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Management of Furcal Perforation Using Mineral Trioxide Aggregate and Endo Microscope-A Case Report

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KEYWORDS
- Endodontics
- Mineral Trioxide Aggregate (MTA)
- Perforation.

ABSTRACT:

Furcal perforations are challenging complications in endodontics, often resulting from insufficient knowledge and magnification. They rank as a common cause of treatment failures. Successful management depends on factors like size, location, and timing of repair, as well as the patient's dental health history. Magnification tools, such as dental operating microscopes, have improved precision in diagnosing and repairing these perforations. Mineral Trioxide Aggregate (MTA), known for its sealing ability and biocompatibility, is particularly beneficial when combined with magnification. We present a case of a challenging furcal perforation repair in a mandibular molar using MTA, demonstrating successful 18-month follow-up healing. This case highlights the importance of accurate diagnosis, precise repair, MTA usage, and magnification for effective furcal perforation management in endodontics.

1. Introduction

Iatrogenic furcal perforations, a severe and challenging complication of root canal treatment, can have detrimental consequences, potentially leading to tooth loss [1,2]. These perforations may arise during various phases of treatment, including access cavity preparation, post space preparation, or as a result of internal resorptions extending into peri radicular tissues [3]. Several factors influence the survival of perforated teeth, such as the size, location, and timing of repair, the presence of periodontal disease, and the pre-endodontic pulp vitality status [4]. Effective management of furcal perforations can be either surgical or non-surgical, with the choice depending on specific characteristics [5,6]

The key to a successful outcome in furcal perforation repair lies in accurate diagnosis and precise repair with a material that offers excellent sealing capability and biocompatibility [2,6] The use of magnification techniques, such as dental microscopes and loupes, has revolutionized the field of endodontics, enabling practitioners to enhance precision during perforation repair procedures. Mineral trioxide aggregate (MTA), which possesses favorable properties including sealing ability, biocompatibility, bactericidal activity, radiopacity, and the ability to set in the presence of blood or tissue fluids, benefits significantly when combined with magnification [7-9].

Root canal treatment primarily aims to achieve 3-D obturation to prevent re-infection, with inadequacies during shaping, cleaning, and obturation being potential causes of re-infection. Iatrogenic furcal perforations, occurring during access cavity preparation or canal exploration in multirooted teeth, can severely compromise the prognosis of root canal treatment [10]. The application of magnification in diagnosing and repairing perforations has transformed the precision and effectiveness of these procedures [11].

The ideal biomaterial for sealing perforations should possess several essential qualities, including antibacterial properties, biocompatibility, non-toxicity, radiopacity, and the ability to induce hard tissue formation. MTA, composed of hydrophilic particles with excellent biocompatibility and bacteriostatic properties, has emerged as a promising option for perforation treatment [12].

The presented case report details the successful repair of a significant furcal perforation in a right first mandibular molar using MTA. This case report includes the observation of the healing process in the underlying periodontal tissues and furcation bone, as evidenced by radiographic evaluation conducted at the 21-month follow-up assessment.

Case Report

A 26-year-old female patient reported to the Department of Conservative Dentistry and Endodontics with chief complaints of persistent pain in her lower left posterior tooth area. The discomfort had been ongoing for the past 10 days following an initial dental treatment attempted by a private clinic dentist. The patient reported that the previous dentist had encountered difficulties in locating the root canal orifices during the initial procedure. Clinical examination showed a presence of large furcation polyp filing the entire access cavity (Figure 1).

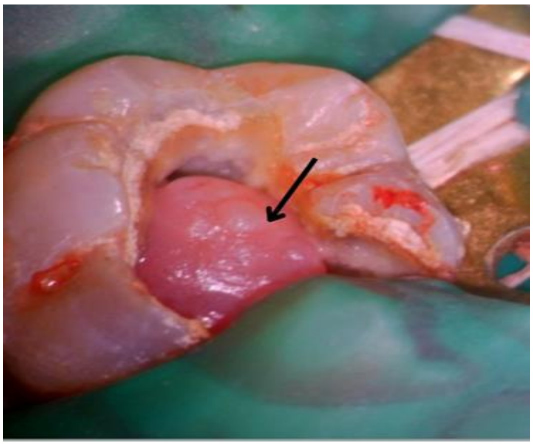

Figure 1: Intraoral image showing large furcation polyp filing the entire access cavity.

The tooth revealed no sensitivity to percussion or palpation tests, and the mean probing pocket depth was within the normal range. However, radiographic examination indicated a radiolucent area in the furcal region of tooth 46, strongly suggestive of a furcal perforation (Figure 2).

Figure 2: Intraoral periapical radiograph showing a radiolucent area in the furcal region of tooth 46.

The tooth exhibited no mobility, but the surrounding gingival tissue appeared inflamed. Subsequently, a comprehensive evaluation was conducted using a dental operating microscope (Global A-3 Series, Saint Louis, USA) after removal of the polyp (Figure 3)

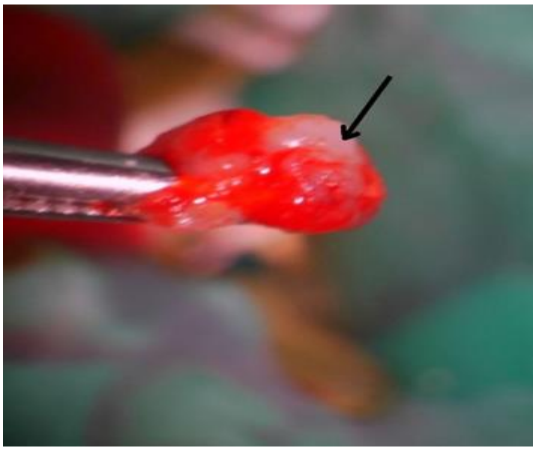

Figure 3: Showing the polyp removal under Endo microscope

under local anesthesia 2% lidocaine containing 1:200,000 epinephrine (Themicaine AD, Themis Medicare Ltd, Mumbai, India) endodontic treatment was initiated under rubber dam isolation, revealed the presence of a perforation site located at the junction of the buccal wall and the pulpal floor (Figure 4).

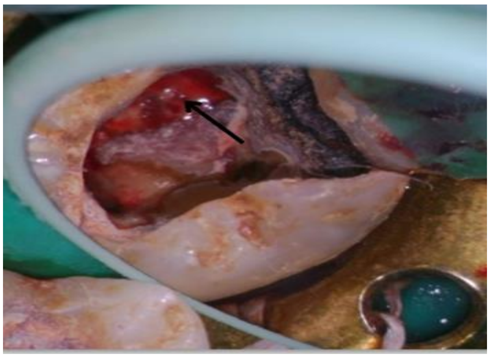

Figure 4: Intraoral image showing the perforation site located at the junction of the buccal wall and the pulpal floor.

The patient's medical history was found to be non-contributory. A treatment plan was formulated, consisting of two key components: i) Conventional Endodontic therapy, and ii) Sealing of the perforation site using Mineral Trioxide Aggregate (MTA)

The patient received a detailed explanation of the proposed procedure, and his conversant consent was obtained. Following which, endodontic treatment was initiated under rubber dam isolation. A round bur (Mani, Tochigi, Japan) was used to redefine the access opening. Patency was achieved using #10k file (Mani, Tochigi, Japan).

The determination of the working length was achieved using hand K-files (Mani, Tochigi, Japan) in conjunction with an apex locator (E-pex pro, Eighteeth, Changzhou, Jiangsu, China). The canals were shaped using neoendo flex (Orikam Healthcare Ltd., Gurugram, Haryana, India) up to size 35/06, employing a crown-down technique with the assistance of an endomotor (Eighteeth, Changzhou, Jiangsu, China). Throughout the procedure, irrigation was conducted using a solution comprising 5.25% sodium hypochlorite (Prime Dental, Thane, India) and saline.

A 30-second ultrasonic activation of a 5.25% NaClO solution was performed. Calcium hydroxide paste (Avue Cal, Dental Avenue, Param Enterprises, Pune, India) was employed as intra-canal medication for the subsequent 10 days, & access cavity was sealed using Temporary cement (Cavit, 3M ESPE, seefeld, Germany).

During second visit, medication was removed, & the tooth was irrigated with 5.25% sodium hypochlorite (Prime Dental, Thane, India) solution and saline. A master cone radiograph was obtained, and the canals were carefully dried with paper points.

Gutta-percha was then placed in the root canals throughout the perforation repair procedure (Figure 5).

Figure 5: Intraoral periapical radiograph showing gutta-percha placed in the root canals throughout the perforation repair procedure.

MTA (Prevest Denpro Ltd., Jammu, Jammu and Kashmir, India) was introduced into the perforation site using an amalgam carrier (Figure 6),

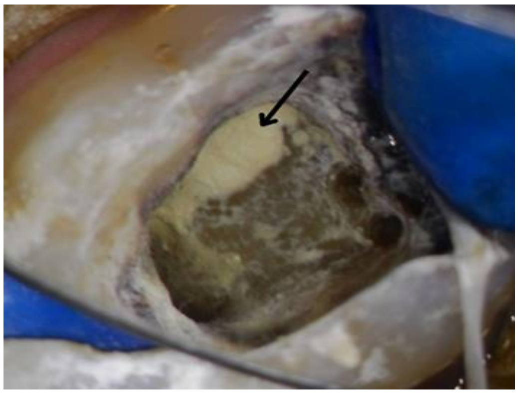

Figure 6: Intraoral image taken under dental operating microscope showing perforation repair using MTA (Prevest Denpro Ltd., Jammu, Jammu and Kashmir, India).

and a cotton pellet was strategically placed in the pulp chamber to create a humid environment, facilitating the complete setting of MTA (Prevest Denpro Ltd., Jammu, Jammu and Kashmir, India). The tooth was temporarily restored with temporary restorative material (Cavit, 3M ESPE, seefeld, Germany).

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The patient returned to the clinic three days later, reporting no symptoms or signs of discomfort. At this follow-up appointment, the temporary sealing materials and the moist cotton pellet were removed. The hardness of the MTA (Prevest Denpro Ltd., Jammu, Jammu and Kashmir, India) was assessed using an operative explorer, and the root canals were subsequently obturated with gutta-percha and AH Plus sealer (Figure 7).

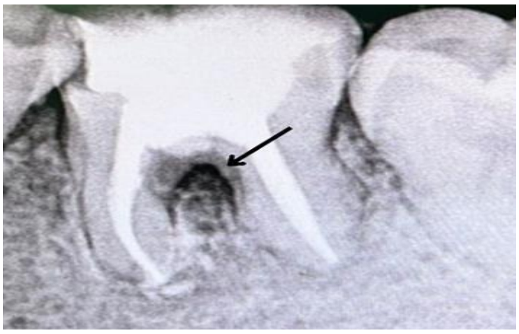

Figure 7: Intraoral periapical radiograph showing a radiolucent area in the furcal region of tooth 46

During the 18-month recall examination, the patient remained asymptomatic (Figure 8).

Clinical assessments revealed no pain, no response to percussion or palpation, and normal probing depths. This case highlights the successful management of a challenging furcal perforation through a well-executed combination of MTA repair and conventional root canal therapy.

Figure 8: Intraoral periapical radiograph showing the bone regeneration at 18-month recall.

Discussion

Endodontic therapy can be complex and risky, with certain procedures carrying a higher risk of complications. One such risk is endodontic perforation, which is an artificial opening in a tooth or its root that can occur during treatment. These perforations can lead to issues such as communication between the root canal and periodontal tissues, or even the oral cavity, causing root or furcation perforations [13].

Root and furcation perforations are typically iatrogenic, meaning they result from errors made during treatment. They are a significant cause of endodontic failure, accounting for a substantial portion of unsuccessful cases. Non-iatrogenic causes include root resorption and caries [13].

Accidental root perforations occur in approximately 2-12% of endodontically treated teeth and can lead to serious problems, including infections, pain, suppuration, and potentially abscesses. Chronic conditions may even result in bone resorption and the need for tooth extraction. However, early diagnosis and proper management of perforations can lead to the long-term survival of the tooth [14].

The prognosis of perforation repair in endodontic therapy depends on several key factors. Timely detection and immediate repair of perforations are crucial for a favourable outcome. Smaller perforations tend to respond better to repair than larger ones, which can result in more tissue damage and increased contamination risk [15]. The location of the perforation along the root surface plays a critical role, with proximity to the crestal bone and epithelial attachment increasing the risk of bacterial contamination. Different types of perforations, such as subgingival, midroot, and apical, require specific approaches for successful repair [14,15].

Accurate detection and localization of root perforations are critical for successful treatment in endodontics. Warning signs such as sudden bleeding and pain during root canal instrumentation can signal a potential perforation, although bleeding alone is not always a reliable indicator. Radiographic techniques, including the use of radiopaque materials and careful examination from different angles, can help identify perforations, but their effectiveness can be limited, especially when perforations are located at the buccal or palatal aspects of the root. Electronic apex locators (EALs) are highly reliable tools for pinpointing perforation locations, particularly when readings indicate a significant deviation from the original working length. Dental operating microscopes, with their high magnification and illumination, provide precise visualization of perforations along straight root canals. Additionally, the presence of a narrow isolated periodontal defect may suggest a periodontal breakthrough due to root perforation, and periodontal probing can help confirm this. In cases of narrow isolated periodontal defects, differential diagnosis from vertical root fractures may be necessary through explorative surgery [11,13-15]

Various materials used for perforation repair in endodontics include Indium foil, amalgam, plaster of Paris, zinc oxide eugenol, Super EBA, IRM (Intermediate Restorative Material), gutta-percha, Cavit, glass ionomer cement, metal-modified glass ionomer cement, composite, dentin chips, decalcified freeze-dried bone, calcium phosphate cement, tricalcium phosphate cement, hydroxyapatite, calcium hydroxide, Portland cement, MTA (Mineral Trioxide Aggregate), Bio dentine, Endo sequence, Bio aggregate, and New Endodontic Cement. These materials offer various properties and are selected based on the specific needs of the perforation repair procedure [16].

MTA (Mineral Trioxide Aggregate) emerged in the 1990s and has since become a preferred material for repairing furcal and root perforations in endodontics. It is composed of calcium and phosphorus ions with a biocompatible pH of 12.5. MTA is less toxic compared to alternative materials like amalgam, Super EBA, and IRM [17]. It fosters the growth of cementum-like substances and elicits fewer inflammatory responses over time. MTA exhibits excellent marginal adaptation to dentin and minimal leakage during lateral root perforation repairs. It is particularly adept at resisting leakage in the presence of blood contamination [18]. In clinical use, MTA has demonstrated successful outcomes with normal tissue healing and no pathological changes near perforation sites. Although MTA has proved effective, ongoing research aims to enhance its radiopacity, sealing ability, and ease of use, while preserving its beneficial biological properties. Consequently, MTA is the material of choice for perforation repair in endodontics [19].

This case illustrates the successful management of a challenging furcal perforation in a 26-year-old patient. By combining Mineral Trioxide Aggregate (MTA) repair with conventional root canal therapy, the patient's persistent pain was effectively addressed. The careful execution of root canal therapy, including the use of rubber dam isolation and meticulous canal preparation, ensured precision in treatment. MTA sealed the perforation site, and a controlled humid environment facilitated its setting. The patient remained symptom-free and showed normal clinical assessments during the18-month follow-up, underscoring the importance of precise endodontic procedures and appropriate treatment planning for complex cases like furcal perforations.

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