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Management of Perforation: A Case Report with Review of Literature

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Abstract

Root canal treatment is a routine endodontic procedure, but complications such as root perforations can compromise prognosis. Perforations create communication between the root canal system and supporting tissues, leading to bacterial contamination, periodontal involvement, and potential tooth loss if untreated. This case report highlights the management of a furcal perforation in a maxillary first molar using Biostructure Mineral Trioxide Aggregate (MTA) putty, with a review of literature on perforation classification, diagnosis, prevention, and treatment strategies. A 14-year-old male presented with pain and incomplete root canal treatment in relation to tooth 16. Clinical and radiographic examination revealed furcal perforation and incomplete obturation. The canals were cleaned and shaped, and the perforation was sealed with Biostructure MTA putty. Subsequent obturation was performed with gutta-percha and BioACTIVE RCS, followed by composite restoration and zirconia crown placement. Follow-up at 3, 6, and 12 months demonstrated successful healing, bone regeneration in the furcal area, and absence of symptoms. Successful management of perforations depends on early diagnosis, appropriate material selection, and operator expertise. MTA has proven effective due to its biocompatibility, sealing ability, and regenerative potential. Literature supports its long-term success in perforation repair, with favorable outcomes in both clinical and radiographic evaluations. Furcal perforations, if managed promptly with suitable materials such as MTA, can achieve predictable healing and favorable prognosis. This case reinforces MTA's role as a gold standard in perforation repair and highlights the importance of careful diagnosis and treatment planning in endodontics.

Keywords: Root canal treatment, Furcal perforation, Mineral Trioxide Aggregate, Endodontic complications,

INTRODUCTION

Root canal treatment is the most commonly performed endodontic procedure. As the number of endodontically treated teeth increases, the incidence of complication also increases. During the preparation of the access pulp cavity, some factors may predispose to iatrogenic complications related to root canal treatment or procedural errors. One of these iatrogenic complications is pulp chamber and root perforation. These serious defects are associated with significantly endodontic treatment outcomes, especially when the development of bacterial infection has occurred.

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Perforations are artificial communication between the root canal systems and the supporting tissues of teeth or to the oral cavity. It occurs in approximately 2-12% of endodontically treated teeth. This acts as a pathway for the ingress of microorganisms either from the oral cavity or periodontal tissues, thus contaminating the perforation site and preventing its healing process. If left untreated or unnoticed, it leads to secondary periodontal involvement, suppuration, fistula formation, and prognosis of such tooth becomes questionable and extraction becomes the most likely treatment option.

ETIOLOGY

The causes of perforation can be iatrogenic or non- iatrogenic. Iatrogenic perforations occur mainly due to the lack of attention to the internal anatomy and failure to consider and anticipate the possible variations that can occur in the root canal system. These iatrogenic perforations can occur at any level of the endodontic treatment. Non-iatrogenic causes include resorption, external, or internal, mostly secondary to trauma and caries that is extensively involving the furcal area.

CLASSIFICATION

According to fuss and trope, perforation can be classified based on time, size, and location[1].

➢ Based on time

- Fresh perforation - perforations that occurs at the same appointment characterized by fresh blood at the perforation site. These, if treated immediately or shortly after occurrence under aseptic conditions, have a good prognosis.
- Old perforation - previously not treated or unnoticed with likely bacterial infection or caries these have a questionable prognosis.

➢ Based on the size:

- Small perforation - these are smaller than size 20 endodontic instruments because the mechanical damage to tissue is minimum, and the due to the ease of sealing, they have a good prognosis.
- Large perforation – it occurs mainly during post preparation with significant tissue damage and obvious difficulty in providing adequate seal, there is obvious salivary contamination or coronal leakage, these have questionable prognosis.

➢ Based on the location:

- Coronal perforation - perforations that occur coronal to the level of crestal bone and epithelial attachment, and they cause minimal damage to the supporting tissues and are easy to access and seal a good prognosis.
- Crestal perforation - perforations at the level of the epithelial attachment into the crestal questionable prognosis.
- Apical perforation - perforations apical to the crestal bone and the epithelial attachment, minimal risk of salivary contamination, and hence, a good prognosis.

DIAGNOSIS

Accurate diagnosis of root perforation can be tricky. Sudden bleeding and pain during instrumentation are warning signs of a potential root perforation. Continuous and profuse bleeding will occur in case of perforation, and the patient will complain of severe pain. The appearance of blood on paper points after instrumentation may be indicative of either strip perforation or apical perforation. However, it is unreliable as the bleeding may originate from the apical foramen also.

Radiographs taken at different angles with radiopaque instruments in the root canal are better option and may confirm the presence of perforation**.**

Electronic apex locators can accurately determine the location of perforations, making them more reliable than radiographs. A dental operating microscope is another effective tool in detecting perforation during orthograde root canal therapy and in surgical endodontic treatment.

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MEASURES TO PREVENT PERFORATION

The following few precautions can be followed to prevent the complication of perforation:

- Before root canal access, a pre-operative x-ray must be well studied regarding the number of canals, angulation of the root and curvature of the canals, the distance between the floor and roof of the pulp chamber, the and presence of calcifications.
- During access preparation, understanding the tooth anatomy and applying the basic principles such as the location of pulp chamber centrally at the level of CEJ and the canals are located at the junction of floor and walls of the pulp chamber and the location of canals directly under their respective cusps.
- During cleaning and shaping, pre-curving the files for curved canals prevents strip perforation and transportation. Accurate determination of working length using both radiographs and apex locators to prevent apical perforation.

MANAGEMENT OF PERFORATION

The successful management of root perforation depends on early diagnosis, choice of treatment, materials used, and the experience of the practitioner. The main aim is to achieve a tight and permanent seal that will prevent bacteria and its by-products in the root canal from entering the surrounding tissues. Perforations can be managed either by non-surgical or orthograde approach and surgical approach or intentional replantation.

Non-surgical approach

Non-surgical or orthograde approach is done in cases of small, uncomplicated perforations that are easily accessible. Perforations present at the crown portion of the tooth can be repaired by conventional filling material such as GIC or composite.. Perforations present at the coronal-third of the root can be filled non surgically, provided it is accessed easily.

Surgical Approach

Surgical intervention is required in cases of large perforations that are not easily accessible, such as due to resorption, failure to heal after non-surgical repair. The main purpose of surgical treatment is to provide a tight seal against the entry of bacteria and its by-products into the periodontium. The success of the surgical repair depends on the following factors:

- Amount of remaining bone
- Extent of osseous destruction
- Periodontal disease status
- Duration of perforation
- Soft tissue attachment level
- Patients oral hygiene status
- Operator's expertise.

In case of surgical intervention, it is advisable to properly treat and fill the root canals before repair. The flap is elevated at the perforation site, and the repair material is packed directly on to the defect carefully without extruding it to the adjacent tissues, after which the flap is approximated. In cases of apical perforations, resection of the apical root to sound root structure with adequate filling is recommended. Crestal perforations are tricky to repair, as it will certainly result in loss of epithelial attachment and apical migration of tissues leading to pocket formation and secondary periodontal involvement. In such scenario's guided tissue regeneration has been attempted as the GTR membrane acts as a barrier for apical migration of the epithelium.

IDEAL REQUIREMENTS OF THE ROOT REPAIR MATERIALS

- It should provide adequate seal.
- It should be biocompatible.
- It should have the ability to produce osteogenesis and cementogenesis.
- It should be bacteriostatic and radiopaque, nontoxic, and noncariogenic.

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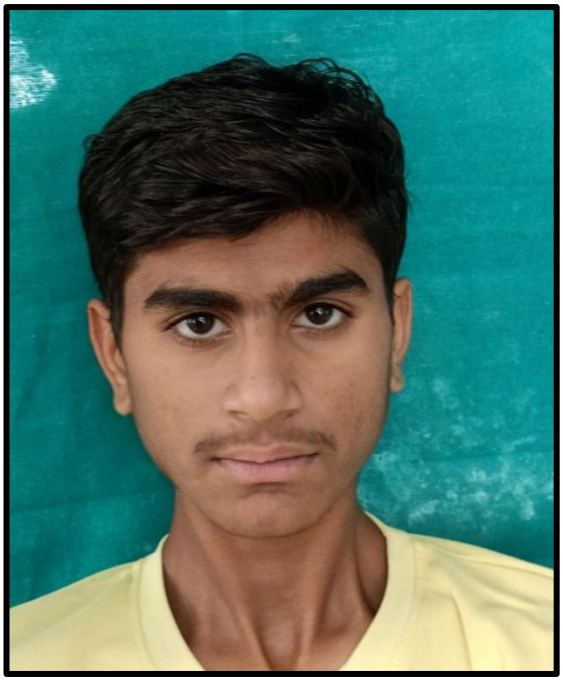
- It should provide an absorbable matrix over which the sealing material may be condensed.

Conventionally, amalgam, EBA, gutta-percha was used as root repair material. However, with the immense research on material science, newer materials are being constantly introduced. The newer materials include GIC, composite, dentin chips, decalcified freeze-dried bone, calcium phosphate, calcium hydroxide, Portland cement, MTA, Biodentine, endosequence, Bioaggregrate, and new endodontic cement (NEC).

Thus this article aims to review a case report of management of furcal perforation in upper 1st permanent molar treated with Biostructure MTA putty.

CASE REPORT

A 14-year-old male patient reported to the department of pediatric & preventive dentistry with a chief complaint of pain in the upper right back tooth region of the jaw for 1 month. Patient gave the history of incomplete root canal treatment. Clinical examination showed dislodged temporary restoration in relation to 16 & there was a pain on percussion. Radiographically radiolucency involving enamel, dentine, pulp & the furcal area with an incomplete GP obturation was done in relation to 16. Local anaesthesia was administered using 1:80,000 adrenaline containing 2% local anaesthesia. In the 1st appointment gutta percha remenance was removed followed by cleaning & shaping. All the canals were cleaned and shaped using ProTaper Rotary Filesystems (Dentsply, Maillefer, Switzerland) in a crown down technique and copious irrigation with 5.25% sodium hypochlorite & final rinse with normal saline. The furcal perforation was sealed with Biostructure MTA Putty (Safe Endo) which is a ready to use in syringe and damp cotton pellet was then placed in the pulp chamber to produce a humid environment for the MTA with the aim of achieving solidification, and the tooth was temporary filled with Cavit temporary restoration material (Cavit-G, 3M ESPE, St. Paul, Minnesota, USA) on 2nd appointment. On 3rd appointment temporary sealing materials and wet cotton pellet were removed and the hardness of the MTA was tested radiographically & clinically with an explorer followed by master cone selection was done and root canals were obturated with Gutta percha points and BioACTIVE RCS (Safe Endo) using lateral condensation technique. The patient was recalled after 7 days to the department with no symptoms or signs. In this appointment, permanent restoration was done using composite (3M ESPE Filtek P60 Posterior / Packable Composite). Later, Zirconia crown was chosen to restore the teeth.





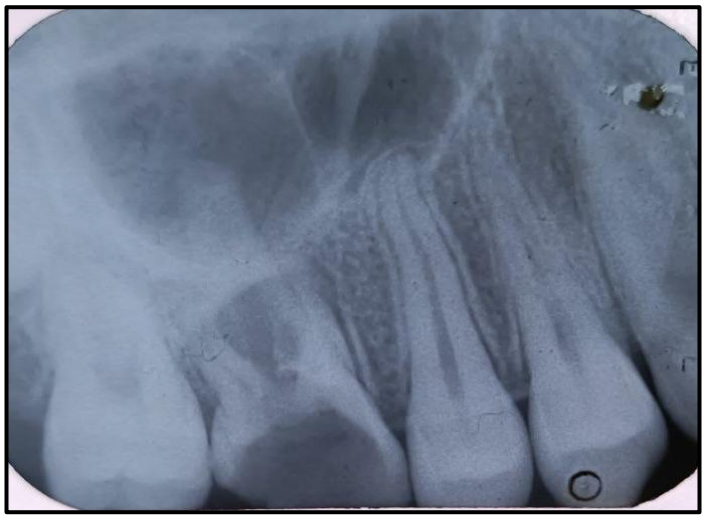
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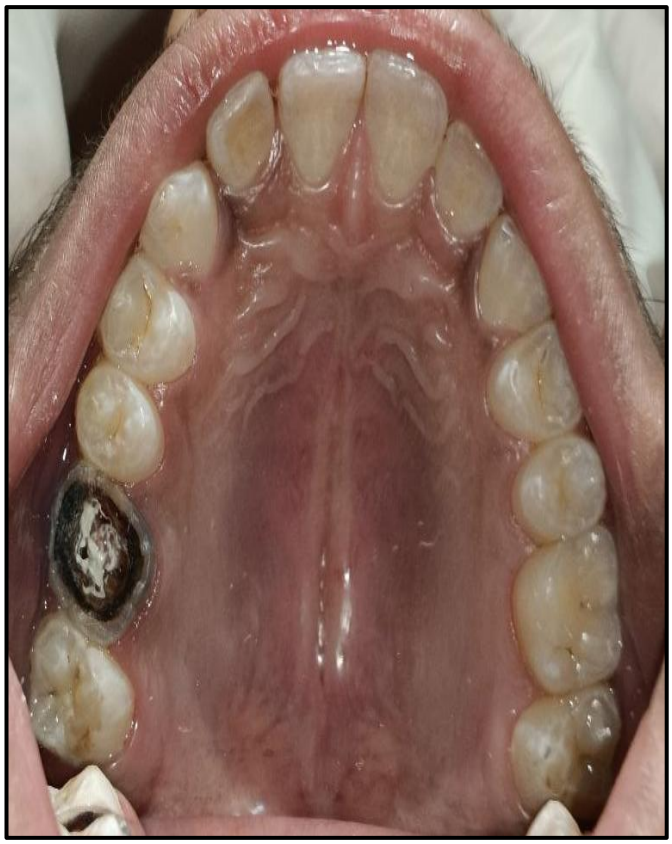


PRE-OPERATIVE PHOTOGRAPH

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PRE-OPERATIVE RADIOGRAPH



AFTER MTA PLACEMENT

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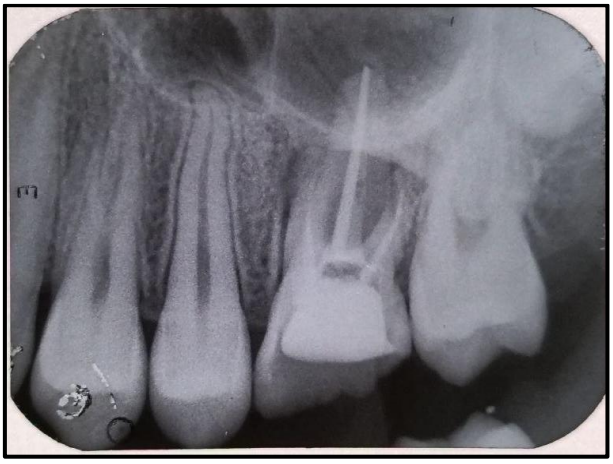
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IOPAR AFTER MTA PLACEMENT



OBTURATION



IOPAR AFTER ROOT CANAL TREATMENT

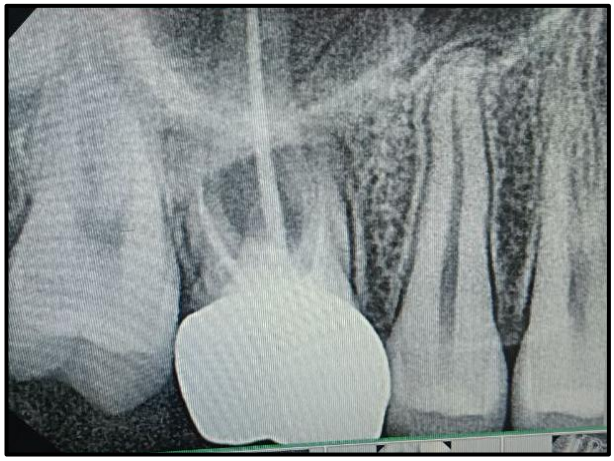
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POST OPERATIVE PHOTOGRAPH



IMMEDIATE POST OP IOPAR



THREE MONTH FOLLOW-UP IOPAR

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FOLLOW UP

A follow-up appointment after 15 days reported no pain symptomatology or discomfort. Periodic clinical and radiographic follow-up examinations were carried out at 3, 6, 12 months after the treatment. The tooth remained asymptomatic and with no mobility, swelling, or fistula during the entire period. The radiographic evaluation revealed reduction of the radiolucent area as a result of bone formation in the inter-radicular area.

DISCUSSION:

Perforation repair is a critical aspect of endodontic treatment, as perforations can compromise the prognosis of affected teeth. Mineral Trioxide Aggregate (MTA) has emerged as a highly effective material for repairing perforations due to its unique properties, including biocompatibility, sealing ability, and regenerative potential[2].

Perforations can occur due to pathological processes such as caries or resorptive lesions, or as a result of iatrogenic errors during endodontic procedures. These perforations create a communication between the root canal system and the external tooth surface, leading to inflammation, destruction of periodontal fibers, and bone resorption. The choice of repair material is crucial to ensure the restoration of normal tissue architecture and the prevention of further complications.

MTA has been widely studied and utilized for perforation repair. A long-term study conducted by Craig Main, Nina Mirzayan, Shahrokh Shabahang, and Mahmoud Torabinejad demonstrated the success of MTA in repairing root perforations[2]. The study included 16 cases where MTA was used to seal perforations, and follow-up radiographs showed normal tissue architecture adjacent to the repair site[3]. Teeth with pre-existing lesions exhibited resolution, while those without lesions maintained their healthy state. This highlights MTA's ability to provide an effective seal and promote healing.

The material's biocompatibility is a key factor in its success. MTA is non-toxic, insoluble in tissue fluids, and capable of promoting the regeneration of periradicular tissues. Its sealing ability prevents microleakage, which is essential for maintaining the integrity of the repair[4]. Additionally, MTA's hydrophilic nature allows it to set in the presence of moisture, making it suitable for challenging clinical scenarios[5,6].

Clinical case reports further support the efficacy of MTA in perforation repair[3,7] For instance, a case report by Dr. Darshan Shah, Dr. N. U. Manwar, Dr. Manoj Chandak, and Dr. Navdheeraj Pattanaik described the management of a furcal perforation using MTA. The material was applied to seal the perforation, and the tooth was restored with glass ionomer cement and a metal veneer crown. Follow-up evaluations showed successful outcomes, with no radiolucency in the furcation area and functional tooth stability.

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