

## GALLIUM ARSENIDE LOW LEVEL LASER THERAPY AS AN ADJUNCTIVE MODALITY IN TREATMENT OF CELLULITE AFTER LIPOSUCTION

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### ABSTRACT

**Background:** Cellulite is a consequence of alterations that develop in the lymphatic system and lead to an accumulation of substances in subcutaneous tissue, in particular in the cellular interstice. These alterations may be influenced by hormones or by any other mechanism that predisposes the individual to an accumulation of fluids and other substances in the cellular interstice.

**Purpose:** To determine the therapeutic efficiency of Gallium Arsenide Low Level Laser Therapy on cellulite after liposuction.

**Materials and Methods:** Thirty Female patients had cellulite in their thigh after liposuctions were assigned into two equal groups: Group A consisted of 15 females with received Gallium Arsenide Low Level Laser Therapy (wavelength 904 nm, 30 minutes session, 2 times per week for 6 weeks). Group B consisted of 15 females who have liposuction only. Cellulite grading scale and skin fat caliper was measured for each patient before and after treatment.

**Results:** T-test revealed that there was a significant difference ( $p= 0.0000$ ) between experimental and control group in skin fold (mm) post treatment. T-test revealed that there was significant difference ( $p= 0.0000$ ) between experimental and control group in cellulite grading scale post treatment.

**Conclusion:** Gallium Arsenide Low Level Laser Therapy is efficient for cellulite reduction after liposuction.

**KEY WORD:** Cellulite, Liposuction, Low Level Laser, Gallium Arsenide, Skin Fold Caliper, Cellulite Grading Scale.

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### Access this Article online

#### Quick Response code



DOI: 10.16965/ijpr.2017.169

#### International Journal of Physiotherapy and Research

ISSN 2321- 1822

[www.ijmhr.org/ijpr.html](http://www.ijmhr.org/ijpr.html)

Received: 30-04-2017

Accepted: 05-06-2017

Peer Review: 02-05-2017

Published (O): 20-07-2017

Revised: None

Published (P): 11-08-2017

### INTRODUCTION

Cellulite (also named gynoid lipodystrophy) is a tissue that exhibits a rippled appearance of the skin mainly observed in the abdomen, thigh and buttock of women, and is especially a cosmetic problem, since it markedly impairs skin appearance [1].

It is largely observed in the gluteal-femoral regions with its 'orange-peel' or 'cottage cheese' appearance. It is not specific to overweight women although increased adipogenicity will exacerbate the condition. It is a complex problem involving the microcirculatory system and lymphatics, the extracellular matrix and the

presence of excess subcutaneous fat that bulges into the dermis [2].

Cellulite represents the most common lipo-dystrophic disease. Between 85% and 98% of post-pubertal females display some degree of cellulite. It is prevalent in women of all races but is more common in Caucasian females than in Asian females. Cellulite is more common in obese women but, obesity is not necessary for its presence [3].

Cellulite is observed almost explosively in women, where it is limited to the fat deposits in the upper thighs and buttocks, often subsequent to the hormonal up levels of estrogen during adolescence, pregnancy and menopause [4].

**Cellulite grading scale** for assessment of cellulite from clinical point of view [5]:

0 degree: no alteration in the skin surface

1st degree: no alteration in the skin surface at rest, but alterations are present during muscular contraction of the affected area or by the pinch test

2nd degree: Alterations to the skin surface are visible with the patient standing, with relaxed muscles and without any manipulation

3rd degree: same alterations as seen in 2nd degree, plus raised areas and nodules

The skin fold caliper has been the most frequent method of measuring subcutaneous fat thickness. These device has many distinct advantages especially in field situation: it is painless, noninvasive, simple to use, portable and does not require elaborate electronic technology, more over a very substantial literature exist on skin fold measurement and on subcutaneous fat as an index of total body fat [6].

Many different treatments have been proposed to treat the cellulite. Weight loss is frequently employed as well as skin massage and a variety of topical agents. Mechanical devices, surgical procedures, and oral supplements can also be recommended [2].

Low level laser therapy (LLLT) or "cold" lasers use radiation intensities so low so it is thought that any biological effects occur are due to the direct effects of radiation rather than the result of heating. Energies delivered are typically about 10 joules per cm<sup>2</sup> and using laser operating at

powers of 50mW or less. LLLT devices have been advocated for relief of pain, healing of soft tissue disorders and treatment of peripheral neuropathies, and there is a number of low intensity lasers used clinically. The two most commonly used types are Helium Neon (He-Ne) laser and The Gallium Arsenide (Ga-As) laser. He-Ne laser is a continuous wave with an averaged power output of 1mW. It has a depth of penetration (5 to 10 mm) depending on its wavelength (632.8 nm). It was the first laser available and it is reported to have beneficial effects in wound healing. It has the advantage that it emits red light, which is visible and therefore, the blink reflex protects the eye from it [7].

Research has shown that LLLT is effective in reducing overall body circumference measurements of specifically treated regions, including the hips, waist, thighs, and upper arms, with recent studies demonstrating the long-term effectiveness of results [8].

Noninvasive body contouring and fat reduction of cellulites and reduction in serum cholesterol and triglyceride levels [9].

## MATERIALS AND METHODS

**Subjects:** Thirty patients who have undergone Liposuction surgery and they complained from cellulite, their ages ranged from 25 to 45 years. There were no significance differences ( $p > 0.05$ ) between both groups in age.

They were selected from a private clinic for plastic surgery called Clinique du Cairo. They were free from any other health problems that may affect the results of the study as pregnancy, locations diseases of the skin, known malginoma, chemotherapy or anti-coagulation therapy.

Patients were randomly subdivided into two equal groups, each group consisted of 15 patients, and the first group (A) was the experimental group who received Gallium Arsenide Low Level Laser Therapy (30 minutes session, 2 times per week for 6 weeks) after liposuction. The second group (B) was the control group who received only liposuction.

**Procedures:** A verbal explanation about the importance of this study procedure, main aims and conceptual approach was explained to every patient.

The procedures of this study divided into two main procedures:

**Measurement procedures:** Three measurements were taken before treatment, and at end of treatment:

**Skin fold caliper** to measure skin fold in mm: Purchase a skin fold caliper and then choose vertical fold midway between knee and top of thigh.

Pinch the skin at your chosen site with your fingers, grasping skin and adipose tissue but not muscle (the muscle will be denser and more firm than skin and adipose tissue. Try it as many times as necessary to get a feel of the tissues.

Apply the caliper on millimeter below your fingers and right angle to the skin surface. Take your measurement after waiting two seconds with the calipers engaged, then release and take another measurement, averaging two values.

**Cellulite grading scale:** [10] and [11] (as shown in Table 1)

**Table 1:** Cellulite grading from clinical point of view (Rossi and Vergnanini, 2000):

Grade	Description
0	Smooth surface of skin while lying down and standing. Wrinkles upon pinch-test
1	Smooth surface of skin while lying down and standing. Mattress phenomenon upon pinch-test Smooth surface of skin while lying down
2	Mattress-phenomenon spontaneously while standing
3	Mattress-phenomenon spontaneously while standing and lying down

**Therapeutic Procedures:** Before treatment, all patients received full explanation to the purpose of the treatment, the therapeutic and physiological benefits of this method of treatment.

Each patient informed by the date and the time of her session.

Before starting the treatment, all measurements of each patient were taken for a comparison.

The patients were instructed to wear goggles each time on laser irradiation to protect their eyes.

Each patient was placed into comfortable position that allowed the vision of the treated area (supine lying position for treating the anterior thigh and prone lying position for treating the posterior thigh).

consisting of Gallium Arsenide Low Level laser sessions for 6 minutes ,3 times/week for 6 weeks, Maximum average power 1 Watts, Wave length: 904 nm, Energy density: 3.6 J/cm<sup>2</sup>.

The study group applied this program 3 times/ weeks for 6 weeks after liposuction.

The control group applied liposuction only.

After the end of treatment, all measurements of each patient were taken for a comparison.

**Statistical procedures:** Statistics were analyzed using SPSS software package. Results are shown as the mean ± SD. Both t-tests were used to assess significance of differences within each group and between the two groups. Significance was accepted as P-value ≤ 0.05.

## RESULTS

The mean values ± SD of cellulite grading scale for the experimental group before application of Gallium Arsenide low level laser therapy was 2.33± 0.49 while after application of Gallium Arsenide low level laser therapy was 1±0.76. The mean difference was 1.33 and the percent of improvement was 57.08 %. There was significant difference (P=0.0000) between pre and post treatment in cellulite grading scale. (as shown in Table 2, fig. 1).

**Table 2:** Paired t test for comparison between pre and post treatment mean values of cellulite grading scale for experimental group:

Item	Cellulite grading scale	MD	% of improvement	t- value	p-value	Sig
	X±SD					
Pre	2.33± 0.49	1.33	57.08%	10.583	0	S
Post	1 ± 0. 76					

**Table 3:** Paired t test for comparison between pre and post treatment mean values of skin fold for experimental group.

Item	Skin Fold	MD	% of improvement	t- value	p-value	Sig
	X±SD					
Pre	39.67±2.77	9	22.68%	37.6497	0	S
Post	30.67±2.61					

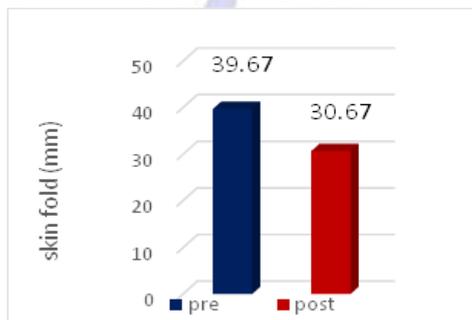
T-test revealed that there was a significant difference (p= 0.0000) between experimental and control group in skin fold (mm) post treatment.

Regarding the skin fold measurement for the experimental group, the mean values ± SD of skin fold (mm) before application of Gallium Arsenide low level laser therapy was 39.67±2.77 mm while after application of Gallium Arsenide

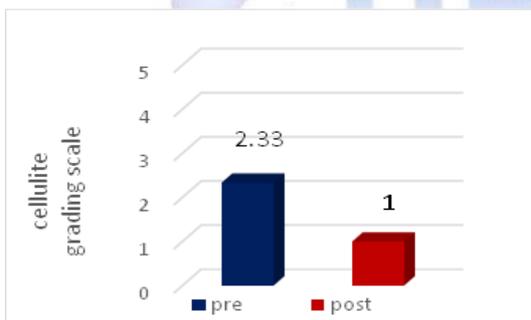
low level laser therapy was  $30.67 \pm 2.61$  mm. The mean difference was 9 and the percent of improvement was 22.68 %. There was significant difference ( $P=0.0000$ ) between pre and post treatment in skin fold (mm). (as shown in Table 3, fig. 2).

T-test revealed that there was significant difference ( $p= 0.0000$ ) between experimental and control group in cellulite grading scale post treatment.

**Fig. 1:** Pre and post treatment mean values of cellulite grading scale in experimental group.



**Fig. 2:** Pre and post treatment mean values of skin fold (mm) in experimental group.



## DISCUSSION

In the present study, effects of Low level laser therapy on cellulite in female's thigh were investigated. The result revealed that Gallium Arsenide Low Level Laser Therapy is efficient for cellulite reduction after liposuction.

Cellulite the aesthetically disturbing dimpling of the skin commonly occurs in the thighs and buttocks affecting most post-adolescent woman of all races-Incipient. Cellulite is recognized by an "orange peel" aspect while full blown cellulite is characterized by a dimpled skin surface [3] and [12].

The effects of LLLT appear to be limited to a specified set of wavelengths of laser [13].

And though more research is required to determine the ideal wavelengths, durations of treatment, dose and location of treatment [14].

Administering LLLT below the dose range does not appear to be effective [15].

The factors of wavelength, effective dose, dose-rate effects, beam penetration, the role of coherence, and pulses (peak power and repetition rates) are still poorly understood in the clinical setting. The typical laser average power is in the range of 1-500 m W; some high-peak-power, short-pulse-width devices are in the range of 1-100 W with typical pulse widths of 200 ns. The typical average beam irradiance then is 10mW/cm<sup>2</sup> - 5 W/cm<sup>2</sup>. The typical wavelength is in the range 600-1000 nm (red to 102 near infrared), but some research has been done and products outside of this range are available [16].

LLLT in the current study was performed using diode laser which is a cheap, easy to handle and does not produce heat as it depends on the chemical effect and not thermal effect, On the other hand both conventional liposuction and laser-assisted lipolysis used by many authors [17], [18] And [19] depend on internal application of laser energy to adipose tissue to induce selective thermal lipolysis, are more complicated procedures and may be associated with epidermal and dermal thermal injuries [20].

Thornfeldt and coworkers in 2016 concluded that one weekly low-level laser therapy treatment for six weeks was clinically effective for reducing waist, hip, thigh, and upper abdomen circumference and may be more effective than the previous two-week treatment protocol [21]. The results of the current study agree with Lach (2008) who reported significant reduction in the subcutaneous fat in the thighs of normal women. The thighs of each individual ( $n = 102$ ) were randomized to either laser light (dual wavelength of  $650 \pm 20$  nm and  $915 \pm 10$  nm) and massage or to massage alone (control). Individuals who completed the study ( $n = 74$ ) received a mean of 14.3 treatments over 4-6 weeks. This revealed that fat thickness decreased for the leg treated with laser massage by 1.19 cm<sup>2</sup> (mean) and increased by 3.82 cm<sup>2</sup> (mean) for the control leg over time. The difference was statistically significant ( $p < 0.001$ ). Among those who completed that study, 82.26% responded to treatment. Individuals reported loose fitting clothing and satisfaction with the procedure and

results [22]. As well as Briefs & Pankratov in 2008 stated that The 900 +/- 20 nm, which includes about 915 nm, wavelength penetrates well into the tissue with even less scattering than 650 nm but gets absorbed by the lipids in fat. The temperature inside the adipocytes gets slightly elevated causing fat liquefaction. The 650 nm and 915 nm wavelengths are also known to stimulate collagen regeneration and improve or restore blood and lymphatic circulation [23]. Jackson et al., 2009 and Jackson et al., 2012 who reported significant reduction in the circumferential measurements across waist, hips and thighs. They used diode laser with wavelength 635nm. Transmission electron microscopic images have demonstrated the formation of transitory specialized cell membrane-associated pores in adipocytes followed by collapse of adipose cells after brief treatment with LLL [24,25]. Gold et al., 2011 investigated the efficacy of LLLT in reducing thigh circumference as it increases collagen production, reduce edema, increases membrane permeability and relieves pain inflammation, all 105 without destroying fat cells. And showed a significant reduction in thigh circumference statistically and by MRI proven fat reduction [26].

As well as the study by Jackson and his coworkers in 2013 which investigated the efficacy of the ability of low-level laser therapy to improve the appearance of cellulite. Low-level laser therapy using green 532 nm diodes is safe and effective for improving the appearance of cellulite in the thighs and buttocks. In contrast with other technologies, LLLT is effective as a stand-alone procedure without requiring massage or mechanical manipulation. Future studies will assess the long-term benefits of LLLT for the treatment of cellulite [27].

Also Avci in 2013 suggested that use LLLT has a potential to be used in fat and cellulite reduction as well as in improvement of blood lipid profile without any significant side effects. One of the main proposed mechanism of actions is based upon production of transient pores in adipocytes, allowing lipids to leak out. Another is through activation of the complement cascade which could cause induction of adipocyte apoptosis and subsequent release of lipids [28].

While Savoia in 2013 and colleagues evaluated

the application of a 635 nm and 0.040 W exit power per multiple diode laser in combination with vibration therapy for the application of non-invasive reduction of circumference in patients with localized adiposity and cellulite. The results produced were statistically analyzed and resulted in a significant reduction of fat thickness when compared to the measurement prior to the treatment [29].

On the other hand the results of the current study contradict the results of a studies done by Elm et al., (2011) and McBean and Katz, (2011) [20,30].

Elm et al., (2011) evaluated the efficacy of diode laser for body contouring and circumference measurements revealed no statistically significant reduction at either 7days or 1 month post treatment. The authors came into conclusion that there is a need for more evidence to 106 show clinical circumferential reductions before LLLT can be recommended as an effective therapeutic option, but the difference between this study and the results of the current study may be due to different duration of treatment [30].

McBean and Katz (2011) reported that while an increasing number of studies evaluated the effects of LLLT as a save modality for removal of unwanted fatty tissue, Controversy remains regarding the efficacy of this treatment at a clinical level [20].

Also Adis Medical Writer in 2015 said that the treatment of cellulite, a major cosmetic concern for many women, remains challenging. Although a number of studies have investigated the effects of a wide range of products/procedures on cellulite-related endpoints, most of these studies have important methodological flaws. At present, there is no clear clinical evidence that any evaluated treatments have good efficacy in reducing cellulite, with the most promising results shown with acoustic wave therapy [30].

The result provide an evidence that Gallium Arsenide Low Level Laser Therapy is efficient for cellulite reduction after liposuction.

## ACKNOWLEDGEMENTS

It is an honor for me to express my deepest

gratitude and deep thanks to Prof. Dr. Wafaa Hussain Borhan, Professor of Physical Therapy for Surgery, Faculty of physical therapy, Cairo University. For being an outstanding advisor and excellent professor. Her constant encouragement, support and valuable scientific suggestions made this work successful.

I am also grateful for Prof. Dr. Haidy Nady Asham Assistant Professor of physical therapy for Surgery Disorder, Faculty of physical therapy, Cairo University for her great help, supervision and guidance throughout the procedures of the study.

**Conflicts of interest: None**

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**How to cite this article:**

Amr M. Ibrahim, Wafaa H. Borhan, Sameh A Abdelrahman, Haidy N Asham. GALLIUM ARSENIDE LOW LEVEL LASER THERAPY AS AN ADJUNCTIVE MODALITY IN TREATMENT OF CELLULITE AFTER LIPOSUCTION. *Int J Physiother Res* 2017;5(4):2187-2193. **DOI:** 10.16965/ijpr.2017.169