Journal of Academy of Dental Education, 12-16, DOI: 10.18311/jade/2018/22998
ISSN (Print) : 2348-1595
ISSN (Online) : 2348-2621

Low-Level Laser Therapy in Periodontics: A Review Article

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Abstract

Low-Level Laser Therapy (LLLT) is a light source treatment that generates light of a single wavelength. The low-level lasers do not cause temperature elevation within the tissue, but rather produce their effects from photobiostimulation effect within the tissues. Low-level lasers do not cut or ablate the tissue. The therapy performed with Low-Level Lasers is called as LLLT. LLLT devices include the gallium arsenide, gallium aluminum arsenide infrared semiconductor (gallium-aluminum-arsenide), and helium-neon lasers. The output powers range from 50 to 500 mW with wavelengths in the red and near infrared of the electromagnetic spectrum, from 630 to 980 nm with pulsed or continuous-wave emission.

Keywords: Lasers, Low-Level Laser Therapy, Periodontal Disease, Therapeutic Lasers

Date of Receipt: December 2018 Date of Submission: December 2018 Date of Acceptance: December 2018

1. Introduction

The term 'LASER' means light amplification by stimulated emission of radiation. Low Level Laser therapy was first introduced by mester and his colleagues also called soft laser therapy[1]. Low Level Laser is a red light or infra red light its absorption parameter is in sub cellular photo receptors, electron transfer in the respiratory chain of mitochondria membrane Capable of penetrating into tissues in depth of 3-15 mm[2]. In-vivo and In-vitro experiments it has been shown that low-level laser is capable of speeding up repair process[3,4]. It will also reduce post-op pain .It includes stability of nerve cell membrane, Increase ATP production etc.

2. Mechanism of Action of Low-Level Lasers

Low-Level Therapy is also referred as biostimulation and biomodulation[5]. Biostimulatory effect of laser irradiation acts directly on antenna pigments of respiratory chain and will increase ATP production. This effect will induce intracellular metabolic changes, faster cell division proliferation, fibroblast migration and speed up matrix production[6,7]. Most frequently used is gallium-aluminium-arsenide operates in spectrum between 780 and 830 nm. Output is between 10 and 500 mW. Advantage is small in size, it works in continuous mode, but can be electronically or mechanically pulsed[8].

3. Low-Level Laser Impact on Pain

Pain occurs because of tissue trauma and release of inflammatory mediators following removal of local anaesthesia[9]. Low-level laser will relieve pain and repairs wound. The mechanism of this pain reliever is not yet clear but the studies have offered mechanism that include stability of lipid double membrane, enhancement of revival system and increased ATP production[10].

4. Low-Level Laser and Gingivectomy

Removal of supra-bony pocket or the pockets not extending from the muco-gingival junction is called

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gingivectomy. Patient may experience pain due to open wound secondary repair formed after gingivectomy[11,12].

Amorim et al., 22 conducted a clinical study of gingiva healing after gingivectomy and low-level laser therapy in a split mouth randomized clinical trial. In that he studied 20 patients they had two-sided increased gingival volume on premolar[13]. Gingivectomy performed in test group and then low-level laser was used for 80 sec, 24 hrs later and third seventh day of post-op parameter include diode laser wavelength of 685 nm power of 50mW in continuous mode. After all surgeries dressing were used and renewed after 24 hrs, third and seventh day of post-op. Following surgeries photographic images were taken on third, seventh, fourteenth, twenty first and forty fifth day. It was reviewed by three skillful periodontists based on clinical condition of wound repair, tissue color and contour. For biometrical assessment reference composite inserted at medial section of buccal plane then the pocket depth, keratinized gingival distance and distance with gingival margin were calculated. Clinical visits showed better wound repair in laser group patients after the third day post-op. On twenty first and twenty eighth day biometric assessment showed improvement in laser group patients. Finally, Amorim et al., 22 concluded that application of low-level laser along with gingivectomy improved better condition and faster repair[14,15]. A pilot study on wound healing after gingivectomy by low-level irradiation conducted by Ozcelik et al.23. 20 patients participated with an increased two-sided gingival volume in atleast six teeth. In this split mouth randomized controlled clinical trial, for one week in the test group low-level laser was radiated to target points for five minutes after surgery. Parameters with wavelength of 588nm power of 120mW in continuous mode were used. Same periodontist done all the operation dressing was not used. Pain relievers were not prescribed. To check the presence or absence of epithelium, lack of keratinization Mira-2-tone detector solution was used after each laser application. Using image analysis software comparison made. There was no difference between two groups for color after third, seventh and fifteenth day. Laser applied group had fewer colored areas ($p<0.001$). Therefore application of low-level laser results in increased epithelization and wound healing following gingivectomy and gingivoplasty[16,17]. After gingivectomy in patients with fixed orthodontics for aesthetic purposes using diode low-level laser showed faster and painless wound healing it was proved by Sobouti et al., 2014 in comparison with those for whom surgical knife was used[18,19].

5. Low-Level Laser and Periodontal Flaps

A Split mouth study on coronally advanced flap adjunct with low intensity laser therapy on 10 patients with 74 symmetrical gingival recessions of Miller's classes I and II was conducted by Ozturan et al[20]. Due to traumatic brushing, patient affected with atleast two buccal gingival recessions of Millers classes I and II which has been adjacent to each other were participated. Depth and width of gingival recession, Probe depth, Keratinized gingival thickness and joint commissure prior to surgery and 12 months post-op were calculated. Laser radiated to target area after CAF and before suturing. Parameters include 588nm power of 120mW with continuous mode and 5 mins radiation duration. Laser was radiated to target area following suturing. Laser therapy given for 7 days for 5 mins. Dressing was not used. Following CAF surgery laser was used to blind the patients mind i.e., in switched off form in the control group. In width, depth of gingival recession, keratinized Gingival thickness and clinical attachment level (P=0.018, P=0.009, P=0.015, P=0.014) difference were found. Complete root coating in test group (n=7.70 %) was more than that of control group (n=3.30%). Considering these authors suggested laser application may enhance treatment prognoses following CAF[21,22].

13 patients were studied in a split mouth randomized controlled clinical trial, a study on the effect of 810 nm diode laser on post-op. Pain and tissue response following modified widmanflap surgery in humans performed by Sanz-Moliner et al[23]. Aluminium-Gallium-Zinc-Arsenide diode laser with 810nm power 1W was used in continuously radiated for 10 seconds and for 30 seconds it was stopped. And again power of 0.1W was radiated. The switched-off laser was radiated to target area in control group after MWF performance.

Between two surgeries the time span was 3 weeks. The same person performed all surgeries. Patient were prescribed Ibuprofen (200mg) for pain relief every 8 hrs after the operations. Based on modified visual analogue scale from 0-10, patient were asked to note their pain level for a week every night & also number of sedative tablets taken was noted. Considering color and tissue edema tissue response was also documented as a secondary variable in physical examination. Between the two groups for tissue edema ($P<0.041$), dose of sedative drug taken ($P<0.001$), post-op pain ($P<0.001$) significant difference was found. But for tissue color ($P=0.98$) there was no difference. After the second surgery patient reported more pain. Therefore the application of diode laser 810 nm along with MWF results into pain reduction and post-op edema. Therefore author concluded laser application is useful as compared to surgery[24,25].

6. Low-Level Laser and Free Gingival Graft

In split mouth randomized clinical trial a study on utilization of low-intensity laser during healing of free gingival grafts was conducted by Almeida et al. In one month 10 patients underwent double-sided gingival graft in the mandible done by the same surgeon. Diode-Aluminium-Gallium-Arsenide laser with a wavelength of 660nm (RED) for fast repair effect and with a wavelength of 780 nm (Infrared) for anti-pain effect following graft in the test group. The parameters with a power of 40mW energy dose of 10j/cm²[26,27]. Continuously emitted onto each side after surgery and 48 hrs post-op laser was used twice. To make them believe switched off laser was used in control group following free gingival graft. At 7, 15, 30 & 60 days post-op photographs were produced that was studied based on morphology, texture and shade by 5 skillful periodontist. Based on visual analogue scale from 0-10. Patients were asked to record their pain level for 3 hrs, 24 hrs and 7 days post-op. Between two groups no difference were found. So from this low-level laser would not be useful in pain reduction and wound healing was concluded[28,29]. A Split mouth randomized clinical trial a study on "Evalution of effect of 660nm low power laser on pain and healing in palatal donor site conducted by Moslemi et al. In that 12 patients participated. Diode laser with 660 nm and power of 200mW was applied for 32 seconds to target site on 1,2,4,7 post-op following free gingival graft OPS in the test group. Switched -off laser was used in the control group in the same way. Photographic images were used to evaluate amount of epitheliazation. H_2O_2 and for clinical repair observations[30]. To assess pain scale, sedative drugs taken were recorded. Palatal group in laser -applied group was significantly better healed than control group regarding clinical repair and epitheliazation in day 14. Epitheliazation amount was better in laser-applied group than control group in day 21. Therefore author finally concluded low-level laser may heal wound in palatal graft site[31,32].

By reducing biochemical markers, oxidative stress and edema in a dose-related relation (active dose range 0.3 to 19 j/cm² with average dose 7.5j/cm² loe level laser may able relieve pain it was mentioned by bjordal et al.,[33,34] in a systemetric review article. In the first 72 hours POST-OP the anti pain effect of low level laser with a high radiation density is more effictive. For faster pain relief low level laser doses have to be continued it was concluded by author previous studies shown that low density laser would relieve pain faster and high doses reduce reproduction of fibroblast and growth factor release. Anyway low level laser radiation depends. On various parameters the difference in research results attributed to such parameters[35,36].

7. Clinical Applications of Low-Level Laser Therapy

It includes promotion of wound healing in sites like surgical wounds extraction sites recurrent aphthous ulcerations etc[37]. Main advantage of using LLLT in dental and periodontal treatment it has the ability to speed up healing process[38]. Also used in pain management in the treatment of gingivectomies fibroblast keratinocyte motility, collagen synthesis angiogenesis and growth factor release all these were facilitated by low level laser[39,40].

7.1 Advantage

- Low Level Laser Therapy is an effective treatment against chronic and acute injuries.
- laser therapy has also been shown to effectively reduce pain and inflammation caused by musculoskeletal conditions such as temporomandibular joint disorder.
- The low-level light stimulates your body's own healing process without the risk of burning.
- If you're sensitive or allergic to harsh medications, LLLT is a wonderful alternative that is safe, natural, and effective.

7.2 Disadvantage

- Patients do not typically get full relief or resolution from their pain symptoms after the first treatment.
- Patients often have to return to the doctor for treatments at least 2 to 4 times per week.
- Old injuries may be aggravated for a few days after treatments, but for most patients this sensation is short term, lasting for a couple of days.

8. Conclusion

Thus after LLLT, enhanced cell metabolic function shows activation of photo -receptors within the electron transport chain of mitochondria.

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