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Er: YAG or diode laser versus traditional irrigation in combined periodontal-endodontic lesions and its impact on periodontal parameters

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Abstract:

Combined periodontal-endodontic lesions remain difficult to manage because conventional irrigation may not adequately eliminate microorganisms from complex root canal and periodontal environments. Sixty patients were randomly assigned to receive adjunctive Er: YAG laser therapy, diode laser therapy, or conventional irrigation and periodontal parameters were evaluated at baseline and after 1, 3 and 6 months. Both laser groups showed significantly greater reductions in probing pocket depth, clinical attachment loss, bleeding on probing and plaque index than the conventional irrigation group, with the Er: YAG laser producing the greatest improvements at 6 months. Adjunctive laser therapy, particularly Er: YAG provided superior clinical outcomes compared with conventional irrigation for the non-surgical management of combined periodontal-endodontic lesions. Thus, data shows the incorporation of Er: YAG laser therapy as an effective adjunctive treatment to enhance long-term periodontal healing and clinical outcomes.

Keywords: Combined periodontal-endodontic lesions, Er: YAG laser, diode laser, conventional irrigation, periodontal therapy, probing pocket depth, clinical attachment loss, bleeding on probing, plaque index, non-surgical periodontal treatment

Background:

Periodontitis is a chronic inflammatory disease affecting the supporting structures of the teeth, including the gingiva, periodontal ligament and alveolar bone, which, if untreated, lead to progressive attachment loss and tooth loss [1]. A dysbiotic biofilm initiates the disease cascade, triggering a host inflammatory response that mediates tissue destruction. Non-surgical periodontal therapy (NSPT) has long been the cornerstone of management, targeting bacterial load reduction, inflammation control and periodontal tissue healing [2]. Standard NSPT includes scaling and root planing combined with chemical irrigation using agents such as sodium hypochlorite or chlorhexidine. However, these methods face inherent limitations in accessing complex root anatomy, deep periodontal pockets, furcation areas and accessory canals where biofilm may persist [3]. Incomplete debridement in these areas reduces treatment effectiveness and increases the risk of disease recurrence. Recent technological advancements have introduced laser-assisted periodontal therapy as a potential adjunct or alternative to conventional approaches [4]. Er: YAG lasers have gained prominence owing to their strong absorption by water and hydroxyapatite, enabling effective removal of calculus and bacterial biofilm from root surfaces with minimal collateral thermal damage [5]. The ablative effect facilitates accurate

debridement of necrotic tissue, reduces bacterial load and refines root surfaces, thereby promoting periodontal regeneration. Diode lasers, operating at different wavelengths, exert antimicrobial and photo bio modulatory effects that accelerate tissue healing, reduce inflammation and modulate the cellular responses of periodontal tissues [6]. Integration of mechanical debridement with laser therapy has been proposed to enhance clinical outcomes, especially in moderate-to-severe periodontitis or combined periodontal-endodontic lesions where conventional irrigation may prove inadequate. Key clinical measures for evaluating treatment efficacy include probing pocket depth (PPD), bleeding on probing (BOP), clinical attachment level (CAL) and plaque index (PI) [7]. By examining the effects of laser-assisted interventions on these parameters, clinicians can ascertain whether these technologies provide quantifiable benefits compared to traditional methods, refine treatment protocols and potentially enhance long-term periodontal stability [8]. Understanding the role of laser therapy in complex periodontal conditions provides a basis for evidence-based incorporation of these modalities into standard periodontal practice [9, 10]. Therefore, it is of interest to compare the clinical efficacy of Er: YAG and diode lasers with conventional irrigation in the non-surgical management of combined periodontal-

endodontic lesions by evaluating periodontal clinical parameters over a six-month follow-up period.

Methodology:

The current study was structured as a randomised controlled clinical trial to assess the effectiveness of Er:YAG and diode laser therapy in comparison to traditional irrigation for the treatment of combined periodontal-endodontic lesions and their influence on periodontal parameters. Sixty patients were recruited from the periodontology outpatient department who had chronic periodontitis with combined lesions affecting at least one tooth with periodontal pocket depth ≥ 5 mm and radiographic signs of periapical involvement. Individuals with systemic diseases, pregnancy, recent antibiotic treatment, or prior periodontal or endodontic therapy within the last six months were excluded. Participants were randomly divided into three groups: Group A received Er:YAG laser therapy, Group B received diode laser therapy and Group C underwent conventional mechanical debridement and irrigation with saline and 0.12% chlorhexidine. Baseline periodontal parameters including probing pocket depth (PPD), clinical attachment level (CAL), bleeding on probing (BOP) and plaque index (PI) were recorded using a standard periodontal probe. Periapical radiographs were used to assess periapical healing and bone support. In Group A, Er: YAG laser therapy was administered per manufacturer specifications, targeting affected periodontal pockets and root surfaces with multiple passes to ensure decontamination and granulation tissue removal. In Group B, diode laser therapy (810–940 nm) was applied in non-contact mode to periodontal pockets and root canal spaces following mechanical instrumentation. Group C underwent standard mechanical debridement, scaling and root planing, followed by saline and chlorhexidine irrigation. All procedures were performed under local anaesthesia as required. Periodontal parameters were reassessed at 1, 3 and 6 months post-treatment. Microbial sampling was performed to assess bacterial reduction and recolonisation patterns. Repeated measures ANOVA was used for inter- and intra-group comparisons, with $p < 0.05$ considered statistically significant.

Results:

All 60 patients completed the 6-month follow-up without major complications. Baseline periodontal parameters (PPD, CAL, BOP, PI) were comparable across all three groups ($p > 0.05$). All groups demonstrated significant improvements in PPD and CAL at 1, 3 and 6 months post-treatment; however, laser-treated groups showed greater improvements than the conventional irrigation group. The Er:YAG laser group showed the greatest reduction in PPD (from 6.5 ± 0.8 mm at baseline to 3.2 ± 0.5 mm at 6 months), followed by the diode laser group (6.4 ± 0.9 mm to 3.8 ± 0.6 mm) and the conventional irrigation group (6.6 ± 0.7 mm to 4.5 ± 0.7 mm). Similarly, CAL improved most in the Er: YAG group (from 7.2 ± 0.9 mm to 3.5 ± 0.5 mm), followed by the diode laser and conventional groups. Full comparisons of PPD and CAL are presented in (Table 1). Bleeding on probing and plaque index scores were also significantly lower in the laser groups compared to the control at six months. BOP decreased by

78% in the Er: YAG group, 65% in the diode laser group and 48% in the conventional irrigation group. Plaque scores were reduced across all groups, with laser-treated groups maintaining significantly lower values (Table 2). Radiographic assessment showed signs of periapical healing and bone regeneration in all groups, with marginally greater improvements observed in the Er: YAG group.

Table 1: Comparison of Probing Pocket Depth (PPD) and Clinical Attachment Level (CAL) across groups

Group	Baseline PPD (mm)	6-month PPD (mm)	Baseline CAL (mm)	6-month CAL (mm)
Er:YAG Laser	6.5 ± 0.8	3.2 ± 0.5	7.2 ± 0.9	3.5 ± 0.5
Diode Laser	6.4 ± 0.9	3.8 ± 0.6	7.0 ± 0.8	4.0 ± 0.6
Conventional Irrigation	6.6 ± 0.7	4.5 ± 0.7	7.1 ± 0.8	4.8 ± 0.7

Table 2: Comparison of Bleeding on Probing (BOP) and Plaque Index (PI) across groups

Group	Baseline BOP (%)	6-month BOP (%)	Baseline PI	6-month PI
Er:YAG Laser	88 ± 6	20 ± 4	2.8 ± 0.5	0.8 ± 0.3
Diode Laser	86 ± 7	30 ± 5	2.7 ± 0.4	1.2 ± 0.4
Conventional Irrigation	87 ± 6	45 ± 5	2.9 ± 0.5	1.8 ± 0.4

Discussion:

The present study shows that Er: YAG and diode laser therapies are significantly more effective than conventional irrigation in treating combined periodontal-endodontic lesions. The primary objectives of non-surgical periodontal therapy are bacterial load reduction, inflammation control and tissue regeneration. While traditional mechanical debridement with chemical irrigation is effective, it is limited by its inability to access deep periodontal pockets, furcation areas and complex root anatomies where residual biofilm may persist. Shiba *et al.* (2023) [11] showed that laser-assisted periodontal management significantly reduces microbial burden and supports soft tissue healing in patients with advanced periodontitis, underscoring the clinical utility of laser adjuncts in complex periodontal cases. Er: YAG lasers have long been recognised for their capacity to effectively remove calculus and disrupt biofilm without causing thermal damage to surrounding periodontal tissues. Fahim *et al.* (2024) [12] reported that Er:YAG laser-assisted comprehensive pocket therapy significantly reduced residual pocket depths in patients with refractory periodontitis, showing sustained clinical improvements over follow-up periods consistent with those observed in the present study. Er: YAG energy is highly absorbed by water and hydroxyapatite, facilitating efficient removal of diseased tissue and improving root surface conditions conducive to periodontal regeneration. Multiple studies have confirmed that Er: YAG laser therapy can significantly reduce PPD, BOP and CAL loss. Grzech-Lesniak *et al.* (2021) [13] showed through systematic review and meta-analysis that Er:YAG laser therapy yields quantifiable improvements in clinical attachment levels and reduces periodontal inflammation, supporting its role as an effective adjunct to conventional non-surgical therapy. Diode lasers offer additional benefits through their photothermal and photobiomodulatory effects. Estrin *et al.* (2024) [14] reported that

diode laser adjunctive therapy significantly reduced periodontal pathogens and improved clinical parameters in patients with chronic periodontitis, highlighting the antimicrobial and regenerative capacity of diode lasers when combined with conventional instrumentation. The photobiomodulatory effects of diode lasers have been associated with accelerated healing, reduced inflammation and improved patient comfort during and after treatment. Shenoy *et al.* (2025) [15] showed that diode laser irradiation produced significant antimicrobial effects against periodontal pathogens and modulated cellular responses in periodontal ligament cells, thereby enhancing the regenerative capacity of laser-assisted periodontal therapy. The combined use of Nd: YAG and Er:YAG lasers has been shown to produce superior results compared to monotherapy. Gong and Li (2022) [16] showed that combined Er:YAG and Nd:YAG laser therapy yielded significant improvements in periodontal parameters within 3–6 month observation periods, reinforcing the concept that complementary laser wavelengths provide more comprehensive periodontal management by targeting both bacterial load and tissue regeneration simultaneously. The integration of photobiomodulation with laser therapy has also been shown to accelerate clinical recovery. Yu *et al.* (2022) [17] highlighted that photobiomodulation promotes fibroblast proliferation, collagen synthesis and angiogenesis, which collectively enhance soft tissue healing and accelerate periodontal repair following laser-assisted therapy. These mechanisms are consistent with the superior BOP and PI reductions observed in laser-treated groups in the present study. Short-term randomised clinical studies have confirmed significant improvements in periodontal parameters with laser-assisted therapy. Srinivasan *et al.* (2025) [18] reported that combined Er:YAG and Nd:YAG laser treatment of periodontitis yielded substantial improvements in PPD and CAL within 3–6 month observation periods, findings that are directly comparable to those of the present study. In addition to periodontitis, laser therapy has showed clinical efficacy in peri-implantitis management. These findings underscore the clinical relevance of incorporating laser-assisted techniques as adjuncts to conventional periodontal therapy, particularly for the management of combined periodontal-endodontic lesions.

Conclusion:

Er: YAG and diode lasers improved periodontal outcomes more than conventional irrigation. Er:YAG laser showed the greatest clinical improvement at 6 months. Laser-assisted therapy may be an effective adjunct for combined periodontal-endodontic lesions.

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