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Review Paper: Effect of adjunctive low level laser therapy on gingival graft: A Review of the Literature

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ABSTRACT

Introduction: Mucogingival surgery is performed to correct defects in the morphology, position, and/or amount of gingiva. Such post-operative complications as bleeding, swelling, and pain have often been documented after mucogingival surgery and are associated with discomfort after surgery. The low-intensity laser has been used to promote analgesia. Low level laser therapy (LLLT) not only accelerates wound healing by acting on the inflammatory process but also improves micro angiogenesis. It has been reported that lasers also reduce pain. This study was aimed to review effect of adjunctive LLLT on gingival graft.

Materials and Methods: The most recognized databases such as PubMed, Google scholar and Science direct, were searched using keywords Gingival recession; Free gingival graft; Gingival Graft; Low-level laser therapy; Low-level laser; Photo biomodulation therapy during 2009 to 2021. At last, only 8 articles were included in the study.

Results: 3 studies failed to show effect of LLLT on the healing of gingival grafts analgesia. 4 studies could show that LLLT was an effective adjunctive treatment in pain control during early healing of free gingival graft. One study showed that the LLLT could increase the predictability of CAF, with significantly higher percentages of complete root coverage.

Conclusion: In summary, data demonstrated that the surgery with laser therapy provided clinical advantages in terms of wound healing and postoperative pain. It may help less shrinkage of the graft dimensions and accelerate the rate of epithelialization at the donor site.

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Introduction

Gingival recession was described as the apical displacement of the gingival margin from the cement-enamel junction(CEJ), and this situation exposed the root surface to the oral environment(1). One or more root surfaces can be locally or generally affected by gingival recession, which result in many adverse effects, such as root caries, dentin hypersensitivity, erosion, abrasion, and esthetic concerns.

Gingival recession is associated with the accumulation of biofilm and dental plaque, tissue inflammation, traumatic brushing, improper restoration, high frenum and muscle tension, and age(2).

Attached gingival tissue is necessary for maintenance of gingival health. Mucogingival surgery is performed to correct defects in the morphology, position, and/or amount of gingiva(3-5). For the grafted sites, there was a significantly greater reduction in inflammation, a reduction in recession, and a gain in clinical attachment level compared with the nongrafted areas(4). The graft success rate depends on the remaining and the survival of the transplanted connective tissue. The formation of the fibrous tissue between the graft and the recipient bed needs several days. The full and functional integration of the graft takes approximately 17 days and it can be distinguished from the surrounding tissue(6). For those with systemic diseases(such as diabetes, cancer, etc), faster wound closure is a major factor in the quality of care and their recovery(7). Such post-operative complications as bleeding, swelling, and pain have often been documented after mucogingival surgery and are associated with discomfort after surgery(8).

Wound healing is a complex procedure that involves several biological and cellular processes: Inflammation, proliferation, and differentiation are the phases of wound healing that are necessary for successful wound repair. Retarded wound healing, excessive bleeding, and postoperative pain have been reported after FGG procedures. Pain is more intense in the inflammatory stage during the first hours and days after injury and usually decreases with the evolution of the healing process(9-11).

The use of soft lasers to augment conventional dental therapy has increased dramatically in recent years. Low level laser therapy(LLLT) is referred to lasers with 1-1000 mW and wavelengths from 632-1064 nm. LLLT has no heat, sound, or vibration but has a thermal effect by inducing a photochemical reaction in the tissue (10-12). LLLT stimulates biological systems and accelerates cell proliferation and tissue regeneration. The laser may stimulate healing by increasing in the number of fibroblasts, collagen synthesis, and remodeling, and it may also change the direction of stress on the surgical wound(11). In periodontics, LLLT may be used for root scaling procedures, as an adjunctive to periodontal treatment, and also with periodontal surgeries with a view to accelerating the healing process, promoting analgesia, and reducing postoperative discomfort(12). For two decades, however, the LLLT has been used to promote analgesia(13). LLLT stimulates and accelerates wound healing by altering the cellular behavior of fibroblasts and keratinocytes and by enhancing collagen synthesis, angiogenesis, and growth factor release, in a dose-dependent manner(14). These influences resulted in the stimulation of regeneration and epithelialization in human and animal tissue. LLLT not only accelerates wound healing by acting on the inflammatory process but also improves micro angiogenesis. It has been reported that lasers also reduce pain(14-16). This study was aimed to review effect of LLLT on gingival graft.

Materials and Methods

The most recognized databases such as PubMed, Google scholar and Science direct, were searched using keywords as Gingival recession; Free gingival graft; Gingival Graft; Low-level laser therapy; Low-level laser; Photo biomodulation therapy during 2009 to 2021. The result of this search was first limited to English only, which resulted in 30 articles. Out of which, 14 articles were selected for full-text reading after an evaluation of titles and articles. At last, only 8 articles were included in our

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study.

Result

Table 1 shows the results of the literature. Seda Ozturan evaluated Coronally advanced flap adjunct with LLLT(diode laser (588 nm)) and the findings of this clinical pilot study have shown that the LLLT could increase the predictability of coronally advanced flap, with significantly higher percentages of complete root coverage at the post-operative first year(17). In one study soft tissue procedure was connective tissue graft and it showed that LLLT protocol may not improve the clinical and esthetics outcomes after 2 years of follow up.

6-month results of this clinical trial indicated an increase in predictability of connective tissue graft when LLLT was used(18).

6 studies investigated Low-Level Laser Therapy and Free Gingival Graft. Among these studies 4 studies could show that LLLT was an effective adjunctive treatment in pain control during early healing of free gingival graft(15, 19-21).One study failed to show effect of LLLT on the healing of gingival grafts analgesia(10). The result of Heidary et al. study was that FGG procedure could accelerate the rate of epithelialization at the donor site, it did not reduce postoperative pain(22).

Table 1.The Summery of included studies

study	Author/ year of publication	Samples Country	Type of recession	Laser Type	Wavelength	Wave form	Soft tissue procedure	Conclusion
Utilization of Low-Intensity Laser During Healing of Free Gingival Grafts	Ana L.P.F. Almeida, 2009	10	Miller Class I and II	diode laser	780 nm	continuous power of 40mW, energy dose of 10 J=cm2, and individually applied (20 sec=site)	Free Gingival Grafts	Low-intensity laser therapy did not improve the healing of gingival grafts and did not influence analgesia.
Coronally advanced flap adjunct with low intensity laser therapy: a randomized controlled clinical pilot study	Ozturan S, 2011	10	Miller Class I and II	diode laser	588 nm	output power of 120 mW and the power density for 5 min. was 4.0 J/cm	Coronally advanced flap (CAF)	LILT could increase the predictability of CAF, with significantly higher percentages of complete root coverage at the post-operative first year
Effect of Low Level Laser Therapy on Revascularization of Free Gingival Graft Using Ultrasound Doppler Flowmetry	Lalitha T Arunachalam 2014	2	Miller's grade II	diode laser	830 nm	output power of 0.1 W	free gingival graft	LLLT was an effective adjunctive treatment in promoting revascularization and pain control during early healing of free gingival graft.
2-Year Assessment of Tissue Bioestimulation With Low-Level Laser on the Outcomes of Connective Tissue Graft in the Treatment of Single Gingival Recession. Randomized Clinical Trial	Mauro Pedrine Santamaria 2016	40	Miller Class I and II	diode laser	660 nm	output power of 30 mW, power density was 15 J/cm2	Connective tissue graft	LLLT protocol may not improve the clinical and esthetics outcomes after 2 years of follow up. the 6-month results of this clinical trial indicated an increase in predictability of CRC when LLLT was used.
Low-Level Laser Therapy in Enhancing Wound Healing and Preserving Tissue Thickness at Free Gingival Graft Donor Sites: A Randomized, Controlled Clinical Study	Gulbahar Ustaoglu, 2017	40		Ga Al As	940 nm	doses of 8.6 J/ cm2, 3W in continuous-wave mode	Free Gingival Graft	biostimulation using the LLLT could benefit wound healing at the FGG donor area, LLLT also helps to reduce postoperative self reported bleeding

study	Author/ year of publication	Samples Country	Type of recession	Laser Type	Wavelength	Wave form	Soft tissue procedure	Conclusion
Effect of laser photobiomodulation on wound healing and postoperative pain following free gingival graft: A split-mouth triple-blind randomized controlled clinical trial	Mohadeseh Heidaria, 2017	12		diode laser	660 nm,	200 mW, continuous mode, time of irradiation:32 s, energy density: 4 J/cm2, spot size:0.5 cm)	free gingival graft	FGG procedure could accelerate the rate of epithelialization at the donor site. However, it did not reduce postoperative pain
Free gingival graft adjunct with low-level laser therapy: a randomized placebo-controlled parallel group study	Mehmet Selim Yildiz 2018	30	Class I or II Miller	diode laser	810 nm,	0.1 W, energy density 6 J/cm2	Free gingival graft	The use of an 810-nm diode laser provided additional benefits to FGG in terms of less shrinkage of the graft dimensions and postoperative pain
The Clinical Evaluation of the Effects of Low-Level Laser Therapy on the Donor and Recipient Sites of the Free Gingival Graft: A Case Series	Ardeshir Lafzi1 2019	12	Class I or II Miller	diode laser	808 nm	50 mW with an energy dose of 15 J/ cm2 for 30 seconds	Free Gingival Graft	LLLT could reduce post-operative pain 24 hours after surgical treatment. Furthermore, the application of LLLT could improve the donors' site healing and the recipients' site color matching.

Discussion

Gingival graft is used to reduce gingival recession and to increase keratinized tissue, but it can cause discomfort in the donor site. Pain is typically present after periodontal surgery. Patients' perception of pain is subjective and varies considerably among different people(23).

The use of LLLT for healing is a matter of debate(24), although better results are expressed in animals26 and in vitro studies(25, 26). It seems that LLLT is effective in the fibroblastic stage of wound healing, in which there exists maximum fibroblast activity, angiogenesis, and epithelial proliferation. The effects of the low-level laser on fibroblasts like increased proliferation, maturation, increased secretion of growth factors, and transforming to myofibroblasts have been shown in previous studies(27).

Depending on the wavelength of the lasers and without any increase in tissue temperature, significant cell activity is present. According to the meta-analysis by Woodruff et al, there are better results by higher energy density(19-24 J/cm2). However, these results have to be analyzed carefully(28). The positive mechanism of the laser on various tissues have not been stated clearly, but numerous possibilities have been evaluated, such as the stimulation of porphyrin and cytochromes that cause an increase in cell activity and ATP concentration(29).

One of the main complications after periodontal surgery is postoperative pain initiated after 1st hours of surgery. Pain relief or analgesic drugs are usually prescribed which followed by side effects like gastrointestinal problems. LLLT can be beneficial for this purpose due to analgesic and anti-inflammatory effects(30, 31).

The mechanism of pain reduction is not clear but it may be referred to stabilization of nerve cell membrane and increased accumulation of ATP in neuronal membrane led to decrease in pain transmission. Also, the stabilization of nerve cell membranes due to the more stable formation of the lipid bilayers induced by LLLT, and the associated important proteins of the nerve cell membrane has been reported in studies(32).

On the other hand, wound healing can be achieved by photo biomodulation effect on cell proliferation, migration, and differentiation. Higher collagen synthesis and vascular proliferation accompanied by enhanced epithelial

cell division are also should be considered(33).

Yildiz et al. showed that the LLLT protocol that was used(810 nm, 6 J/cm2) may decrease the shrinkage of the graft after 6 months. From a clinical point of view, laser-treated recipient sites showed less pain relief(20).

Lafzi et al. assessed the effect of LLLT on the donor and recipient sites of the free gingival graft and indicated the effects of LLLT on enhancing healing and reducing the post-operative pain of FGGs in donor and recipient sites and a better color match with adjacent tissues(19). Heidari et al. showed that the PBM protocol that was used(660 nm, 32 J/cm2) can promote epithelialization of donor site and thus reduce wound repair time in the palate from clinical point of view, laser-treated recipient and donor sites showed better healing at days 1 and 14, respectively. However, the effect of laser on alleviation of postoperative pain was not confirmed through the trial(22).

Almeida et al. in assessing the effect of two different wavelengths of diode laser(660 nm and 780 nm) on healing process and analgesia reported that the application of low level laser immediately after surgery and 48 hours later with output power of 40 mW and energy density of 10 J/Cm2 did not have an influence on pain level and improvement of healing(34). On the other hand, Vieira et al. investigated the biomodulation effect of diode laser(660 nm) with energy density of 8 J/Cm2 after free gingival graft stated that low level laser therapy had positive effects on pain reduction and wound healing(35).

More randomized clinical trials are needed to determine the efficacy of laser in periodontal surgeries with or without low level laser application for management of postoperative complications to compare the pain level and wound healing.

Conclusion

In summary, the data demonstrated that the surgery with laser therapy provided clinical advantages in terms of wound healing and postoperative pain. It may help less shrinkage of the graft dimensions and accelerate the rate of epithelialization at the donor site. Therefore, further studies in this area are required to evaluate the clinical outcomes based on well conducted and long-term randomized controlled trials.

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None

Authors' contributions

Meysam Malekzadeh: Conceptualization, Methodology, Writing - Review & Editing **Dina Maleki**: Writing - Original Draft, Data Curation, Supervision **Maryam Zohary:** Resources, Investigation, Visualization

Conflict of Interests

The authors declare no conflict of interest.

Ethical declarations

Not applicable

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Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

References

1. Kassab MM, Cohen RE. The etiology and prevalence of gingival recession. Journal of the American Dental Association (1939). 2003;134(2):220-5.https://doi.org/10.14219/jada.archive.2003.0137

2. Lindhe J, Socransky SS, Nyman S, Westfelt E. Dimensional alteration of the periodontal tissues following therapy. The International journal of periodontics & restorative dentistry. 1987;7(2):9-21.

3. Myoung H, Kim M-J, Hong S-D, Lee J-I, Lim C-Y, Hong S-P. Expression of membrane type I-matrix metalloproteinase in oral squamous cell carcinoma. Cancer letters. 2002;185(2):201-9.https://doi.org/10.1016/S0304-3835(02)00281-1

4. Kim DM, Neiva R. Periodontal soft tissue non-root coverage procedures: a systematic review from the AAP Regeneration Workshop. Journal of periodontology. 2015;86(2 Suppl):S56-72.https://doi.org/10.1902/jop.2015.130684

5. Yan J, Zhang J, Zhang Q, Zhang X, Ji K. Effectiveness of laser adjunctive therapy for surgical treatment of gingival recession with flap graft techniques: a systematic review and meta-analysis. Lasers in medical science. 2018;33(4):899-908.https://doi.org/10.1007/s10103-018-2440-x

6. Miller PD, Jr. A classification of marginal tissue recession. The International journal of periodontics & restorative dentistry. 1985;5(2):8-13.

7. Mester E, Szende B, Spiry T, Scher A. Stimulation of wound healing by laser rays. Acta chirurgica Academiae Scientiarum Hungaricae. 1972;13(3):315-24.

8. Tavakoli M, Yaghini J. Evaluation of effect of low-dose methotrexate on osseointegration of implants: a biomechanical study on dogs. The open dentistry journal. 2018;12:546.https://doi.org/10.2174/1874210601812010546

9. Wilder-Smith P. The soft laser: therapeutic tool or popular placebo? Oral surgery, oral medicine, and oral pathology. 1988;66(6):654-8.https://doi.org/10.1016/0030-4220(88)90311-8

10. Almeida AL, Esper LA, Sbrana MC, Ribeiro IW, Kaizer RO. Utilization of low-intensity laser during healing of free gingival grafts. Photomedicine and laser surgery. 2009;27(4):561-4.https://doi.org/10.1089/pho.2008.2292

11. Increasing the Width of Periodontal Attached Gingiva Using an Nd:YAG Laser and GTM: Results of a Clinical Study. Journal of Clinical Laser Medicine & Surgery. 1999;17(5):217-22.https://doi.org/10.1089/clm.1999.17.217

12. Cobb CM. Lasers in Periodontics: A Review of the Literature. Journal of periodontology. 2006;77(4):545-64.https://doi.org/10.1902/jop.2006.050417

13. Hashemi IS, Maleki D, Monir SE, Ebrahimi A, Tabari R, Mousavi E. Effects of Diode Low-Level Laser Therapy of 810 Nm on Pulpal Anesthesia of Maxillary Premolars: A Double-Blind Randomized Clinical Trial. European Endodontic Journal. 2021 May 25.https://doi.org/10.14744/eej.2020.41636

14. Khalighi Sigaroudi A, Maleki D, Zare H, Maleki D. Is Low-Level Laser Therapy Effective for Complications of Mandibular Third Molar Surgery? A Literature Review. International Journal of Scientific Research in Dental and Medical Sciences. 2020 Sep 1;2(3):72-80.

15. Ustaoglu G, Ercan E, Tunali M. Low-Level Laser Therapy in Enhancing Wound Healing and Preserving Tissue Thickness at Free Gingival Graft Donor Sites: A Randomized, Controlled Clinical Study. Photomedicine and laser surgery. 2017;35(4):223-30.https://doi.org/10.1089/pho.2016.4163

16. Saygun I, Karacay S, Serdar M, Ural AU, Sencimen M, Kurtis B. Effects of laser irradiation on the release of basic fibroblast growth factor (bFGF), insulin like growth factor-1 (IGF-1), and receptor of IGF-1 (IGFBP3) from gingival fibroblasts. Lasers in medical science. 2008;23(2):211-5.https://doi.org/10.1007/s10103-007-0477-3

17. Ozturan S, Durukan SA, Ozcelik O, Seydaoglu G, Haytac MC. Coronally advanced flap adjunct with low intensity laser therapy: a randomized controlled clinical pilot study. Journal of clinical periodontology. 2011;38(11):1055-62.https://doi.org/10.1111/j.1600-051X.2011.01774.x

18. Santamaria MP, Fernandes-Dias SB, Araújo CF, Lucas da Silva Neves F, Mathias IF, Rebelato Bechara Andere NM, et al. 2-Year Assessment of Tissue Biostimulation With Low-Level Laser on the Outcomes of Connective Tissue Graft in the Treatment of Single Gingival Recession: A Randomized Clinical Trial. Journal of periodontology. 2017;88(4):320-8.https://doi.org/10.1902/jop.2016.160391

19. Lafzi A, Kadkhodazadeh M, Mojahedi SM, Amid R, Shidfar S, Baghani MT. The Clinical Evaluation of the Effects of Low-Level Laser Therapy on the Donor and Recipient Sites of the Free Gingival Graft: A Case Series. Journal of lasers in medical sciences. 2019;10(4):355-60. https://doi.org/10.15171/jlms.2019.58

20. Yildiz MS, Gunpinar S. Free gingival graft adjunct with low-level laser therapy: a randomized placebo-controlled parallel group study. Clinical oral investigations. 2019;23(4):1845-54.https://doi.org/10.1007/s00784-018-2608-6

21. Arunachalam LT, Sudhakar U, Janarthanam AS, Das NM. Effect of low level laser therapy on revascularization of free gingival graft using ultrasound Doppler flowmetry. J Indian Soc Periodontol. 2014;18(3):403-7. https://doi.org/10.4103/0972-124X.134592

22. Heidari M, Paknejad M, Jamali R, Nokhbatolfoghahaei H, Fekrazad R, Moslemi N. Effect of laser photobiomodulation on wound healing and postoperative pain following free gingival graft: A split-mouth triple-blind randomized controlled clinical trial. Journal of photochemistry and photobiology B, Biology. 2017;172:109-14.https://doi.org/10.1016/j.jphotobiol.2017.05.022

23. Pilatti GL, André dos Santos F, Bianchi A, Cavassim R, Tozetto CW. The use of celecoxib and dexamethasone for the prevention and control of postoperative pain after periodontal surgery. Journal of periodontology. 2006;77(11):1809-14.https://doi.org/10.1902/jop.2006.060128

24. Singer AJ, Clark RA. Cutaneous wound healing. The New England journal of medicine. 1999;341(10):738-46.https://doi.org/10.1056/NEJM199909023411006

25. Del Pizzo M, Modica F, Bethaz N, Priotto P, Romagnoli R. The connective tissue graft: a comparative clinical evaluation of wound healing at the palatal donor site. A preliminary study. Journal of clinical periodontology. 2002;29(9):848-54.https://doi.org/10.1034/j.1600-051X.2002.290910.x

26. Yu W, Naim JO, Lanzafame RJ. The effect of laser irradiation on the release of bFGF from 3T3 fibroblasts. Photochemistry and photobiology. 1994;59(2):167-70. https://doi.org/10.1111/j.1751-1097.1994.tb05017.x

27. Moslemi N, Heidari M, Fekrazad R, Nokhbatolfoghahaie H, Yaghobee S, Shamshiri A, et al. Effect of

660nm low power laser on pain and healing in palatal donor sites a randomized controlled clinical trial. jdm. 2014;27(1):71-7.

28. Woodruff LD, Bounkeo JM, Brannon WM, Dawes KS, Barham CD, Waddell DL, et al. The efficacy of laser therapy in wound repair: a meta-analysis of the literature. Photomedicine and laser surgery. 2004;22(3):241-7. https://doi.org/10.1089/1549541041438623

29. Ahad A, Tandon S, Lamba AK, Faraz F, Anand P, Aleem A. Diode Laser Assisted Excision and Low Level Laser Therapy in the Management of Mucus Extravasation Cysts: A Case Series. Journal of lasers in medical sciences. 2017;8(3):155-9.https://doi.org/10.15171/jlms.2017.28

30. Saber K, Chiniforush N, Shahabi S. The effect of low level laser therapy on pain reduction after third molar surgery. Minerva stomatologica. 2012;61(7-8):319-22.

31. Canakçi CF, Canakçi V. Pain experienced by patients undergoing different periodontal therapies. Journal of the American Dental Association (1939). 2007;138(12):1563-73.https://doi.org/10.14219/jada.archive.2007.0105

32. Moshkovska T, Mayberry J. It is time to test low level laser therapy in Great Britain. Postgraduate medical journal. 2005;81(957):436-41.https://doi.org/10.1136/pgmj.2004.027755

33. Amorim JC, de Sousa GR, de Barros Silveira L, Prates RA, Pinotti M, Ribeiro MS. Clinical study of the gingiva healing after gingivectomy and low-level laser therapy. Photomedicine and laser surgery. 2006;24(5):588-94.https://doi.org/10.1089/pho.2006.24.588

34. Utilization of Low-Intensity Laser During Healing of Free Gingival Grafts. Photomedicine and laser surgery. 2009;27(4):561-4.https://doi.org/10.1089/pho.2008.2292

35. Vieira J, Lopes CB, DeMarco AC, de Melo Filho AB, Jardini MAN. Clinical study of laser biomodulation (650λ) after free gingival grafts. J Oral Laser Appl. 2010;10:159-63.