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Evaluation of success of MTA pulpotomy in mature permanent carious molars with irreversible pulpitis

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ABSTRACT

BACKGROUND & OBJECTIVE: Pulpotomy is a common treatment for vital teeth, and recent advances in materials and techniques have extended its use to mature permanent molars with irreversible pulpitis. Vital pulp therapy encompasses various modalities, including direct and indirect pulp capping, partial pulpotomy, and full pulpotomy. In irreversible pulpitis, where pulpal inflammation is extensive, full pulpotomy is preferred to preserve the apical pulp stump. Mineral Trioxide Aggregate (MTA) has gained attention for pulpotomy due to its biocompatibility, sealing properties, and regenerative potential. This study aimed to determine the success rate of MTA pulpotomy in permanent molars diagnosed with irreversible pulpitis.

METHODOLOGY: A quasi-experimental study was conducted with 103 participants aged 15 years or older. Mature permanent teeth with restorable deep carious lesions, closed apices, and cold test–based diagnosis of irreversible pulpitis were included. Exclusion criteria were tenderness on percussion/palpation, sinus tract/fistula, or pathological mobility. Treatment was performed in two visits, involving anesthesia, isolation, caries removal, and MTA placement. Outcomes were analyzed using chi-square tests to compare success rates across gender, age groups, and jaw types.

RESULTS: The mean age was 24.38±6.44 years, with 42 (40.8%) females and 61 (59.2%) males. Pulpotomy success was achieved in 89.3% of cases. Comparative analysis revealed no significant differences in success by gender ($p > 0.99$), jaw ($p > 0.99$), or age group ($p = 0.44$).

CONCLUSION: MTA pulpotomy demonstrates a high success rate and may serve as a reliable alternative to conventional root canal treatment for managing irreversible pulpitis in permanent molars.

KEYWORDS: Dental Caries, Dental Pulp, Dental Pulp Exposure, Endodontics, Pulpotomy.

INTRODUCTION

In dentistry, Gutman introduced the concept of Minimal invasive endodontics, which included vital pulp therapy. The indications of vital pulp therapy (VPT) are expanding, so the question of which cases are suitable for VPT and how to improve the success rate of VPT is a problem that often bothers us. The main purpose of VPT is to eliminate pulpitis by promoting the formation of reparative dentin or a calcium bridge, so that it can continue to perform various physiological functions and finally achieve the purpose of preserving pulp vitality and long-term preservation of affected teeth. Pulp capping and pulpotomy are the most common methods for VPT [1].

These procedures involve removing a portion of pulp tissue while preserving the healthy part. Similarly, histological and microbiological studies have found that inflammation and microbial infection associated with irreversible pulpitis may be limited to the local pulp tissue near the lesions, rather than involving the entire pulp. A few millimeters away from the infected, necrotic pulp, the pulp tissue is usually free of inflammation and bacteria.

The aim of VPT with MTA is to sustain pulp vitality, support ongoing root development, and encourage reparative dentine formation over the exposed pulp surface, enhancing both pulp health and overall tooth structural integrity [2,3].

Formocresol, a long-used pulpotomy medicament in dentistry, has raised concerns due to observed issues such as pulpal inflammation, necrosis, cytotoxicity, systemic disturbances, mutagenic potential, and immunologic responses [4,5]. To address these concerns, various alternatives have been proposed to maintain partial pulp vitality, aiming to reduce risks associated with formocresol while achieving the therapeutic goals of pulpotomy [6].

Mineral trioxide aggregate (MTA) is an approved material by FDA as an endodontic material. MTA's sealing ability in root canals is superior to other materials like amalgam because of its bioregnerative ability [7]. Histological studies have found that MTA is used in root perforation as repair material, with minimal inflammation. Additionally, research showed that MTA stimulates cytokine release from human osteoblasts and induces hard tissue formation [8].

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This past study observed the radiographical success of pulpotomy in mature permanent teeth utilizing MTA. It included 75 cases with a follow-up period of 6 months, and the results indicated a 92% success rate with no periapical radiolucency [9] .Another past study showed that the traditional RCT is related to several drawbacks. Some studies have shown that all RCT systems will lead to the accumulation of stress along the tooth structure. Excessive tooth cutting in RCT may lead to tooth fracture [10].

This study assesses the success of MTA vital pulp therapy in mature permanent teeth with dental caries and irreversible pulpitis. Usually the vital pulp therapy is not the option clinicians opt for treatment of teeth with caries and irreversible pulpitis, they directly go for pulpectomy, the main reason for doing MTA pulpotomy here was to use the bio regenerative properties of MTA and save the remaining vital pulp tissue after removal of inflamed pulp which can be maintained in the tooth with vital pulp therapy.

Success was evaluated on the basis of absence of periapical radiolucency over a period of 6 months. These findings will inform clinical practice regarding insights into the success rate across different demographic groups and guiding conservative treatment decisions which are less time consuming instead of non-vital pulp therapy. The purpose of this study was to assess the success rate of MTA vital pulp therapy in permanent teeth with closed apices and inflamed pulp.

METHODOLOGY

The quasi-experimental study was carried out at Operative dentistry department of Rawal Institute of Health Sciences from August 1, 2023, to February 10, 2024. Prior to inception of the study, ethical approval was taken from hospital ethical review committee with ethical approval number RIHS/IRB/ D/24/00. Written informed consent was obtained from all participants. They were reassured of maintaining confidentiality.

The study included both genders aged 15 years and above, focusing on mature permanent teeth, with restorable deep carious lesions, irreversible pulpitis, and closed apices radiographically were included in the study. Inclusion criteria involved cases with inflamed vital pulp with lingering pain.

Those patients with carious teeth experiencing tenderness on percussion or palpation, sinus tract/fistula presence, and pathological mobility were excluded from the study. The sample size was 114 participants at 95% confident level and 5% margin of errors using success rate 89.9 % of MTA pulpotomy from previous literature [9].

A non-probability consecutive sampling technique was used for data collection. Detailed histories and post-clinical examinations were conducted for each participant, and data such as age and gender were recorded. The treatment protocol involved two dental visits, including anesthetizing, tooth isolation, caries removal, and MTA application in the first visit. Anesthesia was administered in the lower arch using lidocaine with 1:10,000 adrenaline through a regional block in the lower arch and infiltration in the upper. Tooth isolation was achieved with a rubber dam.

Caries was removed, and an access cavity was created using a slow speed handpiece having a round bur. The coronal pulp was removed up to the floor of the pulp chamber with a slow-speed handpiece. Irrigation of the pulp chamber was performed with 5.25% sodium hypochlorite. After achieving hemostasis using hypochlorite and removing all inflamed pulp with wet cotton wool placement, a 2 to 4mm thick layer of MTA was placed, followed by placement of glass ionomer cement as a provisional restoration.

The second visit, after one day, included checking MTA hardening, followed by tooth restoration with amalgam or composite. Post-operative peri-apical radiographs were taken immediately. After six-month follow-ups, patients were recalled to assess success based on the absence of periapical radiolucency.

Statistical analysis was performed in R software (ℝ-4.4.3 for Windows) Descriptive statistics were calculated and reported in form of frequency and percentages, input data is in the form of a table that contains the count value of the variables in the observation. Mean was calculated for age. Chi-square test was used in turn to compare success among variables of gender, age group and arch.

RESULTS

Among 114 initially included participants, 9 patients missed the follow-up after 6 months post operatively. Therefore, we finally analyzed 103 patients. presents the demographic statistics of the 103 participants included in the study. As reported in Table-I. The overall success of pulpotomy in molar teeth was observed in 92(89.32%) Participants .

Table-I: Distribution of age and gender of the participants.

Variables	Characteristic	n(%)
Gender	Female	42 (40.78)
	Male	61 (59.22)
Age group (years)	15-20	34 (33.01)
	21-35	69 (66.99)
Success of Pulpotomy	Yes	92 (89.32)
	No	11 (10.68)
Age (years), Mean±SD	24.38 ± 6.44	

Table-II provides a comparative analysis of pulpotomy success among different demographic categories, involving a total of 103 participants. Chi square test was used to calculate p-value. The p-value=0.755 for gender comparison was greater than 0.05, suggesting no statistically significant difference in pulpotomy success between males and females. The p-value=0.726 for jaw comparison was greater than 0.05, indicating no significant difference statistically in pulpotomy success between upper and lower jaws. In terms of age groups. The p-value for age group comparison was 0.331, suggesting no statistically significant difference in pulpotomy success between the age groups.

Table-II: Comparison of success of pulpotomy among genders, age group and jaw.

Variables	Characteristic	Pulpotomy		P-value*
		Failed n=11 n(%)	Success n=92 n(%)	
Gender	Female	5 (11.9)	37 (88.1)	0.755
	Male	6 (9.8)	55 (90.2)	
Arch	Lower	8 (10.3)	70 (89.7)	0.726
	Upper	3 (12)	22 (88)	
Age groups (years)	15-20	2 (5.9)	32 (94.1)	0.331
	21-35	9 (13.0)	60 (87.0)	

***Chi square test**

DISCUSSION

The present study evaluates the clinical success of mineral trioxide aggregate (MTA) pulpotomy in mature permanent carious molars. In vital pulp therapy, we have various modalities to save the pulp, direct pulp capping, indirect pulp capping, partial pulpotomy and full pulpotomy, However, in irreversible pulpitis the inflammation of the pulp is more, so we adopt the modality of full pulpotomy, keeping the apical vital stump maintained. The findings suggest that MTA full pulpotomy is a viable alternative to conventional root canal treatment (RCT) in cases where the pulp exhibits reversible inflammation, aligning with recent literature on vital pulp therapy (VPT) in mature teeth with a success rate of 89.32%.

This clinical study investigated the effectiveness of vital MTA pulpotomy for permanent teeth with closed apices in a dental public health setting. A total of 27 mature permanent first molars and two premolars, involving 25 patients aged 10 to 15 years with carious exposure, underwent MTA pulpotomy. The treatment demonstrated an estimated success rate of 90%. The high clinical success rate observed in this previous research demonstrates the biocompatibility and bioactivity of MTA. Studies have shown that MTA induces dentin bridge formation, provides an effective bacterial seal, and maintains pulp vitality [10]. Present study findings are consistent with a meta-analysis, which reported success rates exceeding 85% for MTA pulpotomy in mature permanent molars with carious exposures.

Pain reduction and resolution of clinical symptoms were significant within the first few weeks postoperatively. This aligns with studies indicating that MTA's alkaline pH and antimicrobial properties contribute to inflammation resolution and favorable healing [11,12]. However, some failures observed in our study were attributed to improper case selection or preoperative undetected irreversible pulpitis, consistent with previous reports emphasizing the importance of accurate pulp diagnosis [13].

Radiographic evaluation showed continued root integrity and dentin bridge formation in most cases. The formation of a mineralized barrier is a crucial indicator of pulpal healing, supported by histological studies demonstrating osteodentin and tertiary dentin formation after MTA application. Our results align with a randomized clinical trial by Singla , et al (2023), which reported radiographic success in over 80% of cases up to 2 years postoperatively [15].

Calcium silicate-based materials, including MTA and newer bioceramics, have gained popularity for VPT. While MTA remains the gold standard, recent studies suggest that biodentine exhibits similar or superior outcomes in terms of faster setting time and better handling properties. However, present study supports the continued use of MTA due to its proven long-term success and favorable biological interactions [16].

In the study conducted by Linsuwanont et al (2017) an evaluation of mineral trioxide aggregate (MTA) pulpotomy was performed on 66 permanent teeth with exposed pulp. The researchers reported a noteworthy clinical success rate of 87.3%. This assessment was conducted over a substantial follow-up period of 62 months, indicating the effectiveness and durability of MTA pulpotomy in treating exposed pulps in permanent teeth [17].

Despite the high success rates, limitations include a relatively short follow-up period and a limited sample size. Future long-term randomized controlled trials (RCTs) are needed to further validate the superiority of MTA pulpotomy over conventional RCT in mature molars. Additionally, the role of case selection criteria, operator experience, and patient-related factors should be further investigated.

CONCLUSION

MTA pulpotomy demonstrates a high success rate in mature permanent molars with carious exposures, reinforcing its potential as a conservative alternative to RCT. The favorable biological properties of MTA, including dentinogenesis induction and biocompatibility, contribute to its success. Further research with extended follow-ups and larger cohorts is necessary to establish standardized guidelines for its clinical application.

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Authors Contributions:

Farah Mushtaq: Designed the study, collected the data and Data analysis.
Brig.Manzor Ahmed: Proof reading and Overall reviewing the concept of study.

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