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INTEGRATIVE LITERATURE REVIEW

LOW-POWER LASER THERAPY IN WOUND HEALING

TERAPIA A *LASER* DE BAIXA POTÊNCIA NA CICATRIZAÇÃO DE FERIDAS

TERAPIA A LASER DE BAJA POTENCIA EN LA CICATRIZACIÓN DE HERIDAS

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ABSTRACT

Objective: to identify the action of low power laser therapy in wound healing. Method: this is a bibliographical study, of integrative review type, with search of articles published between 2004 and 2017, in the MEDLINE, LILACS and virtual library SciELO databases. After the articles were read, the data was extracted and analyzed, and presented in figure form. ***Results:*** 24 articles were selected, with different research designs. It has been found that low-power laser therapy promotes positive actions in oxygenation, cell growth and modulation due to irradiated light, which affects the metabolic processes and produces cellular and vascular biostimulants essential to the tissue repair process. ***Conclusion:*** it is concluded that low-power laser therapy is an adjuvant treatment that accelerates the tissue repair process and promotes patient comfort benefits. ***Descriptors:*** Laser therapy; Low Intensity Light Therapy; Healing; Review; Treatment Outcome; Wounds.

RESUMO

Objetivo identificar a ação da terapia a *laser* de baixa potência na cicatrização de feridas. ***Método*:** trata-se de um estudo bibliográfico, tipo revisão integrativa, com busca de artigos publicados entre 2004 a 2017, nas bases de dados MEDLINE, LILACS e biblioteca virtual SciELO. Efetuaram-se, após a leitura dos artigos, a extração e a análise dos dados, e apresentam-se em forma de figura. ***Resultados*:** selecionaram-se 24 artigos, com diferentes delineamentos de pesquisa. Verificou-se que a terapia a *laser* de baixa potência propicia ações positivas na oxigenação, crescimento e modulação celular devido à luz irradiada, que afeta os processos metabólicos e produz bioestimulantes celulares e vasculares essenciais ao processo de reparo tecidual. ***Conclusão*:** conclui-se que a terapia a *laser* de baixa potência é um tratamento adjuvante que acelera o processo de reparação tecidual e promove benefícios ao conforto dos pacientes. ***Descritores*:** Terapia a laser; Terapia a Luz de Baixa Intensidade; Cicatrização; Revisão; Resultado do Tratamento; Feridas.

RESUMEN

Objetivo: identificar la acción de la terapia láser de baja potencia en la cicatrización de las heridas. ***Método:*** se trata de un estudio bibliográfico, tipo revisión integrativa, con búsqueda de artículos publicados entre 2004 a 2017, en las bases de datos MEDLINE, LILACS y biblioteca virtual SciELO. Se realizaron, después de la lectura de los artículos, la extracción y el análisis de los datos, y se presentan en forma de figura. ***Resultados:*** se seleccionaron 24 artículos, con diferentes delineamientos de investigación. Se ha comprobado que la terapia láser de baja potencia propicia acciones positivas en la oxigenación, crecimiento y modulación celular debido a la luz irradiada, que afecta los procesos metabólicos y produce bioestimulantes celulares y vasculares esenciales al proceso de reparación del tejido. ***Conclusión:*** se concluye que la terapia láser de baja potencia es un tratamiento adyuvante que acelera el proceso de reparación tisular y promueve beneficios al bien estar de los pacientes. ***Descriptores*:** Terapia por Láser; Terapia por Luz de Baja Intensidad; Cicatrización de Herida; Revisión; Resultado del tratamento; Heridas y Lesiones.

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INTRODUCTION

It is considered that the process of wound healing requires a continuous cycle of treatment and, in some cases, for a long period of time, which can negatively impact the quality of life of the individual. It is known that healing is complex, with vascular and cellular alterations, mechanisms of cellular proliferation, synthesis and deposition of collagen, elastin production and revascularization, until the contraction of the wound.[1] It is noted that in order to mobilize these mechanisms, frequent dressings are necessary, as well as the individual's orientation for self-care, which includes rest intercalated with exercise and a diet that favors healing.[2]

However, other technologies have been used to treat these lesions, and one of them is low power laser therapy (LPLT), which has been shown to be applicable to wound care, with positive results in different types of wounds.

LPLT is believed to exhibit photochemical, photophysical and photobiological effects, with non-ionizing, polarized, coherent and collimable monochromatic light capable of altering cellular behavior, favoring tissue repair.[1,3-5] It is necessary, for its use, to consider the correct parameters associated with the distance between skin and apparatus, radiated area, type of lenses or mirrors used, type of source, output power, beam divergence emitted, application time, depth of fabric, dispersion, absorption and application technique.[6] In addition, wavelength, pulse type, energy density and frequency of treatment should be considered to provide therapeutic efficacy.[1]

It is inferred that although LPLT is a technological possibility that can contribute to the process of tissue regeneration, there are still doubts related to the parameters employed and their actions in the different areas of health care.[6-11]

OBJECTIVE

- To identify the action of low power laser therapy in the tissue repair of wounds.

METHOD

It is an integrative review of organized literature based on five stages: identification of the problem; search in literature; evaluation and analysis of data and presentation of knowledge synthesis.[12]

To guide the integrative review, the following guiding question was formulated: "What are the actions of the low power laser in the tissue repair of wounds?".

Data was collected between October 2017 and January 2018, in the MEDLINE, LILACS and SciELO virtual library databases. The descriptors were listed according to the Descriptors in Health Sciences (DeCs) and MeSH: laser therapy, low power laser therapy and wound healing, as well as their correspondents in English. The combinations between the descriptors laser therapy AND low-level OR low power AND wound healing were used.

The following inclusion criteria were adopted: articles published from 2004 to 2017, in English, Spanish and Portuguese. Articles of systematic or integrative review, theses, dissertations, and complete papers that did not allow online access were excluded. Articles available in more than one database were included only once. Initially, 907 articles were found, of which 142 were evaluated and after a thorough reading of the eligibility, a final sample of 24 articles.

A flowchart for the article selection process was constructed according to the search strategies: inclusion of descriptors; identification of databases and articles with related themes; sorting (repeated titles, unrelated themes, excluded after reading); eligibility criteria and inclusion and exclusion criteria, according to figure 1. It is highlighted that the search was carried out by two reviewers, independently, until consensus was reached when there were divergent results.

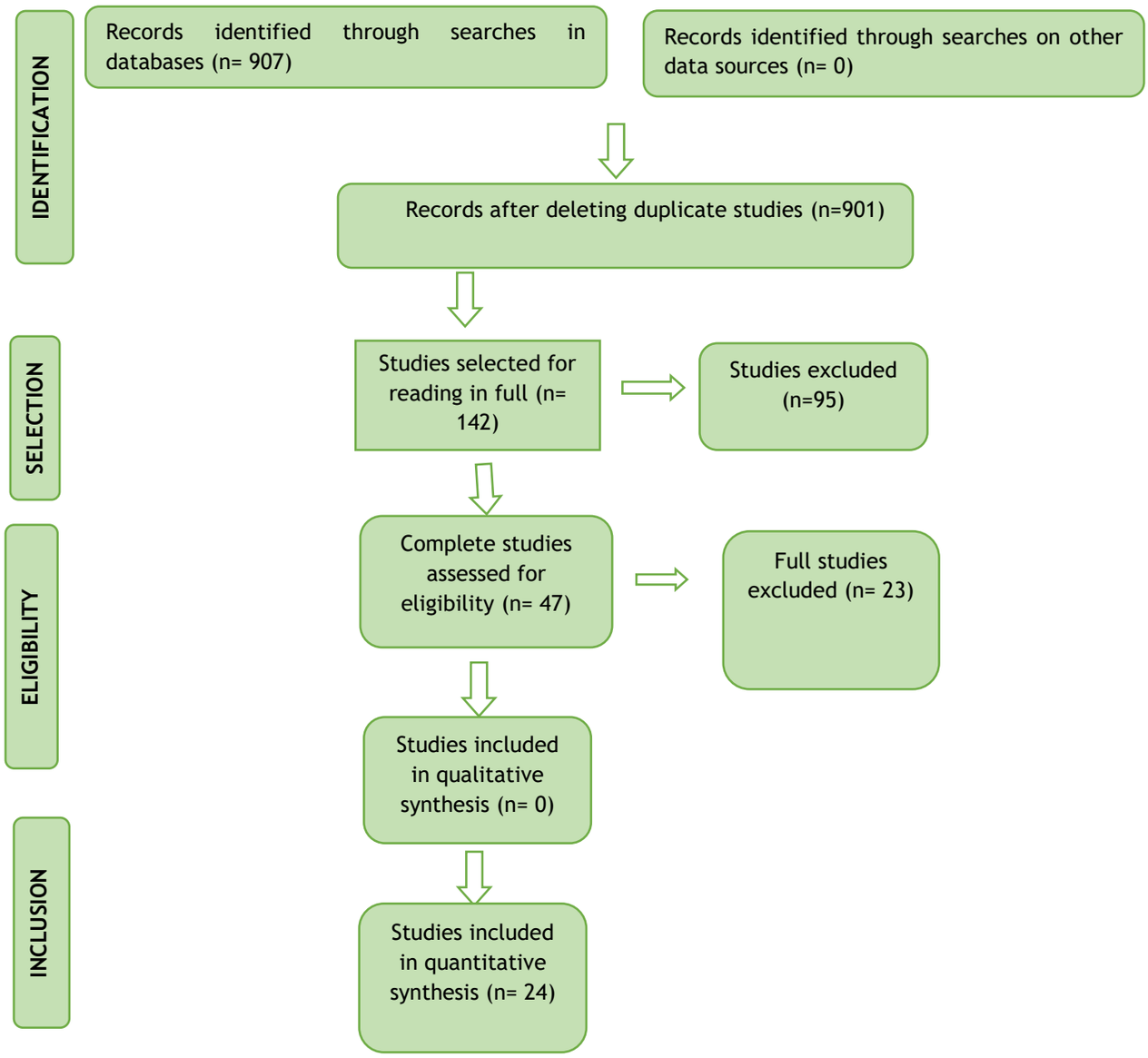

Figure 1. Flowchart of article selection. Porto Alegre (RS), Brazil, 2017.

For the evaluation of the sample, an instrument containing information on authors, title, year, country, objective, design, impact factor and outcome of the study was used. The studies were summarized in a synoptic chart organized into three thematic categories: low-power laser action on tissue oxygenation, cell growth and tissue modulation.

The ethical aspects were respected, maintaining the authenticity of the ideas, concepts and definitions, in order to ensure the authorship of the articles analyzed.

RESULTS

Twenty-four articles were selected at the end of the refinements, of which 50% were published in the years 2013-2015 and, in the country of origin, Brazil had nine (40.90%) articles, followed by India, with four (18.18%); Poland, with three (13.63%); China and Iran, with two (9.09%) each, and in addition, Israel, Romania, Colombia and the United States had one item each.

It was found, in relation to the research outline, that the most frequent was the case study, with eight (33.33%) articles, followed by six (25%) randomized clinical trials, four (18.18%) studies of prospective case-control and three (13.63%) experimental, in addition to other less used designs. The impact factor was higher than one in seven (31.8%) publications, three (42.8%) from Poland, two (28.6%) from Brazil and one (14.3%) from China and the US, respectively. It is reported that there were different approaches in the studies, however, seven (29.16%) dealt with chronic wounds and four (16.67%), acute wounds; six (27.27%) treated on Periodontia and seven (31.81%) on cell culture.

The results of the integrative review are presented in detail, according to figure 2.

Year	Country	Journal	Title of the article
2004	Brazil	J Appl Oral Sci	Clinical evaluation of the effects of low intensity Laser (gaalas) on wound healing after gingivoplasty in humans [5]
	Brazil	Brazilian Journal of cardiovascular circulation	Low level laser therapy in acute dehiscence saphenectomy: therapeutic proposal[13]
2009	Brazil	Inst Journ Health Scien	Treatment of chronic ulcers secondary to scleroderma with low-power laser - case report[14]
	Brazil	Einsten Journ	Pilot study in newborns using low-level laser therapy in the immediate postoperative period of myelomeningocele[15]
	Brazil	An Braz Dermatol	Biostimulating effects of low-power laser in the repair process [16]
2010	Brazil	BioMed Central	Clinic-epidemiological evaluation of ulcers in patients with leprosy sequelae and the effect of low level laser therapy on wound healing: a randomized clinical trial[17]
2011	Israel	Ostomy Wound Management	Conservative Management of Achilles Tendon Wounds: Results of a Retrospective Study[18]
2012	India	BMJ Case Reports	Closure of non-healing chronic ulcer in Klippel-Trenaunay syndrom (KTS) e using low-level laser therapy[19]
	Brazil	Journal Biophotonic	Low-level laser therapy can produce increased aggressiveness of dysplastic and oral cancer cell lines by modulation of Akt/ mTOR signaling pathway[20]
	Romania	Journal of Medicine and Life	Fat Graft, Laser CO2 and Platelet-Rich-Plasma Synergy in Scars Treatment[21]
2013	India	Indian Journal of Dental Research	Low level laser therapy in the treatment of aphthous ulcer[22]
	Poland	Journal of Physiology and Pharmacology	Phototherapy with low-level laser influences the proliferation Of endothelial cells and vascular endothelial growth factor And transforming growth factor-beta secretion[23]
	Colombia	Journ Univ.Ind.Santander.Salud	Effects of low level laser therapyand high voltage stimulation on diabetic wound healing[24]
2014	China	Photomedicine and Laser Surgery	Helium-Neon Laser Irradiation Promotes the Proliferation and Migration of Human Epidermal Stem Cells In Vitro: Proposed Mechanism for Enhanced Wound Re-pithelialization[25]
	Brazil	Acta Brazilian Surgical	Effects of the Low-Level Laser Therapy (LLLT) in the process of healing diabetic foot Ulcers[26]
	Brazil	Escola de Enfermagem da USP	Pressure Ulcer Scale for Healing and Nursing Outcomes Classification[8]
	China	Hindawi Publishing Corporation Mediators of Inflammation	Modulation of Extracellular ATP Content of Mast Cells and DRG Neurons by Irradiation: Studies on Underlying Mechanism of Low-Level-Laser Therapy[27]
2015	Poland	Lasers in Med Science	Tissue laser biostimulation promotes post-extraction neoangiogenesis in HIV-infected patients[28]
	USA	Journal of Biomedical Optics	Combination of low level light therapy and nitrosyl-cobinamide accelerates wound healing[29]
	Poland	Lasers in Medical Science	Low-level laser irradiation effect on endothelial cells under conditions of hyperglycemia[30]
	India	Journal of Clinical and Diagnostic Research	Low Level Laser Therapy in the Treatment of Intra-Osseous Defect- A Case Report[31]
2016	India	Journal of Indian Society of Periodontology	Effect of low-level laser therapy on wound healing after depigmentation procedure: A clinical study[32]
2017	Iran	J Lasers Med Sci	The Effect of Low Level Laser Therapy on Pemphigus Vulgaris Lesions: A Pilot Study[11]
	Iran	J Dent (Shiraz)	Clinical Evaluation of High and Low-Level Laser Treatment (CO2vsInGaAlP Diode Laser) for Recurrent Aphthous Stomatitis[33]

Figure 2. Characterization of articles analyzed, Porto Alegre (RS), Brazil, 2017

It was observed in the studies that the use of LPLT is heterogeneous, with different potencies and with parameters that varied between fluences of one and ten J/cm², with periodicity of application also variable, from daily to weekly application.

Three summary tables of the 24 articles were organized to present the results regarding the action and outcomes of LPLT use, in which: tissue oxygenation, cell growth and tissue modulation.

It was observed that five (20.83%) articles demonstrated that LPLT action improved tissue oxygenation, altering the structure and formation of blood vessels, according to figure 3.

Type of study	Objective	Action	Outcome
Case study[14]	To report the effect of cutaneous ulcer treatment with LPLT in a female patient diagnosed with scleroderma.	Neovascularization, ATP synthesis, fibroblast increase, collagen and elastin, release of chemical mediators. Inhibition of nervous degeneration.	Decrease in lesion area with presence of scar tissue in 28 days, improvement of vascular appearance and improvement in sensitivity after 70 days.
Case study[16]	To study the biostimulation phenomenon and to highlight the main effects of LPLT in tissue repair.	Biochemical, bioelectric and bioenergy modifications, promoting cell proliferation and maintenance.	Acceleration of the process of repair of tissues injured by the biostimulating effects after 24 days of the surgical procedure of exodontia.
Case-control study[29]	Show the combination of LILT and nitric oxide and nitrosyl cobinamide (NO-CBI) in the improvement of the lesions.	Repair by electron transport of the chain-dependent cytochrome oxidase (C-ox) and increase of ATP production.	C-ox was validated as the primary photoreceptor by: increased oxygen consumption, reduced healing in the presence of sodium azide and cyanide dissociation after application.
Case-control study[28]	To evaluate the rate of wound neoangiogenesis after LPLT and clinical parameters (sex, tooth position and lymphocyte count CD4).	Improves the formation of new blood vessels promoting healing after tooth extraction in patients with HIV.	Statistically significant Neoangiogenesis, with daily application for five days. Reduction of complications.
Experimental[30]	To evaluate the action of LPLT with two wavelengths (635 and 830 nm) on the secretion of inflammatory factors under conditions of hyperglycemia.	It causes a reduction in the concentration of inflammatory cytokines - TNF-α. It acts in the stimulation of the cellular metabolism after the absorption of energy.	Correction of adverse effects of hyperglycemia in vascular endothelial cells with wavelength of 830 nm. Two sessions were applied in one week.

Figure 3. Articles demonstrating low-power laser action in improving tissue oxygenation, Porto Alegre, Brazil, 2017.

Eleven (45.83%) articles were identified that demonstrated the action of LPLT on cell growth, according to figure 4.

Type of study	Objective	Action	Outcome
Case study[19]	To assess the healing of chronic ulcers in a patient with KTS by the combination of helium-neon (He-Ne) and LED lasers.	It develops healthy granulation tissue and ulcer healing. Eliminates foul odor from the wound.	Wound healing, no recurrence of ulcer after eight months of healing.
Case study [31]	To demonstrate the positive LPLT result in conjunction with bovine demineralized bone matrix in the surgical treatment of moderate chronic periodontitis with periodontal abscess.	Promotes wound healing and reduces pain after gingivectomy. LPLT enhances bone regeneration by promoting the proliferation and maturation of human osteoblasts.	CAL gain of 4 mm in the bone matrix after five days. 37% bone filling in 12 months. Soft tissue healing, with minimal edema and pain on the 2nd day, with suspension of analgesics.
Retrospective study [18]	To evaluate the results of patients who received LPLT in Achilles tendon injuries	It favors the proliferation of keratinocytes. Improves the organization of fibroblasts.	Complete reepithelialization in 77% of cases after an average time of 19 ± 10 weeks

	during the years 2004 to 2008.	Helps in the anti-inflammatory effect.	(range 5-42 weeks) with laser.
Randomized clinical trial[26]	To assess the effects of LPLT on tissue repair in diabetic ulcers.	Increased fibroblasts and neovascularization. Reduction of pain. Repair of fabrics.	Significant reduction in wound size in ten days. Pain improvement.
Randomized clinical trial [20]	To investigate the influence of LPLT as a cell stimulation pathway for head and neck cancer.	Significantly modifies the expression of proteins associated with progression and invasion in all cell lines.	Oral dysplastic cells may undergo transformations and this interferes with a malignant phenotype when irradiated.
Experimental[23]	To evaluate the influence of visible and infrared gamma laser light on vascular endothelial cell proliferation in vitro and the secretion of angiogenic factors.	It stimulates the proliferation and concentration of VEGF-A (endothelial cell growth factor) and TGF-ß (growth factor).	Changes in the concentration of VEGF-A and TGF-ß with 635 nm and 830 nm laser. Highest increase with the use of the wavelength of 635 nm and the energy density of 4 J/cm^2.
Experimental[25]	To investigate the effects of helium-neonatal LPLT (He-Ne) on the proliferation, migration and differentiation of cultured human epidermal stem cells.	It promotes cell proliferation and migration with increased ERK phosphorylation (protein regulated by extracellular signals).	The low power HeNe laser contributed to the acceleration of epithelization of lesions.
Experimental[27]	To know the effects of red laser irradiation on extracellular ATP content of mucosal mast cells and dorsal root ganglia and neurons (DRG).	Elevation of extracellular ATP in the human mast cell (MH) chain, with a combined increase in intracellular ATP content. In DRG neurons, the reduction was in the extracellular ATP content.	Red laser irradiation in MC and DRG neurons has opposite effects on the extracellular content of ATP. Complex underlying laser mechanism that needs to be further developed.
Randomized clinical trial [32]	To evaluate and compare the effects of LPLT on wound healing after the depigmentation procedure.	Proliferation of fibroblasts, keratinocytes and immune cells. Migration of cells in the margins.	Healing until the 3rd day. On the 3rd and 15th days, the difference in healing was not statistically significant.
Randomized clinical trial [24]	To compare the additional effects of LPLT, pulsed high voltage current (HVPC) and conventional treatment in diabetic foot ulcers.	Stimulates fibroblast proliferation by growth factor.	Improvement in the mobility of LPLT-treated patients evaluated by the Euroquol-5D instrument (EQ-5D), different from the other groups.
Case-control study [5]	Clinically evaluate the effects of the gallium arsenate 670 nm laser on wound healing after gingivoplasty.	Activation of fibroblasts in the extracellular matrix and growth factors.	Improvement of color, texture and gingival contour. There was no statistical difference between the irradiated and the non irradiated side with laser.

Figure 4. Articles demonstrating the action of low-power laser on cell growth, Porto Alegre (RS), Brazil, 2017.

Eight (33.33%) articles that demonstrated LPLT action in tissue modulation, according to figure 5, were classified.

Type of study	Objective	Action	Outcome
Case study[13]	To evaluate the response of laser therapy as a therapy in saphenectomy dehiscence.	Involution of erythema and edema, proliferation of the granulation and border delimitation.	Complete wound healing in the 9th session.
Case study[8]	Evaluate the healing process by (PUSH) and wound healing result: second intonation of the NOC in critical patients with pressure ulcer in treatment with	Release of histamine, serotonin and bradykinin, resulting in the production of ATP and increased epidermal regeneration, analgesic, anti-inflammatory, anti-	Significant decrease in size in five weeks. Reduction of maceration and erythema on edges after the third day. Higher NOC score scores and PUSH scores decreased.

	conventional dressing and LPLT.	oedematous and healing action.	
Case study[22]	To evaluate the laser action in two patients diagnosed with RAS (Recurrent Aphthous Stomatitis).	Biomodulation and immediate analgesic effect. It acts on vasodilation with relevance in the treatment of inflammation.	Reduction in size, healing time and intensity of pain in four days. Absence of relapse in one year.
Prospective study [15]	To analyze the behavior of tissue repair of corrective surgical incision in newbonrs with myelomeningocele submitted to low intensity laser.	Modulation of macrophages, fibroblasts, keratinocytes, lymphocytes and endothelial cells. Reduction of edema and promotion of vascularization.	Patients treated with LILT had twice as many dehiscences as in the control group.
Prospective study [21]	To evaluate the efficacy of the combination of laser with platelet rich plasma in the treatment of atrophic and contractile scars.	Photobioactivation of transplanted fat cells, better graft picking. Increased cellular function by acting on organelles.	Significant difference in collagen structure, number and quality of adipocytes. Appearance of the scar, skin condition, edema, bruising assessed as excellent by more than 50% of patients.
Randomized clinical trial [17]	To analyze the clinical and epidemiological characteristics of patients with leprosy ulcers and to evaluate the effect of LILT on the healing of specific wounds.	Fibroblast stimulation in response to growth hormone. Cellular Biomodulation.	The area, depth and PUSH scale did not show statistical difference between groups for 12 weeks (3x / week application) in leprosy lesions.
Randomized clinical trial [11]	To assess the effect of low and high level laser therapy on pain control and wound healing of recurrent aphthous stomatitis.	Analgesic action	Time of absence of pain after treatment was higher in the groups that used lasers. Duration of repair time without statistical difference.
Case study[34]	To evaluate the efficacy of low-power laser in the treatment of pemphigus lesions.	Analgesic action	Additional reduction of 1.30 points in the mean of the qualitative evaluation of the wound and pain in eight weeks.

Figure 5. Articles demonstrating the action of low-power laser in tissue modulation, Porto Alegre (RS), Brazil, 2017.

DISCUSSION

Included in this integrative review were 24 articles from different parts of the world and published in different journals. Studies with different research designs and important results regarding tissue oxygenation, cell growth and tissue modulation resulting from LPLT action were presented.

It was verified that five articles described the action of the laser in the improvement of the cellular oxygenation, providing anti-inflammatory action.[14,16,28-30] Neoangiogenesis was observed by increasing the diameter and quantity of capillaries, improving the tissue oxygenation of the injured region, as well as benefits such as reduction of edema and acceleration of repair of damaged tissues, triggered by the action of the laser on inflammatory mediators.[16,28-30]

It was identified in the case-control study with human osteosarcoma cells, the acceleration of the healing of the lesions by the increase in the electron transport and increase of the production of ATP.[29] In addition, the reduction of edema in patients with cutaneous ulcers due to scleroderma through new mitoses with formation of fibroblasts, collagen, elastin and the release of chemical mediators such as histamine, serotonin and bradykinin.[14] The reduction of inflammatory cytokine levels in hyperglycemic vascular endothelial cells and the increase in cell proliferation when compared to the wavelength 635nm were observed when the 830nm wavelength laser was used.[30]

It was identified that 11 articles mentioned about the action of the laser in the cellular growth.[5,18-20,23-27,31-32] This action is related to the mechanisms of the proliferative phase of cicatrization, which corresponds to the formation of the granulation tissue and the new vessels of the cell matrix.[33] It is inferred that there was also positive evidence related to re-epithelialization of chronic wounds and the acceleration of healing, as well as decrease of pain during treatment.[33]

It is observed that the action of the laser has proved effective when associated with other therapies for skin and tissue injuries. In a retrospective study with patients with Achilles tendon injury, it is suggested that the laser associated with topical hyperbaric therapy is an alternative treatment with positive effects on keratinocyte proliferation, fibroblast organization and anti-inflammatory action.[18] In another study, the acceleration in the regeneration of bone matrix used in the surgical treatment of periodontitis, proved by radiography31, and in another case of a patient with chronic ulcer, a consequence of Klippel-Trenaunay Syndrome (KTS), was used the 632.8 nm laser for 15 minutes, associated with LEDs with wavelengths of 660 nm and 950 nm, twice a week, until the wound was healed, totaling seven months of treatment.[19] Eradication of the unpleasant odor of the lesion, the evolution of the granulation tissue, the healing of the lesion and the absence of recurrence after eight months of healing were verified in a study.[19]

The effects of laser were attributed to cell growth in an experimental study that demonstrated a significant increase in the migration and differentiation of human epidermal stem cells cultured and irradiated with He-Ne laser at 632.8 nm with 2 J, which corroborates its positive action on tissue healing.[25] It was found in this experimental line that, when placental endothelial cells were exposed to irradiation with 635nm and 830nm lasers, there was an increase in cell growth factors, especially VEGF, which is responsible for regulation and endothelial survival, proliferation , migration and formation of vascular tube.[23]

It is inferred that, in diabetic lesions, the use of the laser was also promising.[24,26] It was added that a study evaluated the effect of the laser with a wavelength of 632.8nm (4J / cm2), for 80 seconds, in patients with diabetic ulcers followed on days interspersed for 30 days, demonstrating a significant improvement in the size of the lesions in the intervention group, in addition to the reduction of pain and no occurrence of peripheral amputation.[26] The healing of diabetic foot ulcers was achieved in 77% of those who used LPLT and 66% of those undergoing conventional treatment, with a follow-up of 16 weeks, however, there was no statistical difference between the treatments. It was observed, however, that in the mobility dimension of the Euroquol-5D instrument, which evaluates quality of life, the patients who received the LPLT obtained a better score, configuring its additional effect for the diabetic foot.[24]

There is also a favorable effect of LPLT on pain control as it is an adjuvant treatment. It was inferred, in one of the studies, that its action on modulation of cellular Ecto-ATPases of dermal neurons or mucosal mast cells (MCs) and dorsal root ganglia (DRG) provided algic control. These Ecto-Atpases are bound to the membrane that hydrolyzes extracellular ATP cells and adenosine, which exist in the peripheral nervous system, which could explain the effect on ATP and pain relief.[27]

It was observed that in the postoperative wound, the laser promoted healing until the 3rd day, but in the 7th and 15th days, the difference in healing was not statistically significant.[32] A similar difference was found in another study that observed that the laser is linked to the increase in fibroblastic activities, but without statistical difference in the healing time of the oral mucosa after a gingivoplasty procedure. It was referred, through these findings, the need for new immunohistological studies correlating the clinical alterations to findings at the cellular level.[5] It is also demonstrated in current studies that the laser, by its action of biostimulation, modifies the cellular behavior, which does not recommend it in a region with cell proliferation or dysplasia. This was corroborated in a study that observed that laser significantly modified proteins associated with progression and invasion in all cell lines, increasing the expression of pAkt, PS6 and Cyclin D1 proteins and the production of an aggressive Hsp90 isoform.[20]

It was verified that, in eight articles of this review, the LPLT action is linked to cellular modulation, that is, the final phase of epithelization.[8,11,13,15,17,21-2,34] In these studies, there was an important difference in the remodeling of collagen, with improved scar appearance due to maturation and alignment of the fibers, better underlying skin condition and shorter recovery time, and fewer dehiscences. It is noteworthy that laser was an agent that facilitated the healing of acute injuries, such as that of a patient with surgical wound dehiscence due to Bypass, with

complete wound healing and pain improvement after nine applications.[13] In other acute lesions such as canker sores in the oral cavity, healing after four days and immediate pain relief with only one laser session.[22]

It is also worth noting that the LPLT has a positive impact on the delimitation of the lesion edges, with a better quality of the repair process in the lesions treated with laser. It was pointed out, in a study with patients in the postoperative period of myelomeningocele, a lower incidence of dehiscence when compared to the conventional therapeutic responses.[15] It is known that this effect produces a lower risk of infection in the child's central nervous system and, therefore, better chances of recovery.[15]

It was evidenced that there are favorable actions also in chronic wounds, in which one study showed reduction in the dimensions of pressure injury in a patient with paraplegia, with increased epithelial tissue, decreased secretion and odor after conventional therapy plus LPLT.[8] In a prospective study, improvement in the appearance of the scar and skin condition, reduction of symptoms such as edema, ecchymosis and recovery time after grafting on chronic cervical-facial and contractile atrophic scars in the abdominal region and legs were observed.[21] LPLT has also been shown to be effective in the lesion caused by pemphigus vulgaris, which is represented by painful lesions, [11] and similarly, the treatment of patients with recurrent aphthous stomatitis lesions with LPLT has demonstrated absence of pain after their application in a shorter period of time than when treated with other therapies.[34]

However, the results of a randomized clinical trial with leprosy patients using LPLT showed no significant change.[17] Mycobacterium leprae is hypothesized to infect peripheral nerves resulting in neural and sensory damage, motor and autonomic disorders that may adversely affect wound healing, and therefore, therefore, LPLT has not demonstrated any additional benefit to conventional treatment.

It was observed that the LPLT parameters varied from 610 to 940m, but most of the studies (13 = 59.09%) used between 610 and 685m, which indicates the standardization of this therapy in the cicatrization of wounds. It is considered as another important point the number of applications, which ranged from a single application up to 48 times. This aspect is an important factor to be evaluated, taking into account the characteristic and etiology of the lesion, as well as the availability of the patient and the service for the implementation of this therapy.

CONCLUSION

It is concluded that LPLT is an adjuvant treatment with action capable of accelerating the healing process of tissue lesion, with evident anti-inflammatory, analgesic and tissue repair action and, even when there is no total wound healing, LPLT promotes improvement, which has repercussions on the greater well-being of the patient and possible positive impact on their quality of life.

However, the biochemical effect is related to the release of preformed substances (histamine, serotonin, and bradykinin), which stimulate the production of ATP and inhibit the production of prostaglandins, lead to a decrease in inflammatory effects and promote repair structural. It is cautioned that caution is required in the irradiation of tissues with active cell dysplasia, since the growth of all cells involved can be stimulated.

It is understood that the technique and parameters used for the LPLT application are not yet homogeneous and require more in-depth knowledge of the power (W or mW), mode (continuous or pulsed), pulse (Hz frequency, pulse duration nanoseconds), wavelength (λ), tip type, and instrument calibration. The dose should be explored in relation to energy density (J / cm^2) and power (W / cm^2), treated area or active tip area (cm^2 or mm^2), time of application (s), number of treated points , number of joules per point and total number of joules per treatment in protocols for different clinical situations, to provide uniformity and safety to the procedure.

It is therefore recommended that clinical studies be developed in different scenarios in order to improve the evidence that involves the cicatricial process of lesions treated with LPLT.

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