Journal of Nursing
Revista de Enfermagem
UFPE On Line
ISSN: 1981-8963

CLINICAL CASE REPORT ARTICLE

EXPERIENCE REPORT ON THE USE OF LOW-POWER LASER IN THE TREATMENT OF NEUROTROPHIC ULCERS

RELATO DE EXPERIÊNCIA SOBRE O USO DO LASER DE BAIXA POTÊNCIA NO TRATAMENTO DE ÚLCERAS NEUROTRÓFICAS

RELATO DE EXPERIENCIA SOBRE EL USO DE LÁSER DE BAJA POTENCIA EN EL TRATAMIENTO DE ÚLCERAS NEUROTRÓFICAS

Jardênia Marçal Rosa[1], Simone Gomes Torquato[2], Danielli Mello[3], Estélio Henrique Martin Dantas[4]

ABSTRACT

Objective: to report the results of neurotrophic ulcers healing. ***Method:*** case-type descriptive study conducted with six leprosy patients aged between 20 and 50 years, with ulcers treated using low-power laser. Patients underwent two sessions of laser therapy per week, totaling 12 applications of light beams on the neurotrophic ulcers. The Pressure Ulcer Scale for Healing was used to assess the healing effect of low-power laser. The research project was approved by the Research Ethics Committee, under Protocol No. 0001/2011. ***Results:*** significant improvement in the healing process was observed after treatment. ***Conclusion:*** the preliminary results showed that the use of low-power laser, applied on neurotrophic ulcers, promoted celerity in the healing process. ***Descriptors:*** Leprosy; Cutaneous Ulcer; Low-Power Laser Therapy; Healing.

RESUMO

***Objetivo*:** relatar os resultados de cicatrização de úlceras neurotróficas. ***Método*:** estudo descritivo, tipo estudo de caso, realizado com seis pacientes com hanseníase entre 20 e 50 anos de idade, com úlceras tratadas com laser de baixa potência, submetidos a duas sessões de laserterapia por semana, totalizando 12 aplicações do feixe de luz sobre a úlcera neurotrófica. Para a avaliação do efeito cicatrizante do laser de baixa potência, foi utilizada a escala *Pressure Ulcer Scale for Healing*. O projeto de pesquisa foi aprovado pelo Comitê de Ética em Pesquisa, sob Protocolo n. 0001/2011. ***Resultados*:** após o tratamento, observou-se melhora expressiva no processo de cicatrização. ***Conclusão*:** os resultados preliminares demonstraram que o uso do laser de baixa potência, aplicado sobre as úlceras neurotróficas, promoveu a celeridade no processo de cicatrização. ***Descritores*:** Hanseníase; Úlcera cutânea; Terapia a laser de baixa potência; Cicatrização.

RESUMEN

Objetivo: reportar los resultados de la cicatrización de úlceras neurotróficas. ***Método:*** estudio descriptivo, tipo estudio de caso, realizado con seis pacientes con lepra comprendidos entre 20 y 50 años de edad, con úlceras tratadas con láser de baja potencia. Los pacientes fueron sometidos a dos sesiones de terapia láser por semana, con un total de 12 aplicaciones del haz de luz sobre las úlceras neurotróficas. Para la evaluación del efecto cicatrizante del láser de baja potencia fue utilizada la escala *Pressure Ulcer Scale for Healing*. El proyecto de investigación fue aprobado por el Comité de Ética de la Investigación, con el Protocolo N° 0001/2011. ***Resultados:*** fue observada una mejoría significativa en el proceso de cicatrización después del tratamiento. ***Conclusión:*** los resultados preliminares demostraron que el uso de láser de baja potencia, aplicado sobre úlceras neurotróficas, promovió rapidez en el proceso de cicatrización. ***Descriptores:*** Lepra; Úlcera cutánea; Terapia Con Láser de Baja Potencia; Cicatrización.

[1]Physiotherapist, Dr. Clementino Fraga Infectious Contagious Diseases Hospital Complex. João Pessoa, PB, Brazil. Email: jardhy@yahoo.com.br; [2]Msc., Physiotherapist, Professor at UNIPÊ. João Pessoa, PB, Brazil. Email: simonegtorquato@gmail.com; [3]PhD., Physical Education teacher at Department of Post-Graduation/Physical Education College of Brazilian Army (EsEFEx). Rio de Janeiro, RJ, Brazil. Email: danielli.mello@globo.com; [4]PhD., Physical Education teacher at Programa de Pós-graduação Stricto Sensu em Enfermagem e Biociências - PPGEnfBio (Doutorado) da Universidade Federal do Estado do Rio de Janeiro (UNIRIO) – Rio de Janeiro, RJ, Brazil. Email: estelio.dantas@unirio.br

INTRODUCTION

Leprosy is an infectious and contagious disease requiring mandatory report in Brazil.[1] It is caused by the alcohol-resistant acid bacillus *Mycobacterium leprae*, which exhibits tropism through the mixed peripheral nerves,[2] in addition to affecting the skin and the oral and nasal mucous membranes.

According to the Ministry of Health, man is considered the only source of leprosy transmission.[3,4] Infection takes place through contact of susceptible individuals with untreated bacilliferous patients through the upper airways.[5] Among other factors, the occurrence of different clinical manifestations is due to the host/parasite interaction after two to seven years of incubation.[4]

This disease has high infectivity, low pathogenicity and high disabling potential.[6] Nerves affection can lead to neural damage and changes of sensory and/or motor functions.[7,9] This way, it predisposes to the appearance of neurotrophic ulcers, which can evolve to osteomyelitis, gangrene, amputations and loss of bone segments.[10] Neural impairment generates different degrees of disability, changes in the levels of pain and decreased muscle strength. Early physiotherapeutic intervention is indicated in order to minimize these functional changes.[11]

Leprosy also impairs the quality of life related to health[12] and interpersonal relationships, causing suffering, in addition to pain and malaise strictly linked to physical harm and stigmatizing power.[13] Quality of life impairment is more intensely associated to some specific situations of diseases in the multibacillary clinical form, such as leprosy reaction and physical disability.[14]

Neurotrophic ulcers—a frequent complication in patients with leprosy—occur due to loss of protective sensibility or anesthesia. This results in changes of the motor fibers due to weakness and paralysis of the muscles and leads to deformities, impairment of the function and increased risk of the emergence of this kind of wounds.[15]

There are several products and dressings targeted to the treatment of cutaneous ulcers. A therapeutic modality currently used is the low-power laser therapy associated with different dressings to assist in the healing process. The use of laser therapy aims to speed up the healing process as a result of the photochemical, photophysical, and photobiological effects on cells and tissues.[16]

Although low-power laser has beneficial effects on healing processes, its use for the treatment of ulcers, particularly neurotrophic ulcers, is not frequent in our context. Thus, it constitutes a resource that deserves the attention of researchers and health professionals involved in healthcare provided to patients with wounds, in order to broaden the range of options that can contribute to the healing process and consequently to the quality of life of these patients. In view of the above, this study aims to report the results of neurotrophic ulcers healing.

METHOD

This is a clinical case study conducted with six patients in the outpatient sector of a reference hospital for treating neurotrophic ulcers in the city of João Pessoa, State of Paraíba. The service has a Skin Department with a trained and qualified multiprofessional team (nurses, nursing technicians, dermatologists, vascular surgeon, plastic surgeon, physical therapist, nutritionist, psychologist, and social service). This service aims at the rapid rehabilitation, better quality of life and return to the family and social life of patients with neurotrophic ulcers.

The patients (one woman and five men, aged between 20 and 50 years) had been diagnosed with leprosy and neurotrophic ulcers without associated chronic diseases. They were non-smokers and did not consume alcoholic drinks and had already been cared for in the outpatient Skin Department of the hospital. Patients excluded from the study were those who had failed to attend three consecutive sessions during treatment, presented carcinomas, bleeding, or gravid uterus.

The research met the standards for conducting research with humans according to the Declaration of Helsinki,[17] and it was approved by the Research Ethics Committee of the State Department of Health of Paraíba, under Opinion No. 0001/2011. All patients who agreed to participate in the study signed an informed consent form.

The Pressure Ulcer Scale for Healing (PUSH) was developed in 1996 by the National Pressure Ulcer Advisory Panel (NPUAP). It was adapted and validated in Brazil and used for assessing the ulcers in the present study.[18] This scale was used for observation of the area of the wound, with score from 0 to 10 regarding the length and width of the ulcer and 0 to 3 for the amount of exudate.

For the type of tissue, the PUSH score ranges from 0 to 4 (0 - closed wound; 1 – epithelial tissue; 2 - granulation tissue; 3 - sphacelus; and 4 – necrotic tissue). For the amount of wound drainage, the distribution is:

0 = absent, dry ulcer tissue; 1 = small amount, moist ulcer tissue, moisture distributed evenly in the wound; 2 = moderate, saturated ulcer tissue, drainage may or may not be well distributed in the wound; and 3 = large amount, ulcer tissue bathed in fluid, drainage freely demonstrated.

In the first medical appointment, the patients were asked about the number of times that the exchange of the dressing was performed daily at their residences. Subsequently, the amount of wound drainage, the type of tissue present in the ulcer bed and its size (disposable millimeter rule) were assessed. At the end of the assessment, all individual scores (wound size, type of tissue and exudate) were added in order to find the result in the PUSH, thus enabling to obtain the value, according to the guidelines for use of the scale. Reassessment was performed every eight days, for six weeks, obtaining photographic records of each meeting.

After cleaning the ulcer with saline solution—performed by the nursing staff—the procedure proceeded with the implementation of the InGaP low-power laser (gallium-indium-phosphorus), generated by a Bioset® Physiolux Dual device with continuous (CW) and pulsed emission, 30mW power, 670 nm wavelength (visible red), and dose of 5 joules/cm^2, because the doses from 3 to 6 J/cm^2 have healing effect.[19,20] This application was performed twice a week, before covering the wound with an occlusive dressing.

The method for laser application consisted of scanning the ulcer bed (15 minutes) and irradiating per points on the ulcer edges (15 seconds per point), at a distance of 1 to 2 cm^2 between points. The laser pen was covered by a PVC plastic and the researcher wore procedure gloves. After each service, the asepsis of the equipment was performed using 70% alcohol.

When the physiotherapist completed the laser application, the nurse selected the dressing to be used on the wound after assessing its characteristics. Four types of bandages were used for the dressings: (a) sterile absorbent polyurethane foam, impregnated with silver ions and with an outer layer impermeable to water, organic fluids and bacteria; (b) tape with calcium alginate, fibrous and flexible tissue, highly absorbent (indicated for filling cavities with variable exudation); (c) composed of unsaturated fatty acids (linoleic acid), medium-chain triglycerides (caprylic acid, capric acid, linoleic acid), vitamin E, and vitamin A, with exemption of components of animal origin; and (d) hydrolytic gel for debridement composed of calcium alginate, collagen and aloe vera gel.

RESULTS

Table 1 shows the progression of the wound area from the first to the sixth week of laser applications and dressings used.

Table 1. Ulcer areas in cm² according to the PUSH. João Pessoa, 2012.

	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6
1st Week	36	9	8.75	27.5	7.5	4
2nd Week	27	5.28	4	18	3.75	1.5
3rd Week	27	3	0	14	1	0.8
4th Week	20	1.5	-	10.8	0.4	0.25
5th Week	20	0.8	-	7.2	0	0
6th Week	16.2	0.15	-	2.4	-	-

It can be observed that three subjects had total wound healing until the third or fifth week of treatment (subjects 3, 5 and 6) and another subject had complete healing at the end of the sixth week (subject 2). Subject 3 had superficial ulcer in the left lower limb, located on the sole of the foot. During the consultations with the professionals, the patient stated that always avoided putting high and prolonged pressure on the limb, this way preventing local ischemia, which would hinder the healing process.

Table 2. Exudate amount according to the PUSH. João Pessoa, 2012.

	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6
1st Week	3	3	2	3	3	2
2nd Week	3	2	1	3	2	2
3rd Week	3	2	0	2	1	1
4th Week	2	2		2	1	1
5th Week	2	1		1	0	0
6th Week	2	1		1		

Legend: 0 = Absent; 1 = Small; 2 = Moderate; 3 = Large.

According to Table 2, it is initially observed that all subjects presented from moderate (saturated ulcer tissue, drainage may or may not be well distributed in the wound) to large exudate amounts (ulcer tissue bathed in fluid, drain freely demonstrated across the wound). During the course of treatment, it was found that the decrease of the exudate occurred from the second week in subjects 2, 3 and 5. On the other hand, subject 1 presented

exudate reduction in the fourth week and the subject 6 in the third week, whose drainage at the end of the sixth week still remained moderate.

Table 3 shows the type of tissue present in the ulcer beds during the therapeutic applications

Table 3. Tissue type present in the ulcer beds according to the PUSH. João Pessoa, 2012.

	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6
1st Week	3	3	2	3	3	2
2nd Week	2	2	1	2	2	2
3rd Week	2	2	0	2	1	1
4th Week	2	2		1	1	1
5th Week	2	1		1	0	0
6th Week	2	1		1		

Legend: 0 = Closed wound; 1 = Epithelial tissue; 2 = Granulation tissue; 3 = Sphacelus; 4 = Necrotic tissue.

It can be observed that in just two weeks of laser application all six subjects presented evolution in the ulcer healing process. In the third week, subject 3 presented healing by wound closure, and subject 5 and 6 showed complete healing in the fifth week. Since the wounds of subjects 1, 2 and 4 had larger diameters, they did not reach the total closure of the ulcers in the six-week treatment, but they showed great evolution in tissue repair throughout the course of treatment.

Table 4 shows the sum of the scores assessed with the PUSH.

Table 4. Ulcer progression according to the PUSH. João Pessoa, 2012.

	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6
1st Week	16	14	12	16	7	10
2nd Week	15	11	8	14	6	8
3rd Week	15	9	0	13	3	5
4th Week	13	8		11	2	3
5th Week	13	5		10	0	0
6th Week	13	3		7		

Legend: Higher values mean non-healed stages of the ulcer; zero means that the ulcer was healed.

According to Table 4, it can be observed that during treatment, considering the sum of the PUSH scores, all patients presented evolution in the healing process, noting that three of the subjects had complete healing of the wound in up to five weeks of treatment. Only three subjects did not complete healing during treatment in the six weeks, although they showed gradual and considerable evolution.

DISCUSSION

The results show complete tissue repair of three ulcers treated with dressings—selected according to the characteristics of the wounds—associated with the low-power laser. Subject 6 presented a superficial ulcer in the left upper limb (lateral surface of the arm), what facilitated healing due to its location. Subject 5 presented an ulcer in the right lower limb. The wound was also superficial, located in the posterior part of the lateral border of the foot.

The depth of the wound constitutes one aspect of extreme relevance for healing, since the deeper the injury, the greater the time required for restoration of the affected layers. At the same time, the depth increases the risk of complications such as infection. Therefore, the fact that the ulcers were superficial in the three patients assessed was a contributory factor in healing.

The success in the process of complete wound healing can also be caused by the laser action due to the absorption of the radiation by the body. The light energy is absorbed in the cytochromes and porphyrins, within the mitochondria and cell membrane, producing a small amount of free oxygen as a result of absorption inside the cell, forming a gradient of protons across the cell membrane and the membrane of the mitochondrion. This change in the permeability of the cell membrane also causes changes in the permeability of the mitochondrial membrane, leading to an increase in the level of cellular adenosine triphosphate (ATP). The penetration of radiation and the amount absorbed will depend on the absorbent structures of the tissue or skin radiated and body characteristics.[21]

The subjects who had larger wounds (identified as 1 and 4), as expected, did not achieve complete wound healing until the sixth week of treatment. However, it can be observed that there was a significant decrease in the areas of the wounds, which began to occur from the second week and, at the end of follow-up, healing greater than 50% was achieved in the affected area of subject 1 and greater than 90% in subject 4 (Table 1).

The effect on exudate reduction can be caused by the laser associated with the other dressings. The effect of the laser on the inflammation initially occurs due to the inhibition of chemotaxic factors released. It interferes on the effects of chemical mediators induced in the inflammation by changing vascular permeability with consequent decrease in the exudate amount.[22,23]

A study showed the effects of laser on healing and decreasing exudate, especially in chronic ulcers, proving to be more efficient than conventional methods used today.[24] Another study obtained 100% of healing in arterial, venous and diabetic ulcers using clinical treatment associated with HeNe laser (632.8 nm) and AsGa laser (904 nm). In the present study, some cases evolved to complete wound healing in a short treatment time and deeper wounds had not only reduced exudate but also reduced sizes; even though there were few sessions of 670 nm laser application.

A recent research showed four wavelengths whose stimulation at the cellular level was maximal. They were 620, 670, 760, and 830 nm, providing a much greater stimulation of the DNA/RNA synthesis. This way, they favor epithelial regeneration, collagenogenesis, neovascularization, and increase in tension force.[26]

The low-power laser stimulates cell membranes and mitochondrias, inducing cellular biomodulation. It is indicated for pathological pictures in order to accelerate the process of tissue repair and decrease acute or chronic edematous and algic pictures. Laser beams have primary and secondary effects when they are absorbed by the tissues.[21] The primary effects are biochemical, bioelectrical and bioenergetic. Biochemical effects consist of releasing preformed substances such as histamine, serotonin and bradykinin, which will stimulate the production of ATP and the inhibition of prostaglandins production. The bioelectrical effect comprises the improvement of the sodium-potassium pump function, responsible for the maintenance of the cell membrane potential and the increase of ATP production. Finally, the bioenergetic effect is the energetic normalization of the bioplasma.

The side-effects consist primarily in local circulation through the biochemical effect of histamine release and increased cell tropism, due to the bioelectric effect of increased ATP production, mitotic speed and tissue repair. As a result of all the effects produced, the low-power laser eventually has a supporting role in the healing process.

Healing includes integrated action of cells, matrix, and chemical messenger in order to restore the integrity of the tissue as soon as possible. The repair is not a simple linear process in which growth factors trigger cellular proliferation, but the integration of dynamic processes that include soluble mediators, figurative elements of the blood, extracellular matrix production, and parenchymatous cells. Proper vascularization and the importance of perfusion and oxygenation are indispensable factors for healing to occur.

The application of low-power laser has been positive in the inflammatory stage and tissue repair stages. Cellular photobiomodulation occurs, i.e., growth factors and reduction of the number of inflammatory cells take place at the same time. Thus begins the second stage called proliferative, in which the neoformation of blood vessels occurs due to photostimulation of endothelial cells, proliferation of fibroblasts and consequent deposition of collagen. Thereby, the formation of granulation tissue for effective wound contraction is stimulated.[21] The remodeling of the wound is the last stage of the healing process. This is constituted by the reorganization of the blood vessels and collagen fibers. In addition to increase the proliferation of fibroblasts in the wound bed, low-power laser therapy also causes a significant angiogenesis increase.[27]

A schema for dose criteria employed in low-power laser application depends on the clinical situation.[19] The uses are: doses of 2 to 4 joules for analgesic effect; doses of 1 to 3 joules for anti-inflammatory and circulatory effect; and doses of 3 to 6 joules for healing effect. The same author also describes the type of dosage according to the stage of the ulcer. Low doses of 1 to 3 joules are used for acute ulcers, medium doses of 3 to 4 joules for subacute ulcers, and high doses of 5 to 7 joules for chronic ulcers. A dose of 5 joules was used in the clinical cases assessed in the present study, obtaining a satisfactory result in the healing process. This fact demonstrates the suitability of the dose for the characteristics of the ulcers.

Disabling factors can be observed in individuals afflicted by leprosy, which is an infectious and contagious chronic disease that mainly affects the peripheral nerves responsible for the motor and sensory stimulus conduction that enables the function of upper and lower limbs. These disabilities can lead to

disadvantages which are characterized by differences in the individual capacity to accomplish the expectations of society in relation to the individual, representing thus the socialization of the disability and its difficulties. With this, individuals with physical disabilities caused by ulcers—such as amputations or deformities—are subject to prejudice and some form of exclusion.

It is possible to observe that working with a multiprofessional team is an important strategy for the reorganization of the work processes in healthcare. It provides patients a comprehensive and resolutive approach, which requires concomitant changes in work organization, training, and professional qualification.[28]

It is worth noting that the effects of using different dressings associated with laser from the first applications were satisfactory, together with the team's guidelines regarding the care provided to the affected areas and general health of the patients. This way, the sum of technologies, skills and knowledge was positive.

It should also be noted that the approach of multidisciplinary teams that work in the prevention and treatment of wounds must be global. In this way, the interaction of the multiprofessional team caring for patients with wounds is of substantial importance for successful treatments.

CONCLUSION

In this study, it was possible to observe a satisfactory evolution in patients with neurotrophic ulcers. There was a significant increase of granulation tissue in the wound, possibly stimulated by laser radiation. This procedure increases the proliferation of fibroblasts and consequent release of collagen and elastic fibers. At the same time, it stimulates neoangiogenesis in the wound bed, thus aiding in the healing process.

The results obtained corroborate the viability of using low-power laser as adjuvant in the healing process. It enables faster healing of neurotrophic ulcers when associated with other dressing types. Although studies available to the scientific community have demonstrated that the low-power laser is a viable resource, pointing to the rapid improvement in the treatment of neurotrophic ulcers, these studies are still scarce. Therefore, further research with methodological strictness and control of different variables, such as case control that assess the effect of low-power laser on neurotrophic ulcers healing, need to be conducted, in order to reinforce/confirm the beneficial effects of this technology for this type of ulcers and other types.

REFERENCES

1. Penna GO, Domingues C, Siqueira Jr JB, Elkhoury ANSM, Cechinel MP, Grossi MAF et al. Dermatological diseases of compulsory notification in Brazil. Anais brasileiros de dermatologia 2011;86(5):865-77. http://www.ncbi.nlm.nih.gov/pubmed/22147024

2. Gomes FG, Frade MAC, Foss NT. Úlceras cutâneas na hanseníase: perfil clínico-epidemiológico dos pacientes. Anais Brasileiros de Dermatologia[Internet] 2007 [cited 2013 Jan 20]; 82:433-37. Available from: http://www.scielo.br/pdf/abd/v82n5/a06v82n05.pdf

3. Brasil, Saúde Md, Saúde FNd. Guia de controle da hanseníase. 2nd ed. Brasília: MS/FNS/CENEPI/CNDS; 1994:156.

4. Brasil, SES/SESMG. Como conhecer e tratar Reações Hansênicas. Belo Horizonte: Coordenadoria Estadual de Dermatologia Sanitária; 2005.

5. Véras LST, Vale RGdS, Mello DBd, Castro JAFd, Dantas EHM. Avaliação da dor em portadores de hanseníase submetidos à mobilização neural. Fisioterapia e Pesquisa [Internet] 2011 [cited 2013 Jan 20];18:31-36. Available from: http://www.revistas.usp.br/fpusp/article/download/12232/14009

6. Saúde Md. Guia de Vigilância Epidemiológica. In: Saúde Md, editor. Brasília; 2010.

7. Pimentel MIF, Nery JAC, Borges E, Gonçalves RR, Sarno EN. O exame neurológico inicial na hanseníase multibacilar: correlação entre a presença de nervos afetados com incapacidades presentes no diagnóstico e com a ocorrência de neurites francas. Anais Bras Dermatol [Internet] 2003 [cited 2013 Jan 20]; 78(5):561-8. Available from: http://www.scielo.br/pdf/abd/v78n5/17553.pdf.

8. Brasil. Cadernos de prevenção e reabilitação em hanseníase. 3 ed. Brasília: Ministério da Saúde/ Secretaria de Vigilância em Saúde/ Departamento de Vigilância Epidemiológica; 2008.

9. Campanelli F. Efeitos da radiação ultra-sônica pulsada e de baixa intensidade sobre o mal perfurante plantar (MPP), manifestação cutânea decorrente da Hanseníase [Dissertação de Mestrado]. Universidade de São Paulo; 2011.

11. Véras LST, Vale RGdS, Mello DBd, Castro JAFd, Lima V, Trott A, et al. Degree of disability, pain levels, muscle strength, and electromyographic function in patients with Hansen's disease with common peroneal nerve damage. Revista da Sociedade Brasileira de Medicina Tropical [Internet] 2012 [cited 2013 Jan 20];45(3):375-79. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0037-86822012000300018.

12. Lustosa AA, Nogueira LT, Pedrosa JIS, Teles JBM, Campelo V. The impact of leprosy on health-related quality of life. Revista da Sociedade Brasileira de Medicina Tropical [Internet] 2011 [cited 2013 Jan 20];44(5):621-266. Available from: http://www.scielo.br/scielo.php?pid=S0037-86822011000500019&script=sci_arttext.

13. Nunes JM, Oliveira EN, Vieira NFC. Hanseníase: conhecimentos e mudanças na vida das pessoas acometidas. Ciência & Saúde Coletiva [Internet] 2011 [cited 2013 Jan 20];16:1311-186. Available from:

14. Martins BDL, Torres FN, Oliveira MLW-D-Rd. Impacto na qualidade de vida em pacientes com hanseníase: correlação do Dermatology Life Quality Index com diversas variáveis relacionadas à doença. Anais Brasileiros de Dermatologia 2008;83:39-43.

15. Bajay HM. Manual de tratamento de feridas. In: Campinas UEd, editor. São Paulo: Hospital das Clínicas. Grupo de Estudos de Feridas; 2006:79.

16. Corazza AV. Fotobiomodulação comparativa entre LASER e LED de baixa intensidade na angiogênese de feridas cutâneas de ratos [dissertação]. Universidade de São Paulo/USP; 2005.

17. Declarationof Helsinki. Ethnical principles of medical reseach involving human subjects. In: Association WM, editor. Seoul: General assembly; 2008.

18. Santos VLCG, Azevedo MAJ, Silva TS, Carvalho VMJ, Carvalho VF. Adaptação transcultural do Pressure Ulcer Scale for Healing (PUSH), para a língua portuguesa. Rev Latino-am Enfermagem [Internet] 2005 [cited 2013 Jan 20];13(3):305-13. Available from: http://www.revistas.usp.br/rlae/article/viewFile/2086/2171.

19. Colls J. La terapia Laser hoy. Barcelona: Centro documentacion Laser de Meditec, 2003.

20. Tavares MR, Mazzer N. Efeito do laser terapêutico na cicatrização tendinosa: estudo experimental em ratos [Dissertação]. Universidade de São Paulo; 2002.

21. Souza K, Lucena ACT, Nascimento AC, Araújo A. O uso do laser de InGaP de 670 nm na cicatrização de úlceras de perna em pacientes com anemia falciforme. 1999:1-10.

22. Sandoval-Ortiz MC. LASER de baixa intensidade: princípios e generalidades: Parte 1. Fisioterapia Brasil [Internet] 2001 [cited 2013 Jan 20];6(1):2(1):221-40. Available from: http://www.proec.ufla.br/conex/ivconex/arquivos/trabalhos/a143.pdf.

23. Karu T. Photobiology of low-power LASER therapy. London: Harwood Academic Publishers, 1989.

24. Fuirini NJ. Utilização do laser He-Ne em cicatrização de úlceras rebeldes. Fisioterapia em Movimento [Internet] 1993 [cited 2013 Jan 20];6(1):9-15. Available from: http://www.bib.unesc.net/arquivos/60000/60700/11_60793.htm.

25. Arantes CVA. Fisioterapia preventiva em complicações de úlcera de membros inferiores. Fisioterapia em movimento [Internet] 1991/1992 [cited 2013 Jan 20];1(2):17-66. Available from: http://www.bib.unesc.net/arquivos/60000/60700/11_60721.htm

26. Imbramed. Manual de operações - aparelho laserpulse. São Paulo: Amparo; 2010.

27. Maffei FHA. Doenças vasculares periféricas. São Paulo: MEDSI; 2002.

28. Ferreira RC, Varga CRR, da Silva RF. Trabalho em equipe multiprofissional: a perspectiva dos residentes médicos em saúde da família. Ciência e Saúde Coletiva, Brasil [Internet] 2009 [cited 2013 Jan 20];14:1421-28. Available from: http://www.readcube.com/articles/10.1590/S1413-81232009000800015?locale=en

Submission: 2013/02/15
Accepted: 2014/03/17
Publishing: 2014/05/01

Corresponding Address

Jardênia Maçal de Oliveira
Rua Ester Borges Bastos, s/n
Bairro Jaguaribe
CEP: 58015-270 — João Pessoa (PB), Brazil