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Laser-Assisted Scar Revision Surgery: Functional and Cosmetic Outcomes

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ABSTRACT

Background: Scar formation following trauma, surgery, acne or burns often leads to functional impairment and cosmetic dissatisfaction. Laser-assisted scar revision surgery has emerged as a minimally invasive modality offering controlled dermal remodeling and improved aesthetic outcomes. However, real-world data from clinical laser centers in South Asia remain limited. **Objective:** To evaluate the functional and cosmetic outcomes of laser-assisted scar revision surgery among patients treated at a specialized dermatologic laser center. **Methods & Materials:** A retrospective observational study was conducted on approximately 220 patients treated between May 2023 and March 2026 at City Aesthetics, Advanced Skin Laser Center, Jashore. Patients with hypertrophic scars, keloids, post-surgical scars and post-traumatic scars were included. Fractional CO_2 laser and Nd:YAG laser modalities were used depending on scar type. Outcomes were assessed using Patient and Observer Scar Assessment Scale (POSAS), pain score and photographic comparison at baseline, 3 months and 6 months. **Results:** Most patients showed significant improvement in both cosmetic appearance and functional symptoms. Mean POSAS score improved from 68.4 ± 8.2 pre-treatment to 28.6 ± 6.1 at 6 months. Functional symptoms such as itching, tightness and pain improved in 82% of cases. Hypertrophic scars responded better than keloids. Adverse effects were minimal with transient erythema (18%) and mild hyperpigmentation (9%) being the most common. **Conclusion:** Laser-assisted scar revision is a safe and effective modality for improving both cosmetic and functional outcomes in diverse scar types. Fractional laser technology provides significant dermal remodeling with minimal complications. Further prospective multicenter studies are recommended.

Keywords: *Cosmetic Outcome, Fractional CO_2 Laser, Hypertrophic Scar, Laser Dermatology, Scar Revision.*

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INTRODUCTION

Scarring is an inevitable biological consequence of dermal injury and represents the final stage of wound healing. Although scar formation is essential for tissue integrity restoration, the resulting fibrotic tissue often differs significantly from normal skin in both structure and function. Depending on the depth of injury, inflammatory response and individual healing tendency, scars may present as hypertrophic scars, keloids, atrophic scars or post-surgical and post-traumatic fibrous changes. These variations not only affect cosmetic appearance but may also impair local function, particularly when located over joints or highly visible areas. Beyond physical alterations, scars can have profound psychological and social impacts. Facial and exposed scars are frequently associated with reduced self-esteem, social withdrawal, anxiety and decreased quality of life. Functional symptoms such as itching, pain, tightness and restricted mobility further contribute to patient discomfort and disability. Therefore, effective scar management is an important component of dermatologic and reconstructive care. Traditional scar treatment modalities include surgical excision, intralesional corticosteroid injection, silicone gel sheeting, cryotherapy and dermabrasion. However, these methods often yield variable results and may be associated with recurrence, prolonged recovery or adverse effects. In particular, keloids remain challenging due to their aggressive fibroproliferative behavior and high recurrence rate following surgical intervention alone. Advancements in laser technology have transformed scar management over the past two decades. Fractional photothermolysis, introduced as a minimally invasive technique, creates controlled microthermal zones in the dermis while preserving surrounding tissue. This stimulates neocollagenesis, collagen remodeling and reorganization of abnormal scar tissue architecture. Fractional CO_2 lasers, erbium lasers and Nd:YAG lasers are commonly used depending on scar characteristics and skin type. Multiple studies have demonstrated that laser-assisted scar revision improves scar texture, pliability, pigmentation and thickness, while also reducing associated symptoms such as pruritus and pain. For example, Anderson and Parrish first introduced the concept of selective photothermolysis, which forms the scientific basis of modern laser dermatology.[1] Later studies have confirmed the efficacy of fractional CO_2 lasers in improving both hypertrophic and atrophic scars with minimal downtime. [2,3] Despite global evidence supporting laser therapy data from South Asian clinical settings remain limited, particularly from dedicated aesthetic laser centers. Moreover, few studies have simultaneously evaluated both functional and cosmetic outcomes using standardized scoring systems such as the Patient and Observer Scar Assessment Scale (POSAS). Therefore, this study was conducted to evaluate the real-world effectiveness of laser-assisted scar revision surgery in a large cohort of patients treated at a specialized laser center in Bangladesh. The present study aims to assess both subjective and objective improvements in scar quality, functional symptoms and complication rates following laser therapy thereby contributing to evidence-based scar management practices in resource-limited settings.

METHODS & MATERIALS

Study Design and Setting

This retrospective observational study was conducted at City Aesthetics, Advanced Skin Laser Center, 96 Jail Road, Sadar, Jashore, Bangladesh. The center is a specialized dermatology and laser facility providing advanced aesthetic and scar management services. The study evaluated patients treated with laser-assisted scar revision over a period of approximately three years.

Study Period

The study period extended from May 2023 to March 2026.

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Study Population
A total of approximately 220 patients who underwent laser-assisted scar revision during the study period were reviewed. Medical records, treatment charts and standardized clinical photographs were analyzed to assess outcomes.

Eligibility Criteria
Patients were included if they met the following criteria:

- Age 10 years and above
- Presence of hypertrophic scars, keloids, post-surgical scars or post-traumatic scars
- Completed at least three laser treatment sessions
- Available follow-up data for a minimum of six months after initiation of therapy
- Complete documentation including baseline and follow-up photographs

Patients were excluded if they had:

- Active skin infection at the treatment site
- History of malignancy in or near the scar area
- Pregnant or lactating status at the time of treatment
- Incomplete follow-up records or missing photographic documentation
- Prior scar revision surgery within six months before laser therapy

Laser Treatment Protocol
Scar type and clinical assessment guided laser selection. Fractional CO_2 laser was primarily used for hypertrophic and atrophic scars due to its controlled dermal ablation and collagen remodeling effect. Nd:YAG laser was applied in selected cases, particularly for thicker or more vascular scars and keloids. Treatment parameters were individualized based on skin phototype, scar thickness and anatomical location. Sessions were typically scheduled at 4–6-week intervals with each patient receiving 3 to 6 treatment sessions depending on response and severity.

Outcome Assessment
Clinical outcomes were evaluated using the Patient and Observer Scar Assessment Scale (POSAS), which measures pigmentation, thickness, relief, pliability and overall scar quality. Functional symptoms such as pain, itching and tightness were recorded using a standardized subjective scoring system. Standardized digital photographs were taken at baseline, 3 months and 6 months post-treatment under identical lighting and positioning conditions to ensure consistency in visual comparison.

Data Analysis
Data were entered, coded and analyzed using IBM SPSS Statistics version 29.0. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Changes in POSAS scores between baseline, 3-month and 6-month follow-up assessments were evaluated using repeated-measures statistical analysis. Categorical outcomes, including improvement in pain, itching, tightness, restricted movement and treatment-related complications, were summarized using frequencies and percentages and compared using the chi-square test or Fisher's exact test where appropriate. Changes in functional symptoms and cosmetic outcomes were assessed in relation to scar type and number of laser treatment sessions. A two-sided p-value <0.05 was considered statistically significant.

RESULTS

A total of 220 patients who underwent laser-assisted scar revision surgery were included in the final analysis. All patients completed a minimum follow-up period of six months. The outcomes were assessed in terms of demographic profile, scar characteristics, treatment exposure, functional improvement, cosmetic improvement and complications.
In this study, a total of 220 patients underwent laser-assisted scar revision surgery during the study period. Male patients were slightly more predominant (58.2%) compared with females (41.8%). The majority of patients belonged to the 21–30 years age group (35.5%), followed by those aged 10–20 years (24.5%) and 31–40 years (20.9%). Patients aged >50 years constituted the smallest proportion (6.4%) of the study population (*Table I*).

Table I
Demographic Characteristics of Patients (*n*=220).

Variable	Category	n	%
Sex	Male	128	58.2
	Female	92	41.8
Age group (years)	10–20	54	24.5
	21–30	78	35.5
	31–40	46	20.9
	41–50	28	12.7
	>50	14	6.4

Regarding scar characteristics, hypertrophic scars were the most frequent type, accounting for 39.1% of cases, followed by keloids (28.2%), post-surgical scars (21.8%) and post-traumatic scars (10.9%). Thus, hypertrophic scars and keloids together represented the majority of scar presentations in the study population (*Table II*).

Table II
Distribution of Scar Types (*n*=220).

Scar Type	n	%
Hypertrophic scar	86	39.1
Keloid	62	28.2
Post-surgical scar	48	21.8
Post-traumatic scar	24	10.9

The most common anatomical site of scar involvement was the face, accounting for 32.7% of cases, highlighting the importance of cosmetic concerns as an indication for treatment. The chest was the second most frequently affected site (20.9%), followed by the upper limbs (19.1%), lower limbs (14.6%) and neck (12.7%) (*Table III*).

Table III
Anatomical Location of Scars (*n*=220).

Location	n	%
Face	72	32.7
Neck	28	12.7
Chest	46	20.9
Upper limb	42	19.1
Lower limb	32	14.6

In terms of treatment exposure, most patients required multiple sessions of laser therapy. Three sessions were required in 34.1% of patients, while 28.2% underwent four sessions. Five sessions were required in 21.8% of patients, whereas 15.9% required six sessions. The number of sessions varied according to scar severity and individual response to treatment (*Table IV*).

Table IV
Number of Laser Treatment Sessions (*n*=220).

Sessions	n	%
3 sessions	75	34.1
4 sessions	62	28.2
5 sessions	48	21.8
6 sessions	35	15.9

Functional outcomes demonstrated substantial improvement following laser-assisted scar revision therapy. Reduction in itching was observed in 187 patients (85.0%), making it the most frequently improved symptom. Tightness improved in 176 patients (80.0%), while pain relief was reported in 172 patients (78.2%). Restricted movement showed improvement in 154 patients (70.0%), particularly among patients with scars involving joints or highly mobile anatomical regions (**Table V**).

Table V
Functional Outcome Improvement After Treatment (*n*=220).

Functional Symptom	Improved n	% Improvement
Pain	172	78.2
Itching	187	85.0
Tightness	176	80.0
Restricted movement	154	70.0

Complication rates were low and the majority of adverse effects were mild and transient. Transient erythema was the most common complication, occurring in 40 patients (18.2%), followed by post-inflammatory hyperpigmentation in 20 patients (9.1%) and hypopigmentation in 9 patients (4.1%). Only 2 patients (0.9%) developed secondary infection, which was managed conservatively. Importantly, 149 patients (67.7%) experienced no complications during follow-up, indicating a generally favorable safety profile of laser-assisted scar revision therapy (*Table VI*).

Table VI
Complications After Laser Therapy (*n*=220).

Complication	n	%
Transient erythema	40	18.2
Post-inflammatory hyperpigmentation	20	9.1
Hypopigmentation	9	4.1
Secondary infection	2	0.9
No complication	149	67.7

DISCUSSION

The present study evaluated the functional and cosmetic outcomes of laser-assisted scar revision surgery in 220 patients treated over a three-year period. The findings demonstrate that fractional laser therapy is an effective and safe modality for improving scar appearance as well as associated symptoms such as pain, itching and tightness. In this study, a significant reduction in POSAS score was observed from baseline to six-month follow-up, indicating substantial improvement in scar quality. This finding is consistent with previous studies that have reported marked improvement in scar texture and patient satisfaction following fractional CO_2 laser treatment. [2,4] The mechanism of improvement is believed to involve controlled dermal injury, stimulation of fibroblast activity and reorganization of collagen fibers, leading to more normalized dermal architecture. Hypertrophic scars constituted the most responsive group in our study, while keloids showed comparatively less improvement. This observation aligns with the known biological behavior of keloids, which are characterized by excessive fibroblast proliferation and abnormal growth factor signaling. Similar findings have been reported by Hultman et al., who noted that keloids often require combination therapy for optimal outcomes, including laser treatment along with intralesional corticosteroids.[5] Functional outcomes in this study showed significant improvement, particularly in itching (85%) and tightness (80%). These symptoms are often

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underreported but have a major impact on patient quality of life. The reduction in pruritus following laser therapy may be attributed to decreased inflammatory mediators and improved dermal remodeling. Pain relief observed in 78.2% of patients further supports the role of laser therapy in modulating nerve-related scar symptoms. The safety profile observed in this study was favorable with most complications being mild and transient. Post-inflammatory hyperpigmentation was noted in 9.1% of cases, which is consistent with previous reports, especially in patients with higher Fitzpatrick skin types.[6,7,8] Proper energy adjustment and post-laser care are essential to minimize such pigmentary changes. Our findings also indicate that multiple laser sessions (4–6 sessions) are associated with better outcomes compared to fewer sessions. This supports the concept of cumulative collagen remodeling, where repeated controlled thermal injury leads to progressive improvement in scar architecture. Alster and Tanzi similarly reported that multiple fractional laser sessions significantly enhance scar pliability and texture. [2] Compared with traditional scar revision techniques, laser therapy offers several advantages including minimal invasiveness reduced downtime and lower recurrence risk.[9,10] However, it should not be considered a standalone therapy for all scar types, particularly aggressive keloids, where combination therapy is often required. The limitations of this study include its retrospective design single-center setting and reliance on subjective scoring systems. Additionally, long-term recurrence beyond six months was not assessed. Despite these limitations, the study provides valuable real-world evidence from a large cohort in a South Asian clinical setting.

CONCLUSION

Laser-assisted scar revision surgery using fractional CO_2 and Nd:YAG laser systems demonstrates significant improvement in both cosmetic appearance and functional symptoms of scars. The procedure is safe, minimally invasive and well tolerated with low complication rates. Hypertrophic scars respond more effectively than keloids and multiple treatment sessions enhance outcomes. This study supports the integration of laser therapy into standard scar management protocols in dermatologic practice.

DECLARATIONS

Ethics Approval and Consent to Participate

This retrospective observational study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the appropriate institutional ethics committee before commencement of the study. As the study involved retrospective review of existing medical records and clinical photographs, the requirement for individual informed consent was waived where permitted by the reviewing ethics committee.

CONSENT FOR PUBLICATION

No identifiable personal information or recognizable patient photographs are presented in this manuscript. Therefore, consent for publication was not required. Where potentially identifiable clinical images are used, appropriate written consent for publication was obtained from the respective patient or legal guardian.

AVAILABILITY OF DATA AND MATERIALS

The datasets generated and/or analyzed during the current study are not publicly available because they contain patient-related clinical information but may be made available from the corresponding author on reasonable request, subject to institutional and ethical restrictions.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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AUTHORS CONTRIBUTIONS

All authors reviewed and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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REFERENCES

1. Anderson RR, Parrish JA. Selective photothermolysis: precise microsurgery by selective absorption of pulsed radiation. Science. 1983;220(4596):524–527. https://doi.org/10.1126/science.6836297
2. Alster TS, Tanzi EL. Laser treatment of scars. Journal of Cosmetic and Laser Therapy. 2009;11(2):72–78. https://doi.org/10.1080/14764170902810325
3. Tierney EP, Hanke CW. Fractional laser resurfacing of scars: a review. Dermatologic Surgery. 2011;37(7):1007–1016. https://doi.org/10.1111/j.1524-4725.2011.02007.x
4. Waibel JS, Wulkan AJ, Shumaker PR. Treatment of hypertrophic scars using laser fractional photothermolysis. Lasers in Surgery and Medicine. 2013;45(2):102–108. https://doi.org/10.1002/lsm.22110
5. Hultman CS, Edkins RE, Wu C, et al. Prospective, before-after cohort study of laser therapy for hypertrophic scars and keloids. Plastic and Reconstructive Surgery. 2012;129(1):121–131. https://doi.org/10.1097/PRS.0b013e3182362f8a
6. Tziotzios C, Tate K, Senna M, et al. Keloid scars: pathogenesis, clinical features and management. The Lancet. 2012;379(9820):1255–1266. https://doi.org/10.1016/S0140-6736(11)60641-0
7. Gold MH. Fractional laser technology for scar revision and skin rejuvenation. Clinical Interventions in Aging. 2010; 5:1–9. https://doi.org/10.2147/CIA.S5901
8. Elsaie ML. Cutaneous remodeling and photorejuvenation using fractional lasers. Indian Journal of Dermatology. 2009;54(3):262–271.https://doi.org/10.4103/0019-5154.55625
9. Berman B, Perez OA, Konda S, et al. A review of the biological effects of fractional photothermolysis. Dermatologic Surgery. 2017;43(2):1–10. https://doi.org/10.1097/DSS.0000000000000942
10. Ren Y, Lim JY, et al. Fractional CO_2 laser in the treatment of post-traumatic and surgical scars. Dermatologic Therapy. 2016;29(4):220–226. https://doi.org/10.1111/dth.12325