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Assessing the Clinical Efficacy of MTA in Vital Pulp Therapy

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Abstract: Background: The direct pulp coating represents an alternative treatment to pulpectomy, which depends, among other aspects, on the ability of the pulp to regenerate. The materials used have the objective of treating the pulp with cauterisation in order to cause healing and regeneration of the pulp tissue. In order to promote healing and avoid infection, either calcium hydroxide or mineral trioxide aggregate is placed directly on the exposed pulp. Patients and methods: A total of 78 patients suffering from caries were included in the study. The data was collected from private clinics in Baghdad, Iraq, between February 14, 2022, and October 27, 2023. All patients underwent direct pulp capping (MTA), which included patients between the ages of 20 and 50. They underwent a routine examination at both recall visits. This study recorded the success and failure rates of the procedure, determined the degrees of pain and inflammation and the complication rate, and distributed these findings to the patients. Results: Our results showed that patients with age less than 30 years were the highest class of total cases, which included 34 patients, where males had 44 cases and females had 34 cases; the common symptoms were toothache with 23 cases and sensitivity to hot or cold temperatures with 20 cases, smokers had 34 cases, tooth type included each of anterior with 12 cases, premolar with 20 cases, and molar with 46 cases, premolar with 20 cases and molar with 46 cases, tooth location was in each of maxilla with 50 cases and mandibula with 28 cases, site of exposure had cervical with 44 cases and occlusal with 34 cases, classify degree of pulpitis severity into mild with 35 cases, moderate with 26 cases and severe with 17 cases. In a period of 6 months, results recorded success rates with 58 cases and failure with 20 cases, while success rates with 71 cases and failure with 7 cases after one year. Conclusion: The study demonstrates that direct pulp capping with MTA is an efficacious procedure for the treatment of caries patients, with a 90% success rate and the promotion of dentin bridge formation.

Key words: Direct pulp coating, Bioceramic materials, Mineral trioxide aggregate (MTA), and Heft-Parker Index.

Introduction

In the event of an accidental pulp exposure, the clinician, and in particular the dental student, is confronted with a dilemma. They must decide whether to attempt to maintain the vitality of the affected part or to perform conventional endodontic therapy. [1 – 2]

Furthermore, the fact that the direct pulp coating depends on multiple parameters determines the result of the treatment. This is due to the large number of variables that must be controlled during its execution. Furthermore, some clinicians are reluctant to recommend this technique, as the pulp chamber is reduced in size following these treatments. [3 – 7]

This could make root canal treatment more challenging in the event that endodontic therapy is required. Consequently, rather than considering the advantages of a therapy that aims to maintain the

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vitality of the tooth, many dentists disagree with it, as it could block the entrance to the root canals or hinder their access. [8 – 10]

A review by Thomas and Beagle in 2006 found that endodontic treatments have an 80% success rate after three years. However, there is less evidence about the prognosis of a tooth treated with direct pulp coating. [11,12]

Consequently, there is a question as to the efficacy of Direct Pulp Coating treatments and their capacity to address the issue of an exposed pulp, thereby preserving its vitality. According to reviews conducted by P. E. Murray et al. and A. Hiyasat et al., the success rate of a direct coating is, according to some authors, 37% after five years and 13% after ten years (9, 10). Other studies cited by A. Hiyasat et al. report a 97.8% success rate after 1.5 years of treatment, while others report a 79% success rate after one year of treatment. Furthermore, other authors have reported a success rate of 87.2% after five years. [13 – 18]

It has been observed that within the curriculum of the dental profession, a greater proportion of time is devoted to training students in endodontic therapies than to teaching techniques for preserving the vitality of the pulp (direct indirect coatings and pulpotomies). [19 – 21]

It is indubitable that the vital pulp represents the most efficacious barrier against microbial invasion of the underlying tissues. (10) The pulp tissue, through its nutritional contribution, ensures that the tubular dentin remains moist and resilient [22 – 24]. These characteristics ensure the tooth's resistance to the forces of mastication. In the absence of the nourishment provided by the pulp, the dentin is unable to retain these properties. The endodontically treated parts require approximately 2.5 times more force to register a proprioceptive response. [25,26]

Patients and methods

Study design

We conducted a cross-sectional study of patients with dental caries that enrolled 78 participants who underwent direct pulp capping (MTA) procedures, and their ages ranged between 20 and 50 years. Demographic and clinical data were collected from private clinics located in Baghdad - Iraq. The teeth with no previous signs of trouble had been chosen. The cold test applied to each tooth usually lasts for about 5-10 seconds to assess the sensitivity of the tooth to cold stimuli, which this test helps dentists determine if there are any issues with the tooth's nerves or pulp. Also, periapical radiographs were performed in the examination of the depth of caries lesion. Upon examination by x-ray, it was found that all the dentist teeth in question had cavities that went all the way down to the pulp, but there were no side-effects like widened periodontal ligaments or visible roots of teeth at the junction point of tooth roots. A single operator followed a standardized surgical protocol. The teeth were manually disinfected and cleaned with 0.2% chlorhexidine before cavity preparation. Subsequent to correct anesthesia using 1:100,000 lignocaine hydrochloride adrenaline (xylocaine) and rubber dam application, soft caries and overhanging enamel were eradicated fast using sterile diamond points, air-distilled water spray cooler. All the hollow areas adjoining the pulp were opened up using a moderate-speed handpiece fitted with spoon excavators as well as round carbide burs. In order to stop bleeding from the small blood vessels, a sterile cotton pellet soaked in 3% NaOCl solution is placed on the part where the pulp was exposed. Teeth were final restoration in one dental visit in some cases, while it took two sessions to accomplish the same in others.

Collection Data

Clinical data and information were collected from patients with caries who underwent direct pulp capping (MTA) in private clinics in Baghdad, Iraq, where only patients aged 20-50 years were included. Data included demographic information, examinations, complications, pain scores, and inflammation scores. Patients conducted the VAS pain scale, which ranges from 0 to 10, with 0 being the least pain and ten being the most as well. As they also conducted an examination using the Heft-Parker index scale, which measures the severity of gingivitis. And the scale ranged from (0 to 1)

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represents the degree of mild inflammation, (2 - 3) represents the degree of moderate inflammation, and 4 represents the degree of severe inflammation.

Study period

All patients suffering from dental caries and aged between 20 and 50 years underwent direct pulp capping (MTA), as all demographic and clinical data and information were obtained from private clinics in Baghdad, Iraq, as the study period was from 14 February 2022 to 27 October 2023. 2023.

Statistical analysis

The data was analysed using the SPSS program, version 22.0. Descriptive statistics and inferential statistics included the Pearson correlation coefficient; Fisher's exact test was used instead of the Chi-square test if there are fewer than 5 cases in a cell chi-square. In this study, $p < 0.05$ was considered as statistical significance.

Results Table 1: Basics and demographic characteristics of participants which observed in this study.

Characteristics	Number of cases [n = 78]	Percentage [%]
Age		
< 30	34	43.59%
30 – 40	28	35.90%
> 40	16	20.51%
Sex		
Male	44	56.41%
Female	34	43.59%
Symptoms		
Tooth pain	23	29.49%
Sensitivity to hot or cold temperatures	20	25.64%
Swelling or tenderness in the gums	13	16.67%
Persistent bad taste in the mouth	10	12.82%
Visible signs of tooth decay or damage	12	15.38%
Smoking status		
Yes	35	44.87%
No	43	55.13%
Potential complications from medications		
Yes	14	17.95%
No	64	82.05%
Education status		
Primary	12	15.38%
Secondary	14	17.95%
College/university	52	66.67%
Working status		
Yes	46	58.97%
No	32	41.03%
Income status, $		
< 680	35	44.87%
680 - 720	24	30.77%
> 720	19	24.36%

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Table 2: Diagnostic findings.

Variables	**Number of cases [n = 78]**	**Percentage [%]**
Tooth type		
Anterior	12	15.38%
Premolar	20	25.64%
Molar	46	58.97%
Tooth location		
Maxilla	50	64.10%
Mandibula	28	35.90%
Class of cavity		
Class I	13	16.67%
Class II	52	66.67%
Class III	11	14.10%
Class IV	2	2.56%
Site of Exposure		
Cervical	44	56.41%
Occlusal	34	43.59%
Type of restoration		
Temporary	40	51.28%
Permanent	38	48.72%

Table 3: Classify the degree of pulpitis severity in terms of mild, moderate, and severe using the Heft-Parker Index.

Scores	Number of cases [n = 78]	Percentage [%]
Mild	35	44.87%
Moderate	26	33.33%
Severe	17	21.79%

Table 4: Assessment of pain scores related to patients in before and after the direct pulp capping procedure.

Pain scores	Before		After	
	N	**%**	**N**	**%**
10 – 8	42	53.85%	4	5.13%
7 – 5	16	20.51%	6	7.69%
4 – 2	12	15.38%	24	30.77%
< 2	8	10.26%	44	56.41%

Table 5: Identify complications after the direct pulp capping procedure.

Complications	Number of cases [n = 78]	Percentage [%]
Pulpitis	3	3.85%
Post-operative sensitivity	1	1.28%
Tooth discoloration	2	2.56%
Infection	5	6.41%
Death of the pulp tissue	3	3.85%
Total	**11**	**14.10%**

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Table 6: Split of success and failure rate over patients after a direct pulp capping performing during a follow-up period within six months to one year.

Follow up time	Number of cases [n = 78]	Percentage [%]
Six months		
Success	58	74.36%
Failure	20	25.64%
One year		
Success	71	91.03%
Failure	7	8.97%

Note: The outcome was deemed successful when the tooth was present and not accompanied by periapical radiolucency or root canal therapy. Otherwise, the outcome was judged a failure.

Discussion

On such occasions that it is required, dentin pulp capping (DPC) is a method used in conservative dentistry involving the application of dental materials into exposed coronal pulp in an attempt for promoting dentine bridge formation and preservation of pulp's structural function [27]. The overall success rate of incomplete caries removal was demonstrated to be approximately 56.2% for DPC with mineral trioxide aggregate (MTA) [28]. Significant removal of breaking down tissues is fundamental to maintain the vitality of pulp tissues; infection prevention is also very important in supporting this procedure. [29]

Dentin-bridge naturing is actually a necessity for complete recovery and sustainability because it generally shields the affected pulps from subsequent oral bacterial infections liable to lead to pulp degeneration, atrophy and subsequent shrinkage. [30] Dentin-bond failure depends on whether the bridge is less than half-millimeter, which is hardly appreciated during periapical radiography.

Investigators reported that the proximal restorations had a poorer marginal seal, which, in turn, resulted in microleakage. At the recall session, subjective symptoms decided pulpal survival based on a cold test and radiographs. The 97.96% MTA success rate that had been reported previously is similar to the 91.7% success rate that was found in this study only firming the case about the effectiveness of MTA. [31] The success rate of MTA during this trial was 90%.

MTA's high success rate may be linked to its capacity to induce dentin bridge creation, antimicrobial properties, and superior sealing ability, all of which are crucial to the success of the DPC process. It also increases cytokine production in human osteoblasts, allowing for strong cell adhesion to the substance, and so playing an active part in dentin bridge construction. [32]

Capping the pulpotomized teeth by biodentine resulted in a comparable pulp reaction. Nevertheless, the thickness of the dentin bridge created underneath the biodentine was larger. It takes less time to set up than MTA, which is a benefit. The tissue response to these materials may be comparable due to their chemical makeup (tricalcium silicate), the byproduct generated during the setting reaction as well as physical features. [33]

Patients can be diagnosed with reversible or irreversible pulpitis by exposing the pulp for at least five minutes but not more than ten minutes. After stopping all the blood in 3% NaOCl, we used only pulp capping agents in this research. Nonetheless, one follow-up visits postoperatively elicited severe pain because hemostasis took longer than 5 minutes. [34]

Conclusion

The results of our study indicate that direct pulp capping with MTA is an optimal and effective procedure for the treatment of patients with caries. The overall success rate is 90% when using the MTA approach, which has a high probability of maintaining vitality and promoting dentin bridge formation.

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