A New Non-Invasive Approach for Body Contouring:

The Application of Low-Level Laser Therapy

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Non-invasive modalities targeting subcutaneous fat to achieve a slimming effect continue to emerge and garner a significant amount of interest amongst physicians and patients. Several delivery mechanisms have been developed to achieve adipocyte destruction including, ultrasound, infrared, and radio frequency.[1-5] However, the external application of photonic energy with high output intensities can produce significant adverse events if not properly employed; therefore, it is necessary to explore all parameters in order to identity which delivery mechanism yields the most desirable results while minimizing adverse events.

In recent years, there has been an increase in the application of low-level laser therapy (LLLT) across a diverse selection of medical disciplines.[6-10] LLLT has been proven to be a safe and effective therapeutic option in clinical and histological trials for multiple applications.[11-18] Several Food and Drug Administration (FDA) approvals have been given to LLLT to serve as an adjunctive instrument for post-operative care following breast augmentation and lipoplasty. These approvals have come following extensive clinical and histological trials. Numerous studies have identified that the application of laser therapy at 635nm to cultured adipocytes reveals the formation of a transitory pore within the bilipid membrane inducing cell emulsification.[19,20] A collection of scanning and transmission electron microscopy (SEM and TEM) images from multiple studies have exhibited the release of fat from adipocytes subsequent to LLLT, a phenomenon not observed in control SEM and TEM images.[19,20]

To better understand the clinical implications for such an instrument; a placebo-controlled, double-blind, randomized, multi-site clinical study was conducted to assess the efficacy of LLLT as an independent modality for non-invasive body sliming.

The study enrolled sixty-seven subjects between the ages of 18 to 65 years who satisfied the inclusion and exclusion criteria. Patients were asked to sign an affidavit stating that no modifications in their daily dietary or exercise habits will be made throughout the study. In order to properly assess the placebo-effect, the clinical study was randomized and a sham device was used for those 32 patients assigned to receive sham-treatment.

Subjects assigned to the test group were treated with a multiple head low-level diode laser consisting of 5 independent diode laser heads each with a scanner, each emitting 635nm with an intensity of 17mW (The Zerona, manufactured by Erchonia Medical Inc.). Sham-treatment group participants were treated with a multiple head non-laser light emitting diode (LED) consisting of 5 independent red diode light heads each with a scanner, each emitting 635nm (red) with an intensity of 2.5mW. Both the sham treatment light and real laser devices were designed to have the same physical appearances, including the appearance of any visible light output.

TABLE 1: Mean change in total combined circumference measurements from baseline to endpoint for treatment groups (n=67)

Mean Reduction (in.)	Test Group (n=35)	Control Group (n=32)
Mean reduction in total circumference (in.)	-3.521	-0.684

In. indicates inches

The circumference in inches (in.) of the subject's waist, hip, and thighs were measured and recorded across all time points. Subjects were evaluated at four different times: pre-procedure; end of first procedure week; end of second procedure week; and two weeks post-treatment phase.

The treatment phase was for two weeks, with each subject receiving six total treatments with either the laser or sham-light scanning device. There were three procedures per week, each treatment two days apart. Patients received both anterior and posterior stimulation, with the waist, hip, and thighs being targeted simultaneously. The diodes were positioned approximately 6 inches above the plane of the skin and were activated for 20 minutes for the anterior side and 20 minutes for the posterior side.

The primary efficacy outcome measure was defined as the change in total combined inches in circumference measurements from baseline to study completion (end of week 2). An individual subject success criterion, set by the FDA, was defined as at least 3.0 inch reduction in combined circumference measurements from baseline to study completion. The overall study success criterion, established by the FDA, was defined as at least a 35% difference between treatment groups, comparing the proportion of individual successes in each group. To further identify the clinical meaningfulness of the device, patients were asked to record a rating on a 5 point scale of very satisfied, somewhat satisfied, neither satisfied nor dissatisfied, not very satisfied, not at all satisfied.

Of the 32 sham group participants, 6.38% (2 subjects), demonstrated a total decrease in combined circumference measurements from baseline to study endpoint of 3.0 inches or greater, while 22 (62.9%) of the 35 test group participants demonstrated a reduction of -3.0 inches or greater, a significant difference between both groups ($p<0.0001$). Fifty-seven percent more test group participants than sham light treated group participants showed a total decrease in combined circumference measurements from pre-procedure to study endpoint of 3.0 inches or greater. This outcome exceeded the pre-established target of 35% difference between treatment groups by 22%.

Comparison of the two independent group means for the continuous variable of mean change in total combined circumference (total number of inches) from study baseline to endpoint demonstrated a mean difference of -2.837 (Table 1). The difference was found to be statistically significant ($p<0.0001$).

Compared with baseline, the total combined circumference measurements for test subjects were significantly lower at all three subsequent evaluation points while sham light treated group participants compared with baseline demonstrated insignificant changes in total combined circumference measurements across all three subsequent evaluation points. Further, changes in total circumference measurements between groups were statistically significant at all three subsequent evaluation points. (Table 2).

Twenty-one test group participants (70%) and 8 sham light group participants (26%) recorded a "satisfied" rating. Moreover, one test group participant and 11 control group participants recorded a "dissatisfied" rating. The difference of the rating score between the two treatment groups was found to be statistically significant ($p<0.0005$).

The observation following this trial revealed that LLLT of the appropriate wavelength applied 3 times per week for two weeks can significantly reduce the circumference at specifically targeted tissue sites due to reduction in the adipose layer. It is important to note that

TABLE 2: The difference in change in total circumference measurements between evaluation time points between treatment groups (n=67)

Mean Reduction (in.)	Test Group (n=35)	Control Group (n=32)	Difference between groups
Baseline – week 1	-2.06	-0.27	-1.794
Baseline – week 2	-3.52	-0.68	-2.838
Baseline – 2 weeks post	-3.21	-0.62	-2.953
Week 1- Week 2	-1.46	-0.42	-1.044
Week 1- 2 weeks post	-1.15	-0.36	-0.799
Week 2- week 4	+0.31	+0.06	+0.245

In. indicates inches

no adverse events were reported in this clinical trial. Further following a two-week treatment administration phase, a non-randomized, non-controlled study was conducted assessing serum triglyceride and cholesterol levels

with no significant elevations reported.[25] It is important that all non-invasive modalities claiming to modify subcutaneous fat should provide lipid panel clinical data.

Laser therapy has positioned itself as a viable non-invasive option because of its ability to induce a circumferential reduction, measured in inches, without producing a single adverse event. Since LLLT promotes a photochemical reaction, the observable clinical effect is achieved without producing a photothermal or photoacoustic event. An identified target of laser therapy is a highly specialized enzyme, cytochrome c oxidase, which plays a crucial role in the bioenergetics of the cell increasing the production of Adenosine Triphosphate. How the upregulation of ATP coupled with reactive oxygen species production induces the formation of the transitory pore remains unclear; however, what is lucid is that the application of LLLT can serve as a safe and effective modality, generating inch reduction in just two weeks without a single adverse event.◆

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