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EVALUATION OF THE SUCCESS OF MATURE MOLAR PULPOTOMIES USING MTA VERSUS BIODENTINE. A CLINICAL STUDY

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ABSTRACT

Objectives: This study was aimed to evaluate the success of adult pulpotomies for permanent molars with irreversible pulpitis using MTA versus Biodentine. **Subjects and Methods**: Forty-four patients with carious permanent molars with signs and symptoms of irreversible pulpitis were included in the study. Cases were randomly grouped into 2 groups: MTA and Biodentine. After caries removal and access cavity preparation, excavation of all coronal pulp to the floor of the pulp chamber was achieved. Control of bleeding was done using pressure with a saline-soaked cotton pellet. The capping material was prepared according to the manufacturer's instructions. In the MTA group, after MTA application to the floor of the pulp chamber, a wet cotton pellet was placed over the MTA, then the tooth was temporized. Forty-eight hours later, the cotton pellet was removed, and the final filling was applied. In the Biodentine group, the final filling was placed 12 min. after Biodentine application. The patients were followed after 12, and 18 months. **Results**: After 12-months follow-up, the success rate was 86.4% for the MTA versus 81.8% for the Biodentine. After 18-months, the success rate was 85.7% for the MTA versus 75% for the Biodentine. There was no statistically significant difference between the success rate of MTA and Biodentine. **Conclusions**: Higher success rate could be attained in adult pulpotomies using bioactive materials. Irreversible pulpitis is not a contraindication for adult pulpotomies.

KEYWORDS: Biodentine, Irreversible pulpitis, MTA, Pulpotomy

INTRODUCTION

Vital pulp therapy (VPT) is a biological approach to minimally invasive endodontics as an alternative to total pulpectomy in the management of pulpitis in mature permanent teeth [(1)]. These procedures maintain the remaining tooth structure thus reducing the propensity of tooth fracture and preserve the vitality of the remaining pulp tissue along with its defensive functions. One of the VPT procedures is pulpotomy which may be miniature, partial, or complete depending on the amount of inflamed pulp tissue removed [(2)]. Previous studies showed that pulpotomies for adult permanent teeth have high success rates ranging between 85% and 94% [(3,4)].

During a pulpotomy, the placement of a capping material is mandatory. Many different materials such as formocresol, zinc-oxide eugenol, glutaraldehyde, and ferric sulfate have been suggested for capping the pulp tissue, but these are more appropriate for deciduous teeth pulpotomies as they devitalize or cauterize the remaining pulp stump and hence are

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not suitable for adult pulpotomies [5]. On the contrary, Pulpotomies in mature permanent teeth aims to encourage the radicular pulp to heal, so the materials used should have several properties, including the ability to eliminate bacteria, being biocompatible, and create an adequate seal [6]. Examples of these materials include MTA, bioceramics, biodentine, calcium-enriched mixture cement, and tricalcium phosphate cement [7].

The challenge that arises during diagnosis is the determination of the degree of pulpal inflammation and its correlation with the success rate of pulpotomy procedures. Historically, it was difficult to correlate between preoperative signs and symptoms and the histologic picture of the pulp as demonstrated by Dummer et al [8] in 1980 and García in 1990 [9]. Recently in 2005, Cisneros-Cabello and Segura-Egea [10] found a partial correlation between them. More recently in 2014, Ricucci et al [11] demonstrated a good agreement between clinical and histologic diagnosis of the pulp setting the stage for better decision making with regards to the teeth that will undergo pulpotomy.

This study aimed to evaluate the success of mature molar pulpotomies in adult molars with irreversible pulpitis using MTA and Biodentine. The null hypothesis of the study was there would be no difference between MTA and Biodentine.

SUBJECTS AND METHODS

Patients Selection

This single-blind randomized clinical trial study was approved by the ethical committee with the ethical code of 122/139. Sixty-two (62) patients out of a total of (103) were selected from the outpatient clinic in the faculty of dental medicine at Al-Azhar University to take part in this study with the exclusion of forty-one (41) patients due to multiple causes such as pregnancy, periodontitis and unwilling to participate in the study.

Exclusion Criteria:

Patients who had any of the following criteria were excluded from the study: Patients with a medical condition affecting the pulp or had a condition affect the treatment or preventing him/her from attending the follow-up visits such as diabetes mellitus, blood disorders, or pregnancy. Moreover, immature teeth, Non-restorable teeth, necrotic teeth, and teeth with apical periodontitis were excluded. Furthermore, Teeth with reversible pulpitis, periodontally affected, and molars with buccal restoration were also excluded.

Forty-four patients out of (62) were followed up after treatment for 12 months. Further (3) cases out of (44) did not attend the 18-months follow-up. The patients were aged between 20 and 50 years old and had a permanent first or second molar tooth with irreversible pulpitis due to caries. All patients were clinically examined and radiographically assessed. Following initial examination and acceptance, written informed consents were taken from the patients after a detailed explanation of the procedure and the follow-up period with emphasis on the possible outcome. The initial state of the pulp was determined using cold testing, and electric pulp testing.

Pulp Sensibility Testing*:* The target tooth and their adjacent teeth in the same quadrant were isolated with cotton and dried using the 3-way syringe. Before testing the target tooth, the adjacent teeth were tested as controls to observe a baseline normal response. Cold testing was accomplished by applying Endo Ice (Endo-Ice, Hygenic Corp, Akron, OH, USA) using a small cotton pellet held with a tweezer and placed on the middle of the buccal surface of the tooth for 5 seconds, or till a patient response was elicited. Any tooth that exhibited a sharp lingering pain upon testing (30 seconds or longer after stimulus removal) was considered to have irreversible pulpitis. Confirmation of the initial state of the pulp was done using Electric Pulp Tester (Denjoy Dental Co., Shangsha City, Hunan Province, China). A dab of toothpaste was placed

on the buccal surface as a conducting medium to ensure that the current passed from the electrode to the tooth surface. The lip hook was attached to the lip of the patient to complete the circuit and the probe tip was applied to the middle third of the facial surface of the tooth. The current flow was increased slowly to allow the patient enough time to respond to the stimulus. When the patient raised his/her right hand, the device was then switched off. If a response was not obtained, the patient was excluded from the study.

Grouping of patients: The patients in the study were randomly allocated into two groups according to the capping material using research randomizer software (Research Randomizer (Version 4.0), Computer software):

1. MTA group ((MTA, Angelus, Londrina, Brazil).
2. Biodentine group (Septodont, Saint Maur de Fosses, France).

Access cavity preparation:

All clinical maneuvers were performed using a dental operating microscope (Zumax Medical Co., Ltd, China) under a magnification range from 6.9x to 17 x. Local anesthesia was established using (1.8ml of 2% Mepivacaine HCl with levonordefrin 1:20.000), administered with a 27-gauge long needle mounted in a metal dental syringe. Following anesthesia and rubber dam isolation, removal of carious dentin and defective restorations were done using a size #3 carbide round bur (SS White Burs, Inc., New Jersey; USA) mounted in a high-speed contra-angle handpiece with coolant followed by building up the missing parts of the target tooth using a light-cured resin-modified glass ionomer capsules (RMGIC) (Riva Light Cure (SDI, Victoria, Australia). Access cavity was gained using size #3 carbide round bur, while complete de-roofing and cavity refinement was done using an Endo Z bur (Dentsply Maillefer, U.S.A).

Pulpotomy procedure:

After access cavity preparation and deroofing, pulp excavation to the level of the orifices was performed using a size #3 high-speed carbide round bur under water coolant. The access cavity is then flushed with sterile saline. Haemostasis was achieved by the application of a cotton pellet moistened with saline for 2 min. and repeated if required up to 6 min.

After establishing hemostasis, and preparation of the capping material according to the manufacturer's instructions, 2-3 mm of the capping material was placed over the remaining pulp stumps using a Micro apical placement system (MAP) (Produits Dentaires SA, Switzerland) and adapted with a wet cotton pellet.

In the MTA group, after MTA application, a moistened cotton pellet was placed directly over it and the tooth was then temporized with glass–ionomer filling (KetacTM Molar Aplicap TM 3M, ESPE, Seefeld, Germany). Forty-eight hours later, the glass ionomer filling and the cotton pellet were removed and the final restoration was placed. While, in the Biodentine group, after mixing the capsule, the material was applied on the remaining pulp stumps and left for 12 min for the initial setting, then the final restoration was placed.

Final Restoration:

The final restoration was accomplished using a layering technique with resin-modified glass ionomer and resin-bonded composite ((3M, ESPE, St. Paul, USA).

Post-Operative Evaluation:

The patients were evaluated clinically and radiographically at 12,18 months.

Statistical analysis of the data:

Data were statistically analyzed using the Chi-Square test for groups comparison, Fischer exact test as a correction for Chi-square test, and McNemar test to compare before and after changes.

The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp. (Franz Faul, University of Kiel, Germany).

RESULTS

When comparing the success rate between MTA and Biodentine groups, the success rate was 86.4% for the MTA group versus 81.8% for the Biodentine group at 12-months. While, at 18-months, the success rate was 85.7% for the MTA group versus 75% for the Biodentine group (figure1). There was no statistically significant difference between the MTA and Biodentine groups at 12 months and at 18 months ($p>0.05$) (Table 1). McNemar test illustrated a non-statistically significant difference in the success rate between 12 and 18 months for the Biodentine and MTA groups ($p=0.591$ & 0.951, respectively).

TABLE (1): Comparing of success rate between Biodentine and MTA groups at 12 and 18 months.

Outcome	Biodentine	MTA	Test of significance
Success at 12 months:	81.8%	86.4%	P=0.680
Success at 18 months:	75%	85.7%	P=0.387
Test of significance	P=0.591	P=0.951	

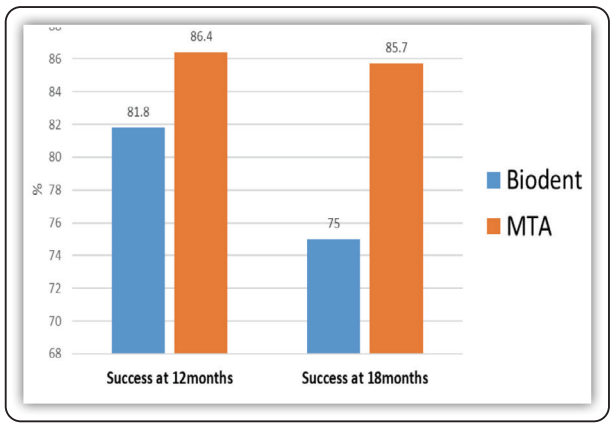

FIG (1) A bar chart representing a comparison between the success rate of MTA and Biodentine at 12 and 18 months.

DISCUSSION

Most clinicians perform total pulpectomy for mature exposed carious teeth as it is believed that once the pulp is exposed, it must be extirpated [12]. However, histologic studies have been done to evaluate the extent of pulpal inflammation in exposed carious teeth and they showed that inflammation is mostly confined to the coronal region of the pulp immediately beneath the carious exposure while the radicular pulp is most commonly uninflamed [13,14]. Adult pulpotomies have been advocated as a more conservative alternative to total pulpectomy. The outcome of adult pulpotomies is dependent on the initial state of the pulp which should be evaluated first to better help clinicians in case selection prior to treatment choice. This study aimed to evaluate the outcome of adult pulpotomies on mature molars with irreversible pulpitis using MTA and Biodentine.

Patients selected for this study were aged from 20 to 50 years old because this is the most common age for carious exposure, and this represents a wide range of ages to evaluate the effectiveness of adult pulpotomies in different ages. Only molar teeth were selected for evaluation in this study as these are the most common teeth exposed due to caries [15]. Teeth having buccal restoration were excluded as this could have affected the electric pulp tester readings. Furthermore, only molars with irreversible pulpitis were included as this is the most common cause for total pulpectomy and root canal treatment. Diagnosis of irreversible pulpitis was determined according to the approved terminology of The American Association of Endodontists [16] as the presence of a sharp lingering pain upon cold testing (30 seconds or longer after stimulus removal).

With regards to the capping material, MTA is considered the gold standard material in vital pulp therapy [17]. While, Biodentine has a short setting time and is easy to mix, apply, and has excellent mechanical properties in addition to its bioactive properties [18]. No significant difference was found between MTA and Biodentine. The lack of

significance could be due to multiple reasons; both materials are biocompatible, bioactive, similar in sealing ability, and have similar antibacterial efficacy [19]. In addition, a significant difference may have been achieved if the evaluation period had been extended or if the sample size was increased.

CONCLUSION

1. Higher success rate could be attained in adult pulpotomies in teeth with irreversible pulpitis using bioactive materials
2. It seems that irreversible pulpitis is not a contraindication for adult pulpotomies.

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