Low Level Laser Therapy and Its Efficacy on Wound Healing and Pain Relief after Vaginal Delivery with Episiotomy

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ABSTRACT

This study was conducted to determine the efficacy of low level laser therapy (LLLT) on wound healing and pain relief after vaginal delivery with episiotomy. Thirty women (primipara) having episiotomy were participated in this study. Their age ranged from 20-35 yrs. They were recruited from the inpatient department of Obstetrics and Gynaecology of EL Galaa Teaching Maternity Hospital. They were divided into two groups (A and B) equal in number. Group A (study group) received 4 sessions of low level laser therapy on perineal incision (2 sessions per day for 2 days) with wavelength 670 nm, pulse width 450 microseconds, power 200 mw, pulse frequency 1000 Hz and duration 1.5 min/cm^2 and they received the prescribed dose of non steroidal anti-inflammatory drug. While group B (control group) received the same dose of non steroidal anti-inflammatory drug as group (A). Evaluation was done by using PPi scale immediately after episiotomy, and after 24, 48 hrs from episiotomy as well as assessment of basal cell density (BCD) and proliferation Marker Ki-67 after 3 weeks of episiotomy. The results of this study showed that there was no significant difference (P> 0.05) in pain level immediately after episiotomy between both groups (A and B), but there was a statistically highly significant decrease (P< 0.001) in pain level after 24 and 48 hrs after episiotomy for both groups (A and B), with more decrease favouring group (A). Also there was a statistically highly significant increase (P< 0.001) in basal cell density (BCD) level and in proliferation marker Ki-67 in group (A) in comparison to group (B), and the collagen was dense and parallel in group (A), while it was dense and non parallel in group (B) which indicate better collagen arrangement in group (A) so it could be concluded that low level laser therapy is considered as one of the efficient alternative methods in accelerating wound healing and pain relief after episiotomy.
Key words: *Low level laser therapy, pain, wound healing, episiotomy.*

INTRODUCTION

Episiotomy is an incision in the perineum that enlarges the vaginal opening for birth[1]. It is usually advised in vaginal deliveries to reduce resistance and the length of the second stage[4], as perineal trauma at the time of delivery can result in dyspareunia and perineal pain[18]. Also it is used to prevent ragged tearing of tissues during delivery[1].

Swelling and bruising which follow an episiotomy produce a degree of pain for women, interfering with their ability to move easily and sit comfortably during breast feeding. So laser has been used in some centers to promote perineal healing and relieve pain[11].

Episiotomy is also a major risk factor for infection, loss of sexual pleasure, and incontinence. Women who have been subjected to episiotomies take longer to heal from delivery, even compared to women who have equivalent tears[7]. Several side effects of episiotomy have been reported, including infection, increased pain, prolonged healing

time and increased discomfort once sexual intercourse is resumed[10].

Episiotomy is suitable for studying healing, since this is a short wound (of about 3-5 cm) exposed to adverse conditions and subject to easy infection, bruising, and frequently occurring hematomas[9].

The complications of women after delivery, who were not treated with any form of phototherapy were essentially more severe (complete decay with resuture, subcutaneous and cutaneous adhesion with purulent secretion), and they started to occur most frequently in the 4th day after the delivery. The treatment typically consists of pharmacotherapy and bathing. The result of these procedures is usually a keloid scar, which is unpleasant to the woman and which must sometimes solved by a plastic surgery intervention[9].

Low level laser therapy (LLLT) is now considered as an effective way to treat a variety of soft tissue injuries, painful conditions, bad healing wounds and inflammation[2]. It has a positive biomodulatory effect on the repair of cutaneous wounds as it increases collagen production and organization[12].

Laser therapy is an effective tool for promoting wound repair as it has significant positive effects on specific indices of healing, for example, acceleration of inflammation, augmentation of collagen synthesis, increased tensile strength, reduced healing time and diminution of wound size[21].

It was reported that using a therapeutic laser at energy of 2 J/cm^2 resulted in high healing rate of episiotomies with minimum secondary complications[9].

The purpose of this study was to determine the efficacy of LLLT on wound healing and pain relief after episiotomy.

SUBJECTS, MATERIAL AND METHODS

Subjects

Thirty primipara women having episiotomy (medio lateral episiotomy), were participated in this study. They were recruited from the in patient department of Obstetrics and Gynaecology of El-Galaa Teaching Maternity Hospital. Their age ranged from 20-35 years old. Subjects were classified into two groups equal in number, group A (study group) and group B (control group).

All patients were free from previous perineal scars due to previous operation and diabetes mellitus. Informed consent form had been signed from each subject before starting the study indicating her voluntary participation in this study.

Study group: "group A"

Composed of 15 subjects. They received 4 sessions of LLLT on the perineal incision (2 sessions per day for 2 days) with wavelength 670 nm, pulse width 450 microseconds, power 200mw, pulse frequency 1000 HZ and duration 1.5 min/cm^2 and they received the prescribed dose of non steroidal anti-inflammatory drug (50 mg Diclofenac for 3 times per day).

Control group: (group B)

Composed of 15 subjects they received the same dose of non-steroidal anti-inflammatory drug only as in group A.

Summary of subjects physical characteristics are summarized in table (1).

Table (1): Physical characteristics of both groups (study and control).

	Group (A)		Group (B)		P-value	Significance
	Mean	SD	Mean	SD		
Age (yrs)	24.8	±3.46	26.26	±4.00	> 0.05	NS
Weight (Kgs)	72.8	±10.76	73.40	±8.48	> 0.05	NS
Height (cms)	163.4	±6.85	162.13	±7.29	> 0.05	NS
BMI (Kg/m^2)	27.32	±4.26	27.93	±2.84	> 0.05	NS

Instrumentations

A) Evaluative instruments

Present pain intensity (PPi) scale: which is a graphic rating scale with numerical values placed equidistantly along aline. The descriptors and numbers help the subject to place her estimate on the line (0-4) fig. (1) (Prithvi, 1999)[15].

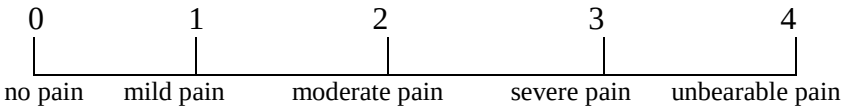

Fig. (1): Present Pain Intensity (PPi) scale.

B) Treatment instruments

Uni-laser^{TM} 201 unit. Continuous semiconductor laser class 3B (Ga AL As) wavelength: 670 nm frequency ranged from 1 to 1000 Hz, pulse width: 450 microseconds, power ranged from 1 mw to 2000 mw, dimensions 20 * 22 * 7 cms and weight about 3 Kg.

Procedures

A) Evaluative procedures

1- Personal data:

All data and information of each subject participated in this study were recorded in a recording sheet.

2- History taking:

A detailed, medical and gynaecological history was taken from each subject to confirm that the only cause of pain was episiotomy.

3-Pain assessment:

Assessment of pain intensity for each subject was done before starting the treatment and each session by Present Pain intensity PPi.

4- Pathological wound healing assessment:

Skin biopsy:

Skin biopsy was taken from each subject in both groups (study & control) by a 1 mm skin key punch biopsy after 3 weeks of episiotomy. Local anaesthetic spray (0.5-1 ml lignocaine 1 ± 2% adrenaline) was used prior to a single key punch biopsy performed perpendicular to the skin surface. Each subject's biopsy was coded so evaluation could be carried out blindly. The biopsy tissue was fixed in 4 % formalin, processed and embedded in paraffin. The following sections were prepared for:

1- Haematoxylin-eosin (H and E) and masson trichrome (M-T) stained sections for:

a) The evaluation of epidermal healing was through the evaluation of basal cell density (BCD). Basal cells were manually counted at high power (x400) in 3 High power field (HPF) and average counts were determined. Only the interfollicular epidermis was assessed and melanocytes present were excluded from the count.

b) The evaluation of dermal healing was through the evaluation of quality and arrangement of collagen.

2- Immunostained sections using proliferation marker Ki-67 as follows:

De-paraffinised samples were put into a plastic rack, placed in a trough containing 250ml of 10 mM citric acid (pH adjusted to 6.0 using 2 M sodium chloride) and microwaved at 750W three times (4-min pulses). They were then left to stand at room temperature for 10 min, before being washed in running tap water, rinsed in Tris buffer saline (TBS), drained and the section circled with a risen pen. DAKO Monoclonal Mouse Anti-Human Ki-67 Antigen (dilution range 1:75-1:150) was then applied. Next the slides were washed three times in TBS, Biotinylated anti-mouse antibody (diluted 1/4000) applied for 1 hr, washed a further three times in TBS and had AB Complex /Strept AB Complex applied for a further hour.

Following further washing in TBS, diaminobenzadine (DAB) solution was applied for 5min and the sections rinsed in distilled water, washed under a running tap and counterstained with haematoxylin for 60 s. They were then washed again, dehydrated and mounted in DPX.

The stained slides were analyzed at high power with manual counting. The total number of cells in the interfollicular basal and first suprabasal layers, termed the basal compartment, were counted and then the number of these cells that had clear-cut and strong nuclear staining for Ki-67was counted.

B) Treatment procedure

Low level laser treatment

Each subject was instructed briefly and clearly about the nature of LLLT and its value in controlling pain and promoting wound healing to gain her confidence and co-operation all through the study.

Each subject was positioned in crock lying with both knees apart from each others and the perineum exposed. The laser probe was held as close as possible to the target tissue without making skin contact. Irradiation occurred at 1 cm intervals along the episiotomy wound. Laser probe tip was cleaned by alcohol wipes before and after treatment. The wave length was 670 nm, pulse width was 450 microseconds, power was 200 mW and pulse frequency was 1000Hz.

Scanning was made by shifting the laser spot on wound edges and infiltrates seroma, and hematomas that located around wound edges, with exposition time of the field of 1.5 min[11].

Statistical Analysis

- Descriptive statistics was used for the collected data to calculate the mean and the standard deviation (SD) to estimate central tendency and homogeneity within variables of both groups.
- Paired t-test used to compare mean difference within each group to determine specific significant difference.
- Inferential statistical analysis was used in the form of independent t-test for comparing between the study and control groups.
- Significance level of 0.05 was used through out the entire statistical test within this study P–value < 0.05 indicated a significant result and P-value >0.05 indicated a non significant result[8].

RESULTS

As shown in table (2) and fig. (2), the mean values of PPi scales for group (A), immediately after episiotomy was (3.89

±0.21), after 24 hrs, it was (1.52 ±0.48) and after 48 hrs, it was (0.21 ±0.79) these changes revealed a statistically highly significant decrease (P< 0.001) of pain perception after 24 and 48 hrs from episiotomy.

While in group (B) the mean values of PPi scales immediately after episiotomy was (3.59 ±0.40), after 24 hrs from episiotomy it was (2.54 ±0.46) and after 48 hrs, it was (1.91 ±0.91).

These changes revealed a statistically highly significant decrease (P< 0.001) of pain perception after 24 and 48 hrs from episiotomy. Comparing between both groups (A and B) as shown in table (3), there was no significant difference (P > 0.05) in pain level immediately after episiotomy, but there was a statistically highly significant decrease (P< 0.001) in pain level after 24 and 48 hrs of episiotomy.

Table (2): Mean values of PPi scale in both groups (A and B).

	Group A			Group B		
	Immediately after episiotomy	After 24hrs	After 48hrs	Immediately after episiotomy	After 24hrs	After 48hrs
Mean	3.89	1.52	0.21	3.59	2.54	1.91
SD	±0.21	±0.48	±0.79	±0.40	±0.46	±0.91
P- Value	> 0.05	< 0.001	< 0.001	> 0.05	< 0.001	< 0.001
Significant	NS	HS	HS	NS	HS	HS

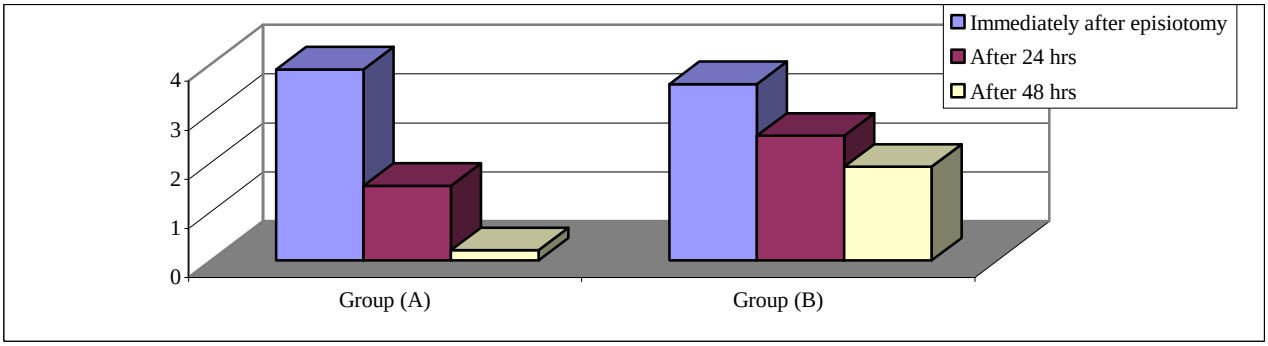

Fig. (2): Mean values of PPi scale immediately after episiotomy, after 24 hrs and 48 hrs for both groups (A and B).

Table (3): Mean values of PPi scale between both groups (A and B).

Present pain intensity	Immediately after episiotomy	After 24hrs	After 48hrs
Mean difference	0.30	1.02	1.70
P- value	> 0.05	< 0.001	< 0.001
Significance	NS	HS	HS

Assessment of wound healing according to:

a) Assessment of BCD level

As shown in table (4) and fig. (3) the mean values of BCD level was (61.00 ±8.20) for group (A), while it was (21.21 ±6.21) for group (B) with an increase in the mean difference of 39.79.

Comparing between both groups, the difference between them showed that there was a statistically highly significant increase (P< 0.001) in BCD level in group (A) in comparison to group (B) after 3 weeks of episiotomy.

Table (4): Mean values of BCD level for both groups (A and B) after 3 weeks of episiotomy.

	BCD level			
	Group A		Group B	
	Mean	SD	Mean	SD
	61.00	±8.20	21.21	±6.21
Mean diff	39.79			
t-value	6.31			
P-value	< 0.001			
Significance	HS			

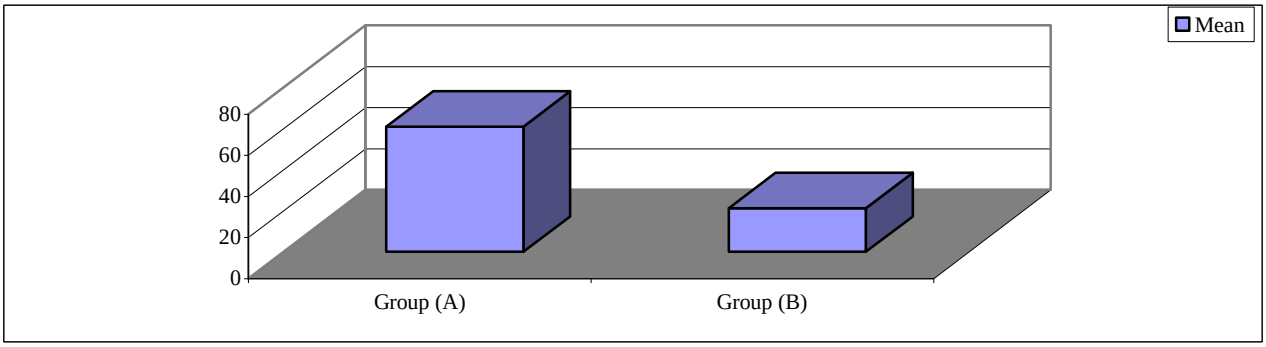

Fig. (3): Mean values of BCD level for both groups (A and B) after 3 weeks of episiotomy.

b) Assessment of proliferation marker Ki-67

As shown in table (5) and fig. (4) the mean values of the proliferation marker Ki-67 was (44.3 ±7.01) for group (A), while it was (19.75 ±3.21) for group (B) with an increase in the mean difference of 24.55 comparing between both groups, the difference between them showed that there was a statistically highly significant increase (P< 0.001) in the proliferation marker Ki-67 in group (A) in comparison to group (B) after 3 weeks of episiotomy.

Table (5): Mean values of proliferation Marker Ki-67 for both groups (A and B) after 3 weeks of episiotomy.

	Proliferation marker Ki-67			
	Group A		Group B	
	Mean	SD	Mean	SD
	44.30	±7.01	19.75	±3.21
Mean diff	24.55			
t-value	8.99			
P-value	< 0.001			
Significance	HS			

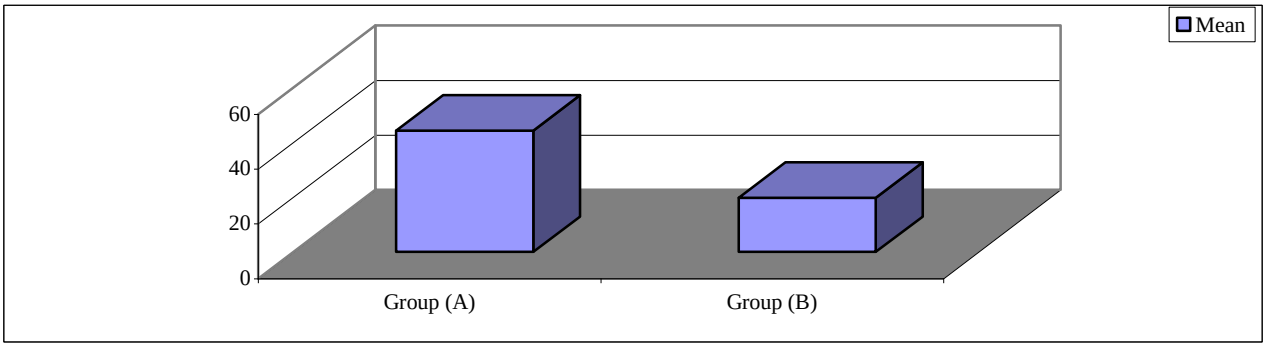

Fig. (4): Mean values of proliferation marker Ki-67 level for both groups (A and B) after 3 weeks of episiotomy.

c) Quality and arrangement of collagen

In group (A), the collagen was dense and parallel in all cases, while in group (B), the collagen was dense and non-parallel in all cases after 3 weeks of episiotomy.

DISCUSSION

Women undergoing episiotomy are characterized by greater blood loss in conjunction with delivery, and there is a risk of improper wound healing and increased pain during the early puerperium[6].

LLLT is non invasive, anti-inflammatory and analgesic treatment. It results in an increased fibroblast proliferation in vitro so it can postulate possible stimulatory effects on wound healing in vivo[20].

The results of this study showed:

A non significant difference (P> 0.05) in pain level immediately after episiotomy between both groups (A and B) while there was a highly significant decrease (P< 0.001) in pain level after 24 hrs and 48 hrs from episiotomy.

Most studies suggested that analgesic effect of low intensity laser therapy (LLLT) derives from the reestablishment of a balance in the gate- control system, therefore it normalize the speed of transmission, which is disturbed because of inflammation, by acting on the A-alpha-fibers rather than on the small-diameter C fibers[19]. Nerve conduction studies have consistently demonstrated that laser-mediated effects via its greatest increases in conduction latency "corresponding to decrease in conduction velocity" occur at radiant exposure of 1.5J/cm^2. Changes in nerve transmission rate particularly are mediated by the descending inhibitory pathway, accompanied by the active synthesis of endorphins and enkephalins[13].

Also, the results of this study showed a highly significant increase (P<0.001) in basal cell density (BCD) level and in proliferation marker Ki-67 in group (A) in comparison to group (B), and the collagen was dense and parallel in group (A), while it was dense and non parallel in group (B) after 3 weeks of episiotomy.

Histological and light microscopic cytomorphometric studies showed that the applied density of the power of laser irradiation of 90mW/cm^2 stimulated most actively the process of tissue repair in complicated operative wounds after obstetrico-gynaecologic surgery. A considerable slowing of the processes of tissue repair was

established after irradiation with densities of the power of 50 mW/cm^2 [3].

However, high healing effects with minimum secondary complications was demonstrated in the treatment of episiotomies using a therapeutic laser at energy density of 2 J/cm^2 [9].

It was reported that low frequency laser irradiation intensifies tissue reparative and fastens healing of wounds of anal canal and perineum[16].

Also, the results of this study agreed with that of Protsenko et al. (1998)[16] who reported that low frequency laser irradiation intensifies tissue reparative and fastens healing of wounds of perineum.

Also, Pinheiro et al. (2005)[14] proved that the use of 685 nm laser light with a dose of 20/cm^2 result in an increase of collagen deposition, and increase in the number of many fibroblast LLLT has a stimulatory action on metabolic process and cell proliferation, human tissue cultures showed significant increase in fibroblastic proliferation which are the precursor cells to connective tissue structures as well as increasing the intracellular material and swollen mitochondria of cells. Thus as laser increases procollagen production will enhance wound healing[17].

Accordingly, it could be concluded that LLLT is considered as one of the efficient alternative methods in accelerating wound healing and pain relief after episiotomy.

REFERENCES

1- Alexander, L., LaRosa, J. and Bader, H.: "Pregnancy and Childbirth"-"Sexual health", New Dimensions in Women's Health , 2nd ed , Jones and Bartielt publisher, Boston, 247-336, 2001.

2- Basford, M., Jeiffery, R., Malong, M., David, A. and Koruse, M.: "A randomized controlled education of low intensity laser therapy: Planter fasciitis", Arch. Phys. Med. Rehabil., 79: 249-254, 1998.

3- Burgudzhieva, T.: "The analgesic and resorptive laser therapy of wound infiltrates, seramos and hematomas in episiorrhaphy and perineorrhaphy", Akush Ginekol (Sofiia), 29(1): 36-39, 1990.

4- Creasy, R. and Iams, J.: "Preterm labour and delivery", In Creasy, R. and Resnik, R. (eds.), Maternal-Fetal Medicine, 4th ed., W.B. Saunders company, Philadelphia, 523, 1999.

5- Enwemeka, C., Parker, J., Dowdy, D. and Harkness, E.: "The efficacy of low-power lasers in tissue repair and pain control: a meta-analysis study", Photomed. Laser surg, 22(4): 323-329, 2004.

6- Haadem, K.: "Review of the literature on advantages and disadvantages: episiotomy: only limited protection against ruptures-time for a revision?", Lakartidningen, 95(40): 4354-4358, 1998.

7- Hartmann, K., Viswanathan, M., Palmieri, R., Garthehner, M., Thorp, J. and Lohr, N.: "Outcomes of routine episiotomy, A Systemic Review", Jama, 293: 2141-2148, 2005.

8- Ingelfinger, J., Moskeller, F., Thibo deau, L. and Wave, J.: "Biostatistics in clinical medicine", Mc Graw - Hill, Ine., New York, 120-140, 1994.

9- Kymplova, J., Navratil, L. and Knizek, J.: "Contribution of phototherapy to treatment of episiotomies", Clin. Laser Med. Surg., 21(1): 35-39, 2003.

10- Lydon-Rochelle, M., Albers, L. and Teaf, D.: "Perineal outcomes and nurse midwifery management", Journal of Nurse Midwifery, 40(1): 13-18, 1995.

11- Mc Lachlan, Z.: "Electrotherapy Options for the Perinatal Period and Beyound", In Sapsford, R.; Bullock- Saxton, J. and Markwell, S. (eds.), Women's Health A Textbook for Physiotherapists, 1st ed., W. B. Saunders Company, 296-298, 1998.

12- Mendez, T., Pinheiro, A., Pacheco, M., Nascimento, P. and Ramalho, L.: "Dose and wave length of laser light have influence on the

repair of cutaneous wounds", J. Clin. Laser Med. Surg., 22(1): 19-25, 2004.
13- Navratil, L. and Dylevsky, I.: "Mechanisms of the analgesic effect of therapeutic lasers in vivo study", Laser Therapy, 9: 33-40, 1997.
14- Pinheiro, A., Pozza, D., Oliveiva, H. and Weissmann, R.: "Polarized light (400-2000nm) and non – ablative laser (685 nm): a description of the wound healing process using immunohisto-chemical analysis, photomed Laser Surg., 23(5): 485-492, 2005.
15- Prithvi, R.: Pain Medicine Comprehensive, 2nd ed., Thorsons Company, California, 36-37, 1999.
16- Protsenko, L., Muradov, B., Maksimova, L., Titov, A. and Poletov, N.: "The treatment of wounds of the anal canal and perineum", Khirurgiia (Mosk), (8): 20-22, 1998.
17- Saliba, E. and Foreman, S.: "Types of Lasers and low Power Laser, In Prentice W. (ed), Therapeutic modalities for Allied Health professionals", Mc Graw-Mill USA, 320-337 and 313-335, 1998.
18- Santon, C.: "Consequences of Childbirth on the Pelvic Floor", In Studd, J. (ed.), Progress in Obstetrics and Gynaecology, Churchill Living Stone, Edinburgh, 137, 2003.
19- Tam, G.: "Low power laser therapy and analgesic action", J Clin Laser Med Surg, 17(1): 29-33, 1999.
20- Vinck, E., Cagnie, B., Cornelissen, M., Declercq, H. and Cambier, D.: "Increased fibroblast proliferation induced by light emitting diode and low power laser irradiation", Lasers Med. Sci., 18(2): 95-99, 2003.
21- Woodruff, L., Bounkeo, J., Brannon, W., Dawes, K., Barham, C., Waddell, D. and Enwemeka, C.: "The efficacy of laser therapy in wound repair: a meta-analysis of literature", Photomed. Laser Surg., 22(3): 241-247, 2004.

الملخص العربي

كفاءة الليزر منخفض الشدة علي التئام الجرح وتخفيف الألم بعد الولادة بشق العجان

الهدف من هذه الدراسة هو تحديد تأثير الليزر منخفض الشدة علي التئام الجرح وتخفيف الألم بعد الولادة بشق العجان . وقد شاركت في هذه الدراسة ثلاثون سيدة تم اختيارهن من القسم الداخلي لأمراض النساء والتوليد بمستشفي الجلاء التعليمي وتم تقسيمهن إلى مجموعتين متساويتين في العدد (مجموعة دراسة ومجموعة ضابطة) . وقد تلقت السيدات في مجموعة الدراسة (أ) علاج بالليزر منخفض الشدة علي شق العجان بعدد 4 جلسات (بواقع جلسريتين) في اليوم لمدة يومين وكان طول الموجة 670 نانومتر، عرض النبضة 450 ميكروثانية ، القوة 200 مللي وات ، التردد 1000 هرتز ومدة العلاج 1.5 دقيقة /سم2 بجانب جرعة العلاج من مضاد الالتهاب ، والمجموعة (ب) الضابطة تم علاجهن بنفس جرعة العلاج الدوائي من مضاد الالتهاب مثل المجموعة (أ) وتم تقييم كفاءة هذه الطريقة باستخدام مقياس شدة الألم مباشرة بعد الولادة بشق العجان وبعد 24 ، 48 ساعة من الولادة بشق العجان ، وأيضاً تقييم كثافة الخلية الأساسية ومحدد تكاثر الخلايا لالتئام الجرح بعد ثلاثة أسابيع من الولادة بشق العجان . وقد أسفرت نتائج هذه الدراسة عن عدم وجود فروق في شدة الإحساس بالألم بين المجموعتين (أ،ب) مباشرة بعد الولادة بشق العجان ، بينما كان هناك نقص ذو دلالة معنوية عالية في شدة الإحساس بالألم بعد 24 ، 48 ساعة من الولادة بشق العجان . أيضا أظهرت النتائج وجود زيادة ذات دلالة معنوية عالية في كثافة الخلية الأساسية ومحدد تكاثر الخلايا لالتئام الجرح في المجموعة (أ) مقارنة بالمجموعة (ب) بعد ثلاثة أسابيع من الولادة بشق العجان . أما الكولاجين فكان كثيف ومتوازي في المجموعة (أ) وكان كثيف وغير متوازي في المجموعة (ب) مما يدل علي ترتيب أفضل للكولاجين في المجموعة (أ) وهكذا يمكن أن نستخلص أن الليزر منخفض الشدة يعتبر احدي وسائل العلاج الطبيعي الفعالة في التئام الجرح وتخفيف الألم بعد الولادة بشق العجان .

الكلمات الدالة : الليزر منخفض الشدة – الألم – التئام الجرح – شق العجان .