Low-level laser therapy as an adjunct to connective tissue graft procedure in the treatment of gingival recession defects: A systematic review and meta-analysis

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ABSTRACT

Objective: The aim of this study was to systematically evaluate the effectiveness of low level laser therapy (LLLT) as an adjunct to connective tissue graft (CTG) procedure for the treatment of gingival recession (GR).

Materials and Methods: The addressed PICO question was: "In patients with Miller Class I or II recession defects (Population), what is the effect of LLLT as adjunct to CTG (Intervention) in comparison to CTG alone (Comparison) on gingival recession depth (Outcome)". Electronic databases were searched up to December 2017. Primary outcomes included gingival recession depth (GRD), whereas secondary outcomes were width of keratinized tissue (WKT) and relative clinical attachment level gain (RCAL). The weighted mean differences (WMD) of outcomes and 95% confidence intervals (CI) for each variable were calculated using random effect model.

Results: Four randomized clinical studies were included. Two studies showed significantly greater improvements with LLLT whereas, 2 studies showed comparable outcomes between LLLT and CTG group. Considering the effects of adjunctive LLLT as compared to CTG, a high degree of heterogeneity for GRD (Q value = 9.40, P = .02, I² = 68.11%) and WKT (Q value = 16.04, P = .001, I² = 81.31%) was noticed among both the groups. Meta-analysis showed a statistically significant GRD (WMD = -0.61, 95% CI = -1.23 to 0.004, P = .05) for LLLT + CTG treatment versus CTG alone only.

Conclusions: LLLT improves clinical and patient-centered outcomes of CTG procedures for the treatment of GR remains debatable. However, due to the small number of included studies and high heterogeneity in the laser parameters, precautions must be exercised when interpreting the results of the present systematic review.

Clinical Significance

Gingival recessions in dentistry are of major esthetic concern. Minimal gingival recessions can be treated by flap operations, but the predictability and stability of the outcomes is debatable. In the present review, low level laser therapy (LLLT) adjunct to connective tissue graft (CTG) depicted a significant improvement in the predictability and stability of root coverage outcomes compared with CTG alone.

1 INTRODUCTION

Gingival recession (GR) is defined as apical displacement of the gingival margin relative to the cemento-enamel junction, with resultant oral exposure of the root.1,2 Exposure of the root surface to the oral environment results in poor esthetics, fear of tooth loss, dental sensitivity, and an increased susceptibility for root caries.3 Gingival recession may be caused by traumatic injury due to excessive and improper tooth brushing, and by tissue destruction in plaque induced periodontal disease.4 However, other factors may also be implicated, including anatomic factors (such as thin and delicate marginal tissue covering a nonvascularized root surface, alveolar bone dehiscence, and high frenal attachment),
occlusal trauma, oral piercings and iatrogenic factors related to restorative, periodontic, prosthetic, and orthodontic treatment.\textsuperscript{4}

The increasing focus on esthetics and the need to alleviate patient discomfort have favored the development of numerous periodontal plastic surgery (PPS) procedures that are aimed to cover the exposed roots. These include free gingival graft, laterally positioned flap, coronally advanced flap, as well as guided tissue regeneration, connective tissue grafts (CTGs), periosteal pedicle graft (PPG), and acellular dermal matrix allograft (ADMA).\textsuperscript{5} The use of graft tissue from the palate in PPS procedures are indicated for the treatment of Miller type I and II recession defects since it provides significant improvements in recession depth, clinical attachment level, and width of keratinized tissue (WKT) with optimal esthetic results.\textsuperscript{6} However, harvesting the graft tissue from the palate is associated with discomfort, tissue necrosis and bleeding as it carries the potential risk of damaging the greater palatine artery.\textsuperscript{7} Nevertheless, there are multiple novel approaches documented in the literature for the treatment of gingival recession. The objective of developing a new technique is to increase the predictability and to reduce patient discomfort including number of surgical sites and also trying to provide highest level of patient satisfaction in terms of esthetics, color, and blending of grafted tissue. Among these, PPG and ADMA are recent graft procedures for the treatment of gingival recession defects and has gained much attention in a short span of time.\textsuperscript{8,9} PPG relies on the periosteum which has the ability to differentiate into fibroblast, osteoblast, chondrocytes, adipocytes and may lead to the production of cementum with collagen periodontal ligament fibers and bone.\textsuperscript{10} Conversely, ADMA retains the basement membrane and extracellular matrix of the dermis that encourages autogenous epithelial cells to attach and migrate over its surface. It has been used successfully a palatal donor substitute to increase the zone of keratinized tissue.\textsuperscript{11}

Advancements in low-level laser therapy (LLLT) in Periodontics have enabled the periodontists to achieve better clinical results.\textsuperscript{12,13} Low-level laser produces tissue surface sterilization which results in reduction of chances of bacteremia, decreases edema, swelling and scarring.\textsuperscript{14} Furthermore, LLLT have been shown to successfully biostimulate and accelerate wound healing by stimulating epithelization and regeneration of human and animal tissue.\textsuperscript{15} It appears that LLLT may show significant improvement in the predictability and stability of clinical outcomes for GR defects.\textsuperscript{15} It is, therefore, the purpose of this systematic review to answer the following P.I.C.O. question: In patients with Miller Class I or II recession defects (Population), what is the effect of LLLT as adjunct to CTG (Intervention) in comparison to CTG alone (Comparison) on gingival recession depth (Outcome)?

2 | MATERIALS AND METHODS

2.1 | Protocol development and eligibility criteria

A protocol was developed and followed the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) statement.\textsuperscript{16}

2.2 | Inclusion criteria (PICOS)

The following eligibility criteria were entailed:

1. Types of participants: (a) patients clinically diagnosed with localized or multiple recession-type defects, (b) recession areas classified as Miller Class I or II $\geq 3$ mm,$^{17}$ (c) $\geq 10$ participants per group at follow-up periods.
2. Intervention: The interventions of interest were root coverage procedures in combination with LLLT.
3. Comparator: LLLT group compared to CTG alone.
4. Outcome: Clinical outcomes—gingival recession depth (GRD) change as primary outcome, whereas, gingival recession width (GRW); WKT change; relative clinical attachment level (RCAL) change; patient-centered outcomes—change of pain assessment (by the patient) through visual analog scale (VAS) and root esthetic score (RES) as secondary outcomes.
5. Study design: Only randomized controlled trials (RCTs) or randomized split-mouth clinical trials.
6. Follow-up: the outcome assessment at $\geq 6$ months.

In-vitro studies; case reports; animal studies; letters to the editor, opinion articles; abstracts; review papers and unpublished articles were excluded.

2.3 | Search strategy

Electronic and manual literature searches were conducted by two independent reviewers in the following databases, MEDLINE/PubMed, EMBASE, Cochran Central Register of Controlled Trials and Cochrane Oral Health Group Trials Register, up to December 2017 for articles addressing the focused question. For the PubMed library, combinations of following MeSH (Medical Subject Headings) terms and other free text words were used: (gingival recession [MeSH Terms]) OR (recession defect) OR (recession-type defect) OR (root coverage) OR (untreated recession) OR (recession progression) AND (lasers [MeSH Terms]) OR (laser therapy [MeSH Terms]).

2.4 | Screening and selection

Screening and assessment of titles and abstracts were conducted independently by two reviewers. Any disagreement involving the eligibility was resolved through discussion or by consulting a third reviewer. Studies which did not fulfill the inclusion criteria, were excluded. Next, full-text papers that fulfilled the eligibility criteria were identified and included in the review. Reference lists of original studies were manually searched to identify articles that could have been missed during the electronic search. Manual searching of the following journals was performed: J Clin Periodontol, J Periodontol, and J Esthet Restorative Dent. Studies that fulfilled the selection criteria were processed for data abstraction. Figure 1 describes the screening process according to PRISMA guidelines.\textsuperscript{16}
2.5 | Data extraction

Two reviewers performed the data extraction independently. The information from the accepted studies was tabulated according to the study setting and design, subject demographics, interventions, follow-up period, outcomes, laser parameters. Data collected were based on the focused question outlined for the present systematic review. The reviewers crosschecked all extracted data. Any disagreement was resolved by discussion until consensus was reached.

2.6 | Risk of bias in individual studies

The risk of bias of RCTs was assessed based on the revised recommendations of the Consolidated Standards of Reporting Trials statement. The risk of bias was estimated for each selected RCT based on the Cochrane Handbook for Systematic Reviews of Interventions. Briefly, subsequent sections were considered: selection bias (randomization and allocation concealment), performance bias (blinding of study personnel), detection bias (blinding of outcome assessors), completeness of follow-up period (attrition bias), and other biases. Studies were classified as having "high risk of bias" (high), "low risk of bias" (low) or "unclear" (?) for each of these sections. Overall, studies were considered as: (i) low risk of bias if all criteria were met (adequate randomization and allocation concealment; "yes" answer to all questions about the completeness of outcome data and blinding, and "no" answer to selective reporting and other sources of bias); (ii) unclear risk of bias if one or more criteria were partly met; or (iii) high risk of bias if one or more criteria were not met.

2.7 | Statistical analysis

Interassessor agreement between the two reviewers with regards to the study selection procedure was calculated using Cohen’s $\kappa$ statistics. In the present review, the primary outcome was GR defects in mm whereas secondary outcomes were WKT, and RCAL gain. Meta-analyzes were conducted separately for each of the primary and secondary outcomes. In addition, heterogeneity among the included studies for each outcome was assessed using the Chi-square test and $I^2$ statistic. For analyzes, if the test indicated substantial or considerable heterogeneity ($I^2 > 50\%$), a random effects model would be used. Otherwise ($I^2 \leq 50\%$), a fixed effects model would be applied. A $P$-value less than .05 represents significant heterogeneity. Forest plots were computed reporting weighted mean difference (WMD) of outcomes and 95% confidence intervals (CI). Funnel plots were generated to evaluate publication bias in the meta-analyzes. The pooled effect was considered significant if $P$-value was $<.05$. Data unsuitable for quantitative analysis were assessed descriptively. All above statistical analyzes were performed by a specialized statistical software (MedCalc Software-B-8400 v 15.11.04, Ostend, Belgium).
3 | RESULTS

3.1 Study selection
A total of 108 study titles and abstracts were initially identified. After removal of the duplicates ($n = 6$), initial screening of titles and abstracts was performed, and 87 articles were excluded as irrelevant to the focus question (κ score for interassessor agreement [95% Confidence Interval]: 0.94 [0.90-0.98]). A total of 15 papers were selected for full-text reading. Of these 15 studies, 11 studies were further excluded. After the final stage of selection, 4 studies$^{20-23}$ were included and processed for data extraction (κ score for interassessor agreement [95% Confidence Interval]: 0.85 [0.75-0.95]). All studies$^{20-23}$ were performed at either universities or health care centers. Figure 1 shows the study identification flow chart according to PRISMA.$^{16}$

3.2 General characteristics of the clinical studies
In all included studies,$^{20-23}$ the number of individuals ranged between 10 and 40 with mean age ranging between 27 and 41.3 years. All included studies included male participants ranging from 3 to 20 and female participants ranged from 6 to 20. The participants of all the studies had either Class I or class II Miller GR defects ranging from ≤1 mm to 3 mm. Two studies$^{20,22}$ employed split mouth technique whereas 2 studies$^{21,23}$ used comparative groups. All the studies performed CTG procedures with LLLT. In all the included studies, the follow up period ranged from 4 weeks to 96 weeks (Table 1).

3.3 Laser parameters of the included studies
All the included studies$^{20-23}$ used Gallium-Aluminum-Arsenide (GaAlAs) diode lasers. The wavelength of laser ranged between 588 nm$^{22}$ to 810 nm.$^{20}$ The energy fluence, power output and duration of irradiation of the laser were 15 joules per square centimeters ($J \ cm^{-2}$), 300 milliwatts (mW) and 10 seconds (s)-300 s, respectively. None of the studies reported the optic fiber diameter and area of irradiation. The frequency of LLLT was reported in ranged from 2 applications to 8 applications to 2 applications to 8 applications (Table 2).

3.4 Main outcomes of the clinical studies
All clinical studies$^{20-23}$ treated the GR defects by LLLT postsurgically. Two clinical studies$^{20,22}$ showed significantly greater improvements with LLLT as compared to CTG at follow-up, whereas, Fernandes-Dias et al.$^{21}$ and Santamaria et al.$^{23}$ showed comparable outcomes between LLLT and CTG group.

For quantitative data assessment, a meta-analysis was performed. Four studies$^{20-23}$ presented data to be included in the meta-analysis considering the effects of adjunctive LLLT on GRD and WKT, whereas 2 studies$^{21,23}$ presented data for RCAL. Significant heterogeneity was observed for GRD and WKT, therefore, random model was employed. Fixed effect model was used for RCAL gain.

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>General characteristics of included studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigators, Year, Country</td>
<td>Study design; setting</td>
</tr>
<tr>
<td>Ozturan et al.$^{23}$ 2011, Turkey</td>
<td>Prospective RCT; university clinic</td>
</tr>
<tr>
<td>Singh et al.$^{20}$ 2015, India</td>
<td>Prospective RCT; university clinic</td>
</tr>
<tr>
<td>Singh et al.$^{20}$ 2011, India</td>
<td>Prospective RCT; university clinic</td>
</tr>
<tr>
<td>Fernandes-Dias et al.$^{21}$ 2015, Brazil</td>
<td>Prospective RCT; university clinic</td>
</tr>
<tr>
<td>Santamaria et al.$^{23}$ 2017, Brazil</td>
<td>Prospective RCT; university clinic</td>
</tr>
<tr>
<td>Ozturan et al.$^{23}$ 2011, Turkey</td>
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<table>
<thead>
<tr>
<th>Interventions</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 individuals (16 males and 20 females; mean age: 40.1 years) with Miller class I and II; GRs ≤3 mm</td>
<td>40 individuals (20 males and 20 females; mean age: 39.7-41.3 years) with Miller class I and II; GRs ≤3 mm</td>
</tr>
<tr>
<td>10 individuals (3 males and 7 females; mean age: 27 years) with Miller class I and II; GRs ≤3 mm</td>
<td>10 individuals (4 males and 6 females with Miller class I and II; GRs ≤3 mm)</td>
</tr>
</tbody>
</table>
| CAF, coronally advanced flap; CTG, connective tissue graft; CAL, clinical attachment level; GR, gingival recession; GRD, gingival recession depth; WKT, thickness of gingival tissue; LLLT, low-level laser therapy; PD, probing depth; RCT, randomized controlled trial; RCAL, relative clinical attachment level; RES, root coverage esthetic score; RGR, relative gingival recession; SCAF, semilunar coronally advanced flap; VAS, visual analog scale; WKT, width of keratinized tissue.

a Split-mouth technique.
3.5 | Primary outcome

3.5.1 | Gingival recession depth

Four studies were included in the meta-analysis for the effect of adjunctive LLLT on GRD.\textsuperscript{20–23} Considering the effects of adjunctive LLLT as compared to CTG alone on GRD, no heterogeneity for GRD (Q value = 9.40, \( P = .02, I^2 = 68.11\%\), Figure 2A) was noticed among both the groups. The overall WMD for GRD between LLLT and CTG groups were significant (GRD: WMD = \(-0.61\), 95% CI = \(-1.23\) to 0.004, \( P = .05\)) at follow-up.

3.6 | Secondary outcomes

3.6.1 | Width of keratinized tissue

Four studies\textsuperscript{20–23} assessed WKT among the study groups and were included in the meta-analysis. A high degree of heterogeneity for WKT (Q value = 16.04, \( P = .001, I^2 = 81.31\%\), Figure 2B) was noticed among both the groups. However, the overall WMD for WKT between adjunctive LLLT and CTG groups were not significant (BD: WMD = 0.55, 95% CI = \(-0.25\) to 1.37, \( P = .17\)) at follow-up.

3.6.2 | Relative clinical attachment level gain

Two studies\textsuperscript{21,23} presented data to be included in the meta-analysis considering the effects of adjunctive LLLT on RCAL gain. Considering the effects of adjunctive LLLT as compared to CTG alone on RCAL gain, no significant heterogeneity for RCAL gain (Q value = 0.007, \( P = .92, I^2 = 0\%\), Figure 2C) was noticed among both the groups. Similarly, no significant statistical differences in RCAL gain (WMD = \(-0.07\), 95% CI = \(-0.51\) to 0.37, \( P = .75\)) were observed at follow-up between the test and control groups.

\begin{table}[h]
\centering
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\hline
\textbf{Investigators} & \textbf{Type of laser} & \textbf{Wavelength (nm)} & \textbf{Energy fluence (J cm}^{-2}\textbf{)} & \textbf{Power output (mW)} & \textbf{Duration of irradiation (seconds)} & \textbf{Optic fiber diameter (cm)} & \textbf{Area of irradiation (cm}^2\textbf{)} & \textbf{Frequency of LLLT application} \\
\hline
Santamaria et al.\textsuperscript{23} & GaAlAs diode laser & 660 & 15 & 30 & 20 & Unclear & Unclear & 8 \\
Fernandes-Dias et al.\textsuperscript{21} & GaAlAs diode laser & 660 & 15 & 30 & 20 & Unclear & Unclear & 8 \\
Ozturan et al.\textsuperscript{22} & GaAlAs diode laser & 588 & 4 & 120 & 300 & Unclear & Unclear & 8 \\
Singh et al.\textsuperscript{20} & GaAlAs diode laser & 810 & 4 & 300 & 10 & Unclear & Unclear & 2 \\
\hline
\end{tabular}
\caption{Laser parameters of included studies}
\end{table}

GaAlAs; Gallium-Aluminum-Arsenide; nm; nanometer, J cm\textsuperscript{-2}; joules per square centimeter, mW; milliwatt, mW cm\textsuperscript{-2}; milliwatt per square centimeter, mm; millimeter.
Numerous clinical trials have compared the clinical results of gingival recessions using subepithelial CTG with other latest techniques.24-26 Gingival recessions in dentistry are of major esthetic concern. Minimal ability and stability of advanced gingival recessions is debatable.24 Gingival recessions can be treated by flap operations, but the predictability of root coverage outcomes compared with CTG seems inadequate in the included studies and longer follow-up periods are recommended to witness changes in the clinical and patient-centered outcomes after LLLT application. In addition, limited number of studies were included in the present systematic review. These methodological shortcomings should be cautiously considered when interpreting the findings of the present study.

3.7 | Patient-centered outcomes

3.7.1 | Visual analog scale

Visual analog scale was used to assess postsurgical discomfort among patients in 2 studies.21,23 Fernandes-Dias et al.21 and Santamaria et al.23 showed comparable VAS scores for LLLT and CTG groups.

3.7.2 | Root coverage esthetic scores (RES)

Root esthetic scores were assessed in 2 studies21,23 and both studies reported comparable RES between the study groups at the follow-up.

3.8 | Risk of bias assessment of clinical studies

All the included clinical studies in this systematic review were RCTs. One RCT did not estimate the sample size.20 All studies20-23 presented appropriate randomization technique, statistical analysis and description of withdrawals and dropouts. The risk of bias was considered low in 3 studies21-23 and unclear in 1 RCT assessed20 (Table 3).

3.9 | Publication bias

Only studies for GRD and RCAL were found within the confidence interval area. Studies for WKT showed significant publication bias (Figure 3).

4 | DISCUSSION

Gingival recessions in dentistry are of major esthetic concern. Minimal gingival recessions can be treated by flap operations, but the predictability and stability of advanced gingival recessions is debatable.24 Numerous clinical trials have compared the clinical results of gingival recession treatment using subepithelial CTG with other latest techniques that have shown comparable clinical outcomes.25-27 Although these techniques being effective, devices that could accelerate wound healing could improve the results of latest graft techniques for root coverage and allow more predictable results. In the present review, LLLT adjunct to CTG depicted a significant improvement in the predictability and stability of root coverage outcomes compared with CTG alone.

The phenomenon of wound healing after PPS predominantly includes the role of fibroblasts, keratinocytes and immune cells. A blood clot mainly consisting of a fibrin reticulum with inflammatory cells, erythrocytes and debris of injured cells helps to fill the space between soft tissue flap and tooth surface.28 LLLT is based on the premise of accelerating wound healing that is achieved by increasing the motility of human keratinocytes, stimulating early epithelisation, increasing fibroblast proliferation and matrix synthesis and by augmenting neovascularization.29 Furthermore, LLLT may offer higher tensile strengths and stability to gingival margins, which may subsequently prevent wound failure, thus reducing clinical recession.30

The present systematic review was based on the hypothesis that LLLT significantly improves clinical and patient-centered outcomes in patients requiring CTG for the treatment of GR defects. Overall, the studies included in the present systematic review showed that LLLT showed significant improvement in clinical parameters for GR treatment. This suggests that LLLT is a potential treatment strategy for the management of Miller class I or II GR defects. However, it is important to interpret these findings with caution due to a number of factors.

It is noteworthy that the included studies had either significant heterogeneity or there was a lack of data pertinent to laser parameters. Parameters such as energy fluence, power output and exposure time (8-300 s) of laser light, varied considerably in the included studies. Other factors such as fiber diameter also has an overall effect on power density and energy output during laser application and can modify the actual amount of energy released during the process, potentially affecting the proliferation of cells and hence anti-inflammatory efficacy of LLLT.31,32 Therefore, further well-designed studies with accurate and standard laser parameters are required to clearly understand the influence of LLLT on wound healing.

The following limitations should be taken into account when considering the conclusions of the present review. The variation in the study results may be related to the heterogeneity in the surgical procedures. In addition, the present systematic review only considered studies in English language. This may have resulted in publication bias with potential relevant studies published in other language being missed.33,34 Furthermore, the authors suggest that to determine the clinical outcomes in the management of GR, the follow-up period seems inadequate in the included studies and longer follow-up periods could have yielded different outcomes. Therefore, further studies with follow up periods of up to 1 year or more are recommended to witness changes in the clinical and patient-centered outcomes after LLLT application. In addition, limited number of studies were included in the present systematic review. These methodological shortcomings should be cautiously considered when interpreting the findings of the present study.

| TABLE 3 | Evaluation of bias risk in the included studies |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Investigators   | Sample size calculation | Allocation concealment | Randomization | Losses (withdrawals/dropouts) | Masking of assessor(s) | Appropriate statistical analysis | Estimated risk of bias |
| Santamaria et al.23 | 2 | 2 | 2 | 1 | 2 | 2 | Low |
| Fernandes-Dias et al.21 | 2 | 2 | 2 | 1 | 2 | 2 | Low |
| Ozturan et al.22 | 2 | 2 | 2 | 1 | 2 | 2 | Low |
| Singh et al.20 | 0 | 2 | 2 | 1 | 1 | 2 | Unclear |

The following limitations should be taken into account when considering the conclusions of the present review. The variation in the study results may be related to the heterogeneity in the surgical procedures. In addition, the present systematic review only considered studies in English language. This may have resulted in publication bias with potential relevant studies published in other language being missed.33,34 Furthermore, the authors suggest that to determine the clinical outcomes in the management of GR, the follow-up period seems inadequate in the included studies and longer follow-up periods could have yielded different outcomes. Therefore, further studies with follow up periods of up to 1 year or more are recommended to witness changes in the clinical and patient-centered outcomes after LLLT application. In addition, limited number of studies were included in the present systematic review. These methodological shortcomings should be cautiously considered when interpreting the findings of the present study.
Besides various biological effects, the growing interest in laser therapy is based on the patients’ wish for less aggressive and painful treatments. However, it is of essential also to understand the cost of the treatment, expertise/training in the use of lasers, and need to review the patients in recall appointments once or twice weekly to ensure proper compliance. Although evidence suggests that LLLT may provide comfortable postoperative experience to the patient with less inflammation and lower levels of pain\textsuperscript{35}; however, the present systematic review did not show additional benefits neither with respect to patient discomfort nor clinical outcomes. To date, surgical CTG procedure is still the gold standard therapy\textsuperscript{36,37} and LLLT seems to be the promising therapy but for limited patients.

The present systematic review is the first study to evaluate the clinical and patient-centered outcomes of LLLT associated with CTGs in the treatment of GR defects. In light of other methodological aspects in the included studies such as nonstandardized laser parameters, short term follow-up and limited number of included studies, it is suggested that the role of LLLT in improving clinical signs and patient-centered outcomes is still debatable. Therefore studies with long-term follow up, and standardization of LLLT parameters with different laser protocols are recommended to reliably assess the benefits of LLLT in periodontal plastic surgeries. Despite the magnitude of the beneficial effects of LLLT in the short term seems questionable, in the long-term LLLT may add additional benefit to the root coverage procedures. Its adjunctive use may benefit less predictable techniques rather than root coverage techniques alone.

5 | CONCLUSION

Whether LLLT improves clinical and patient-centered outcomes of root coverage procedures for the treatment of GR remains debatable. However, due to the small number of included studies and high heterogeneity in the laser parameters, precautions must be exercised when interpreting the results of the present systematic review.

DISCLOSURES

The authors do not have any financial interest in the companies or products used in this study. All authors explicitly state that they have no declarations of interest to report.

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