Original Article

Clinical effectiveness of bio dentine and MTA in pulp therapy for carious exposed teeth: A quasi-experimental study

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Objective: To compare the clinical effectiveness of Bio dentine and Mineral Trioxide Aggregate (MTA) as direct pulp capping agents in permanent teeth with carious pulp exposure.

Methodology: This quasi-experimental study was conducted in Department of Operative Dentistry at de' Montmorency College of Dentistry from Jul 2022 to Jan 2023 and included 150 patients divided into two groups of 75 each. Patients aged 18-45 with permanent teeth exhibiting deep carious lesions, but were vital, were selected. Group I received MTA while Group II received Bio dentine. Direct pulp capping was performed under local anesthesia. Clinical and radiographic evaluations were conducted at a three-month follow-up, focusing on the absence of pain, pulp vitality, and periapical radiolucency. The data were analyzed using SPSS and Chi-square's test was used to compare categorical variables.

Results: Out of 150 patients, 55% were male and 45% were female, with a mean age of 30±7.9 years. Group I (MTA) showed a success rate of 76%, with 57 teeth showing no periapical radiolucency. Group II (Bio dentine) exhibited a significantly higher success rate of 96%, with 72 teeth showing no periapical radiolucency (p=0.001). Statistical analysis showed no significant impact of age (p=0.36) or gender (p=0.19) on treatment efficacy.

Conclusion: Bio dentine demonstrated superior clinical performance compared to MTA in direct pulp capping, suggesting it as a preferable material due to its higher success rate and better handling properties. Further studies on long-term outcomes and cost-effectiveness are recommended.

Keywords: Biodentine, direct pulp capping, mineral trioxide aggregate, restorative dentistry.

INTRODUCTION

In dentistry, new techniques and materials have increased the survival of pulp tissue, regardless of whether the exposure is carious, mechanical, or traumatic.[1,2] Tertiary dentin forms in response to mild injury, and its quantity and quality depend on the extent of the injury, which could be due to carious products, dental procedural insult, or trauma.[3] Vital pulp therapy (VPT) has become a successful treatment for vital permanent teeth with carious exposed pulp, showing overall success rates of 87.5% at one year, 95.4% at two years, 87.7% at three years, and 72.9% after more than three years.[4]

Pulp vitality has an utmost importance in dental health, as it ensures the continuous supply of nutrients to the tooth, thereby maintaining its structural integrity and function.[5] The main goal of VPT is to create a conducive environment for the pulp to heal and regenerate, thereby avoiding the need for more invasive treatments such as root canal therapy. The success of VPT relies heavily on the selection of appropriate materials that can protect the pulp from bacterial invasion and support the regeneration of dentin.[6,7]

"Direct pulp capping" is a conservative approach, aimed at protecting the dental pulp after exposure, promotes the healing, and maintains its health and vitality. Moreover, its success depends on the choice of material, which encourages the formation of secondary reparative dentin, is biocompatibility, and ability to provide an effective seal against the infiltration of bacteria.[8,9]

Various restorative materials have been advocated as direct pulp capping materials, including calcium hydroxide, zinc oxide eugenol (ZOE) cement, polycarboxylate cement, collagen, bonding agents (4-META-MMA-TBB adhesives), calcium phosphate cement, hydroxyapatite, glass ionomer cement, RMGIC, mineral trioxide aggregate (MTA), bio dentine, and growth factors (bone morphogenic protein, insulin-like growth factor). Among these, calcium hydroxide is considered the gold standard.[10,11]

MTA is indicated for various clinical applications, including root end filling, perforation repair, apical barriers for teeth with open apices, pulp capping as well as pulpotomy, because of its good sealing ability. However, it has certain drawbacks like longer setting time, poor handling, cost, alkaline pH, low compressive strength, and potential to cause tooth discoloration.[12] Bio dentine, a newer tri-

calcium silicate cement, has dentine-like mechanical properties and improved handling. It forms calcium silicate gel and calcium hydroxide during its setting reaction, inducing reparative dentine generation and stimulate pulpmineralization.[13,14] Its faster setting time allows immediate crown restoration, making it a preferable alternative to MTA. Previous literature has reported the success rate of MTA to be around 78% to 84 %, while Bio dentine shows a success rate of 92.6%.[9,15] This study aimed to evaluate and compare the clinical efficacy of Bio dentine and MTA as a direct pulp capping agent.

METHODOLOGY

This quasi-experimental study took place in the Operative Dentistry Department" at "de' Montmorency College of Dentistry, Lahore from July 2022 to January 2023, after the approval by the Institutional Review Board (No: 1821/DCD). A written consent was obtained from all patients.

A total of 150 patients were recruited in the study, and were allocated to two groups, with 75 patients in each group through consecutive sampling technique. The sample size for the study was determined using 80% power of the study, a 5% level of significance, and an expected efficacy of 92.68% for the Bio dentine group and 78% for the MTA group.[9] The inclusion criteria included patients of both genders between the ages of 18-45 years, with permanent teeth having deeper carious lesions and no previous history of restorations, confirmed to be vital through clinical examination and vitality tests (thermal and electric). Teeth with periapical and peri radicular pathosis detectable radiographically, as well as patients on medication for pain relief, were excluded.

Prior to the treatment, preoperative examination was done, where each tooth was radio-graphically and clinically examined. The detailed history, periapical radiographs, periodontal probing, percussion testing, and electrical pulp testing were performed and were allocated to two groups i.e., MTA (Group I) and Bio dentine (Group II).

The operator performing the procedure was a postgraduate trainee with specialized expertise in performing dental treatments, particularly in the use of materials like MTA and Bio dentine. The local anesthesia was administered. For pulp capping, Group I received MTA mixed as per the manufacturer's guidelines, with a 2 mm thick layer deposited on the exposure site, and it was later restored by the amalgam. Group II received Bio dentine mixed and applied, later the cavity was bulk-filled and restored with amalgam and contoured with a plastic filling instrument. The patients were recalled after a period of 3 months for the follow-up and were evaluated using detailed dental history, periapical radiographs, and electrical pulp testing.

Statistical Analysis: The data were analyzed using SPSS version 24. The continuous variables, i.e., age, was presented as mean and standard deviation, while categorical variables, such as gender and treatment outcomes, were shown as frequencies and percentages and were compared using the Chi-square's test. A $p<0.05$ was considered as statistically significant.

RESULTS

Out of 150 patients, 82 (55%) were male and 68 (45%) females. Mean age was 30±7.9 years. Bio dentine had a significantly higher success rate compared to MTA (p=0.001). In the MTA group (Group I), 57 teeth (75%) restored using MTA reported no periapical radiolucency, indicating successful treatment. However, in Group II, 72 teeth (95%) restored using Bio dentine were vital and showed no signs of periapical radiolucency (Table 1).

Table 1: Comparative efficacy of MTA and bio dentine for direct ULP capping.

Variable	Efficacy n (%)	X^2	p
MTA	57 (76)	12.45	0.001
Biodentine	72 (96)		

p- value was calculated using Chi-square test.

Table 2: Age and gender-wise comparison of efficacy between MTA and bio dentine.

Variable		N (%)	Efficacy		X^2	p
			MTA	Biodentine		
Age	Young adults	71(55.1)	32(56.1)	39(54.2)	5.48	0.360
	Middle-aged Adults	58(44.9)	25(43.9)	33(45.8)		
Gender	Male	70(54.3)	30(52.6)	40(55.5)	4.58	0.190
	Females	59(45.7)	27(47.4)	32(44.5)		

p- value was calculated using Chi-square test.

The relationship between efficacy of the MTA and Bio dentine and other variables such as age and gender were also analyzed. The P-values for age (0.360) and gender (0.190) were found to be non-significant, indicating that these factors did not

significantly affect the efficacy of the treatment (Table 2).

DISCUSSION

The comparison of two modalities is crucial as maintaining pulp vitality is a fundamental aspect of restorative dentistry, providing benefits such as limited dentin regeneration and reducing the likelihood of apical periodontitis.[7] A randomized controlled trial involving 59 curiously exposed permanent teeth in patients aged 6-18 found no difference in the rate of success or effectiveness between Bio dentine (96.4%) and ProRoot MTA (92.6%) over an average follow-up of 18.9 months.[16]

Another split-mouth study involving bilateral asymptomatic first molars in adult patients reported a very high rate of success for both Bio dentine and MTA at the time treatment was provided, 6 months, and 12 months follow-ups.[17] A pilot retrospective study by Linu et al, on 30 patients reported success rates of 84.6% for MTA and 92.3% for Bio dentine over 18 months, with no significant difference in radiographic outcomes.[18] A prospective study involving 68 vital permanent teeth reported high success rates for both Bio dentine (91.7%) and MTA (96.0%) after three years.[19] Our study fonud that Bio dentine significantly outperformed MTA in terms of efficacy. Higher success rates for Bio dentine due to its superior properties such as faster setting time, better handling, and enhanced bioactivity has been reported.[16,20,21]

The current study found that age and gender did not significantly impact the efficacy of either treatment, suggesting that the material properties and clinical techniques are the primary determinants of treatment success. Clinically, the results advocate for the preference of Bio dentine in direct pulp capping procedures.[14] However, the higher cost of Bio dentine compared to MTA remains a consideration that may affect its adoption in various clinical settings.[22] Overall, our study validates the literature supporting Bio dentine as a superior alternative to MTA for direct pulp capping. Further research, particularly focusing on long-term efficacy and cost-effectiveness, is warranted to reinforce these findings and guide clinical practice.[21]

The significant difference in efficacy between Bio dentine and MTA suggests that Bio dentine should be preferred for direct pulp capping in clinical settings. Its superior performance can lead to higher success rates and better long-term outcomes for patients.[17] Further clinical trials and cost-benefit analyses are necessary to provide a more comprehensive understanding of its utility in various clinical scenarios.[21,22]

The limitations of this study include the relatively shorter follow-up period and reliance on radiographic analysis only, with no inclusion of thermal or electric pulp testing (EPT).

CONCLUSION

Bio dentine was significantly more effective than MTA, with a success rate of 95% compared to 75% for MTA. Neither age nor gender significantly influenced the efficacy of either treatment, suggesting that Bio dentine's advantages are consistent across different demographic groups.

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