Comparative study between Extracorporeal Shockwave Therapy alone and combined Low level laser therapy with Extracorporeal Shockwave Therapy on Cellulite

Osama Mahmoud Abd El-Aziz El-Mehrath[1]; Mahmoud Saber Elbasiouny[2]; MahaRafie Abo Eittah[3]; MostafaShawky Mohammed Khaled[4]; Hala Ahmed Abdelgawad[5]

[1]Physical therapist in Shebin El-koom teaching hospital, Shebin El-koom, Menoufia, Osama.elmehrat@yahoo.com.

[2] Professor of general surgery- Department of medical applications of Laser, National Institute of Laser Enhanced Sciences- Cairo University, Giza, Egypt. ssaber78@yahoo.com.

[3] Professor of Dermatology- Department of medical applications of Laser, National Institute of Laser Enhanced Sciences- Cairo University.

[4]Physical therapist in Shebin El-koom teaching hospital, Shebin El-koom, Menoufia.

[5] Professor of physical therapy- DerayaUniversity, Vice dean of faculty of physical therapy- DerayaUniversity.

Corresponding author: Osama Mahmoud Abd El-Aziz El-Mehrath, Al-Galaastreet, above El-beik restaurant,Shebin El-koom, Menoufia. Telephone: 01002223761- 01222223514, e-mail: Osama.elmehrat@yahoo.com

ABSTRACT

Gynoidlipodystrophy, or cellulite is superficial pockets of trapped fat causing the uneven dimpling of skin commonly in women. It has a cosmetic concern and may induce negative psycho-social side-effects.Low Level Laser Therapy (LLLT) is effective but with limited evidence.This randomized controlledinvestigated the effects of LLLT on skinfold and severity of cellulite. It included fifty women with cellulite aged from 18– 55 years old. They were divided equally and randomly into two groups. Group (A) received focused Extracorporeal Shockwave Therapy. Group (B) received Low Level Laser Therapy and focused Extracorporeal Shockwave Therapy. Treatment lasted 6 weeks (2 sessions/week). Patients were assessed by skin fold caliper to measure skin fold in mm and Hexsel cellulite severity scale.Skin fold thickness and

Hexselcellulite severity were significantly improved post-treatment in both groups, but significantly more in the group who received LLLT.Low level laser therapy is effective in improving cosmetic appearance of women suffered from cellulite.

Keywords: Cellulite, Gynoidlipodystrophy, severity, skin fold, laser.

I. INTRODUCTION

Cellulite (Gynoidlipodystrophy)is anaesthetically disturbing dimpling of the skin or interstitial edema by superficial pockets of trapped fat, rather than increased number and size of fat cells that occur in obesity. It isrecognized by an "orange peel" aspect.It is highly prevalent in women affecting about 90%, especially those who are post-adolescent. The common sites were the lower abdomen, buttocks, and thighs(Pavicic et al., 2006; Jackson et al., 2013; Sadick, 2019).

Specific etiology of cellulite is unclear. However, there are some hypothetical cuses and risk factors were reported such as alterations in the intercellular matrix of subcutaneous tissue, and vascular and lymphatic microcirculation, estrogendeficiency plays a role (Rossi and Vergnanini, 2000 &Terranova et al., 2006), genetics, environment, poor lifestyle alcoholism, and increased body weight (Mirrashedet al., 2004; Tokarska et al., 2018).In cellulite, there is herniation of subcutaneous fat lobules at the dermohypodermal junction with fibrosisand retraction of the collagen septa causing the depressions of the cellulite (Sadick, 2019).

Cellulite can arise from weak, large, thick, and fibrous septae that cause contnous tension and hence dimples of the cellulite in the patients (Nürnberger and Müller, 1978; Piérardet al., 2000; Mirrashed et al., 2004).

While not potentially hazardous to health and even considered normal based upon its frequency of occurrence, cellulite remains nonetheless, an issue of cosmetic and psychological problem (Angehrn et al., 2007).

There are several interventions to treat cellulite as massage, laser, injections, shockwave, among others (Di Bernardo et al., 2016). However and till now, there is no cure for cellulite and there is a need for more research about the interventions of cellulite.

Laser delivers laser energy to targeted structures underlying the cellulite (dermis/subcutaneous tissues), and a temperature-sensing cannula integrated with the laser delivery system allows uniform distribution of energy to the treatment site. It was believed that this technique may be more suitable for addressing skin laxity than cellulite dimples (LaTowsky et al., 2023).

Laser activated a wound repair response that resulted in the stimulation of fibroblast activity and collagen reformation/remodeling via its thermal energy and vasodilator effect for microcirculation. As well, it increases skin thickness (ultrasound) and elasticity (Keller et al., 2007; DiBernardo et al., 2011).

Low-level laser therapy can decrease cellulite severity and improve the appearance of cellulite and flatten the skin surface for at least 1 year. So, it can greatly improvesatisfaction of the patients (Jackson et al., 2013; DiBernardo et al., 2016; Sadick, 2019).

The impact of these devices is not very substantial in terms of adipolysis or even disruption of the fibrous septa that characterize cellulite, but Laser has minimal adverse events (Di Bernardo et al., 2016).

II. OBJECTIVE

The objective of this study wasto investigatethe effects of LLLT on skinfold and severity of cellulite.

III. METHODOLOGY

Study Design:

This study was a randomized controlled study.The patients (n=50) were divided randomly into two equal groups. Group (A) received focused Extracorporeal Shockwave Therapy. Group (B) received Low Level Laser Therapy and focused Extracorporeal Shockwave Therapy.

Study setting:

This study was conducted at the outpatient clinic, Shebin El-Kom teaching Hospital.

Patients:

Fiftywomen with cellulite with age ranged between 18– 55 years shared in the study. They were free from any other health problems that may affect the results of the study as pregnancy and local diseases of the skin. They were participated after signing the informed consent.

Procedures:

1. **Measurement procedures:**

These measurements were taken before treatment and at the end of treatment (6 weeks).

1.1.Skin fold caliper to measure skin fold in mm:

Patients were in comfortable standing position. Therapist chose the site of the skin and pinched it by fingers. Then grasping skin and adipose tissue (but not the muscle) (the muscle will be denser and more firm than skin and adipose tissue). The skin caliper was applied at the level of cellulite tissue and therapist's fingers at right angle with the skin surface. The measurement in (mm) was determined after waiting 2 seconds with the caliper still engaged, then released. Another measurement was taken, averaging the two values (Hassan, 2016).

1.2.Hexsel cellulite severity scale:

In order to have an objective assessment, we used a scale to identify the five key clinical morphologic features of cellulite: (A) the number of evident depressions; (B) depth of depressions; (C) morphological appearance of skin surface alterations; (D) grade of laxity, flaccidity or sagging skin; and (E) the grade of cellulite.The severity of each item was graded from 0 to 3, allowing a final sum of scores that range numerically from 1 to 15. Based on the final numeric score, cellulite was further classified as mild, moderate, or severe (Hexsel et al, 2009).

(A) Number of evident depressions:This item refers to the total number of evident depressions by visual inspection in the area to be examined. The scores are expressed as follows:ZERO = None/no depressions, 1 = A small amount: 1–4 depressions are visible,

2 = A moderate amount: 5–9 depressions are visible, and 3 = A large amount: 10 or more depressions are visible.

(B) Depth of depressions:This item evaluates the depth of depressions by visual inspection of the affected areas; ZERO = No depression, 1 = Superficial depressions, 2 = Medium depth depressions, and 3 = Deep depressions.

(C) Morphological appearance of skin surface alterations: It assesses the different morphological patterns of skin surface alterations; ZERO = No raised areas, 1 = 'Orange peel' appearance, 2 = 'Cottage cheese' appearance, and 3 = 'Mattress' appearance.

(D) Grade of laxity, flaccidity or sagging skin:Laxity, flaccidity, or sagging skin confers the affected skin a draped appearance. This effect aggravates the appearance of cellulite; ZERO = Absence of laxity, flaccidity, or sagging skin, 1 = Slight draped appearance, 2 = Moderate draped appearance, and 3 = Severe draped appearance.

(E) Cellulite grading scale:

Patients were evaluated in the standing position with relaxed gluteus muscles. However, if the patient has no evident depressions, they should be asked to contract their gluteus muscles or the pinch test should be applied (by pinching the skin between the thumb and index finger) in order to differentiate between scores 0 and 1.(Table 1).

Table (1): Cellulite grading scale

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
2	Smooth surface of skin while lying down Mattress-phenomenon spontaneously while standing
3	Mattress- phenomenon spontaneously while standing and lying down

The classification of cellulite as mild, moderate, and severe was determined by the severity scores obtained for sections A to E, as shown in table (2)(Hexsel et al, 2009).

Table (2): Classification of cellulite

Hexsel cellulite severity scale	**Cellulite classification**
1–5	Mild
6–10	Moderate
11–15	Severe

2. **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 was informed by the date and the time of their session.Before starting the treatment, all measurements of each patient was 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 allows the vision of the treated area.Other parts of the body which wouldn't be treated were covered.

2.1.Application of Low Level Laser therapy:

The therapy consisted of Low Level laser sessions for 30 minutes, 2 times/ week for 6 weeks. Maximum average power 1 Watts, Wave length: 904 nm, Energy density: 3.6 J/cm^2 (Ibrahim et al., 2017).

2.2. Application of Shock wave therapy:

Shock wave equipment was used (developed by STORZ medical AG), with D-Actor applicator (radial waves) and energy levels (0.1-12) with mean energy level 5. This level corresponds to an energy flux density of 0.13- 0.6 mJ/ mm^2.Each treatment region covered an area about 20x30 cm (typically front or back of one thigh) which was scanned with 2000 shots using D-actor applicator in both horizontal (1000 shots) and vertical (1000 shots) directions for 15 minutes. The treatment was applied 2 times per week for 6 weeks (Hassan, 2016).After the end of treatment program, all measurements of each patient were taken for a comparison.

Statistical analysis:

Statistical package for social sciences (SPSS) version 24 was used for all analysis. Descriptive statistics (means and standard deviations) was presented for all variables. Analytical statistics were done using paired t-test for within-group comparisons and unpaired t-test and analysis of covariance (ANCOVA) for between group comparisons, pre- and post-treatment, respectively. Significance level was set at 0.05.

IV. RESULTS

Baseline characteristics:

Baseline characteristics of all patients in both groups were presented in figure (1) and table (3). Groups were not differed significantly at baseline, i.e. homogenous groups. (p>0.05).

Table (3): Baseline characteristics of patients in both groups

Baseline characteristics	Group A	Group B	P-value
Age (years), mean (SD)	40 (±10)	38 (±11)	0.5
Sex, females (count, %)	25 (100%)	25 (100%)	1

SD: standard deviation

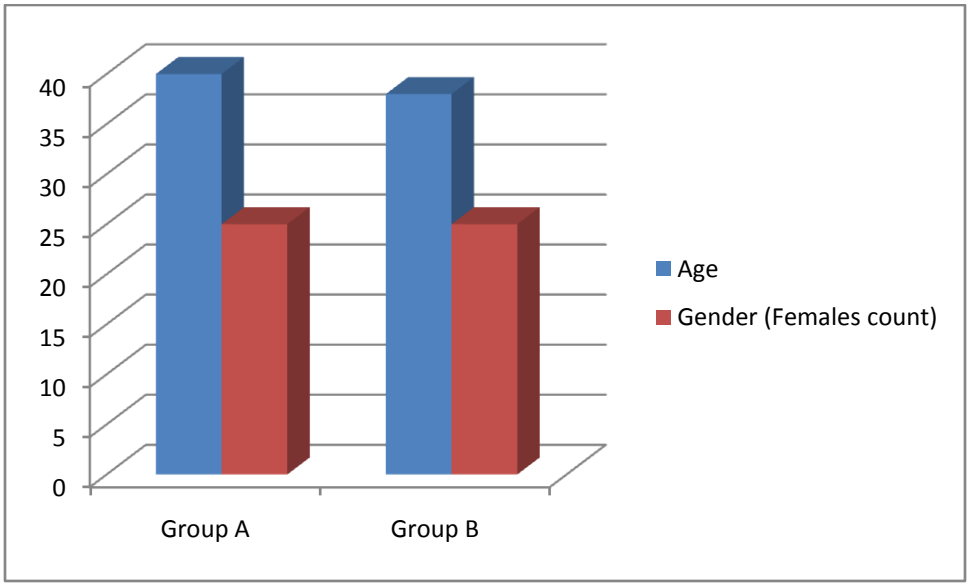


Fig. (1): Bar chart showing age and sex-distribution in both groups

Within-groups comparisons:

Mean (SD) of skin fold (mm) pre- and post-treatment were 39.44 (6.79) mm and 33.16 (6.14) mm, respectively in group A. As well, they were 33.92 (7.22) mm and 27.04 (5.78) mm, respectively in group B. There were significant improvements in skin fold and cellulite severity post-treatment in the two groups (P< 0.001). As shown in table (2) and Figure (2,4).

Mean (SD) of Hexsel scale pre- and post-treatment were 8.8 (3.39) and 5.84 (2.39) points, respectively in group A, and were 5.56 (2.89) and 2.72 (1.7) points, respectively in group B. There were significant improvements in Hexsel scale post-treatment in the two groups (p< 0.001). As shown in table (4) Figure (3,4).

Table (4): Descriptive and analytical statistics of skin fold and cellulite severity within and between groups

Outcomes	Group A Mean (SD)	Group B Mean (SD)	P
Skin fold			
Pre	39.44 (6.79)	33.92 (7.22)	<0.001*
Post	33.16 (6.14)	27.04 (5.78)	0.015*
P	<0.001*	<0.001*	
Hexsel scale			
Pre	8.8 (3.39)	5.56 (2.89)	0.001*
Post	5.84 (2.39)	2.72 (1.7)	<0.001*
P	<0.001*	<0.001*	

P: probability value; (*): significant at P<0.05

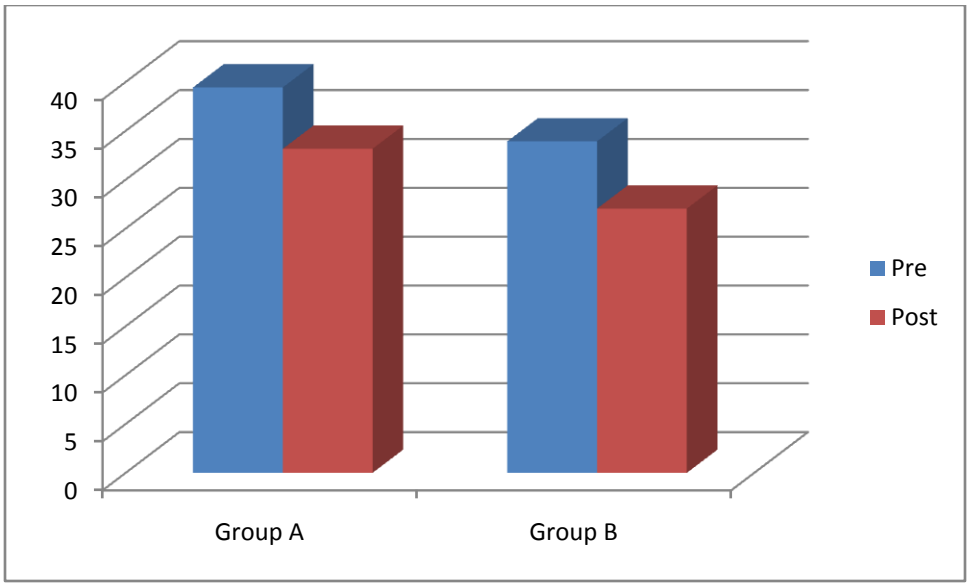


Fig. (2): Bar chart showing means scores of skin fold in both groups pre- and post-treatment

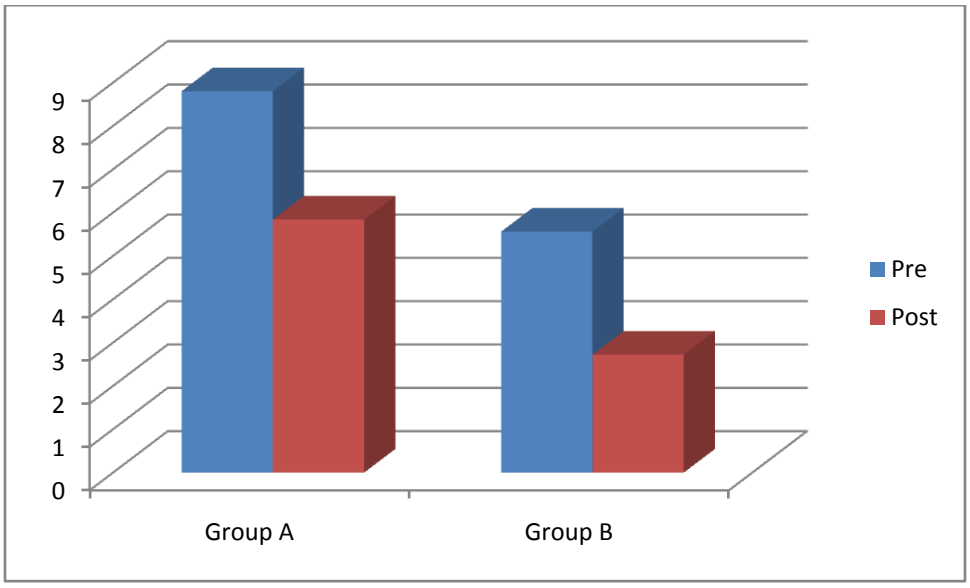
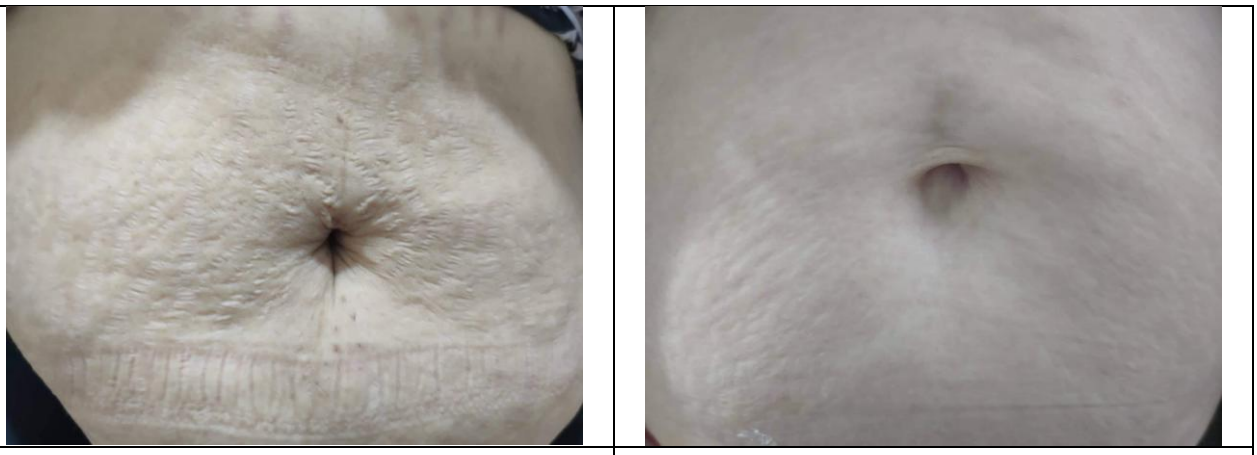


Fig. (3): Bar chart showing means scores of Hexel scale in both groups pre- and post-treatment.



A) Pre-treatment | B) Post-treatment (LLLT+ESWT)

Fig. (4): Improvement in cellulite severity after addition of LLLT; A) Pre-treatment and B) Post-treatment

Between-groups comparisons:

There were significant differences in skinfold (P<0.001) and Hexsel scale (P=0.001) between groups at pre-treatment. So, analysis of covariance (ANCOVA)was used to detect differences between groups post-treatment with pretreatment scores as a covariate. There were significant differences between groupsA and B (P=0.015), in favor of group B.

As well, there were significant differences in Hexsel scale between groups A and B (P<0.001), in favor of group B. As shown in table (2).

V. DISCUSSION

Aim of this study was to investigate the effects of LLLT on skinfold and severity of cellulite.It was observed that regardless of the treatment area, there was significant reduction in skinfold and the severity of cellulite in both groups. However, the improvement was significantly higher in the group who received LLLT.

The minimally invasive pulsed 1440 nm Nd:YAG laseris supposed to have three different effects on the structural features that cause the clinical appearance of cellulite. First, this technique should smooth the uneven dermal-hypodermal interface by selectively melting the hypodermal adipocytes that protrude into the dermis. Second, it should sever the hypodermal septa that connect the dermal and muscle layers by thermal subcision. Lastly, the 1440 nm

Nd:YAG laser should heat the dermis from the inside out to increase dermal thickness and skin elasticity by stimulating neocollagenesis and collagen remodeling (Luebberding et al., 2015).

Non-invasive long-pulsed 1064 nm Nd:YAGlasers have been used in the treatment of cellulite. It is known to deliver thermal energy into the deep dermis and the hypodermis to generate a wound-healing response that promotes the formation of new collagen. Previous studies postulated that a thicker layer of collagen may compress fat herniation, thereby improving the appearance of cellulite (Prieto et al., 2005; Keller et al., 2007; Truitt et al., 2012).

Low level laser therapy 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 (Avci et al., 2013). It also does not cause significantheating in the tissue structure. Therefore, LLLT shouldstimulate collagen synthesis (Luebberding et al., 2015).

The present study came in line with several studies (Sasaki, 2013, DiBernardo, 2011, DiBernardo et al., 2013; Katz , 2013; Jackson et al., 2013) who evaluated the minimally invasive Nd:YAG laser for the treatment of cellulite and confirmed its positive efficacy in clinical appearance of cellulite (reduction in dimple depth and count, as well as a smoother contour), increase in skin elasticity and dermal thickness post-treatment.

The present study is supported with DiBernardo et al. (2016) who In found that a 1440-nm Nd:YAG laser improved dimples and contour irregularities at the 6-month follow-up examination.In addition to that, Savoia et al., (2013) evaluated the efficacy of 635 nm low-level laser in combination with vibration therapy and found a significant reduction of fat thickness and cellulite.

The findings of the current study disagree with Bousquet-Rouaud et al. (2009) and Truittet al. (2012) who used non-in-vasive 1064 nm Nd:YAG laser light to treat cellulite and found non-significant improvement in cellulite severity. The contrasting results between our study and the previous studies may be due to differences in dosage as he previous studies applied

only three treatments at about one month intervals. Higher dose in the present study may increase the efficacy of LLLT on cellulite

CONCLUSION

Low level laser therapy is effective in improving cosmetic appearance of women suffered from cellulite.

Conflicts of interest

Authors declare that there were no conflicts of interests to declare.

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