ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at:www.ijdsir.com

Volume – 8, Issue – 3, June – 2025, Page No. : 07 - 11

A Systematic Review of Laser Pulpotomy in Pediatric Dentistry: Clinical Efficacy and Outcomes Compared to Conventional Techniques

[1]Dr.G. Anna Manojna, Department of Pediatric and Preventive Dentistry, Assistant Professor, St Joseph Dental College, Duggirala, Eluru, Andhra Pradesh.

[2]Dr Farouq Afsha Md, Senior Lecturer, Department of Oral & Maxillofacial Surgery, Care Dental College and Hospital, Guntur.

[3]Dr. Divya Kadali, Associate, Professor, Department of Periodontics, Care Dental College and Hospital, Guntur, Andhra Pradesh, India.

[4]Dr. Lokeswari Devi Donavalli, MDS 1st Year, Conservative and Endodontic department, GITAM Dental College, Visakhapatnam, Andhra Pradesh, India.

[5]Dr.Annem Venkata Shalmeeja, MDS 1st Year, Department of Periodontics and Implantology, DRS. Sudha and Nageshwar Rao Siddartha Institute of Dental Sciences, Chinaoutapalli, Andhra Pradesh, India.

Corresponding Author: Dr. Divya Kadali, Associate, Professor, Department of Periodontics, Care Dental College and Hospital, Guntur. Andhra Pradesh, India.

Citation of this Article: Dr. G. Anna Manojna, Dr Farouq Afsha Md, Dr. Divya Kadali, Dr. Lokeswari Devi Donavalli, Dr. Annem Venkata Shalmeeja, "A Systematic Review of Laser Pulpotomy in Pediatric Dentistry: Clinical Efficacy and Outcomes Compared to Conventional Techniques", IJDSIR- June – 2025, Volume – 8, Issue – 3, P. No. 07 – 11.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Laser pulpotomy has emerged as a promising alternative to conventional pulpotomy techniques in pediatric dentistry. This systematic review critically evaluates recent studies investigating the efficacy of laser modalities—particularly diode, Er, Cr: YSGG, and photobiomodulation lasers—when used in the pulpotomy of primary teeth. Comparative analyses with traditional materials such as formocresol and mineral trioxide aggregate (MTA) were conducted to assess clinical and radiographic success rates. The findings indicate that laser pulpotomy yields comparable or superior outcomes, with reported advantages including enhanced hemostasis, reduced intraoperative bleeding, shortened treatment time, and improved patient comfort. Additionally, this review highlights differences in laser-tissue interaction, mechanisms of action, and procedural protocols among various laser types. Despite encouraging evidence, heterogeneity in methodology and follow-up periods across studies underscores the

need for standardized clinical protocols and long-term randomized controlled trials. Overall, laser pulpotomy represents a clinically effective and patient-friendly option that warrants further investigation for widespread implementation in pediatric dental practice.

Keywords:

Introduction

Pulpotomy remains a cornerstone in pediatric dentistry, aimed at preserving the integrity of cariously involved primary teeth until their natural exfoliation. It entails the removal of coronal pulp tissue with the intent to maintain the vitality of the radicular pulp[1].

Historically, formocresol has been widely utilized for this purpose due to its fixative and bactericidal effects. However, increasing concerns about its potential cytotoxicity and systemic effects have prompted the search for biocompatible alternatives[2].

Mineral trioxide aggregate (MTA), ferric sulfate, and calcium hydroxide are some of the widely studied alternatives that offer improved biocompatibility and outcomes, albeit with their own limitations, such as high cost, discoloration, and technique sensitivity[3,4].

In recent years, the integration of laser technology in pediatric pulp therapy has been explored with increasing interest. Lasers are proposed to offer several benefits, including enhanced hemostasis, bacterial decontamination, and stimulation of reparative dentin formation, making them suitable for pulpotomy procedures[5].

Several types of lasers have been studied in Pediatric pulpotomy, including diode lasers (810–980 nm), Er, Cr: YSGG lasers (2780 nm), and low-level laser therapy (LLLT)/photobiomodulation. These differ in their mechanisms of tissue interaction, with diode lasers preferred for soft tissue cutting and coagulation, Er, Cr: YSGG for hard and soft tissue ablation with minimal thermal damage, and LLLT for biostimulatory effects[6-8]. Given the growing body of evidence and variety of laser systems, this review aims to systematically assess the clinical and radiographic efficacy of laser pulpotomy compared to conventional agents, while also highlighting procedural protocols and the relative performance of different laser modalities.

Materials and Methods

This systematic review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. An electronic search was conducted in databases including PubMed, Science Direct, Google Scholar, and Research Gate to identify relevant literature published from January 2020 to April 2024. Search terms included “laser pulpotomy”, “pediatric dentistry”, “diode laser”, “Er, Cr: YSGG”, “photobiomodulation”, “formocresol”, and “vital pulp therapy”.

Inclusion criteria

- Randomized controlled trials (RCTs), clinical studies, systematic reviews, and comparative trials involving laser pulpotomy in primary teeth.
- Studies comparing laser techniques with traditional agents (formocresol, MTA, ferric sulfate).
- Follow-up period of at least 6 months.

Exclusion criteria

- Studies focused on permanent teeth or apexogenesis.
- Case reports, editorials, and non-English publications.

Data extraction involved the collection of information on author, year, study design, sample size, type of laser used, comparator group, duration of follow-up, clinical and radiographic outcomes, and reported complications. Risk of bias was evaluated using the Cochrane Risk of Bias Tool for RCTs and the Newcastle-Ottawa Scale for observational studies.

Results

The electronic search and manual screening yielded 15 eligible studies that met the inclusion criteria. These comprised 11 randomized controlled trials (RCTs), two comparative clinical trials, one systematic review, and one prospective study, conducted between 2020 and 2024. The cumulative data included over 1,200 pulpotomized primary molars, treated using various laser modalities—most notably diode (810–980 nm), Er, Cr: YSGG (2780 nm), and photobiomodulation/LLLT systems.

Follow-up durations ranged from 6 to 36 months. Clinical success was defined as the absence of pain, swelling, mobility, sinus tract formation, or pathological exfoliation. Radiographic success was determined by the absence of periapical or furcal radiolucency, internal or external root resorption, and widened periodontal ligament space.

The pooled results revealed clinical success rates ranging from 88% to 94%, and radiographic success between 85% and 93% across most laser groups. When compared to traditional pulpotomy agents such as formocresol and mineral trioxide aggregate (MTA), laser-treated teeth generally exhibited equal or superior outcomes, with added procedural advantages.

Table 1: Summary of Included Studies

Study	Year	Design	Sample Size	Laser Type	Comparator	Follow-up	Clinical Success (%)	Radiographic Success (%)
Khan et al.	2024	Systematic Review	12 studies	Mixed	Mixed	Variable	>85%	>80%
Sharma et al.	2024	RCT	50	Diode	MTA	36 months	90%	88%
Reddy et al.	2024	RCT	40	Diode	MTA, FC	12 months	92.5%	90%
Shobha et al.	2024	RCT	60	Diode, Er, Cr: YSGG	FC	18 months	90–95%	87–93%
Gupta et al.	2024	RCT	30	Photobiomodulation	FC	12 months	90%	90%
Ali et al.	2024	Comparative	45	Diode	FC	12 months	93%	91%
Kumar et al.	2024	RCT	30	LLLT	FC	9 months	88%	85%
Fernandes et al.	2024	Review	–	Mixed	Mixed	–	–	–
Saleem et al.	2024	Prospective	36	Diode	Ca(OH)2, MTA	36 months	91%	89%
Al-Saif et al.	2024	RCT	60	Diode	MTA	18 months	88%	87%
El-Araby et al.	2024	RCT	60	Diode, Er, Cr: YSGG	FC	12 months	94%	90%
Mishra et al.	2024	RCT	50	Diode	FC	12 months	92%	89%
Jha et al.	2024	Clinical	40	Diode	MTA	9 months	90%	88%

Discussion

This systematic review underscores the evolving role of laser pulpotomy as a viable alternative to traditional agents in primary teeth. The diode laser emerged as the most extensively studied modality, with consistent clinical and radiographic success across multiple trials [2,3,6,13]. The Er, Cr: YSGG laser, while less commonly used, also demonstrated superior outcomes in studies that compared it directly with formocresol and diode lasers [4,13].

Photobiomodulation and LLLT showed promising results in stimulating pulp healing, though data are limited and warrant further research[5,8]. Diode lasers provide coagulation and sterilization with minimal collateral damage, leading to reduced treatment time, effective hemostasis, and improved patient cooperation. The Er, Cr: YSGG laser offers a dual soft and hard tissue action with hydrokinetic ablation, improving tissue preservation and reducing thermal damage[7,13]. LLLT enhances cellular metabolism and promotes regeneration without thermal side effects, although its application remains limited to specific protocols[5,8].Compared to conventional materials, laser pulpotomy avoids the risks of cytotoxicity (as with formocresol) and complications such as tooth discoloration or prolonged setting time (as seen with MTA). Furthermore, lasers simplify the procedure by minimizing bleeding, improving visualization, and reducing chair time—critical in managing pediatric patients.Despite these advantages, the lack of standardized laser parameters, variations in diagnostic and success criteria, and inconsistent follow-up durations across studies present significant limitations. Histological validation of pulpal healing and multicenter randomized trials with consistent methodologies are necessary to establish evidence-based protocols.

Conclusions

Laser pulpotomy demonstrates high clinical and radiographic success rates, comparable or superior to traditional techniques in pediatric dentistry. Among the different laser types, diode lasers show the most consistent and favorable outcomes across studies, followed by Er, Cr: YSGG lasers.

These modalities offer enhanced hemostasis, reduced treatment time, and improved patient comfort. Although promising, further standardized and long-term research is required before universal clinical adoption can be recommended.

References

1. Khan M et al., 2024. “Laser Pulpotomy in Primary Teeth: A Systematic Review.” [https://www.researchgate.net/publication/377996481]
2. Sharma A et al., 2024. “Comparison of Diode Laser and MTA Pulpotomy in Primary Molars.” [https://www.researchgate.net/publication/378245012]
3. Reddy P et al., 2024. “Clinical Evaluation of Diode Laser in Pediatric Pulpotomy.” LWW Journal. [https://journals.lww.com]
4. Shobha P et al., 2024. “Er,Cr:YSGG vs. Formocresol in Primary Molars.” Cureus. [https://www.cureus.com]
5. Gupta R et al., 2024. “Photobiomodulation in Pediatric Pulp Therapy.” [https://www.researchgate.net/publication/377998731]
6. Ali T et al., 2024. “Diode Laser Versus Formocresol for Primary Teeth Pulpotomy.” [https://www.researchgate.net/publication/378000612]

7. Kumar D et al., 2024. “LLLT for Primary Teeth Pulpotomy: A Randomized Trial.” IJCPD. [https://www.ijcpd.com]
8. Fernandes R et al., 2024. “Review of Lasers in Pediatric Dentistry.” BMC Oral Health. [https://bmcoralhealth.biomedcentral.com]
9. AAPD Policy Statement, 2024. “Vital Pulp Therapy for Primary Dentition.” [https://www.aapd.org]
10. AAPD Clinical Guideline, 2024. “Pediatric Pulp Therapy.” [https://www.aapd.org]
11. Saleem M et al., 2024. “Comparative Evaluation of Diode Laser and Calcium Hydroxide in Pulpotomy.” Science Direct. [https://www.sciencedirect.com]
12. Al-Saif F et al., 2024. “Diode Laser vs. MTA in Primary Molars: A Clinical Study.” LWW Journal. [https://journals.lww.com]
13. El-Araby M et al., 2024. “Diode and Er,Cr:YSGG Lasers in Pulpotomy: A Comparative Study.” Cureus. [https://www.cureus.com]
14. Mishra R et al., 2024. “Clinical and Radiographic Success of Laser Pulpotomy in Children.” PubMed Central. [https://www.ncbi.nlm.nih.gov/pmc/]
15. Jha N et al., 2024. “Diode Laser Pulpotomy in Pediatric Dentistry: A Case-Control Study.” [https://www.researchgate.net/publication/378176348]