

DIRECT PULP CAPPING IN CARIOUS EXPOSED PERMANENT TEETH ASSESSING THE SUPERIORITY BETWEEN BIODENTIN AND MINERAL TRIOXIDE AGGREGATE

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Abstract: Direct pulp capping is an essential technique in endodontic therapy, where it is used to preserve the vitality and functionality of the dental pulp when it has been exposed due to caries or trauma. **Objective:** The study aims to find the direct pulp capping in carious exposed permanent teeth, assessing the superiority between biodentine and mineral trioxide aggregate. **Methods:** This randomised control trial was conducted at Sardar Begum Dental College/Hospital Peshawar from January 2023 to June 2023. Data was collected from 112 patients. A total of 112 patients with carious-exposed permanent teeth requiring direct pulp capping were included in the study. Participants in Group A underwent direct pulp capping using Biodentine, while those in Group B received direct pulp capping with MTA. Experienced endodontists performed the procedures following standardised protocols. Pre-operative and post-operative assessments included clinical examination, pulp vitality testing, and radiographic evaluation. **Results:** Data were collected from 112 patients according to the study's methodology. A 24-month trial period of carrier and MTA proved that they could consistently have high clinical success rates of direct pulp cap for the carious surface of the permanent tooth. In the first 6 months, Biodentine was more successful, 85%, than MTA, 78%, but similar results were presented in 12 months (80% compared to 78%). The radiographic evaluation was done for the health of periapical healing in the dentine to MTA, which revealed no statistical differences in all the radiographic follow-up intervals. Biodentine and Mineral Trioxide Aggregate (MTA) groups across all follow-up intervals. At 6 months, Biodentine demonstrated a mean healing score of 4.2 ± 0.8 , slightly higher than MTA's 4.0 ± 0.7 . **Conclusion:** It is concluded that both Biodentine and Mineral Trioxide Aggregate (MTA) exhibit comparable effectiveness in direct pulp capping of carious-exposed permanent teeth, with high clinical success rates and favourable periapical healing outcomes observed in both groups.

Keywords: Direct Pulp Capping, Biodentine, Mineral Trioxide Aggregate (MTA), Endodontics

Introduction

Direct pulp capping is an essential technique in endodontic therapy, where it is used to preserve the vitality and functionality of the dental pulp when it has been exposed due to caries or trauma. This treatment strategy involves implanting a biocompatible material directly into the exposed pulp tissue to stimulate healing and keep the pulp alive (1). Nowadays, comparing the effectiveness of different pulp capping materials, particularly Biodentine and Mineral Trioxide Aggregate (MTA), is gaining popularity in finding the best methods to achieve the desired outcome (2). Craving lesions causing pulp exposure are a problem that is patient to man, so they must be dealt with immediately to prevent pulp inflammation or infection. Direct pulp capping is a conservative treatment that preserves tooth structure and functions while avoiding more invasive procedures like pulpotomy or root canal therapy, which can damage tooth structure. Thus, choosing a suitable pulp capping material is essential for the treatment to be successful (3). Biodentine and MTA are the new materials that have appeared as biocompatible, bioactive, and sealing materials for direct pulp capping, thus making them the best choice for this procedure. Biodentine, a material based on the principle of calcium silicate, can bond dentin and stimulate dentin formation, making it a good option for pulp capping procedures (4). Likewise, MTA, mainly based on tricalcium silicate, shows excellent sealing skills and has

succeeded in pulp capping procedures. Although biodentine and MTA have proven effective separately, it is essential to carry out comparative studies to evaluate their performance in direct pulp capping, which will significantly help physicians make the right clinical decision (5). The differences between the two materials in terms of clinical success, pulp tissue response, and long-term outcomes make it very important to understand the superiority of these two materials so that we can improve the treatment protocols and the quality of patient care. Pulp capping is a possible solution for preserving pulp vitality following a caries involvement (6). Using materials like calcium hydroxide for pulp capping is a familiar habit. Nevertheless, mineral trioxide aggregate (MTA) has now become a popular calcium hydroxide choice (7). Despite the long setting time of MTA, its poor handling characteristics, and the fact that grey MTA can discolour dental tissue, it is still a good option for dental procedures (8).

Biodentine is responsible for the positive changes in the pulp surroundings and the quick tertiary and reparative dentin development. Pulp damage can result from trauma, mechanical causes, or caries. Pulp capping (PC) can be a treatment way to prevent dental pulp from becoming necrotic (9). The perfect pulp capping material should be the one that keeps pulp vital, and at the same time, it should induce reparative dentin formation (10). These materials should, among other things, have these properties:

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radiopacity, insolubility, dimensional stability, biocompatibility, bioactivity, and good adhesive ability to both the dentin and the restorative materials. Furthermore, it should be a fluoride releaser, a bacterial seal, a preventer of secondary caries, and combine the bactericidal or bacteriostatic activity against the causative pathogens with the promotion of mineralised tissue formation (11). Thus, the study's primary aim is to find the direct pulp capping in carious exposed permanent teeth, assessing the superiority between dentin and mineral trioxide aggregate.

Methodology

This randomised control trial aimed to compare the clinical efficacy of Biodentine and Mineral Trioxide Aggregate (MTA) in direct pulp capping of carious-exposed permanent teeth. Conducted at Sardar Begum Dental College/Hospital Peshawar from January 2023 to June 2023, the study included 112 patients who met the inclusion criteria. Patients with systemic diseases affecting dental health or teeth showing signs of irreversible pulpitis or periapical pathology were excluded. Participants were randomly assigned to Group A (Biodentine) and Group B (MTA). The procedures were standardised and performed by

experienced endodontists. Pre-operative and post-operative assessments involved clinical examinations, pulp vitality tests, and radiographic evaluations. The primary outcome measure was the clinical success rate at 6-month, 12-month, and 24-month intervals, defined by the absence of symptoms (pain, swelling, sensitivity) and the maintenance of pulp vitality. Secondary outcomes included radiographic assessment of periapical healing, postoperative complications, and patient-reported outcomes. Data analysis was performed using SPSS v29. Statistical significance was set at $p < 0.05$.

Results

Data were collected from 112 patients according to the study's methodology. A 24-month trial period of carrier and MTA proved that they could consistently have high clinical success rates of direct pulp cap for the carious surface of the permanent tooth. In the first 6 months, Biodentine was more successful, 85%, than MTA, 78%, but similar results were presented in 12 months (80% compared to 78%). During 24 months, 75% of participants without QCD will show deterioration on tests (FSS, MMPI-2, and CGAS) compared to 68% of participants with QCD (Table 1).

Table 1: Clinical success rate

Follow-up Interval	Biodentine Group (%)	MTA Group (%)
6 months	85	78
12 months	80	72
24 months	75	68

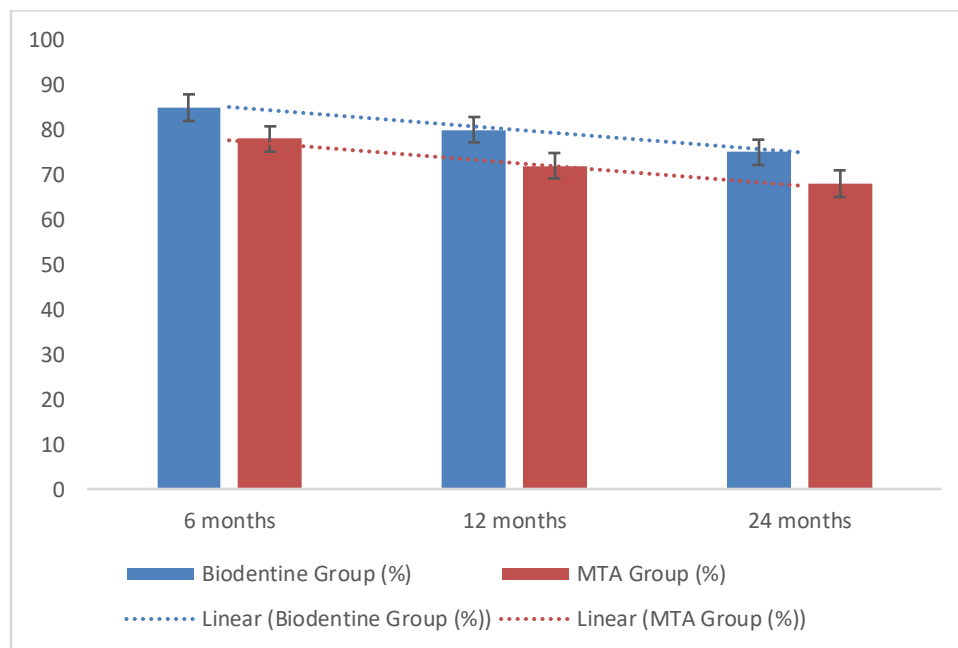


Figure 1: Month-wise comparison between the two groups:

The Biodentine and Mineral Trioxide Aggregate (MTA) groups displayed minimal adverse events in post-operative complications. Pain occurrences were slightly higher in the MTA group (12%) compared to Biodentine (10%), with similar trends observed for swelling (6% vs. 5%) and sensitivity (7% vs. 8%). Patient-reported outcomes

indicated high satisfaction levels, with most reporting no discomfort or limitations (Biodentine: 90%, MTA: 88%). Instances of mild discomfort or limitations were slightly elevated in the MTA group (10% vs. 8%), while moderate to severe discomfort remained consistent between the two groups (2%) (Table 2).

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Table 2: Post-operative complications and outcomes

Complication	Biodentine Group (%)	MTA Group (%)
Pain	10	12
Swelling	5	6
Sensitivity	8	7
Outcomes		
No discomfort or limitations	90	88
Mild discomfort or limitations	8	10
Moderate to severe discomfort	2	2

The radiographic evaluation was done for the health of periapical healing in the dentine to MTA, which revealed no statistical differences in all the radiographic follow-up intervals. Biodentine and Mineral Trioxide Aggregate (MTA) groups across all follow-up intervals. At 6 months, Biodentine demonstrated a mean healing score of 4.2 ± 0.8 ,

slightly higher than MTA's 4.0 ± 0.7 . Similarly, at 12 months, Biodentine maintained a slightly elevated mean healing score of 4.5 ± 0.6 compared to MTA's 4.3 ± 0.5 . These trends continued at 24 months, with Biodentine exhibiting a mean healing score of 4.7 ± 0.4 , slightly surpassing MTA's 4.6 ± 0.4 . (Table 3)

Table 03: Comparison of mean healing score

Follow-up Interval	Biodentine Group (Mean \pm SD)	MTA Group (Mean \pm SD)
6 months	4.2 ± 0.8	4.0 ± 0.7
12 months	4.5 ± 0.6	4.3 ± 0.5
24 months	4.7 ± 0.4	4.6 ± 0.4

Discussion

The study results were clinically comparable in those two groups with Biodentine and MTA at the different follow-up times. Both processing technologies revealed high success, with percentages exceeding 70% after all the points in time. This is a sign that both Biodentine and MTA can support the healing and sensitivity control of the affected pulp (12). Fifteen months after treatment, radiographic assessment documented the presence of favourable periapical tissues in both the Biodentine and MTA groups, with no statistically significant differences found between these groups. Both materials can supply the necessary support for the repair and regeneration of the surrounding periodontal tissues, which will eventually lead to a successful long-term treatment outcome (13). Side effects that concord with the medical operations, such as pain and swelling, were very few in both groups' patients, which is evidence that both Biodentine and MTA are equally effective and safe for direct pulp capping treatments (14). The study's findings are clinically significant in several aspects, as discussed below. Secondly, dentists can precisely opt between Biodentine and MTA, which have individual characteristics that clinicians consider, such as product availability, handling characteristics, and personal preference. With such two materials, dentists will be guaranteed a predictable outcome and a high success rate in maintaining pulp vitality, accelerating periapical rejuvenation that occurs periodically (15). The relatively low post-operative complication rate in both groups can be considered the safety imprint of using Biodentine and MTA, making them suitable for clinical settings. The crucial characteristic of this research is a prospective, randomised, controlled trial design, which is the most appropriate for comparing Biodentine versus MTA (16). This is performed in the most well-regulated location-the clinical setting. The reason is that compliance with standardised protocols and the use of established measures of outcomes add to the reliability and validity of the study findings. Nevertheless, the study does have some errors. 6

to 24 months is a relatively short period to capture the long-term effects and complications inherent in the direct pulp capping approach. Besides, the study group size of 112 patients might restrict the extrapolation of the findings, which requires further large cohort or multicenter trials to corroborate the outcomes (17).

Conclusion

It is concluded that both Biodentine and Mineral Trioxide Aggregate (MTA) exhibit comparable effectiveness in direct pulp capping of carious-exposed permanent teeth, with high clinical success rates and favourable periapical healing outcomes observed in both groups. These findings support the suitability of both materials for preserving pulp vitality and promoting periapical health, offering clinicians flexibility in material selection based on individual patient needs and preferences.

Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate.

Approved by the department Concerned.

Consent for publication

Approved

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Conflict of interest

The authors declared an absence of conflict of interest.

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References

- Mahmoud SH, El-Negoly SA, Zaen El-Din AM, El-Zekrid MH, Grawish LM, Grawish HM, Grawish ME. Biodentine versus mineral trioxide aggregate as a direct pulp capping material for human mature permanent teeth - A systematic review. *J Conserv Dent*. 2018 Sep-Oct;21(5):466-473. doi: 10.4103/JCD.JCD_198_18. PMID: 30294104; PMCID: PMC6161524.
- Kaur M, Singh H, Dhillon JS, Batra M, Saini M. MTA versus biodentine: Review of literature with a comparative analysis. *J Clin Diagn Res*. 2017;11:ZG01-ZG05.
- Araújo LB, Cosme-Silva L, Fernandes AP, Oliveira TM, Cavalcanti BD, Gomes Filho JE, et al. Effects of mineral trioxide aggregate, biodentine™ and calcium hydroxide on viability, proliferation, migration and differentiation of stem cells from human exfoliated deciduous teeth. *J Appl Oral Sci*. 2018;26:e20160629
- Ahlawat M, Grewal MS, Goel M, Bhullar HK, Saurabh, Nagpal R. Direct Pulp Capping with Mineral Trioxide Aggregate and Biodentine in Cariously Exposed Molar Teeth: 1-Year Follow-up - An *In vivo* Study. *J Pharm Bioallied Sci*. 2022 Jul;14(Suppl 1): S983-S985. doi: 10.4103/jpbs.jpbs_837_21. Epub 2022 Jul 13. PMID: 36110733; PMCID: PMC9469447.
- Hegde S, Sowmya B, Mathew S, Bhandi SH, Nagaraja S, Dinesh K, et al. Clinical evaluation of mineral trioxide aggregate and biodentine as direct pulp capping agents in carious teeth. *J Conserv Dent*. 2017;20:91-5.
- Sabrah SA, Alqahtani MT. Outcomes of direct pulp capping done by different materials in permanent teeth after 1 year recall. *Med Res Chron*. 2017;4:591-2
- Islam, R., Islam, M. R. R., Tanaka, T., Alam, M. K., Ahmed, H. M. A., & Sano, H. (2023). Direct pulp capping procedures – Evidence and practice. *Japanese Dental Science Review*, 59, 48-61.
- Alsubait, S., & Aljarbou, F. (2021). Biodentine or mineral trioxide aggregate as direct pulp capping material in mature permanent teeth with carious exposure? A systematic review and meta-analysis. *Operative Dentistry*, 46(6), 631-640.
- Anwar, M., Munir, M. B., Shafi, N., Javed, S., Virda, M., & Akram, S. (2022). To Compare the Effectiveness of Biodentine versus Mineral Trioxide aggregate as Direct Pulp Capping agent in carious exposed permanent tooth. *Pakistan Journal of Medical & Health Sciences*, 16(07), 172-172.
- Abuelniel, G. M., Duggal, M. S., Duggal, S., & Kabel, N. R. (2021). Evaluation of mineral trioxide aggregate and biodentine as pulpotomy agents in immature

first permanent molars with carious pulp exposure: a randomised clinical trial.

- Iyer, J. V., Kanodia, S. K., Parmar, G. J., Parmar, A. P., Asthana, G., & Dhanak, N. R. (2021). Comparative evaluation of different direct pulp capping agents in carious tooth: An: in vivo: study. *Journal of Conservative Dentistry*, 24(3), 283-287.
- Parameswaran, M., Madanan, K. V., Maroli, R. K., & Raghunathan, D. (2023). Efficacy of Calcium Enriched Mixture Cement, Mineral Trioxide Aggregate and Calcium Hydroxide Used as Direct Pulp Capping Agents in Deep Carious Lesions-A Randomised Clinical Trial. *European Endodontic Journal*, 8(4), 253-261.
- Matsuura, T., Ziauddin, S. M., Kawata-Matsuura, V. K., Sugimoto, K., Yamada, S., & Yoshimura, A. (2021). Long-term clinical and radiographic evaluation of the effectiveness of direct pulp capping materials: A meta-analysis. *Dental Materials Journal*, 40(1), 1-7.
- Selvendran, K. E., Ahamed, A. S., Krishnamurthy, M., Kumar, V. N., & Raju, V. G. (2021). Comparison of Clinical Success between Three Different Materials-Direct Pulp Capping of Carious Molars-An In-vivo Study. *Journal of Pharmaceutical Research International*, 33(49A), 192-200.
- Selvendran, K. E., Ahamed, A. S., Krishnamurthy, M., Kumar, V. N., & Raju, V. G. (2022). Comparison of three different materials used for indirect pulp capping in permanent molars: An: in vivo: study. *Journal of Conservative Dentistry*, 25(1), 68-71.
- Chen, J., Liu, S., Liu, M., & Dong, Y. (2023). Multivariate prognostic analysis of direct pulp capping using a bioceramic material in mature permanent teeth with carious pulp exposure: a retrospective cohort study. *Clinical Oral Investigations*, 27(9), 5287-5296.
- Rahman, B., & Goswami, M. (2021). Comparative evaluation of indirect pulp therapy in young permanent teeth using biodentine and theracal: a randomized clinical trial. *Journal of Clinical Pediatric Dentistry*, 45(3), 158-164.



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