fizjoterapia polska

POLISH JOURNAL OF PHYSIOTHERAPY

OFICJALNE PISMO POLSKIEGO TOWARZYSTWA FIZJOTERAPII

THE OFFICIAL JOURNAL OF THE POLISH SOCIETY OF PHYSIOTHERAPY

NR 4/2019 (19) KWARTALNIK ISSN 1642-0136

Wieloprofilowe usprawnianie dziecka z rozpoznanym zespołem dysmorficznym uwarunkowanym heterozygotyczną mutacją w genie ZMIZ1

Multi-profile rehabilitation of a child with diagnosed dysmorphic syndrome conditioned by heterozygous mutation in the ZMIZ1 gene

Fizjoterapia u chorych po zawale serca

Physiotherapy in patients after myocardial infarction

fizjoterapia polska
nr 4/2019 (19)

Efficacy of Low Level Laser Therapy versus Therapeutic Ultrasound on Pediatric Post Burn Hypertrophic Scars: A Scar Split Study

小剂量激光疗法和超声波治疗对小儿烧伤后肥厚性疤痕的疗效：疤痕分裂研究

Khaled M. Hassan[1(A,B,C,D,E,F,G)], Roshdy M. Kamel[2(A,B,C,D,E,F,G)], El-Sayed S. Mehrem[3(A,B,C,D,E,F)], Mahmoud H. Mohamed[4(A,B,C,D,E,F)], Hussein G. Mogahed[5(A,B,C,D,E,F)]

[1]Faculty of medicine, Minia University, Egypt
[2]Department of Basic Science, Faculty of Physical Therapy, Deraya University, Minia, Egypt
[3]Department of Physical Therapy for Pediatrics, Faculty of Physical Therapy, Deraya University, Minia, Egypt.
[4]Department of Physical Therapy for Integumentary, Faculty of Physical Therapy, Deraya University, Minia, Egypt.
[5]Department of Physical Therapy for Surgery, Faculty of Physical Therapy, Cairo University, Giza, Egypt

Abstract

Background. The treatment of scars caused by burn is a difficult challenge in developing countries that includes enormous treatment cost. Burn scars tend to get worse with hypertrophy and contracture, leading to limitations of function. This study aimed to compare the efficacy of low-level laser therapy (LLLT) to therapeutic ultrasound (US) on hypertrophic scar in pediatric burns. Methods. 45 children participated in the study, their age ranges from 12 to 15 years of age, suffering from hypertrophic scars. Each scar divided to 2 identical halves. One half received (LLLT) with deep friction massage and the other received therapeutic ultrasound with deep friction massage. Participants were assessed pre & post two months of study by Ultrasonography and Vancouver Scar Scale. Results. Significant improvement was reported in both halves of scar but laser was more effective in decreasing scar height, and lowering Vancouver scale score ($p < 0.0001$). Conclusion. LLLT and US are proficient and secure modalities for post-burn hypertrophic scars treatment in children.

Key words:

Hypertrophic Scars, LLLT, US and children

摘要

背景。烧伤疤痕治疗在发展中国家是项艰巨的挑战，包括庞大的治疗费用在内。肥厚和挛缩会使烧伤疤痕恶化，导致功能受限。本研究旨在比较小剂量激光疗法（LLLT）与超声波治疗（US）对小儿烧伤肥厚性疤痕的疗效。方法。45 名年龄在 12 至 15 岁间有肥厚性疤痕的儿童参与研究，每道疤痕分成相同的两半，其中一半接受小剂量激光疗法和深摩擦按摩，另一半接受超声波治疗和深摩擦按摩。参与者在两个月研究的前后时期接受超声诊断和温哥华瘢痕量表的评估。结果。根据报告，疤痕的两半都有显著改善，然而激光在降低疤痕高度和减少温哥华瘢痕量表评分上更为有效（$p < 0.0001$）。结论。小剂量激光疗法与超声波治疗为小儿烧伤后肥大性疤痕治疗有效且安全的方法。

关键词：

肥大性疤痕、小剂量激光疗法、超声波治疗和儿童

Introduction

Scars cause functional, esthetic and emotional issues to the affected patients, as well as being bad permanent reminders of upsetting events behind them. Patients with hypertrophic scars have a compromised life quality with physical, psychological, and social problems. Some scars heal quickly and others are transformed into massive hypertrophic scars or keloids. These hypertrophic scars usually need to be treated for several months or years, leading to significant functional, cosmetic and psychological problems [1].

Wounds often heal with red and raised scar tissue then become planner and pale. During healing if wound is exposed widely to tension it becomes thick and rigid, known as hypertrophic scars (HS). HS are raised, erythematous dermal fibro-proliferative disorders distinct to humans that occur following inflammation, surgery, burns, trauma, and don't spread beyond wound boundaries [2]. In hypertrophic scars, epidermis is thicker and more rigid than that of normal skin and islands composed of fibroblasts, blood vessels and collagen fibers are seen within the dermis. Collagen and extracellular matrix component which are important for fibril developing and alignment of collagen fibrils are in excess and differential deposition which shows high amounts of collagen and its cross linkage in these abnormal scars [2].

Hypertrophic scars lead to adverse physical, cosmetic, psychological and social problems. Physical problems include itching, pain, stiffness; scar contractures and tenderness while psychosocial include decreased self-esteem, stigmatization, anxiety, disruption of daily activities and depression [3]. There are many classical treatments and preventive measures for hypertrophic scars, such as pressure garments, manual massage therapy, corticosteroid injections, silicone gel sheets, laser therapy and light emitting diodes, Fluorouracil (5-FU), cryotherapy, interferon, bleomycin, imiquimod 5% cream, and surgical interventions [4].

New advances in laser and technique refinements have made low level laser therapy one of the most efficient modalities for treatment of hypertrophic scars. The application of photobiomodulation [PBM] as a therapeutic method has grown significantly last year leading to enhancement of the treatment of many dermatological conditions. Being a promising technique, it has been used for refinement of skin scars' appearance leading to improving in body functions [5].

Laser with energy density 16 J/cm^2 could suppress hypertrophic scar with DNA damage. The effect on fibroblasts, during wound healing by PBM, should point to find a wavelength that has an inhibitory effect in the treatment of hypertrophic scar [6]. Significant effects of therapeutic ultrasound on hypertrophic scar tissues are well known. In the tissue repair phase of wound healing therapeutic ultrasound enhances the extensibility of mature collagen, which is found in scar tissue. This is due to promoting the re-orientation of the collagen fibers which leads to greater elasticity without loss of strength [7]. So, the aim of this study was primarily to compare between the effectiveness of PBM and ultrasound on burn scar tissue in children.

Materials and Methods

For this study, forty-five of either gender subjects with hypertrophic scar participated in the study, their age range from 12 to 15 years. Every patient was subjected to a detailed history taking and medical examination by a plastic surgeon. The selected treatment protocol discussed with the children's parents, and written informed consent obtained. Subjects were referred to physical therapy outpatient clinic, faculty of physical therapy, Deraya University from Plastic surgery and general surgery departments of Minia hospital as well as outpatient clinic, faculty of physical therapy, Cairo University.

Subjects having keloid, infected scar, immunodeficiency, diabetes, unstable heart disease and general or local contraindications for ultrasonography were skipped. In addition, patients with history of photosensitivity and those with history of the use of any other treatments for the scar in the past 4 weeks prior to the initiation were also avoided. Ethical approval was obtained from Research Ethics Committee, Faculty of Medicine, Minia University with number 192: 4/2019

Outcome measure

Superficial ultrasonography was used to determine skin thickness. Clinical assessment of scar was done using the Vancouver Scar Scale (VSS) grading system. It assesses the skin pigmentation, vascularity, pliability and thickness. The Scale is the most recognized scar assessment method and a widely applicable scale to evaluate therapy and as a measure of outcome in burn studies [8]. Each scar is evaluated before the treatment (pre-test) and 2 months after treatment (post-test).

Intervention

Ga-As low-level laser Giotto MED SPA—Italy, using following parameters: wavelength 905 nm, energy density 16.2 J/cm2, pulsed mode with frequency 3000 Hz, and a peak output power 30 W [9]. Technique of application was circular cluster probe containing three output beams each produce power of 30 W. The treatment duration varied with the size of the scar. Treatment interval was twice per week for 2 months. The other half received therapeutic ultrasound [3MHz, intensity 1.0 - 1.5W/cm^2], duration 10 minutes' continuous mode, three times a week for 2 months.

Statistical analysis

This was done using SPSS, version 20 for Windows; SPSS Inc., Chicago, Illinois, USA. Descriptive statistics for the dependent variable were calculated as minimum, maximum, mean, and standard deviation. Recorded data were examined for normality using Kolmogorov Smirnov normality test. Dependent t-test was used to compare between pre & post treatment values in the same group. Un-dependent t-test was conducted for comparing the pre & post treatment results between groups. The alpha level of significance (α) was set less than 0.05.

Results

As presented in table [1], descriptive statistics for the dependent variable were calculated as minimum, maximum, mean, and standard deviation.

Table 1. Personal characteristics of patients

	Minimum	Maximum	Mean	SD
Age [years]	12	15	13.38	1.19
Weight [kg]	28	50	36.84	4.64
Height [cm]	1.2	1.55	1.41	0.87
BMI [kg/m^2]	12.98	25.6	18.75	3.09

As shown in table [2], dependent t test revealed that US and deep friction massage have significant effect on scar thickness and VSS ($P < 0.05$). In addition, dependent t test revealed that LLLT and deep friction massage have significant effect on scar thickness and VSS ($P < 0.05$). Regarding pre-treatment data, Un- dependent t test revealed no statistically significant difference between groups ($P > 0.05$). Moreover, Post-treatment results showed statistically significant dif¬ference between groups regarding Scar thickness and VSS ($P < 0.05$).

Table 2. Descriptive statistics and post hoc tests for parameters for both groups

	LLLT with deep friction massage		Ultrasound With deep friction massage	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
Scar thickness	6.87 ± 1.11	3.9229 ± 0.8645	6.8267 ± 1.881	5.4762 ± 1.006
VSS	12.78 ± 1.04	8.27 ±0.91	12.78 ± 1.04	10.44 ± 0.92
P value [within group] Paired t test	**Scar thickness**		**VSS**	
LLLT with deep friction massage	0.0001		0.0001	
Ultrasound With deep friction massage	0.0001		0.0001	
P value [between groups] Unpaired t test	**Scar thickness**		**VSS**	
Pre treatment	0.841		0.999	
Post treatment	0.0001		0.0001	

Significant at the alpha level ($p < 0.05$)

Discussion

Development of post-operative scars is uncertain, and the main aim of physicians and patients is to minimize scar appearance as even minimal improvements in scar are valuable [6]. Regarding Scar thickness and VSS results, it was found that ultrasound with deep friction massage, and LLLT with deep friction massage were effective in decreasing thickness of scar, and lowering Vancouver score. Moreover, LLLT with deep friction massage was more effective than ultrasound with deep friction massage as there is a statistically significant dif¬ference between groups ($P < 0.0001$). Ultrasound is used in management of multiple conditions [10], such as in the reduction of edema, accelerating wound repair, subsiding pain and improve scar formation. Consequentially, a demonstrable elevation in tissue temperature associated with improved blood flow following ultrasonic irradiation may produce desirable effects, such as enhanced cellular activity, increased strength and elasticity in collage nous structures and consequently, reduced joint stiffness [11]. Low level lasers have been shown to enhance therapeutic effects in wound healing. However, there are few studies examined the inhibitory effect of LLL on hypertrophic scar [12]. The results of this study are consistent with a study analyzed the effect of LLLT compared to ultrasound therapy for 12-week treatment on scars thickness and VSS. The study clearly showed that both LLLT and

US therapy had beneficial effect on burn hypertrophic scars but LLLT was more effective than US therapy. In general, the studied area of the scars became softer. The scar appearance was measured using the Ultrasonography and VSS [8].
The Vancouver scale scores significantly decreased in the two areas after treatment for three months indicating a change due to natural tissue repair process as the maturation phase of tissue repair may last up to 2 years [13].
However, when comparing the mean values of VSS total score post-treatment of both modalities, there was a significant decrease in the LLLT with deep friction massage area than that of US therapy with deep friction massage area indicating clear effect of LLLT despite the normal remodeling process. Also, the mean values of Ultrasonography results of the two methods confirmed the above finding.
The results of VSS in the present study were supported by the result of a case report conducted by [14]. The study presented pleasing outcomes measured by using VSS after three months of treatment using different types of LLL (Ga-Al-As, He-Ne as well as LED). Patient's response to the treatment was significant and elasticity raised up to 50%, the thickness of the hypertrophic scar decreased up to 90% in marginal area and up to 50% in central zone and hyperpigmentation decreased by 100%.
In this study, Energy density of 16 J/cm^2 was used illustrating mitochondrial activity of fibroblasts in normal and injured human skin following LLL application [15]. They found that the irradiation with 5 J/cm^2 showed an improve in mitochondrial responses when compared with non-irradiated cells while irradiation with 16 J/cm^2 showed a significant inhibition in proliferation whereas cell damage or cytotoxicity by LDH was increased.
Cultured skin fibroblasts irradiated with low-level laser of 632.8, 830, and 1064 nm with a fluency 16 J/cm^2 showed increased apoptosis and improved cellular viability. Scar thickness was measured by using high frequency ultrasound that assesses the distance to the surface of the scarred skin and in-depth fibrosis [16]. In fact, the decreased thickness on the studied area may be explained by a reduction in myofibroblasts' density and an extracellular matrix alteration [13].

Conclusion

The findings of this study indicated considerable changes that occurred to the scar over time due to natural wound healing process and the remodeling phase of wound healing that may last up to 24 months. We used Vancouver Scar Scale for clinical evaluation of scar and ultrasonography for objective measurements of scar thickness. There were clear differences between the two halves of the hypertrophic scar indicating the more beneficial effect of LLLT (905 nm–16 J/cm^2) over Ultrasound therapy (3 MHz, intensity 1.0 - 1.5 W/cm^2), continuous mode. The study suggests that a planned regime of treatment with LLLT can has a significant benefit for a large proportion of patients during the post-burn rehabilitation stage.

Adres do korespondencji / Corresponding author

Mahmoud H. Mohamed

E-mail: mahmoud.hamada78@yahoo.com

Piśmiennictwo/ References

1. Ault P., Plaza A. and Parat J; Scar massage for hypertrophic burn, 2018: 44 [1]: 24-38.
2. Patterson JW., Weedon's skin pathology. 4thedition. Churchill living stone;[2016].
3. Bakker, A., Maertens, K. J., Van Son, M. J., & Van Loey, N. E. [2013]. Psychological consequences of pediatric burns from a child and family perspective: A review of the empirical literature. Clinical psychology review, 33[3], 361-371.
4. Arno A.I., Gauglitz G.G., Barret J.P. and et al.,: Up-to-date approach to manage keloids and hypertrophic scars: a useful guide. Burns 2014 Nov; 40[7]: 1255–1266. Published online 2014 Apr 24. https://doi.org/10.1016/j.burns. 2014.02.011
5. Tripathi P., Nelson S. and Wong B. J. Posttraumatic Laser Treatment of Soft Tissue Injury, 2017: 25 [4]: 617-628.
6. Gauglitz GG., [2013]. Management of keloids and hypertrophic scars: current and emerging options. Clin Cosmet Investig Dermatol 6:103
7. McKinnis, L. N. [2013]. Fundamentals of musculoskeletal imaging. FA Davis.Pg; 90.
8. Hu, M. S., Zielins, E. R.; Longaker, M. T., Lorenz, H. P. [2017]; Assessing scars: Plastic Surgery: Volume 1: Principles, 14, 196-213.e3.
9. Alsharnobi J. and Mohamed O. [2018]. Photo bio-modulation effect on children 'scar 33:497-501.
10. Robertson VJ, Baker KG. A review of therapeutic ultrasound effectiveness studies. Phys Ther. 2001; 81:1339-50.
11. Warden, S.J., McMeeken J.M., ultrasound usage and dosage in sports physiotherapy. Ultrasound in Medicine and Biology, volume 28, p 1057-80, 2002.
12. Marques NCT, Neto NL, Prado MTO, and et al [2017] Effects of PBM in different energy densities and irradiance on maintaining cell viability and proliferation of pulp fibroblasts from human primary teeth. Lasers Med Sci 32[7]:1621–1628
13. Freitas CP, Melo C, Alexandrino AM, Noites A [2013] Efficacy of low-level laser therapy on scar tissue. J Cosmet Laser Ther 15:171– 176
14. Moravvaej H, Daneshvar L, Saeedi M, Barzegar MR [2011] Treatment of a pigmented hypertrophic scar by low-level laser therapy [LLLT]: a case report. J Lasers Med Sci 1[1]:35–38
15. Zungu IL, Hawkins E.D., Abrahamse H [2009] Mitochondrial responses of normal and injured human skin fibroblasts following low level laser irradiation—an in vitro study. Photochem Photobiol 85[4]:987–996.
16. Brusselaers N, Pirayesh A, Hoeksema H, and et al, [2010] Burn scar assessment: a systematic review of objective scar assessment tools. Burns 36:1157–1164.