Case Report

Beyond the Scalpel: Conservative Resolution of a Radicular Cyst

Priyanka Bhojwani[1], Anuja Ikhar[1], Aditya Patel[1], Manoj Chandak[1], Shweta Sedani[1]

[1]Department of Conservative Dentistry and Endodontics, Sharad Pawar Dental College, Datta Meghe Institute of Higher Education and Research, Wardha, Maharashtra, India

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Corresponding Author:
Priyanka Bhojwani, Department of Conservative Dentistry and Endodontics, Sharad Pawar Dental College, Datta Meghe Institute of Higher Education and Research, Wardha, Maharashtra 442001, India
E-mail: pbhojwani0000@gmail.com

Abstract

Radicular cysts are one of the most common types of odontogenic cysts and are typically associated with chronic periapical infections. There is increasing interest in non-surgical alternatives that provide similar outcomes while preserving the tooth structure. Mineral Trioxide Aggregate (MTA), a practical option for non-surgical treatment of periapical lesions, including radicular cysts. This case report discusses the successful non-surgical management of a radicular cyst in a 17-year-old male patient. The patient presented with a history of persistent pain and swelling in the maxillary anterior region. Clinical and radiographic examination revealed a well-defined radiolucent lesion at the apex of a non-vital tooth, suggestive of a radicular cyst. After initial root canal therapy, the infected tissue was carefully debrided, and the cystic cavity was filled with MTA to promote healing. The biocompatible nature of MTA, combined with its ability to form a tight seal, was believed to have contributed to the resolution of the cyst without the need for surgical intervention. Follow-up radiographs taken at 6 months post-treatment demonstrated significant healing of the periapical region. The patient remained asymptomatic, with no clinical complications. These findings suggest that MTA can be an effective and viable option for non-surgical treatment of radicular cysts. In conclusion, using MTA in the non-surgical management of radicular cysts may offer a promising approach to preserving the natural dentition while ensuring satisfactory clinical outcomes. Further long-term studies and clinical trials are needed to better understand the efficacy and limitations of MTA in the treatment of periapical cystic lesions.

Keywords: conservative, cysts, radicular, resolution, scalpel

Introduction

Mineral trioxide aggregate (MTA) is a bioactive, hydrophilic endodontic material known for its biocompatibility, as well as its ability to promote healing and osteogenesis. This material is composed of fine oxide powders, including tricalcium oxide, silicon oxide, and bismuth oxide, along with additional hydrophilic compounds such as tricalcium silicate and tricalcium aluminate. These components are responsible for the unique chemical and physical properties of MTA. The cement sets when exposed to moisture.(1-5) Upon hydration, the powder forms a colloidal gel with a pH of 12.5, which solidifies within 3 to 4 hours.(6,7)

Dental trauma is an unpredictable event, and its management can often pose a challenge for clinicians. Dentists should be prepared to treat patients who have sustained dental injuries, as prompt action can significantly improve the overall prognosis. When a dental trauma results in pulp exposure, immediate intervention is necessary to address the exposed pulp. MTA is commonly used in such cases due to its high biocompatibility and mechanism similar to that of calcium hydroxide ($Ca(OH)_2$), which is known for its strongly alkaline and antibacterial properties.

In contrast to $Ca(OH)_2$, MTA hardens to a solid consistency, making it particularly effective for restorative procedures. Its rapid setting ability allows for definitive restoration after partial pulpotomies performed with MTA.(6) Endodontic treatment is typically indicated when caries or trauma has caused irreversible damage to the pulp tissue, leading to necrosis.

The mechanism by which MTA functions is closely linked to the clinical characteristics of the human oral environment. When MTA comes into direct contact with oral tissues, it releases calcium ions that promote cell proliferation. Additionally, its alkaline pH helps create an antibacterial environment by regulating cytokine production. This further supports the migration and differentiation of cells responsible for forming hard tissue, leading to hydroxyapatite formation on the surface of MTA and providing a biological seal. MTA's advantages include its excellent biocompatibility, antibacterial properties, effective marginal adaptation, sealing ability, and its hydrophilic nature.(7)

Management of radicular cysts involves both non-surgical and surgical approaches, selected based on lesion size, location, symptoms, and response to initial treatment. The primary goal is to eliminate the source of infection and allow for periapical healing. Non-surgical root canal therapy (NSRCT) is the first-line treatment for small to moderately sized cystic lesions. By disinfecting the root canal system and sealing it properly, many radicular cysts resolve without the need for surgery.(7)

When non-surgical management is insufficient–particularly in cases of large, symptomatic, or persistent cysts–surgical intervention is indicated. Enucleation is the most commonly employed surgical technique, involving complete removal of the cystic lining. It is typically chosen for accessible, well-demarcated cysts where surrounding structures are not at risk. In contrast, marsupialization (or decompression) is used when the cyst is large and enucleation could compromise adjacent anatomical structures such as nerves, sinuses, or permanent tooth buds. This technique reduces intra-cystic pressure by creating a surgical window, allowing gradual shrinkage of the lesion. Marsupialization may be followed by enucleation once the lesion is smaller and safer to remove.(7)

In some cases, a combined approach involving both decompression and later enucleation is necessary. Follow-up with clinical and radiographic evaluation is essential to confirm resolution.

Case presentation

A 17-year-old male patient had been referred to the department of endodontics with a chief complaint of severe pain in the upper front region. He gave a history of severe pain and swelling for which he had initiated treatment at a private clinic 9 months earlier but did not follow up there. Cone beam computed tomography examination suggested a radicular cyst in relation to maxillary left central incisor and maxillary left lateral incisor, with dimensions 11.4×6.1×8.8 mm (Figure 1). However, the vitality tests revealed that maxillary left central incisor and maxillary left lateral incisor were non-vital. After the patient and his family had been informed about the treatment process, approval was obtained for the treatment.

Treatment Procedure

Local anesthesia was applied for patient comfort. The access cavity was opened. The old canal medicament in the middle trio was removed using H files of ISO

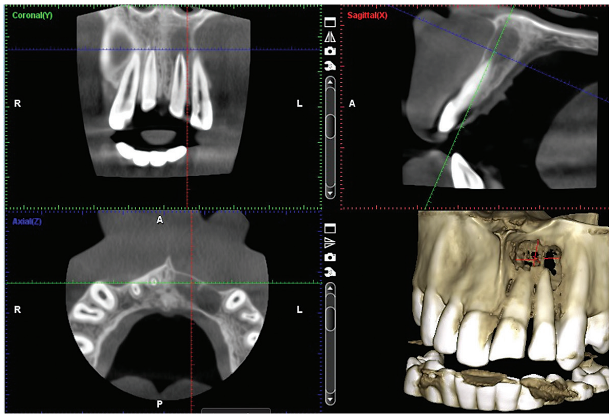

Figure 1: Showing pre-op CBCT image.

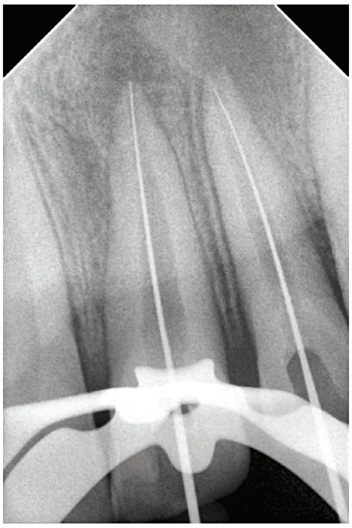

Figure 2: Showing confirmation of working length.

sizes 15, 20, and 25 in an up-and-down motion. Copious irrigation with 2.5% sodium hypochlorite was performed between the use of files. The H file was used again for the apical part. Working length was determined using an apex locator and was confirmed radiographically, as shown in Figure 2.

Later, the apical diameter was prepared with K and H files up to size #50 to clean the necrotic root structure. Copious irrigation was performed between each file. After the master apical diameter was prepared to size #50, root canal preparation was completed with the step-back technique. Serous exudate drained through the canal. After final irrigation, the tooth was closed with a temporary filling. Drainage did not stop, and dressing was continued for the next three sessions. The tooth remained asymptomatic during the sessions. At the fifth appointment, the tooth was ready for obturation. Furthermore, a conical shape was given to the root canal with the step-back technique. There were no irregularities in the root canal wall after preparation.

Plugger fit was checked, and the apical 3-4 mm, which consisted of maximum ramifications, was well sealed with MTA. A moist cotton pellet was placed, and the patient was recalled after 2 days. On the next visit, the remaining canal was obturated using thermoplasticized gutta-percha. Post-endodontic composite was performed with maxillary left central incisor and maxillary left lateral incisor.

Follow-up and outcomes

Follow-up via telephone communication was established regularly, revealing successful treatment with no complaints of pain, alleviation of symptoms, and preservation of tooth integrity. Figure 3 and 4 shows the results at the three-month and six-months follow-up respectively, also Figure 5 shows 3-dimensional post-operative CBCT where the lesion has healed and where we can visualize osteogenesis. This case highlights the efficacy of MTA as an end filling material healing and bone formation in periradicular involvement, offering promising outcomes in challenging endodontic scenarios. Informed consent was obtained from the patient for publication.

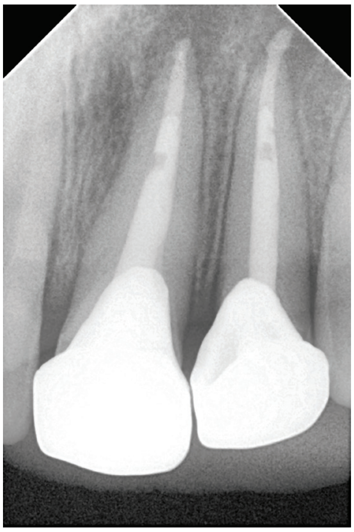

Figure 3: Showing the results at the three-month follow-up.

Discussion

Osteoblast differentiation is influenced by various hormones and growth factors, including TGF-β (trans-

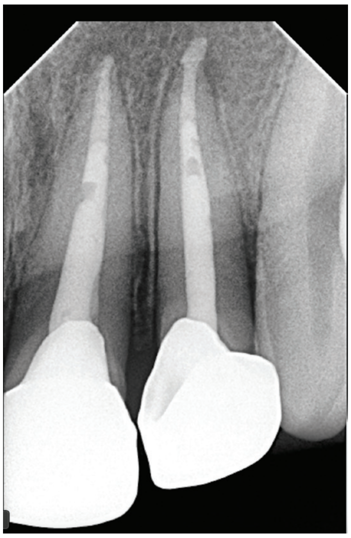

Figure 4: Showing the results at the six-month follow-up.

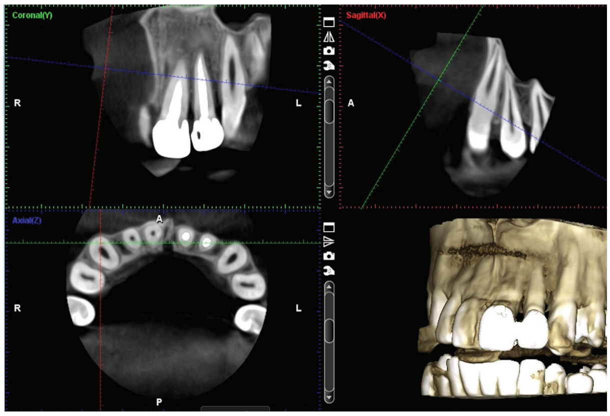

Figure 5: Showing six-month follow-up CBCT image.

forming growth factor-β), BMP-2, and bFGF (basic fibroblast growth factor).[7,8] Among these, BMP-2 is considered the most potent promoter of osteoblast proliferation, differentiation, and mineralization.[9-11] Previous research has demonstrated that MTA not only promotes osteoblastic mineralization but also enhances BMP-2 mRNA expression.[12-14]

Nowicka *et al.*,[12] demonstrated that the formation of reparative dentin bridges is influenced by the type of material used. Bonte *et al.*,[13] found no significant statistical difference between $Ca(OH)_2$ and MTA, but noted that MTA yielded superior dentin healing. They also suggested that apexification with MTA may lead to better outcomes compared to $Ca(OH)_2$. Bernabé *et al.*,[14] highlighted the utility of MTA as a root canal filling material following apicectomy, further noting that sonic vibration could enhance its sealing capacity. Sönmez *et al.*,[15] concluded that the sealing ability of AH Plus and ProRoot was comparable, but MTA Fillapex showed more microleakage when compared to the other two materials. Leye Benoist *et al.*,[16] observed a higher success rate in the MTA group compared to $Ca(OH)_2$. Hansen *et al.*,[17] demonstrated that MTA results in a higher intracanal pH than Endodontic Sealer (ES), a finding that was also supported by Yildirim *et al.*[18] MTA has been shown to be effective as an apical filling material in root canals, particularly in teeth requiring post-core restorations.

Recent studies highlight the remineralizing potential of nanosized materials, which can intercept the progression of early lesions. These materials include calcium phosphate, carbonate hydroxyapatite nanocrystals, nanoamorphous calcium phosphate, and nanoparticulate bioactive glass. Such materials, particularly when they facilitate the self-assembly of proteins, play a crucial role in biomimetic repair, even in the dental field. The small size of these nanomaterials makes them ideal carriers for dental products.[17,19-24]

Consequently, it has been recently proposed that incorporating nanomaterials with biological benefits into adhesives not only enhances their mechanical and physical properties but also improves the durability and longevity of the adhesive bond.

A study by Karan and Aricioğlu in 2020[25], which assessed bone healing after the application of MTA and platelet-rich fibrin in periapical lesions using cone-beam computed tomography, found that MTA achieved high success rates in endodontic microsurgery for periapical lesions. MTA is a biocompatible material that offers superior sealing ability and promotes periapical tissue regeneration, outperforming conventional retrograde materials like gutta-percha (GP).[26,27] Additionally, previous randomized clinical trials reported MTA success rates exceeding 80% after 12 months and over 90% after 24 months of follow-up.[28,29]

Although MTA offers many advantages, it does have some drawbacks, including its relatively long setting time and challenges with proper application. If not carefully handled, the material can be easily displaced. Several factors can influence the setting time and physical properties of MTA, including the nanoparticle size and concentration, the powder-to-liquid ratio, environmental conditions such as pH and room temperature, and the air trapped during the mixing process.[30]

The decision-making process between surgical and non-surgical management of periapical cysts requires a comprehensive evaluation of clinical, radiographic, and patient-related factors. Non-surgical root canal therapy (NSRCT) is widely accepted as the initial treatment of choice, particularly for lesions of endodontic origin that are asymptomatic, well-contained, and of small to moderate size. The rationale is based on the principle that periapical cysts, whether true or pocket cysts, often regress upon removal of the etiologic source–namely, the intraradicular infection. Healing is initiated through effective canal disinfection, reduction of intracanal pressure, and host-mediated immune response. While MTA is commonly highlighted for its bioactive properties, favorable outcomes in cyst resolution are not exclusively attributed to it. Rather, successful healing also occurs with other materials and techniques, provided that microbial elimination and apical sealing are achieved. $Ca(OH)_2$, for example, promotes periapical healing by creating an alkaline pH that inhibits residual pathogens and encourages hard tissue deposition.(14)

However, non-surgical management has its limitations. In cases of persistent or large lesions unresponsive to endodontic therapy, or when there is cortical expansion, tooth displacement, or proximity to vital structures, surgical intervention may be warranted. Enucleation allows for complete removal of the cystic lining and histopathological confirmation, making it the preferred option for accessible and well-defined lesions. Marsupialization, though less definitive, is indicated for extensive cysts where enucleation may compromise anatomical structures. It allows gradual decompression, promoting reduction in cyst size and often followed by enucleation when safer.(14)

Expected outcomes differ: non-surgical treatment is conservative, cost-effective, and often sufficient, though it may require prolonged monitoring.(31) Surgical approaches provide immediate lesion resolution but carry risks such as postoperative complications, longer recovery, and increased cost.(32) Ultimately, the choice between modalities should be individualized, taking into account the lesion’s characteristics, patient preference, and clinician expertise. Regular radiographic follow-up is essential, regardless of the chosen method, to ensure complete resolution and prevent recurrence.(33,34)

Conclusions

This case report highlights the successful management of a radicular cyst using MTA as the primary sealing material. The patient experienced notable clinical and radiographic improvements, with complete resolution of the cystic lesion and retention of the affected tooth. MTA's exceptional biocompatibility, sealing properties, and ability to stimulate tissue regeneration make it a promising material for treating radicular cysts. This case adds to the growing body of evidence suggesting that MTA can be a viable alternative to traditional surgical methods in managing periapical diseases, contributing to favourable healing outcomes. However, further research with larger sample sizes is necessary to validate its long-term effectiveness and potential benefits over conventional treatment approaches.

Ethical Considerations

Informed consent, with all the procedure mentioned was taken before delivering treatment.

Conflict of Interest

The authors declare no conflicts of interest.

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