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A COMPARATIVE CLINICAL AND RADIOGRAPHIC EVALUATION OF DIODE LASER AND MINERAL TRIOXIDE AGGREGATE IN PULPOTOMY OF PRIMARY MOLARS

Paediatric Dentistry

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ABSTRACT

Background: Pulpotomy is a commonly performed vital pulp therapy procedure in primary molars with carious pulp exposure. Mineral trioxide aggregate (MTA) has demonstrated excellent clinical success because of its biocompatibility and sealing ability. Recently, diode laser pulpotomy has gained attention because of its hemostatic and bactericidal effects. **Aim:** To compare the clinical and radiographic success of diode laser pulpotomy and MTA pulpotomy in primary molars. **Materials and Methods:** A randomized clinical study was conducted among children aged 4–9 years requiring pulpotomy in primary molars. eighty teeth were randomly allocated into two groups. Group I underwent MTA pulpotomy, while Group II underwent diode laser pulpotomy. Both groups received definitive restoration (glass ionomer cement in Group I and zinc oxide eugenol in Group II) followed by stainless steel crown (SSC) placement in all teeth. Clinical and radiographic evaluations were performed at 3,6,9 and 12 months using Zurn and Seale criteria. **Results:** Both groups demonstrated high clinical and radiographic success rates during the follow-up period. No statistically significant difference was observed between the groups. **Conclusion:** Both MTA and diode laser pulpotomy demonstrated favourable clinical and radiographic outcomes over 12 months. Diode laser pulpotomy may serve as an effective minimally invasive alternative for vital pulp therapy in primary teeth.

KEYWORDS

Primary Molars, Pulpotomy, Diode Laser, Mineral Trioxide Aggregate, Pediatric Dentistry

INTRODUCTION

Preservation of primary teeth until their normal exfoliation is important for mastication, speech development, maintenance of arch length, and guidance of permanent tooth eruption.[1] Pulpotomy is the most accepted vital pulp therapy procedure for primary teeth with carious pulp exposure but without radicular pathology. The procedure involves removal of the inflamed coronal pulp while preserving vitality of the radicular pulp.[2,3]

The success of pulpotomy depends on proper case selection, infection control, hemostasis, and use of a suitable pulpotomy material. Formocresol was previously considered the gold standard pulpotomy agent; however, concerns regarding its toxicity and mutagenicity have encouraged the search for biocompatible alternatives.[4]

Mineral trioxide aggregate (MTA) is widely used because of its excellent sealing ability, biocompatibility, and ability to induce hard tissue formation.[5] Diode lasers have recently been introduced as minimally invasive alternatives because of their bactericidal, hemostatic, and biostimulatory properties. However, limited evidence is available comparing diode laser pulpotomy directly with MTA pulpotomy. Therefore, the present study aimed to evaluate and compare the clinical and radiographic success of diode laser pulpotomy and MTA pulpotomy in primary molars.[7]

MATERIALS AND METHODS

This randomized clinical trial was conducted in the Department of Pedodontics and Preventive Dentistry, Government Dental College and Hospital, Ahmedabad, after obtaining approval from the Institutional Ethics Committee (IEC GDCH) Reg No: EC/NEW/INST/2021/573. The study was registered with the Clinical Trial Registry of India (CTRI/2026/02/104456). Written informed consent was obtained from parents or legal guardians before enrolment.

Inclusion criteria

- Children in the age group of 4 -9 years
- Patient exhibiting frankl's behaviour rating scale score of 3 and 4
- No history of spontaneous or persistent pain.
- Lack of clinical evidence of pulpal degeneration, such as pain on percussion, history of swelling or sinus tracts.
- Restorable teeth following completion of procedure.
- Following pulpal amputation, hemostasis could be easily achievable within 5 minutes with a sterile moist cotton pellet.
- Radiolucency approaching pulp.
- Minimum of 2/3rd of the root length should be remaining.
- No interradicular/periapical radiolucency.
- Absence of radiographic signs of internal and external resorption.

Exclusion criteria

- Patient with a diagnosed systemic disease
- Patient showing disruptive behaviour during procedure

Sample size calculation

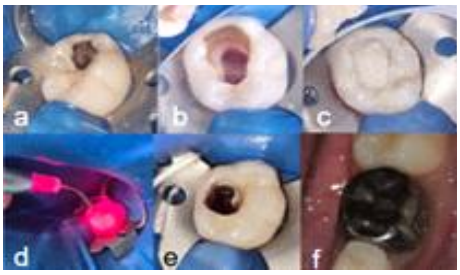
The sample size was calculated using the formula for comparing two proportions based on expected clinical success rates from a previous study. A confidence level of 95% and power of 80% were considered. The minimum required sample size was 32.83 subjects per group, which was rounded to 40 after accounting for attrition. Eligible teeth were randomly allocated into: Group I-MTA pulpotomy Group II-Diode laser pulpotomy

Clinical procedure

All procedures were performed under local anesthesia and rubber dam isolation. Following caries excavation and access opening, coronal pulp tissue was removed using a sterile spoon excavator.

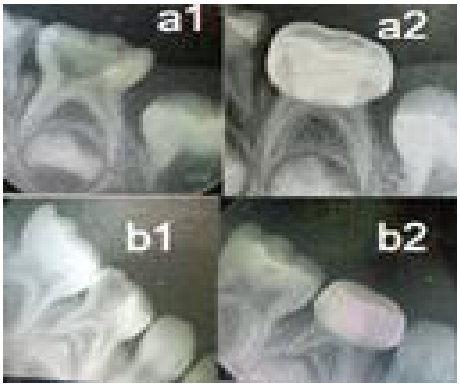
In MTA pulpotomy After achieving hemostasis, MTA was placed over the radicular pulp stumps according to the manufacturer's instructions. The cavity was sealed with glass ionomer cement. In Diode laser pulpotomy Hemostasis was achieved using a 940 nm diode laser in pulsed contact mode at 1.5 W for 2 seconds in each orifices through an optical fiber tip. The pulp chamber was then filled with zinc oxide

eugenol. All treated teeth were restored with stainless-steel crowns.



Clinical procedure (a) Preoperative (b) Hemostasis after moist cotton pellet (c) MTA pulpotomy (d) Laser pulpotomy (e) After laser application (f) Final restoration with SSC

Clinical and radiographic evaluations were performed at 3,6,9 and 12 months using Zurn and Seale criteria. Clinical success was determined by the absence of spontaneous pain, tenderness to percussion, swelling, sinus tract, and pathological mobility. Radiographic success was determined by the absence of furcal radiolucency, root resorption, periodontal ligament widening, and pathological bone destruction.



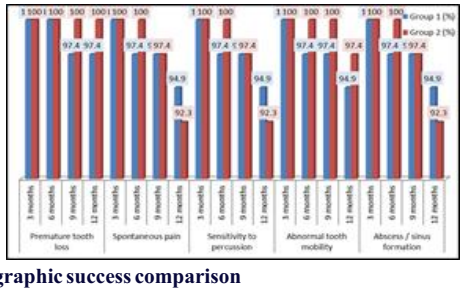
Radiographic evaluation:(a1) MTA pulpotomy preoperative (a2) 12-month follow-up (b1) Laser pulpotomy preoperative (b2)12-month follow up

Data were analyzed using SPSS software. Intergroup comparisons were performed using Chi-square test or Fisher's exact test. Statistical significance was set at $p < 0.05$.

RESULTS

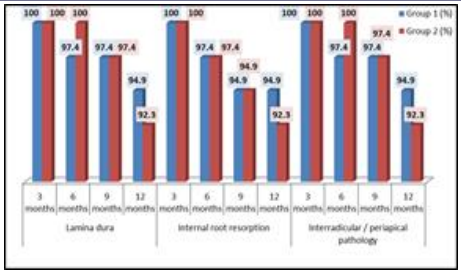
Clinical success comparison

At the 3- and 6-month follow-ups, all clinical parameters showed 100% success in both groups, preventing statistical comparison due to lack of variability. At 9 months, minor differences were observed, with premature tooth loss showing 97.4% success in Group 1 and 100% in Group 2, while other parameters showed 97.4% success in both groups. At 12 months, clinical success rates ranged from 92.3% to 97.4% in both groups. However, no statistically significant inter-group differences were observed for any parameter at any follow-up interval ($p = 1.000$)



Radiographic success comparison

At the 3-month follow-up, all radiographic parameters showed 100% success in both groups. At 6 and 9 months, success rates for lamina dura integrity, internal root resorption, and interradicular or periapical pathology remained above 94% and were comparable between the groups. At 12 months, slight reductions in success rates (92.3%–94.9%) were observed in both groups. However, no statistically significant inter-group differences were found at any follow-up interval ($p = 1.000$)



DISCUSSION

Pulpotomy is one of the most commonly performed vital pulp therapy procedures for cariously exposed primary molars with reversible pulpal inflammation. Contemporary vital pulp therapy focuses on preserving radicular pulp vitality using biocompatible materials and minimally invasive techniques that promote healing and reduce postoperative complications. Therefore, selecting an appropriate pulpotomy modality capable of effective disinfection, hemostasis, and tissue preservation is essential in pediatric dentistry.[6]

The present study demonstrated high clinical and radiographic success rates for both MTA and diode laser pulpotomy in primary molars. The findings suggest that both treatment modalities are effective for maintaining radicular pulp vitality and preventing pathological changes.

MTA has gained widespread acceptance because of its bioactive properties, superior sealing ability, and capacity to stimulate hard tissue formation. Upon hydration, it releases calcium ions and maintains an alkaline pH, promoting odontoblastic differentiation and dentin bridge formation. Previous studies have reported excellent success rates with MTA pulpotomy, supporting the findings of the present study.[5]

Diode laser pulpotomy demonstrated favorable outcomes because of its hemostatic, bactericidal, and biostimulatory properties. Laser irradiation provides rapid coagulation and effective bleeding control while reducing bacterial contamination and postoperative inflammation. The superficial coagulation layer formed by the laser acts as a biological seal, protecting the underlying pulp tissue and promoting pulpal healing.[7]

The present findings are consistent with previous studies, including those by Uloopi et al.[8] and Niranjani et al.[9], who reported comparable clinical and radiographic outcomes between MTA and diode laser pulpotomy. Similarly, Gao Y et al. (2025), in a meta-analysis of 17 randomized clinical trials, found that diode laser pulpotomy showed clinical success rates comparable to MTA and other conventional techniques across all follow-up periods, with no statistically significant difference.[10] These results also align with Agamy HA et al. (2004), who reported 100% radiographic success with MTA at 6 months and 94% at 12 months in primary molars with minimal internal resorption or furcation radiolucency,[11] and Niranjani K et al. (2015), who observed 100% clinical and radiographic success for both MTA and diode laser pulpotomy at 6 months with no significant difference ($p > 0.05$), concluding that both modalities are equally effective in maintaining pulpal health.[9]

The slight reduction in radiographic success at later follow-up intervals may be attributed to microleakage and persistent inflammation leading to interradicular radiolucency or internal resorption. The comparatively lower success of diode laser pulpotomy at 12 months may be due to its limited regenerative potential compared to MTA. Nevertheless, both MTA and diode laser pulpotomy were effective in maintaining periapical health and preventing pathological changes in primary teeth.[12]

The comparable outcomes observed in both groups indicate that successful pulpotomy depends on effective removal of infected coronal pulp, achievement of hemostasis, microbial control, and maintenance of an adequate coronal seal. While MTA promotes pulpal healing through bioactive dentin bridge formation, diode laser achieves disinfection and coagulation through photothermal effects. Overall, both MTA and diode laser pulpotomy proved to be effective treatment modalities for vital pulp therapy in primary teeth.[13]

CONCLUSION

Both MTA and diode laser pulpotomy demonstrated high and comparable clinical and radiographic success rates over 12 months in primary molars, with no statistically significant difference between the groups. MTA provided predictable outcomes because of its bioactive properties, while diode laser pulpotomy offered advantages such as hemostasis, disinfection, and minimally invasive application, making both modalities effective options for pediatric pulp therapy.

REFERENCES:

1. Pinkham, J. R., Casamassimo, P. S., Fields, H. W., Mc Tigue, D. J., & Nowak, A. (2005). Pediatric dentistry: infancy through adolescence. Evaluation, 20(20), 20..
2. Teeth, I. P. (2009). Guideline on pulp therapy for primary and immature permanent teeth.
3. Fuks, A. B., Kupietzky, A. R. I., & Guelmann, M. (2019). Pulp therapy for the primary dentition. In Pediatric dentistry (pp. 329-351). Elsevier.
4. Ranly, D. M. (1994). Pulpotomy therapy in primary teeth: new modalities for old rationales. Pediatric dentistry, 16, 403-403
5. Torabinejad, M., & Chivian, N. (1999). Clinical applications of mineral trioxide aggregate. Journal of endodontics, 25(3), 197-205..
6. Coll, J. A., Seale, N. S., Vargas, K., Marghalani, A. A., Al Shamali, S., & Graham, L. (2017). Primary tooth vital pulp therapy: a systematic review and meta-analysis. Pediatric dentistry, 39(1), 16-123.
7. Pei, S. L., Shih, W. Y., & Liu, J. F. (2020). Outcome comparison between diode laser pulpotomy and formocresol pulpotomy on human primary molars. Journal of dental sciences, 15(2), 163-167.
8. Uloopi, K. S., Vinay, C., Ratnaditya, A., Gopal, A. S., Mrudula, K. J. N., & Rao, R. C. (2016). Clinical evaluation of low level diode laser application for primary teeth pulpotomy. Journal of clinical and diagnostic research: JCDR, 10(1), ZC67.
9. Niranjani, K., Prasad, M. G., Vasa, A. A. K., Divya, G., Thakur, M. S., & Saujanya, K. (2015). Clinical evaluation of success of primary teeth pulpotomy using mineral trioxide aggregate®, laser and biodentineTM-an in vivo study. Journal of clinical and diagnostic research: JCDR, 9(4), ZC35.
10. Gao, Y., Hu, M., & Xu, J. (2025). Clinical efficacy of diode laser for pulpotomy in primary teeth: A meta-analysis of randomised controlled trials. Acta Odontologica Scandinavica, 84, 43804.
11. Agamy, H. A., Bakry, N. S., Mounir, M. M., & Avery, D. R. (2004). Comparison of mineral trioxide aggregate and formocresol as pulp-capping agents in pulpotomized primary teeth. Pediatric dentistry, 26(4), 302-309.
12. Pandiyan, R., Lehl, G. K., Kumar, R., Sharma, U., & Jagachandiran, V. V. (2024). Assessing the efficacy of Laser pulpotomy versus conventional pulpotomy in primary teeth: A systematic review and meta-analysis of clinical trials. Lasers in Medical Science, 39(1), 198.
13. Swarnalatha, C., Babu, J. S., Panwar, P. S., Alquraishi, M. A., Almalaq, S. A., Alnasrallah, F. A., & Nayyar, A. S. (2020). Clinical and radiographic evaluation of results of MTA pulpotomy and laser-assisted MTA pulpotomy. Saudi Endodontic Journal, 10(3), 254-259.