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/cm² 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 birth¹. It is usually advised in vaginal deliveries to reduce resistance and the length of the second stage⁴, as perineal trauma at the time of delivery can result in dyspareunia and perineal pain¹⁸. Also it is used to prevent ragged tearing of tissues during delivery¹.

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 pain¹¹.

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 tears⁷. Several side effects of episiotomy have been reported, including infection, increased pain, prolonged healing
time and increased discomfort once sexual intercourse is resumed\textsuperscript{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\textsuperscript{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 4\textsuperscript{th} 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\textsuperscript{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\textsuperscript{2}. It has a positive biomodulatory effect on the repair of cutaneous wounds as it increases collagen production and organization\textsuperscript{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\textsuperscript{21}.

It was reported that using a therapeutic laser at energy of 2 J/cm\textsuperscript{2} resulted in high healing rate of episiotomies with minimum secondary complications\textsuperscript{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"
Compose 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\textsuperscript{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)
Compose 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).

<table>
<thead>
<tr>
<th></th>
<th>Group (A)</th>
<th>Group (B)</th>
<th>P-value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>24.8 ± 3.46</td>
<td>26.26 ± 4.00</td>
<td>&gt; 0.05</td>
<td>NS</td>
</tr>
<tr>
<td>SD</td>
<td>3.46</td>
<td>4.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>24.8</td>
<td>26.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (Kgs)</td>
<td>72.8 ± 10.76</td>
<td>73.40 ± 8.48</td>
<td>&gt; 0.05</td>
<td>NS</td>
</tr>
<tr>
<td>Height (cms)</td>
<td>163.4 ± 6.85</td>
<td>162.13 ± 7.29</td>
<td>&gt; 0.05</td>
<td>NS</td>
</tr>
<tr>
<td>BMI (Kg/m²)</td>
<td>27.32 ± 4.26</td>
<td>27.93 ± 2.84</td>
<td>&gt; 0.05</td>
<td>NS</td>
</tr>
</tbody>
</table>

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

B) Treatment instruments
Uni-laser™ 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-67 was 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 cooperation 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\(^1\).  

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 throughout 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

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±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).

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Immediately after episiotomy</td>
<td>After 24hrs</td>
</tr>
<tr>
<td>Mean</td>
<td>3.89</td>
<td>1.52</td>
</tr>
<tr>
<td>SD</td>
<td>±0.21</td>
<td>±0.48</td>
</tr>
<tr>
<td>P-Value</td>
<td>&gt; 0.05</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Significant</td>
<td>NS</td>
<td>HS</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Present pain intensity</th>
<th>Immediately after episiotomy</th>
<th>After 24hrs</th>
<th>After 48hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean difference</td>
<td>0.30</td>
<td>1.02</td>
<td>1.70</td>
</tr>
<tr>
<td>P- value</td>
<td>&gt; 0.05</td>
<td>&lt; 0.001</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Significance</td>
<td>NS</td>
<td>HS</td>
<td>HS</td>
</tr>
</tbody>
</table>

Fig. (2): Mean values of PPi scale immediately after episiotomy, after 24 hrs and 48 hrs for both groups (A and B).
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>
<thead>
<tr>
<th>Table (4): Mean values of BCD level for both groups (A and B) after 3 weeks of episiotomy.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BCD level</strong></td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>61.00</td>
</tr>
<tr>
<td>Mean diff</td>
</tr>
<tr>
<td>t-value</td>
</tr>
<tr>
<td>P-value</td>
</tr>
<tr>
<td>Significance</td>
</tr>
</tbody>
</table>

**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 (44.30 ± 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>
<thead>
<tr>
<th>Table (5): Mean values of proliferation Marker Ki-67 for both groups (A and B) after 3 weeks of episiotomy.</th>
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</thead>
<tbody>
<tr>
<td><strong>Proliferation marker Ki-67</strong></td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>44.30</td>
</tr>
<tr>
<td>Mean diff</td>
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<tr>
<td>t-value</td>
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<tr>
<td>P-value</td>
</tr>
<tr>
<td>Significance</td>
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</tbody>
</table>
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 puerperium⁶.

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 vivo²⁰.

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 fibers¹⁹. 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/cm². Changes in nerve transmission rate particularly are mediated by the descending inhibitory pathway, accompanied by the active synthesis of endorphins and enkephalins¹³.

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/cm² 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$^2$. 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$^2$.

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 Protzenko 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$^{9}$. 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


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الملخص العربي

كفاءة الليزر منخفض الشدة على انتناج الجرح وتخفيض الألم في الولادة بشق العجان

هدف من هذه الدراسة هو تحديد تأثير الليزر منخفض الشدة على انتناج الجرح وتخفيض الألم بعد الولادة بشق العجان. وقد شاركت في هذه الدراسة ثلاثون سيدة تم اختيارهن من القسم الداخلي لأمراض النساء والتوليد، تم تقسيمهن إلى مجموعتين متساويتين، مجموعة ضابطة وجدولة فحص، وتم استخدام مقياس شدة الألم مباشرة بعد الولادة بشق العجان وتم استخدام مقياس شدة الألم بعد ثلاثة أسابيع من الولادة بشق العجان. وقد أظهرت النتائج عدم وجود فروق في شدة الإحساس بالألم بين المجموعتين، وتم تقييم كثافة الخلية الأساسية في قسم الدراسات، وتم استخدام مقياس شدة الإحساس بالألم بعد الولادة بشق العجان.

كلمات المفتاح: الليزر منخفض الشدة - الألم - انتناج الجرح - شق العجان.