

SINGLE-VISIT ORTHOGRADE MINERAL TRIOKSIT AGREGATE (MTA) CANAL GRAFTING OF LARGE PERIAPICAL LESION TEETH: CASE SERIES**Babak Mobaraki^{*1}, Solmaz Mobaraki², Can Özükoç³ and Sadeq Mohammed Taqi Fadhil⁴**¹Endodontic Specialist, Tabriz, Iran.²Department of Pedodontics, Van Yüzüncü Yıl University, Faculty of Dentistry, Van, Turkey.³Department of Pedodontics, İstanbul Medipol University, Faculty of Dentistry, İstanbul, Turkey.⁴Department of Prosthodontics, Ankara Medipol University, Faculty of Dentistry, Ankara, Turkey.

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Bioceramic-based dentin replacement and repair materials are mainly calcium silicate and calcium phosphate compounds which exhibit biocompatibility due to their similarity with biological compounds, like hydroxyapatite and have the ability to induce a regenerative response in the organism. For older academics or clinicians, this change might be viewed as the death of conventional dental materials, but for most others, this is the birth of true biomaterials. Mineral trioxide aggregate has been a revolutionary material in endodontics. Since its introduction in the 1990s several studies have demonstrated its use in various clinical applications. Indications were primary/secondary root canal infection, traumatic dental injury, root resorptions, combined endodontic lesions, single-visit apexification, apical/periodontal surgery. New materials, such as OrthoMTA (BioMTA, Seoul, Korea) are newly developed mineral trioxide aggregate cement for root canal obturation. According to the manufacturer, orthograde mineral trioxide aggregate grafting technique is called "Biofilling" of the root canal system with OrthoMTA. The purpose of the report was to compose fully documented cases treated with the orthograde mineral trioxide aggregate canal grafting technique in teeth with large periapical lesions and then the treatment is finished and the prognosis is presented.

KEYWORDS: Bioceramic, Biofilling, Mineral trioxide aggregate, OrthoMTA.**INTRODUCTION**

Abnormal communication between the root canal and the periodontal area, which is caused by iatrogenic and pathological factors such as root resorption or caries, often creates complex and complicated situations in endodontic treatment and affects the prognosis of the treatment.^[1] Lin et al., evaluated the effects of treatment errors on the outcome of treatment and found that errors during treatment increased the risk of root canal failure as it created the conditions for microorganisms to enter the root canal environment.^[2] Bioceramic cements or Endodontic repair cements are successfully used as bioactive repair materials in the field of endodontics due to their physicochemical and biological advantages.⁽³⁾ Torabi Nejad et al., introduced Proroot MTA (Tulsa Dental Product, Tulsa, OK) in 1993 for root-end filling and in 1994 for perforation repair.^[4] Using fluorescent rhodamine B dye, Torabi Nejad et al., showed less leaching of this material than amalgam or Super EBA.^[4] They have also found in other studies that MTA has a better seal than amalgam, Super EBA or IRM (intermediate restorative material) even in the presence of blood.^[5,6] Today, bioceramic cements can also be used in root canal obturation.^[7] If there is continuous bleeding,

since it is difficult to completely close the selective area, it is recommended to try obturation of the entire root canal with the orthograde technique with MTA for better results.^[8] As a general feature, it is known that the bonding of bioceramic cements to dentin is carried out with fingerlike structures extending to the dentinal tubules, and this process is called biomineralization.^[9,10] According to the manufacturer, OrthoMTA is an alternative bioceramic cement synthesized by active ingredients of mineral trioxide aggregate with bioactive properties.

MATERIALS AND METHODS**CASE PRESENTATION**

According to the institution's guidelines, ethics committee approval is not required for individual case disclosure. Written consent was obtained from the patients allowing the use of medical information and imaging. In our study, reciprocating preparation systems were used. The cases presented below were treated with the "Biofilling" technique according to the manufacturer's recommendations (see <http://www.biomta.com>) in a single visit treatment.

Case 1

A 35-year-old healthy female patient presented with pain in the apical region of her upper left lateral tooth. The patient stated that she had experienced this problem before and that the dentist performed normal root canal treatment. In the clinical examination, fistula and pus discharge were observed in the buccal mucosa. The tooth was not sensitive to percussion and palpation. In the radiographic examination, an incomplete root canal treatment and apical root resorption were detected. Informed consent form was obtained from the patient after explaining all treatment stages and treatment options, risks and benefits. After isolation with Rubber dam without local anesthetic injection, the access cavity was made and retreatment was performed using Reciproc R25 (VDW) rotary instruments, and the guttaperchas

were removed. The working length was determined to be 1mm shorter than the radiographic apex, and after the root canal was prepared using the Reciproc R40 (VDW) and then Reciproc R50(VDW), irrigation was performed without overflow of irrigating solution through the apical region. The canals were irrigated with 2 mL of 2% NaOCl during preparation. Final irrigation was completed with 5mL of 2% NaOCl for 1 minute followed by 5mL of distilled water for 1 minute. After the canal systems were dried with sterile paper points, the entire root canal was filled up to the root resorption area with OrthoMTA as post application was not required. The patient was called for control after 6 months and 1 year, and no clinical signs and symptoms were detected in the clinical examination of the controls, and the lesion was healed in follow-up x-rays.



Post obturation radiograph



Six months follow-up radiograph



1 year follow-up radiograph

Case 2

A 19-year-old healthy female patient was admitted to our clinic with recurrent swelling in the apical region of her upper left lateral tooth. On clinical examination, a fluid-filled swelling was observed in the buccal mucosa. The tooth was extremely sensitive to percussion and palpation. In the radiographic examination, a radiolucent area including the root of the upper left first, second, third and fourth teeth was detected. In the electrical pulp test, a negative response was obtained only from the lateral tooth. The patient stated that she had trauma to the upper jaw 2 years ago. A diagnosis of symptomatic

apical periodontitis with pulp necrosis was made. Informed consent was obtained from the patient after explaining all treatment stages and treatment options, risks and benefits. After isolation with Rubber dam without local anesthetic injection, the access cavity was made and the working length was determined 1 mm shorter than the apical foramen with a #10 K-type hand file and apex locator, and it was checked by taking radiography. The patient was kept in the chair when the fluid was seen coming out of the root canal, and after the end of the fluid outflow, root canal treatment was performed using Reciproc R25(VDW) and then Reciproc

R40 (VDW) rotary instruments. The canals were irrigated with 2 mL of 2% NaOCl during preparation. Final irrigation was completed with 5mL of 2% NaOCl for 1 minute followed by 5mL of distilled water for 1 minute. After the canal systems were dried with sterile paper points, the entire root canal was filled up to the root

resorption area with OrthoMTA as post application was not required. The patient was called for control after 6 months and 1 year, and no clinical signs and symptoms were detected in the clinical examination of the controls, and healing of the lesion and increase in bone tissue were detected in the follow-up x-rays.



Post obturation radiograph



Six months follow-up radiograph



1 year follow-up radiograph

Case 3

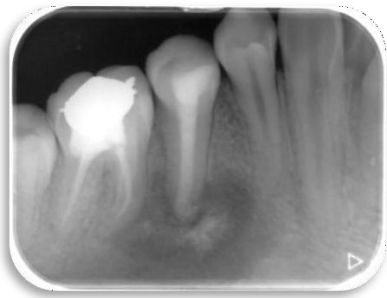
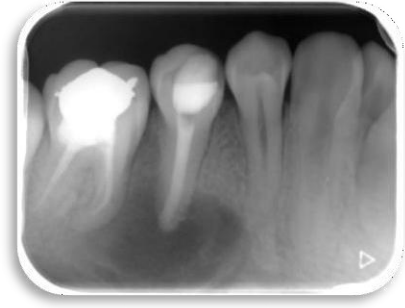
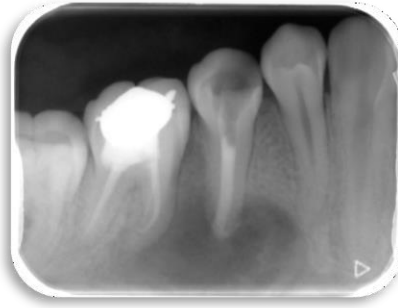
A 22-year-old healthy female patient was referred to our clinic by a general dentist. In the anamnesis taken from the patient, it was learned that she applied to the dentist because of caries in the mandibular right second premolar tooth and it was found that there was a large apical periodontitis lesion in the diagnostic radiograph taken. In the clinical examination, it was observed that the right mandibular second premolar tooth had caries and that the dentist had applied a temporary filling material. The tooth was not sensitive to percussion and palpation. A diagnosis of asymptomatic apical periodontitis with pulp necrosis was made.

After explaining all treatment stages and treatment options, risks and benefits, informed consent was obtained from the patient and it was decided to fill the root with OrthoMTA. Endodontic treatment started after rubber dam isolation without local anesthetic injection. The working length was determined to be 1mm shorter than the radiographic apex by taking a periapical radiograph with a #10 K-type hand file. The root canal

was prepared with a Reciproc R25 (VDW) and then a Reciproc R40 (VDW) rotary file at the working length it was determined. The canal was irrigated with 2 mL of 2% NaOCl during root canal preparation. After instrumentation, irrigation was completed with 5 mL of 2% NaOCl for 1 minute and then 5 mL of distilled water for 1 minute. After the canal systems were dried with sterile paper points, the entire canal was filled with OrthoMTA, as post application was not required as planned. The patient was called for control after 6 months and 1 year, and no clinical signs and symptoms were detected in the clinical examination of the controls, and the lesion was healed in follow-up x-rays.



Post obturation radiograph



Six months follow-up radiograph



1 year follow-up radiograph

RESULTS AND DISCUSSION

Each patient with periapical tissue diseases who applied to our clinic is recorded, treatment opportunities are provided and followed up. Two-dimensional radiographic techniques are frequently used for routine preoperative diagnosis and follow-up, but sometimes root canals cannot be detected in buccolingual projection due to superpositions. This is a limitation of the two-dimensional radiographic imaging technique and is one of the main failure factors in root canal treatment.^[11,12] Three-dimensional complex root canal anatomies can be easily detected with cone-beam computed tomography (CBCT), but the resolution of CBCT is lower than that of modern two-dimensional intraoral imaging, and besides, since CBCT also has disadvantages such as an expensive technique, exposing the person to more radiation, modern two-dimensional radiography is still shown as the most appropriate technique in the diagnosis, treatment and follow-up process in the field of endodontics.^[13-15] Inflammatory destruction of periradicular tissues resulting from microbial infection within the root canal system is defined as apical periodontitis.^[16,17] To treat apical periodontitis, it is the root canal preparation with hand or rotary system files, followed by the sealing of the root canal to prevent re-infection after disinfection with intracanal medicaments using irrigation solutions.^[18] There are studies showing that the influence of the increased apical preparation size in teeth with apical periodontitis on the intracanal microbial load reduction.^[19,20] Salzgeber and Brilliant reported that the required preparation size should be at least #30 for irrigation solutions to reach the apical

region.^[21,22] In order for the irrigation solutions used in our study to reach sufficient depth in the root canals and according to the recommendation of the OrthoMTA manufacturer (see <http://www.biomta.com>), Reciproc R40(VDW) (0.06 taper) and Reciproc R50(VDW) (0.06 taper) rotary files were used to preparation the root canals.^[23,24]

When this treatment process is completed properly, the periapical lesion usually regenerates with hard tissue and heals completely, and is characteristically reduced in radiolucency on follow-up radiographs.^[25-33] However, healing of the periapical lesion may not be observed in every root canal treated tooth. In a clinical study with long-term follow-up, it was shown that resistant periapical radiolucency may result from failure to completely eliminate the infection from its complex structure in the root canal system, inadequate aseptic control, inadequate biomechanical preparation, or restoration leakage.^[34-36] While there was no statistically significant difference between Reciproc, WaveOne, Mtwo and ProTaper systems, it was concluded that all systems eliminated bacteria >99% and endotoxins between 95% and 96%, but the biomechanical preparation was insufficient to completely eliminate bacteria and endotoxins.^[37] In another recent in vitro study, antimicrobial efficacy was evaluated after biomechanical preparation with Reciproc, Mtwo and K-type hand files on human teeth contaminated with *E.faecalis* biofilm, and as a result it has been reported that there was no statistically significant difference between these three systems and bacteria cannot be

completely removed from the root canal.^[38] The smear layer and debris on the prepared root canal wall surfaces are the factors that negatively affect the endodontic success.^[39,40] Due to the complex structure of root canals, it is not possible to remove tissue residues mechanically only. Effective cleaning of these areas is only possible with irrigation solutions and their dissolving properties.^[41]

Final irrigation is the process of washing the tooth roots with irrigation solutions for the last time before filling the canal after the mechanical preparation and cleaning of the teeth, and thus removing the remaining bacteria, organic debris and smear layer. As a result of root canal preparations with hand files or rotary system files, although irrigation is performed during the preparation process, effective final irrigation of the root canals should be performed to remove the smear layer and debris before filling the canal. In the literature, NaOCl is the most commonly used and most effective irrigation solution in root canal treatments because of its ability to dissolve vital and necrotic tissues, its high antimicrobial effect, its cheapness and easy availability.^[19,42,43] In the studies, the antimicrobial efficiency of NaOCl was found to be significantly superior to other irrigation solutions.^[19,42,43] There is no general opinion in the literature about the use concentration of NaOCl in root canal treatment, but usage concentrations between 0.5% and 5.25% are presented, and it has been reported that 5.25% NaOCl has much higher organic tissue dissolution efficiency than 2.5% concentration NaOCl.^[44-47] In our study, we preferred 2% sodium hypochlorite (NaOCl), which has the ability to dissolve necrotic tissues and has antibacterial effect and can effectively clean the organic content of the smear layer on the root canal walls.

The bond strength of root canal fillers to dentin is essential for providing and maintaining sealing.^[48] The formation of cavities due to polymerization shrinkage of root canal sealants and not bonding to gutta-percha can lead to bacterial leakage and recurrent root canal infection.^[49] Research in the field of modern endodontics has focused on the development of various alternative techniques and materials for gutta-percha and root canal filling materials and pulp regeneration. In this point, OrthoMTA (BioMTA, Seoul, Korea) developed for use only in orthograde root canal filling, was introduced in 2013.^[50] OrthoMTA (BioMTA Co.) is a bioceramic cement developed for root canal obturation only. On the other hand, Biofilling / Biografting is the technique of completely filling the root canals with this bioceramic cement. The importance of bioceramics in modern endodontic approaches is increasing day by day.

MTA is able to harden in the presence of moisture and stimulates the differentiation of cells into cells that form hard tissue, resulting in the formation of hard tissue matrix.^[51] MTA is the most preferred material in single-visit apexification technique due to its strong physical, chemical and clinical properties in the apical region,

being bacteriostatic, forming a good plug, dimensional stability, radiopacity, biocompatibility and impermeability.^[52,53] In addition, MTA provides an environment that helps periodontal healing by allowing new cementum formation on its surface.^[54] "Biocompatibility" and "biocompatible substances", which are becoming more important in modern endodontic treatments, mean that the substance used is not mutagenic, toxic and carcinogenic. In a study conducted with experimental immature tooth models, it was stated that MTA also increased the fracture resistance of teeth.^[55] In the past, first generation bioceramics were used as a retrograde filling material in endodontic surgery and as a repair material for dental iatrogenic perforations, but today it is also used as an orthograde root canal filling material. Despite the many advantages of MTA, its rheological properties complicate its clinical application and limit its widespread use.^[56] Some of the MTA that comes out of the canal does not harden and is absorbed over time and remains in the bone, with no effect on prognosis.^[8] During application even if MTA overflows into the periapical tissues causes a low degree of reaction, Controlled use is recommended.^[57]

Studies in the long-term follow-up of the results of apical periodontitis treatment have reported a functional success of 88% to 97%, indiscriminately of root canal treatment or non-surgical root canal retreatment.^[58,59] In many studies, it has been found that the healing of periradicular lesions is followed up radiographically for a long time, and root canal treatments performed in a single-visit and in a multiple-visit are compared.^[60-63] Root canal treatments evaluated in the studies were scored by independent observers, and as a common result, it was concluded that there was no statistically significant difference on the radiographic success of single or multiple-visit root canal treatments. According to this information and complying with the manufacturer's protocol, we finished our treatments in a single visit.

In the 2006 Guidelines of the European Society of Endodontology (ESE), it is clearly stated that clinical and radiographic follow-ups after treatment should be carried out at regular intervals for a minimum of one year.^[64] However, in cases with a history of trauma or incomplete healing, it is also recommended to continue the follow-up period.^[64-67] In the cases followed, the disappearance of swelling, pain or other symptoms, absence of a fistula tract, no loss of function, and healthy monitoring of periodontal tissues in radiographic imaging indicate complete recovery.^[64-67] If the lesion size has not changed or shrunk slightly in the follow-ups on the periapical radiograph, it indicates an imprecise recovery, in which case it is recommended that the patient be followed up periodically until the lesion heals or for a minimum of 4 years.^[64] If the lesion has resisted shrinking during this time, it is termed post-treatment periapical disease.^[64] In our study, in cases with

periapical lesions, the follow-up period was planned to be “minimum one year” in accordance with the root canal treatment follow-up procedure specified in the ESE 2006 guideline. Radiographic follow-up of periapical lesions can give us instant and static information about the status of apical periodontitis; however, it has been shown that the healing process is not a static but a dynamic one.^[68] All of the patients included in this study are still followed-up routinely in our clinic.

CONCLUSION

The cases presented showed acceptable functional and/or successful recovery without recurrence at follow-up examination. Similarly, periapical improvement was seen in X-ray examinations in the following 6-12 months. Clinical symptoms such as percussion pain disappeared at weekly controls. Biofilling technique using OrthoMTA in a single-visit can be considered as a successful obturation material and technique. This technique can be replaced by gutta percha and root canal sealer treatment.

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