

Laser Treatment of Breast Reduction Scars - A Patient Reported Outcomes Study

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Abstract

Background: Scars after reduction mammoplasty are a leading cause of patient dissatisfaction postoperatively. Laser therapy has been reported to treat hypertrophic and keloid scars with benefits of reducing pain, itching, and improving appearance. However, literature reporting on its use in the breast reduction population remains scarce.

Methods: Female patients > 18 years of age interested in scar treatment after breast reduction were identified at a single institution. Exclusion criteria included open wounds and patients < 1-month post-op. Study participants were treated with the Aerolase Neo Elite 1064 nm Nd:YAG laser (Aerolase Corp., Tarrytown, NY) for three treatments spaced four weeks apart with three passes per treatment session. To assess patient reported outcome measures, the Breast-Q Reduction module was administered before and at the conclusion of treatment. Clinical assessment of scars was performed at each time point by a plastic surgeon. T testing and multivariate regression analyses were performed when appropriate and a $p < 0.05$ was considered statistically significant.

Results: Sixteen patients with an average age of 49.3 years and BMI 28.5 kg/m² were included. Patients ranged from Fitzpatrick type II to V. After completion of laser treatment sessions, average Breast-Q scores improved overall (139.3±15.0 versus 144.9±11.9, $p < 0.001$) and individually within each subsection. Patients noted an improvement in scar visibility (3.2±0.7 versus 3.9±0.7, $p < 0.001$). This subjective improvement was supported by improvement in rating of overall scar appearance by the plastic surgeon post-treatment ($p < 0.001$). Notably, number of days from surgery, age, and BMI were not independent predictors of post-treatment Breast-Q scores on multivariate regression analysis.

Conclusions: The use of the 1064 nm Nd:YAG laser is both safe and effective for scar treatment after breast reduction. Utilizing this laser technique postoperatively results in higher patient satisfaction and improved scar appearance.

Keywords: Breast Reduction, Laser, Scar Management

Introduction

Reduction mammoplasty is one of the most common plastic surgery procedures performed annually, with an estimated 97,320 cases performed in the United States in 2020 alone [1]. In addition to seeking relief from symptoms such as rashes in the inframammary fold or neck/back pain, patients also often desire an improved aesthetic appearance of the breast [2]. A major contributor to post-operative satisfaction with breast appearance is related to scar visibility [3]. As a result, minimizing postoperative scarring for reduction mammoplasty patients has received increasing attention.

No single technique for breast reduction is suitable for every patient, and various combinations of scar patterns and pedicle design have been proposed. Frequently used scar patterns include the Wise pattern (inverted T), vertical scar pattern, and the “no vertical scar” technique (horizontal) [2, 4]. In a study by Sprole

et al. examining 121 patients who underwent Wise pattern breast reduction, 86% of patients were highly satisfied with their surgery, but 65% noted persistent dissatisfaction with their scars [5]. As a result, reducing visibility of the scar remains of high importance to improve patient satisfaction postoperatively.

The standard of care for postsurgical scar treatment in the maturation phase of wound healing has included the use of silicone-based products, mechanical massage, sun protection, and compression [6]. However, recent evidence in the literature supports early procedural intervention on surgical scars, such as with laser or microneedling, to improve long term scar appearance [7, 8]. Laser therapy as it applies to scar reduction has been well examined in the dermatology literature, particularly as it applies to reducing acne-related scarring, but the applications among the breast surgery population remain scarce [8-11]. This

study represents the first examination of the efficacy and safety of the 650 usc 1064 nm neodymiumdoped yttrium aluminum garnet (Nd:YAG) laser (Aerolase Neo Elite, Aerolase Cor., Tarrytown, NY) for treatment of breast reduction scars.

Methods

Institutional Review Board approval was obtained (Protocol #53311) for a prospective study designed to evaluate the impact of the 650 us 1064 nm Nd:YAG laser on postsurgical scarring after breast reduction. At a single institution, female patients interested in scar treatment after breast reduction greater than one month postoperatively were identified from February 2020 to September 2021. Exclusion criteria included open wounds and patients less than one month post-op. Based on this criteria, sixteen total patients were enrolled in the study.

For each treatment session, the Aerolase Neo Elite settings were as follows: 5 mm lens, 650 us pulse width, energy mode 6 (fluence of 31 J/cm²), at a frequency of 1.5Hz. Three passes fully covering the scar and immediate surrounding skin were performed at each session. Patients underwent three total sessions spaced four weeks apart. Surgical scars were assessed prior to and after completion of the laser treatment series by the patient and a plastic surgeon.

The Breast-Q Reduction Module was used for assessment of patient-reported outcome measures before and after completion of the treatment period [12]. Formal clinical assessment of scars using a 3-point scale (-1 (worse), 0 (no change), 1 (better)) was performed at each time point by a plastic surgeon. T-testing and multivariate regression analyses were performed when appropriate, $p < 0.05$ was considered statistically significant.

Results

Patient demographics are summarized in **Table 1**. Sixteen patients with an average age of 49.3 years and BMI 28.5 kg/m² were included. Patients ranged from Fitzpatrick type II to V, with 13 Caucasian patients, two African American patients, and one Hispanic patient. Six patients had a history of prior keloid scars. Average number of days from surgery to first laser treatment was 93.9 days with standard deviation of 107.2 days.

After completion of three laser treatment sessions, there was statistically significant improvement in total Breast-Q scores as well as each subcategory. Total evaluation of patient reported outcomes measures based on the overall Breast-Q score improved from 139.3±15.0 to 144.9±11.9 post treatment ($p < 0.001$). Improvement in psychosocial well-being, satisfaction with breasts, satisfaction with nipples, and overall satisfaction with outcome were all improved with $p < 0.05$. Notably, overall satisfaction with scarring improved from 3.2±0.7 to 3.9±0.7 ($p < 0.001$) post-treatment. Number of days from surgery, age, and BMI were not independent predictors of post-treatment Breast-Q scores on multivariate regression analysis. In concordance with patient satisfaction, plastic surgeon rating of scar appearance was also significantly improved after completion of three sessions ($p < 0.001$). Findings are summarized in **Table 2**.

Clinical improvement of scar appearance is highlighted in **Figure 1** and **Figure 2**. In Figure 1A, pre-treatment baseline scarring demonstrates noticeable hyperpigmentation of the peri-areolar and vertical limbs of a Wise pattern reduction. 1B highlights improvement in texture and discoloration of the scar after completion of three sessions of Aerolase Neo Elite Nd:YAG laser. The post treatment photo demonstrates a significant improvement in scarring, most notably in the peri-areolar region. **Figure 2** demonstrates pre and post-treatment photos for another patient with notable improvement of the scarring of the vertical limb.

Discussion

Despite careful surgical technique, postoperative formation of some degree of scarring is an unavoidable phenomenon. Ideally, over time scars become less erythematous, increasingly flat, and more pliable. These clinical changes correlate to the progression through several histologic phases including inflammation, proliferation, and remodeling [13]. Because this process of wound healing and scar remodeling continues several months to years after surgery, many patients desire early intervention to expedite the healing process and reduce scar visibility [8, 14]. This study supports the use of laser therapy, specifically the Nd:YAG laser, for reduction of scar visibility in the reduction mammoplasty population, one of the largest plastic surgery populations annually.

Several treatment modalities have been introduced for scar management in the past including dermabrasion, steroid injection, cryotherapy, and radiation with variable degrees of success in the literature [13, 15, 16]. More recently, lasers such as the CO₂ laser, Nd:YAG laser, and pulsed dye laser (PDL) have been trialed for scar reduction [15-17]. However, the exact laser modality and timing of intervention has not been clearly elucidated. In a study by Nouri et al., patients with linear surgical scars were treated with a 585 nm PDL laser on half of the scar starting on the day of suture removal, with the untreated half of the scar serving as control. The treated halves demonstrated an overall improvement in the Vancouver Scar Scale (VSS) ratings for pigmentation, vascularity, pliability, and height [15, 16]. However, this study included only scars of the face, neck, and upper extremities. Hee Lee et al. investigated the use of CO₂ fractional laser therapy on surgical scars beginning three weeks postoperatively in a split-scar study. After completion of two sessions at two-week intervals, a decrease in VSS score was noted in the treated half of the scars, specifically in terms of texture and thickness [8]. Again, however, none of the patients in this study had scar locations on the breast.

The application of the Nd:YAG laser has recently been examined for post-surgical scarring both as a monotherapy and combined therapy. The 1064 nm wavelength of the Nd:YAG laser deposits nonselective heat into the dermis which is absorbed by melanin, hemoglobin, and to a lesser extent water [18]. When lasers generate heat, they initiate inflammation and consequently increase vascular permeability, matrix metalloproteinase production, and collagen fiber fascicle decomposition [19]. Histologic analysis of Nd:YAG lasered tissue has shown penetration to 500 to 1000 um into the papillary and reticular dermis, which helps to explain its

success for treatment of keloid and hypertrophic scars [19]. It is thought that the penetration of the Nd:YAG laser into the deeper vessels of the dermis leads to inhibition of scar neovascularization and induces hypoxia that prevents abnormal collagen deposition [18]. Tawfic et al. performed a randomized clinical trial to compare the efficacy of fractional CO2 laser versus long-pulsed Nd:YAG laser for treatment of hypertrophic scars and keloids. Vascularity was more improved with the Nd:YAG laser, while pliability was more improved with the fractional CO2 laser, supporting that Nd:YAG lasers may be more suitable for erythematous, “fleshy” scars while fractional CO2 lasers may be more optimal for firm scars. Combination of the two lasers did not result in significant added benefit, but resulted in a higher side effect profile. In a study by Joo Lee et al., the effect of fractional CO2 laser therapy and combination therapy with conventional CO2 laser with an Nd:YAG laser was evaluated for linear, head and neck scars. In contrast to Tawfic et al., the combination therapy exerted more favorable anti-pigmentation effects compared to monotherapy alone [20]. Because the data supporting safety and efficacy of the Nd:YAG laser has grown, this study expands its use to the breast surgery population.

In this study, we introduce the application of a 650 us 1064 nm Nd:YAG laser (Aerolase Neo Elite) specifically for management of postsurgical breast scarring. Compared to typical 1064 nm Nd:YAG lasers that have pulse durations from 3 to 30 milliseconds, the 650 us pulse duration is below the thermal relaxation time of tissue, thus giving the targeted structure less time to lose heat to the surrounding skin [9]. With this new technology, in-

creased temperature of the targeted tissue leads to improved efficacy. This laser has been previously applied to the acne scar patient population with success, but this study represents its first application for breast surgery [9, 21]. Notably, treatment sessions were well tolerated by all patients and there were no cases of adverse side effect profiles such as hypopigmentation. In each case, including patients with prior history of keloids, there was both an improvement in patient reported outcomes and surgeon rating of the scar.

Future studies are necessary to determine optimal timing of intervention of Nd:YAG laser postoperatively, specifically whether early post-operative laser leads to improved long-term outcomes of visibility. Of note, this study was not performed in a split-scar fashion and did not contain a control group for comparison, both helpful options for future investigation. An additional limitation of this study is the lack of histologic analysis performed, which could provide an improved understanding of histologic changes contributing to improved visible scarring with Nd:YAG laser application.

Conclusion

The 650 us 1064 nm Nd:YAG laser is both safe and effective for scar treatment after breast reduction. No patients experienced adverse side effects from laser treatment, and all tolerated laser treatments in office. Utilizing this laser technique postoperatively results in higher patient satisfaction and improved scar appearance. Future data is necessary to determine optimal timing of initiation of laser therapy postoperatively.

Table 1: Patient Demographics

Patient Demographics	
Total Number of Patients	16
Average BMI kg/m2	28.5± 5.3
Days from surgery to first treatment	93.9± 107.2
Patients with history of keloid scars	6
Ethnicity	
Caucasian	13
Hispanic	1
African American	2
Reported as mean ± standard deviation	

Table 2: Summary of Scar Assessment

Scar Assessment Scores				
Patient Reported Outcomes	Pre-Treatment	Post-Treatment	Change in Score	P Value
Total Breast-Q Score	139.3±15.0	144.9±11.9	5.6±4.3	p<0.001
Psychosocial Well-Being	35.8±5.1	38.4±3.9	2.7±2.1	p< 0.001
Satisfaction with Breasts	49.0±5.5	50.5±4.5	1.4±2.5	p=0.03
Satisfaction with Nipples	20.8±2.6	21.3±2.4	0.56±0.7	p=0.002
Satisfaction with Outcome	33.8±4.5	34.7±3.8	0.93±1.2	p=0.006
Scar Visibility	3.2±0.7	3.9 ±0.7	0.8±0.6	p < 0.001
Surgeon Reported Outcomes				
Overall Appearance Score	-1±0	0.63±0.5	1.6±0.5	p<0.001
Reported as mean ± standard deviation				

Figure 1: Pre and Post Laser Treatment Scar Appearance – Patient 1



Figure 1: 1A demonstrates pre-treatment baseline scarring. 1B demonstrates scar appearance after completion of three sessions of Aerolase Neo Elite Nd:YAG laser, highlighting improvement in erythema and overall appearance.

Figure 2: Pre and Post Laser Treatment Scar Appearance – Patient 2



Figure 2: 2A, C demonstrate pre-treatment photos of the right and left breast for Patient 2, respectively. 2B, D represent post treatment photos of the right and left breast, respectively.

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