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Pain and Fibrous Scarring Response to Polarized Light Therapy Following Mammoplasty

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Abstract : Purpose: to evaluate the efficacy of polarized light therapy on pain and fibrous scarring following mammoplasty. **Methods of evaluation** (Visual Analogue Scale and the ultrasonographic measurement of the fibrous scarring in Cm). **Methods:-** Thirty women with pain and fibrous scarring following mammoplasty with ages ranging from 40 to 55 years. They were divided into two groups. One study group for the BLT in addition to the traditional physical therapy routine (BLT group) and a control group for the traditional physical therapy routine only (no BLT group). BLT beam was pointed at the area to be treated, holding the device at right angle (90°) perpendicular to the surface of the treated area and maintaining a distance of 10 cm from the surface of it and applying the BLT for about 10 minutes day after day for six months. Measurements were conducted before starting the treatment as a first record and at the end of the six month of treatment as a second (final) record. **Results and conclusion:-** Results showed that application of polarized light therapy had a valuable improving effects in women with breast pain and fibrous scarring following mammoplasty as evidenced by the highly significant decreases in visual analogue scale and the ultrasonographic measurement of the fibrous scarring.
Key words (Bioptron light therapy, Mammoplasty, Ultrasonography, Visual analogue scale, Pain and Fibrous scarring following mammoplasty).

Introduction:

The mammary glands develop from the mammary ridges or milk lines, which are thickenings of the epidermis that first, appear on the ventral surface of the 5-week fetus extending from the axilla to the upper medial region of the thigh. In humans, most of the ridge does not develop further and disappears during fetal development. Persistence of segments of the milk line is the embryologic anlage for ectopic mammary glandular tissue, which occurs most often at the extreme ends of the mammary ridge in the axilla.[1,2, 11,12.]

Heavy, pendulous breasts are often a source of chronic pain and discomfort for many women. Although women may request reduction mammoplasty to relieve pain and discomfort, many also hope that the procedure will improve their appearance. Prior to undertaking breast reduction mammoplasty, the surgeon should document several measurements that are useful in the procedure. Additionally, the breasts should be appropriately marked with the patient in the standing position, indicating the planned incision pattern; reduction mammoplasty can be performed using a vertical technique, where a superior pedicle is left intact, providing

blood supply to the nipple–areola complex. Alternatively, the procedure can be performed with an inferior pedicle providing the necessary blood supply to the nipple–areola complex. [7,14,15.]

Causes of breast lumps after mammoplasty are; (1) deep hematoma may produce scarring in much the same way that hematoma produces scarring in other soft tissues, (2) fat necrosis may occur as a result of trauma during surgery or inadequate postoperative blood supply to fatty tissue remaining in the breast, and (3) operative techniques may cause fibrous scarring. Hemorrhage into the breast is not a common complication in reduction mammoplasty. Infiltration of local vasoconstrictive drugs, such as epinephrine, along the proposed skin incision lines reduces the amount of perioperative bleeding [2,7,12,15.]

In addition, tissue drains are almost routinely used for 24 hours after surgery. If hemorrhage occurs and the fluid is not evacuated, the patient has a risk of infection and a risk of increased pressure that can reduce the blood supply of surrounding tissue, leading to fat necrosis. Fat necrosis and hematoma in the breast are attended by an inflammatory response. Necrotic cells become surrounded by neutrophils and macrophages, and the debris is encapsulated in a wall of fibrous tissue. The entire area may be replaced by fibrosis. The central scar tissue or the surrounding capsule may later calcify. [1, 11,14.]

Polarized light from low power lasers and non-laser devices has been used as a non-invasive therapy in the treatment of various musculoskeletal disorders, acceleration of wound healing and treatment of skin ulcers. Although the polarized light is known to have numerous photo-biostimulatory effects including cell proliferation, enhanced collagen synthesis, changes to the circulatory system and anti-inflammatory actions, the precise mechanism of its action still remains unclear. The available non-laser optical devices are the Bioptron products which emit a wide beam of polarized, non-coherent, polychromatic, low energy light that contain wavelengths from the visible spectrum (480-700nm) and infrared radiation (700-3400nm); this range provides optimal penetration and stimulation of the tissues without the risk of DNA damage. [3,5,6,13,24,25.]

Bioptron light therapy (BLT) device emits light that is polarized, polychromatic, non-coherent and of low energy. The light emitted has a wide range of wavelengths (480-3400nm) and differs from laser light, which is mono-chromatic (of narrow wavelength), coherent, polarized and of high or low energy. Possible risk of burns is present with the laser therapy, while not possible with the Bioptron light therapy. User skills are essential in laser therapy, but not essential with the Bioptron light therapy**.** Higher costs are present with the laser therapy, but not with the Bioptron light therapy, in addition, treatment of large area is available with the Bioptron light therapy. [8,10,16,18.]

Bioptron light therapy system has a low energy density (fluency) of an average of 2.4 J/cm². Bioptron light reaches the area to be treated with a constant, steady intensity; this energy density has biostimulative effects. With Bioptron light therapy, the energy density dosage can be precisely determined. Furthermore, the effect exerted by light is also defined by its power density. As it is measured at the skin's surface, it varies depending both on the intensity of the light's source and its distance from the area to be treated, the specific power density of Bioptron light is approximately 40 mW/cm² at a treatment distance of 10 cm; this is equivalent to an energy density (fluency) of an average of 2.4 J/ cm² per minute. These properties of Bioptron light allow it to penetrate the surface of the skin with minimum heating effect, no damage to skin and no known side-effects. [17,20,21,23.]

Material and Methods

Subjects:

Thirty women with pain and fibrous scarring following mammoplasty with ages ranging from 40 to 55 years. They were divided into two groups. One study group for the BLT in addition to the traditional physical therapy routine and a control group for the traditional physical therapy routine only. BLT beam was pointed at the area to be treated, holding the device at right angle (90°) perpendicular to the surface of the treated area and maintaining a distance of 10 cm from the surface of it and applying the BLT for about 10 minutes day after day for six months. Measurements were conducted before starting the treatment as a first record and at the end of the six month of treatment as a second (final) record.

Instrumentation:

In this study the measuring equipment were the visual analogue scale (VAS) for pain assessment and ultrasonography for the ultrasonographic measurement of the fibrous scarring (USFS) in Cm, while the therapeutic equipment was the Bioptron Compact III polarized light therapy system (PAG-860 manufactured in Switzerland).[4,9,22.]

Procedures

Evaluation:

1- Visual Analogue Scale (VAS): The pain level was assessed by visual analogue scale (VAS) before starting treatment (first record) and at the end of the total period of treatment after 6 months (second record). The visual analogue scale (VAS) consists of a line, usually 10 cm long, whose ends are labeled as the extremes of pain (e.g., no pain to unbearable pain), Patient was asked to place a mark at the point on the line which best represent her experience of pain between two "no pain" to "worst pain", then the operator measured the distance from the zero "no pain" in centimeters,[4,9.]

2-**Ultrasonography:** Siemens Elagra multipurpose ultrasonography with Sony Video graphic printer up 890 MD was used to determine the size of the fibrous scarring in Cm. All the aforementioned parameters (VAS and the USFS) were measured 2 times; the baseline record that was taken before starting of the study and the second record was taken after 6 months from starting of the study [7,12,22,25.]

- Procedures of the polarized light therapy and the traditional physical therapy routine:

The treated area was cleaned at first by saline rinse and betadine, the plug of the BLT unit was inserted into the main current supply; the on/off switch was switched on, the BLT light beam was pointed at the area to be treated, holding the device at right angle (90°) perpendicular to the surface of the treated area and maintaining a distance of 10 cm from the surface of it and applying the BLT for about 10 minutes day after day for six months, All patients in the 2 groups (BLT group) and (no BLT group) received the same traditional physical therapy routine for six months in the form of range of motion exercises, gentle stretching exercises, shoulder wheel exercises and home exercises in the form of shrug shoulders, lifting arms forward and up, reaching hand behind neck and sliding it down as well as reaching hand to low back and sliding it up to upper limb of the operated side.[3, 5, 6,13, 17, 21,23.]

Data analysis:

The visual analogue scale (VAS) and the ultrasonographic measurement of the fibrous scarring (USFS) in Cm, were measured pre-treatment as a first record and after six months as a second final record in both groups. Collected data were fed into computer for the statistical analysis; descriptive statistics as mean, standard deviation, minimum and maximum were calculated for each group. The t-test was done to compare the mean difference of the two groups before and after application and within each group. Alpha point of 0.05 was used as a level of significance,[19.]

Results

As shown in table (1) and figure (1), the mean value of the VAS before treatment was (9.36667 ± 0.89771) degrees in the first study group (BLT group), while after treatment was (2.06667 ± 0.99372) degrees. These results revealed a highly significant reduction in VAS ($P < 0.0001$). While in the control group (no BLT group), the mean value of the VAS before treatment was (9.36668 ± 0.98771) degrees, while after treatment was (9.37333 ± 0.95428) degrees. These results revealed non-significant reduction in the VAS ($P > 0.05$).

Table (1): Comparison of the mean values of the visual analouge scale (VAS) in degrees before and after treatment in the study and control groups

	Before treatment		After treatment		Mean difference	T-value	P.value	Level of significance
	Mean	SD	Mean	SD				
Study group (BLT group)	**9.36667**	**0.89771**	**2.06667**	**0.99372**	**7.30000**	21.11	0.0001	Highly significant decrease
Control group (No BLT group)	**9.36668**	**0.98771**	**9.37333**	**0.95428**	**-0.006650**	**-0.02**	0.985	Non- significant

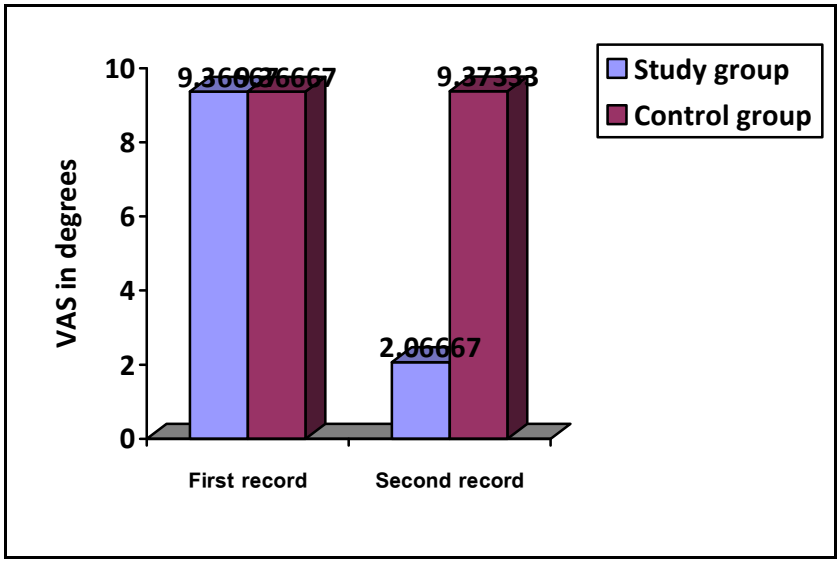

Fig (1): Mean values of the visual analouge scale (VAS) before and after treatment in both groups.

As shown in table (2) and figure (2), the mean value of the ultrasonographic measurement of the fibrous scarring (USFS) in Cm before treatment was (1.99443 ± 0.11224) Cm in the first study group (BLT), while after treatment was (0.31567 ± 0.18809) Cm. These results revealed a highly significant reduction in the ultrasonographic measurement of the fibrous scarring (USFS) in Cm, ($P < 0.0001$), while in the control group (No BLT group), the mean value of the the ultrasonographic measurement of the fibrous scarring (USFS) in Cm before treatment was (1.98000 ± 0.12371) Cm, while after treatment was (1.98766 ± 0.12336) Cm. These results revealed non-significant difference in the ultrasonographic measurement of the fibrous scarring (USFS) in Cm ($P > 0.05$).

Table (2): Comparison of the mean values of the ultrasonographic measurement of the fibrous scarring (USFS) in Cm before and after treatment in the two groups

	Before treatment		After treatment		Mean difference	T-value	P.value	Level of significance
	Mean	SD	Mean	SD				
Study group (BLT group)	**1.99443**	**0.11224**	**0.31567**	**0.18809**	**1.67876**	29.68	0.0001	Highly significant decrease
Control group (No BLT group)	**1.98000**	**0.12371**	**1.98766**	**0.12336**	**-0.007660**	**-0.17**	0.866	Non-significant

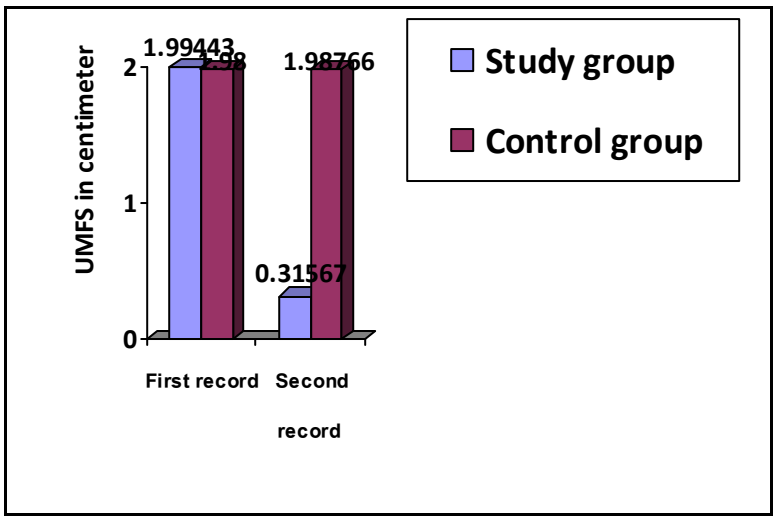

Fig (2): Mean values of the the ultrasonographic measurement of the fibrous scarring (USFS) in Cm of the 2 records in both groups.

Discussion

Augmentation mammoplasty is one of the most common cosmetic procedures performed by plastic surgeons. The procedure is particularly popular among younger women; there are three surgical approaches available for augmentation mammoplasty. These are the axillary, periareolar, and inframammary fold approaches, all three approaches allow the surgeon to create a plane between the breast and the anterior aspect of the pectoralis major muscle, or, alternatively, between the posterior aspect of the muscle and the chest wall. The prostheses for augmentation mammoplasty can be placed either submammary or subpectoral implants. Patients with breast asymmetry may elect to undergo augmentation mammoplasty. In this instance, the prosthesis is generally placed in the submammary position (anterior to the pectoralis major muscle), [1,2, 11,12.]

Fibrotic masses in the breast secondary to fat necrosis or hematoma are a complication of breast reduction mammoplasty. The treatment commonly recommended for this condition is early surgical debridement of necrotic tissue from the entire area, which causes scarring. Development of benign lumps in the breast is a possible complication of both reductive and reconstructive mammoplasty. Multiple small lesions or a single large mass may develop deep in the breast tissue within weeks of surgery. Lumps have been reported to evolve even as long as 3 to 7 years after surgery. The lumps may be well or poorly defined, may vary from minor thickening to dense immobile masses, and may be tender and sore. In some cases, a fibrous band connects the lesion to the overlying skin, causing thickening of the skin or retraction of the breast around the mass. Masses that are very large may distort the shape of the breast. Over a period of years, the lesions may calcify. Although harmless, these lesions may distress patients, [7, 14, 15.]

The biostimulative effects of Bioptron light are the result of synergy between different mechanisms of action as; harmonize the metabolic processes, reinforce the human defence system, stimulate regenerative and reparative processes of the entire organism, promote wound healing and relieve pain or decrease its intensity. The scientific mechanisms underlying various light therapy treatments are still under investigation. However, in general scientists have identified various biological effects that can be initiated and achieved as a result of light stimulation. These include; stimulation of neoangiogenesis, improvement of circulation, increasing the process of phagocytosis, stimulation and activation of ATP production, enhancement of important specific enzymes involved in cell regeneration, increasing the activity of lymphatic system, activation of fibroblast activity and increasing the production of collagen, increasing DNA and RNA production and reducing the excitability of nervous tissue as well as increasing the muscle relaxation' [15,16,17,21.]

Bioptron light therapy system provides new insight into the management of leg ulcers, diabetic foot ulcers, burns, pressure ulcers and wounds following operation and injury. Patients are now able to receive innovative wound-care management. Bioptron light therapy could offer significant support in conjunction with standard wound-care. The success of light therapy on pain and functions may be due to a number of mechanisms,

one of which may be through its positive effect on chondrocyte proliferation and matrix's synthesis. Also, significant stimulatory effect on fibroblast action and enhanced connective tissue repair were noted. These effects seem to be related to the biostimulative effect of light therapy at the cellular level. Normalization of microcirculation and speed of nerve transmission achieved have been reported to interrupt the vicious circle of origin and development of pain.[3, 6,10, 13.]

The findings of the present study showed non-significant differences in the pre-treatment records of both VAS and USFS between the mean values of the study and control groups.

Results of the study group revealed a highly significant decrease in the mean values of VAS and USFS, after application of the BLT, when compared against the pre-application results. But results of the control group revealed non-significant difference in the mean values of VAS and USFS, after application of the traditional physical therapy routine, when compared against the pre-application results.

Significant differences showed in the study and control groups were consistent with those observed and recorded by Baber and Libshitz, 2002; Depuydt et al., 2009; Driver and Franklin, 2006; Garrison and Valiant, 2006; Gigot, 2009; Hoeksema et al., 2002; Hokinson, 2004; Iordanou et al., 2007; Medenica and Lens, 2003; Monstrey et al., 2002; Sakurai et al., 2007; Samoilova et al., 2008; Sattayut et al., 2009; Simic et al., 2006; Smithy, 2008 and Young et al., 2009.

Results of this study support the expectation that application of polarized light therapy had a valuable improving effects in women with breast pain and fibrous scarring following mammoplasty as evidenced by the highly significant decreases in visual analogue scale and the ultrasonographic measurement of the fibrous scarring.

Conclusion

Application of polarized light therapy had a valuable improving effects in women with breast pain and fibrous scarring following mammoplasty as evidenced by the highly significant decreases in visual analogue scale and the ultrasonographic measurement of the fibrous scarring.

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