and IL-17, prostaglandin E2 (PgE2), and tumour growth factor-β (TGF-) from the root canal system[19] .Calcium hydroxide increases the pH of dentine ,and therefore inhibits the activity of osteoclastic acid hydrolases in the periodontal tissue and activates alkaline phosphatases and alkaline phosphatase enhances hard tissue formation.

But it is an established fact that dentine exposed to Ca(OH)2 for an extended period (6 months to one year) results in reduced flexural strength and lower fracture resistance of dentin. Therefore, other treatment modalities such as the apical barrier technique using mineral trioxide aggregate (MTA) can be used to manage teeth with external root resorption cases following a short period of Ca(OH)2 medication. Additional benefit of apical barrier technique using mineral trioxide aggregate (MTA) is that MTA elevates the pH of surrounding environment and eliminate the root resorption causing factors.
Other intracanal medicaments like Ledermix Paste can also be used in external root resorption .It contain corticosteroid and tetracycline, as anti-inflammatory and anti-resorptive agents, shut down or minimize the inflammatory reaction including clastic-cells mediated resorption, and thus promotes more favorable healing but the main disadvantage of this paste is that it causes discoloration of the tooth structure .Kim *et al*. studied the discoloration of teeth due to Ledermix paste as an intracanal medicament and this change in colour may be attributed because of the presence of tetracycline in the formulation.[20]

Mineral trioxide aggregate (MTA) is a calcium silicate containing powder composed of hydrophilic particles which harden at the presence of moisture. The material has a pH of 12.5 and sets in the presence of moisture in approximately four hours[21].MTA has good sealing ability, biocompatibility, and low cytotoxicity[22] and it encourages regeneration of periradicular tissues such as periodontal ligament bone and cementum.[23] These favorable properties render MTA a suitable material for the management of tissues damage caused by external root resorption. The orthograde filling of the entire root canal system with MTA is the logical progression in the application of this material.

Recent studies have reported on the success of MTA-root end apical barrier in treatment of immature apicesranging from 76.5% to 91%.[24]

In both the cases follow up was done at 1 month 3 months and 6 months interval. Clinical evaluation was done by checking presence or absence of pain, redness, swelling or abscess, draining fistula, mobility, any remarkable soft tissue changes at the involved tooth region and presence of tenderness on percussion. Tooth mobility was checked by placing fingures on both the side of the involved teeth and found tooth mobility within physiological limit for both the cases, Periodontal pocket depth was checked in both the cases with periodontal probe and found normal. Both the cases showed no tenderness on percussion. Redness, Swelling or abscess, Draining fistula all were absent in both the cases and the soft tissue around the involved tooth was found normal on palpation.

Radiographic evaluation was done with the help of periapical index (PAI).After 1 month both cases showed score 3,after 3 months follow-up score 2 and at 6 moths follow up score 1 which signifies complete healing of the periapical pathology after 6 month. After completion of the treatment in both the cases no further progession of the pathologic condition was detected in IOPA radiograph.

CONCLUSION

Early detection is essential for successful management and outcome of External root resorption. CBCT appears to be a promising diagnostic tool for confirming the presence, appreciating the true nature, and managing ERR.MTA has proved to be the material of choice in the management of external root resorption with favorable prognostic outcome. Further clinical studies with long term follow up encouraged.

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