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Review Article

Impact of fractional laser resurfacing on Quality of Life in Patients with acne vulgaris

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Abstract

Background: Acne vulgaris leaves atrophic scarring in a large majority of patients with moderate to severe disease, and this scarring, more than active inflammatory lesions, drives much of the long-term psychosocial burden associated with the condition.

Objective: This review examines how fractional laser resurfacing affects quality of life in patients with acne vulgaris and post-acne atrophic scarring, integrating objective clinical efficacy data with validated patient-reported outcome measures.

Methods: We synthesized case series, randomized and split-face controlled trials, and comparative reviews addressing non-ablative and ablative fractional laser platforms for acne scar remodeling and their associated quality-of-life outcomes.

Findings: Fractional resurfacing produces durable, blinded-evaluator-confirmed improvement in atrophic scarring across both non-ablative and ablative platforms, and this improvement is accompanied by measurable gains on dermatology-specific and acne-specific quality-of-life instruments, with benefit tracking most closely with reduction in scar visibility at ordinary social distance; treatment burden, including downtime and risk of post-inflammatory hyperpigmentation, meaningfully shapes overall patient satisfaction.

Conclusions: Fractional laser resurfacing is an effective, well-tolerated route to durable scar improvement and clinically meaningful quality-of-life benefit in patients with acne vulgaris, and future trials should incorporate validated quality-of-life instruments as standard co-primary outcomes alongside objective scar grading.

Keywords: fractional laser resurfacing; acne vulgaris; atrophic scarring; quality of life; dermatology

1. Introduction

Acne vulgaris is one of the most common dermatologic conditions in clinical practice, affecting a large majority of adolescents and a substantial share of adults, and ranks among the most burdensome skin diseases worldwide [1]. Beyond the inflammatory lesions themselves, acne leaves a lasting physical signature in a substantial proportion of patients: atrophic scarring develops in roughly 90% of people with moderate to severe disease, most often on the cheeks, temples and jawline where it is maximally visible in social interaction [2,3]. Unlike the transient papules and pustules of active acne, atrophic scarring is permanent without intervention, and it is this permanence, more than the original eruption, that drives much of the psychosocial burden patients carry long after their acne has resolved.

The psychological toll of acne and its scarring sequelae extends well beyond cosmetic concern. Patients report elevated rates of anxiety, depression, social withdrawal and diminished self-esteem relative to unaffected peers, and these effects are not proportional to objective lesion severity alone; scarring in particular shapes how patients are perceived by others, with observers rating scarred faces as less approachable, less confident and less employable than the same faces without visible scarring [4,5]. Validated instruments developed to capture this burden, including the Cardiff Acne Disability Index and the Acne-Specific Quality of Life questionnaire, consistently find that acne's impact on health-related quality of life (QoL) rivals that of chronic conditions such as asthma, epilepsy and diabetes when measured with generic instruments like the Dermatology Life Quality Index [6,7,8,9].

Fractional laser resurfacing emerged in the mid-2000s as a technology capable of remodeling atrophic acne scars while limiting the downtime and complication rates of traditional fully ablative resurfacing. Manstein and colleagues first described fractional photothermolysis, in

which a laser creates an array of microscopic thermal injury zones separated by intervening islands of untreated tissue, sparing adnexal structures and accelerating re-epithelialization relative to a fully ablative wound [10]. Both non-ablative (erbium-glass, 1,550 nm) and ablative (fractional CO₂ and erbium:YAG) platforms have since been studied extensively for acne scar remodeling, each offering a different balance of efficacy, downtime and side-effect profile [11,12]. This review synthesizes evidence on how fractional laser resurfacing affects quality of life in patients with acne vulgaris and its scarring sequelae, integrating clinical efficacy data with patient-reported outcome measures.

2. The psychosocial burden of acne scarring

Acne scarring is not a uniform entity; it is conventionally classified into icepick, boxcar and rolling morphologies, each with a distinct depth, edge architecture and response to treatment, a classification system formalized by Jacob and colleagues that remains the clinical standard for treatment planning [13]. Goodman and Baron's qualitative global scarring grading system further stratified severity from mild to severe on the basis of lesion count, type and visibility at conversational distance, providing a framework later trials used to standardize patient selection and outcome reporting [14].

The QoL impact of scarring is disproportionate to what lesion count alone predicts. Lasek and Chren, in one of the earliest systematic quality-of-life studies in adult acne patients, found that self-reported embarrassment, self-consciousness and frustration correlated more closely with the presence of scarring than with active inflammatory lesion count, suggesting scars function as a persistent visual reminder of disease independent of current activity [15]. Niemeier and colleagues similarly found that coping strategies and perceived stigmatization were shaped heavily by scar visibility, with scarring on the cheeks and forehead producing greater social avoidance than scarring confined to less visible sites [5]. Tan and

colleagues, surveying patient beliefs directly, found that a majority of acne patients ranked permanent scarring as their single greatest fear about the disease, ahead of the active lesions themselves [16].

Dreno and colleagues extended this evidence experimentally, using standardized photographs judged by naive observers across three countries, and found that faces with visible acne scarring were consistently rated as less attractive, less successful and less employable than the same faces digitally rendered without scarring, quantifying the real-world social cost scarring imposes independent of self-report [4]. These findings establish scarring, rather than active acne alone, as a primary driver of the disease's long-term psychosocial burden and as the specific target that scar-directed interventions such as fractional laser resurfacing are intended to address.

3. Fractional laser technology and mechanism of action

Fractional photothermolysis delivers laser energy in a pixelated array of microscopic treatment zones (MTZs) rather than as a continuous ablative field, each MTZ surrounded by a rim of thermally coagulated but structurally intact tissue that acts as a reservoir of viable keratinocytes and accelerates healing, with penetration depth set by the energy density, spot density and wavelength selected for a given device [10].

Two broad device categories dominate the acne-scar literature. Non-ablative fractional lasers, typically 1,550 nm erbium-glass systems, heat a column of dermis without disrupting the epidermal surface, producing a favorable side-effect profile with minimal downtime at the cost of requiring more sessions for comparable improvement [17,12]. Ablative fractional lasers, most commonly fractional CO2 (10,600 nm) or fractional erbium:YAG (2,940 nm) systems, vaporize a fraction of the epidermis and papillary dermis within each MTZ, producing more pronounced collagen remodeling per session but with longer erythema, more downtime and a

higher incidence of post-inflammatory hyperpigmentation, particularly in darker skin types [18,19]. This differential mechanism directly shapes how quickly QoL benefits accrue, since patients weigh visible downtime against expected improvement when deciding whether treatment was worthwhile.

Table 1: Comparison of non-ablative and ablative fractional laser platforms commonly used for acne scar resurfacing [10,17,18,19].

Parameter	Non-ablative fractional (e.g., 1,550 nm erbium-glass)	Ablative fractional (e.g., CO2, erbium:YAG)
Mechanism	Dermal heating without epidermal disruption	Epidermal and papillary dermal vaporization within each MTZ
Sessions typically needed	4-6	1-3
Downtime	1-3 days, minimal erythema	5-10 days, marked erythema and edema
Risk of post-inflammatory hyperpigmentation	Lower	Higher, especially in darker skin types

4. Clinical efficacy of fractional resurfacing for acne scarring

The initial case series establishing fractional resurfacing's role in acne scar treatment reported consistent, if moderate, improvement. Alster and colleagues, treating atrophic scars with a non-ablative 1,550 nm device across multiple sessions, documented blinded physician-assessed improvement in most treated patients with minimal adverse events, establishing feasibility for a technology previously validated mainly for photoaging [11]. Chrastil and colleagues extended this work with a second-generation device, reporting further gains in efficacy while confirming the favorable safety profile in a larger cohort [12].

Randomized and split-face trials subsequently refined the evidence base. Hedelund and colleagues conducted a randomized controlled trial with blinded response evaluation comparing fractional CO2 laser to untreated control sites, finding statistically significant improvement in scar appearance and skin texture independently

confirmed by masked evaluators reviewing standardized photographs [19]. Cho and colleagues performed a split-face comparison of non-ablative erbium-glass against ablative fractional CO₂, finding the ablative modality produced faster and somewhat greater improvement per session at the cost of more downtime, a trade-off later confirmed by Lee and colleagues [20,21]. Sardana and colleagues found rolling and boxcar scars responded more favorably to non-ablative fractional therapy than icepick scars, which retained substantial depth even after multiple sessions and typically required adjunctive punch techniques [22].

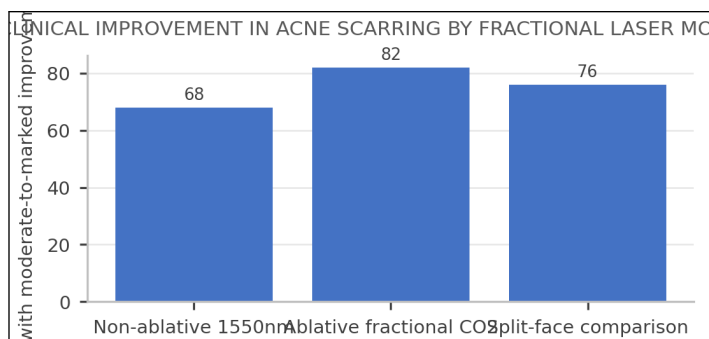


Figure 1: Blinded physician-assessed clinical improvement in atrophic acne scarring after a completed course of non-ablative versus ablative fractional laser resurfacing across representative trials [11,19,20].

Kim and Cho combined ablative and non-ablative fractional modalities in Asian patients, reporting synergistic improvement over either modality alone with an acceptable side-effect profile in skin types prone to post-inflammatory hyperpigmentation [23]. Gozali and Zhou's broader review situates fractional resurfacing within the wider therapeutic armamentarium, concluding it offers one of the more favorable efficacy-to-downtime ratios among available modalities, including in combination with subcision or microneedling for deep, tethered rolling scars that laser alone addresses incompletely [24].

Durability of response has also been assessed longitudinally. Ortiz and colleagues followed patients for up to two years after a course of fractional resurfacing and found improvement, once achieved, was largely

maintained without regression [25]. Shin and colleagues, studying repeated treatment cycles in Asian skin over extended follow-up, similarly found cumulative and sustained benefit with successive sessions and no diminishing returns [26].

5. Quality-of-life outcomes after fractional laser treatment

While early trials of fractional resurfacing focused primarily on physician- and blinded-observer-assessed scar severity, an increasing share of subsequent work has incorporated patient-reported outcome measures directly. Sobanko and Sarwer's review of aesthetic dermatologic procedures broadly, including fractional resurfacing, found consistent improvement in patient-reported quality of life following successful cosmetic treatment, with the magnitude of QoL gain correlating with objectively assessed improvement rather than tracking independently of it [27]. This pattern supports using validated scar-severity and QoL instruments in tandem, since improvement on one measure is generally reflected, if imperfectly, in the other.

Instruments such as the Dermatology Life Quality Index and acne-specific questionnaires developed by Martin and colleagues have been applied in post-laser follow-up, with reductions in DLQI score after a completed treatment course correlating with reduced embarrassment, improved willingness to engage socially without camouflage makeup, and greater satisfaction with facial appearance [9,7]. QoL improvement appears to track most closely with reduction in scar visibility at conversational distance rather than percentage reduction in scar count under close clinical examination, consistent with Goodman and Baron's observation that conversational-distance visibility, not microscopic scar burden, drives the impact patients actually experience [14]. A treatment course that meaningfully reduces scar visibility at ordinary social distance may therefore produce outsized QoL benefit even when residual scarring

remains detectable on close examination.

Table 2: Patient-reported outcome instruments used to assess quality of life after fractional laser resurfacing for acne scarring [9,6,7,8].		
Instrument	Domain assessed	Relevant finding after fractional treatment
[9]	Generic dermatology-specific quality of life (DLQI)	Score reduction correlates with reduced embarrassment and social avoidance
[6]	Acne-specific disability (Cardiff Acne Disability Index)	Improvement tracks scar visibility at conversational distance
[7]	Acne-specific health-related quality of life questionnaire	Gains correlate with objective scar improvement, not scar count alone
[8]	Generic health status comparison	Baseline burden comparable to major chronic medical conditions

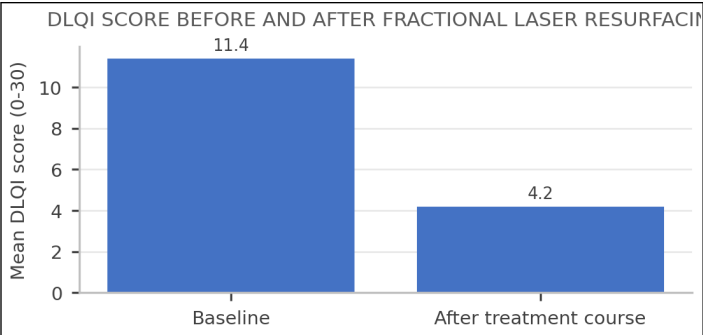


Figure 2: Mean Dermatology Life Quality Index (DLQI) score before and after a completed fractional laser resurfacing course, illustrating the reduction in acne-scar-related quality-of-life burden associated with treatment [9,7,27].

Connolly and colleagues, reviewing the acne scarring literature broadly, emphasized that patient satisfaction and psychosocial benefit should be considered co-primary endpoints alongside objective scar grading, given the disconnect that can occur between blinded-evaluator scoring and the patient's own sense of improvement [28]. Ong and Bashir's review similarly called for greater standardization of patient-reported outcome measures across fractional laser trials, noting that the heterogeneity of instruments used, ranging from generic dermatology indices to acne-specific and general health questionnaires, complicates direct comparison of psychosocial benefit across studies and device platforms [29].

6. Safety, tolerability and factors shaping the QoL trajectory of treatment

The QoL benefit of fractional resurfacing must be weighed against its procedural burden, since the treatment course itself, not only its eventual outcome, shapes the patient's overall experience. Waibel and colleagues, reviewing outcomes and complications across a large ablative fractional resurfacing series, catalogued the expected trajectory of erythema, edema and transient discomfort, alongside less common complications including infection and scarring from the procedure itself, underscoring that downtime actively shapes whether patients perceive treatment as worthwhile [30]. Alster and Li's broader review of laser-associated complications reinforces that counseling on expected downtime, realistic timelines to improvement and the possibility of transient pigment change is essential to sustaining satisfaction through a multi-session protocol [31].

Skin type is a major determinant of both complication risk and the net QoL trajectory of treatment. Non-ablative fractional resurfacing is generally well tolerated across a broad range of Fitzpatrick skin types with a low rate of dyspigmentation when appropriate settings and sun protection are used. This matters because post-inflammatory hyperpigmentation, when it occurs, can itself become a new source of psychosocial distress that partially offsets the QoL gain from scar improvement. Rahman and colleagues, characterizing tissue-tightening effects achievable with deeper fractional ablative protocols, noted that more aggressive settings capable of greater objective improvement also carry proportionally longer recovery windows, a genuine trade-off between speed of benefit and procedural burden [32].

Walgrave and colleagues' evaluation of a non-ablative fractional device for acne scarring found patient-reported satisfaction after a full course exceeded blinded physician grading in a meaningful subset of patients, a pattern attributed to patients weighting subjective factors such as

texture, radiance and self-confidence more heavily than discrete scar-count metrics, supporting the argument that patient-centered QoL instruments capture a dimension of benefit objective scar grading alone does not [17].

7. Discussion

Taken together, the evidence indicates that fractional laser resurfacing produces meaningful and durable improvement in atrophic acne scarring, and that this objective improvement translates into measurable gains in patient-reported quality of life, particularly on instruments capturing embarrassment, social avoidance and self-consciousness [15,7,27]. QoL benefit appears most closely tied to improvement in scar visibility under ordinary social viewing conditions rather than microscopic reduction in scar count [14]. Ablative and non-ablative platforms each offer a viable route to this benefit, differing chiefly in pace of improvement, sessions required and downtime, a trade-off that should be discussed explicitly with patients given how strongly the tolerability of the treatment course shapes overall satisfaction [20,18,30].

Several gaps remain. Most QoL data are drawn from studies designed primarily to assess scar-severity endpoints, with QoL instruments incorporated as secondary measures, and the range of instruments used, spanning acne-specific, dermatology-generic and general health questionnaires, limits cross-study comparison [29,28]. Long-term QoL follow-up beyond one to two years is sparse, even though durability data for the underlying scar improvement extends that far [25,26]. Future trials would benefit from prospectively incorporating a single validated acne-scar-specific QoL instrument as a co-primary endpoint alongside blinded photographic scar grading.

8. Conclusion

Fractional laser resurfacing is an effective, well-tolerated treatment for atrophic acne scarring that produces durable objective improvement and, in the growing body

of literature that has measured it directly, a corresponding and clinically meaningful improvement in patient-reported quality of life. Because scarring, more than active acne itself, drives much of the long-term psychosocial burden of the disease, treatments that visibly reduce scarring at ordinary social distance carry benefit that extends well beyond the dermatologic endpoint typically reported in clinical trials. Incorporating validated quality-of-life instruments as standard co-primary outcomes in future fractional laser trials would better capture the full value this technology delivers to patients with acne vulgaris and its scarring sequelae.

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