

Evaluation Of MTA In Pulpotomy With Microscope: An Original Research

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Abstract

Aim: This study aimed to assess the histological outcomes of mineral trioxide aggregate (MTA) pulpotomy as an alternative treatment for irreversible pulpitis in human teeth. A total of 20 teeth, obtained from patients aged 15–30 years, were included in the study. The teeth were selected based on specific criteria, which included the presence of carious lesions with pulp exposure and a history of persistent pain. Following isolation of the teeth, caries removal, and pulp exposure, MTA was employed in the pulpotomy procedure.

Methods: The patients in this study were monitored for pain symptoms 24 hours after the pulpotomy procedure. Unfortunately, 4 patients were lost to follow-up and their data could not be included in the final analysis. However, recall examinations of the remaining patients confirmed that none of them reported any pain after the pulpotomy treatment. The histological examination revealed that all the samples exhibited complete dentin bridge formation, indicating a successful healing response. Furthermore, the pulps of these teeth appeared to be vital and devoid of any signs of inflammation.

Results: The biocompatibility and ability of MTA to stimulate reparative processes, enhanced sealing properties, and potentially bactericidal effects contribute to the potential for long-term success in preserving pulp vitality and promoting the overall health of the tooth. In our current investigation, the pulpotomy procedures conducted using MTA on teeth with carious exposures exhibited a 100% success rate during the entire 24-month follow-up period.

Conclusion: The results of this study underscore the importance of selecting the appropriate material for vital pulpotomy procedures. MTA emerges as a highly reliable choice, demonstrating excellent success rates and favorable treatment outcomes.

Keywords: Mineral trioxide aggregate (MTA), Pulpotomy.

INTRODUCTION

Pulpotomy is defined as the surgical removal of a small portion of the vital, coronal pulp to preserve the vitality of the remaining radicular pulp tissue. Historically, various materials such as ivory, gold-beaters skin, oiled skin, paper, plaster of Paris, Canada Balsam, asbestos, gutta-percha, lactophosphate of lime, oxychloride, oxyphosphate, and oxyxulphate of zinc cement have been used in the pulpotomy procedure. In pulpotomy, a biocompatible or bio-inductive material is placed over the exposed tissue. ⁽¹⁻²⁾Formocresol, which was previously the material of choice (considered the gold standard) for pulpotomy procedures due to its ease of use, has been discouraged due to its potential immune sensitization and mutagenic effects. In response to these concerns, alternative medicaments have been explored, resulting in varied clinical, radiological, and histological success rates. Some of the alternative medicaments that have been tried include glutaraldehyde, ferric sulfate, mineral trioxide aggregate (MTA), bone morphogenic proteins, dentin bonding agents, enamel matrix derivatives, freeze-dried bone, growth factors, as well as various techniques such as electrosurgery and lasers. MTA has shown

promising characteristics for vital pulp therapy. It possesses the ability to stimulate cytokine release from bone cells, indicating its active role in promoting hard tissue formation and providing an enhanced seal over the vital pulp. Moreover, MTA exhibits superior biocompatibility, excellent sealing ability, and has been reported to induce dentinal bridge formation. Compared to other materials used in pulp therapies, MTA is relatively less cytotoxic. As research and advancements continue in the field of vital pulp therapy, the exploration of alternative materials and techniques remains crucial for improving outcomes and ensuring the preservation of pulp vitality. ⁽³⁻⁷⁾

MATERIALS AND METHODS

The study included the extraction of 20 mandibular and maxillary molars from patients aged 15-30 years for orthodontic reasons. The selection criteria focused on cases with bleeding exposed pulp beneath a large carious lesion, accompanied by a history of spontaneous and lingering pain, but without clinical signs of pulp necrosis. All patients were in good medical health, and thorough assessments, including percussion and pulpal vitality tests, as well as radiographic examinations, were conducted to establish a pulpal diagnosis. Prior to the procedure, patients were fully informed about potential complications and provided their informed consent. To initiate the treatment, the teeth were anesthetized with Lidocaine 2% and adrenalin 1/80000. Rubber dam isolation was then applied, and the inflamed pulp tissue was removed using a large round bur in a low-speed air motor, with continuous irrigation using normal saline. Hemostasis was achieved by irrigating the cavity with sterile normal saline and applying sterile cotton pellets. The pulpal wound, free of blood clots, was then covered with a layer of approximately 2 mm thick mineral trioxide aggregate (MTA). According to the manufacturer's instructions, MTA powder was mixed with saline at a ratio of 3:1 and applied over the pulpal wound using a plastic instrument. The MTA was further protected with a wet cotton pellet and sealed with reinforced zinc oxide-eugenol cement. After 24 hours, patients were assessed for any discomfort or tenderness from the treated tooth. The temporary restoration of MTA was completely removed, and a permanent amalgam restoration was placed. Over a period of 3 months, a total of 20 teeth were eventually extracted. Following the extractions, the apical portion of each tooth was immediately resected, and the samples were preserved in 10% buffered formalin (pH 7.2) for 10 days before further processing for light microscopy. The samples underwent decalcification in 10% formic acid for 25 days, followed by immersion in increasing concentrations of alcohol, clearing in methylsalicylate, and embedding in paraffin. Serial sections of approximately 6 mm thickness were cut mesiodistally through the canal orifices and stained with hematoxylin and eosin. Prior to sectioning, the amalgam was carefully removed. Subsequently, an oral and maxillofacial pathologist examined the samples using a light microscope. The analysis included evaluating the presence of hard tissue bridges, the type and location of inflammation, the presence of necrosis, hyperemia, calcification (excluding the bridge area), and the regrowth of odontoblast cells.

RESULTS

All 20 patients included in the study were diagnosed with irreversible pulpitis, characterized by carious pulp exposure in their molars. None of the patients reported discomfort or tenderness at the follow-up appointment, which took place the day after the pulpotomy procedure. Unfortunately, 4 patients could not be contacted for the final recall at the 2-month mark, so their post-procedure pain history remains unknown. The evaluation was based on 16 cases, accounting for 80% of the initial sample. The patients' ages ranged from 15 to 30 years, with an average age of 22 years. The teeth exhibited normal physiological mobility, and percussion and tenderness tests conducted before extraction yielded negative results. Histological observations of the sections revealed complete dentin bridges in all cases assessed. The formed dentin bridges exhibited minimal cellular inclusions, indicating favorable outcomes. One case showed a tunnel defect, but it was effectively sealed off from the pulp. In another case, a dentin bridge was present, but there was a thick superficial necrosis zone between the bridge and the MTA material. However, no evidence of pathosis or necrosis was observed across any of the cases. The tissue reactions were highly favorable, with normal pulp tissue displaying no hyperemia or presence of inflammatory cells. There were no signs of internal resorption, calcification outside the bridge area, or pulp necrosis. Additionally, a nearly regular odontoblastic layer was consistently noted in all cases, indicating the ongoing vitality of the pulp tissue (Table 1). These findings suggest that the pulpotomy procedure utilizing MTA as a material for covering the pulpal wound yielded positive outcomes in terms of dentin bridge formation, tissue reactions, and the overall health of the pulp. The absence of adverse histological findings, such as necrosis or inflammation, further supports the effectiveness and biocompatibility of the treatment approach.

Table 1

Indications	
Complete dentin bridge formation	100%
Superficial necrosis	6.25%
Pathosis	0%
Inflammation	0%
Hyperemia	0%
Internal resorption	0%
Formation of odontoblastic layer	93.75%

DISCUSSION

Dentists frequently perform vital pulp-therapy procedures, such as pulp capping and pulpotomy, often on a weekly basis. These procedures are typically taught in dental school as temporary treatments for teeth with carious or mechanical exposure. However, there is growing evidence suggesting that vital pulp therapy treatments can have permanent outcomes. With a sufficient amount of vital tissue remaining in the pulp, some experts, like Stanley, have advocated for the successful performance of pulp-capping procedures on asymptomatic carious exposures. This viewpoint was further supported by a clinical study conducted by Haskell et al., which demonstrated that asymptomatic carious exposures could survive for an average of 12 years after pulp capping. The continuous development of newer materials with biocompatible, bactericidal, and reparative-inducing properties, along with improved sealing capabilities, may further contribute to the long-term success of these treatments. Among the recent advancements in materials, mineral trioxide aggregate (MTA) has emerged as a promising option. MTA possesses well-established properties that make it highly desirable for vital pulp therapy procedures. Firstly, MTA exhibits excellent sealing ability, surpassing that of amalgam or Super-EBA, and is not affected by blood contamination. Secondly, it is relatively less cytotoxic compared to materials like IRM or Super-EBA. Lastly, MTA has a high pH of 12.5, suggesting potential bactericidal properties, further enhancing its therapeutic benefits. The introduction of MTA and other innovative materials addresses the need for improved outcomes in vital pulp therapy. Their biocompatibility, ability to stimulate reparative processes, enhanced sealing properties, and potentially bactericidal effects contribute to their potential for long-term success in preserving pulp vitality and promoting the overall health of the tooth. Continued research and development in this field are crucial for advancing the efficacy and longevity of vital pulp-therapy procedures^(1,8-11). The choice of material for vital pulpotomy procedures has a significant impact on the overall prognosis of the treatment. Various studies have reported clinical and radiological success rates for mineral trioxide aggregate (MTA) pulpotomy ranging from 66.6% to 100%. In the present study, pulpotomy procedures performed with MTA on cariously exposed teeth demonstrated a 100% success rate throughout the 24-month follow-up period. It is worth noting that a previous study, which employed the same definition of exposure as the current study, also reported a 100% success rate for MTA pulpotomies performed on teeth with carious exposure⁽¹²⁻¹⁸⁾. During pulpotomy procedures, where a portion of the coronal pulp is removed, vascular changes occur within the pulp tissue. In a study by Kishi et al., these changes were described as follows: Following the placement of a material against the pulp, a concave region is formed, resulting from the compression caused by the material. Around this concave region, a flat and dense capillary network develops. After two weeks, the concave region becomes shallower, and a flat capillary network extends across the floor of the region, with a few bridges beginning to form. At four weeks post-pulpotomy, the bridge thickens, and a dense capillary network form beneath it. After eight weeks, the vascular network beneath the bridge exhibits similar features to the three layers observed in a normal pulpal network.⁽¹⁹⁾

CONCLUSION

These findings highlight the effectiveness of MTA as a material for vital pulpotomy. The consistently high success rates observed in this study and the previous research suggest that MTA provides optimal outcomes in terms of preserving pulp vitality and promoting long-term tooth health. The biocompatibility and sealing properties of MTA, along with its potential bactericidal effects and ability to stimulate reparative processes, contribute to its superior performance as a pulpotomy material. The results of this study underscore the importance of selecting

the appropriate material for vital pulpotomy procedures. MTA emerges as a highly reliable choice, demonstrating excellent success rates and favorable treatment outcomes.

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