

Efficacy of Fractional CO₂ Laser with PRP for Cutaneous Leishmaniasis Scar

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ABSTRACT

Background Atrophic or dyschromic scars are frequently left behind after cutaneous leishmaniasis (CL) healing, leading to both psychological misery and physical deformity. Although they eliminate parasites, current antileishmanial treatments do not stop scarring. Although there is little data regarding CL scars, novel regenerative techniques such as fractional CO₂ laser and platelet-rich plasma (PRP) have demonstrated potential in treating acne and traumatic scars. Objective To explore the efficacy of fractional CO₂ laser with PRP in improving cutaneous leishmaniasis scars, focusing on both clinical and patient-reported outcomes. Methods One hundred patients (18–50 years old) with CL scars that had been there for at least six months were enrolled in a qualitative study at a dermatology department in Quetta. Following fractional CO₂ laser treatment, participants received topical autologous PRP. Clinical photography, outcome measures, and patient interviews were used to gather data during a six-month period. Scar look, texture, pigmentation, psychological impact, social acceptance, satisfaction, and side effects were identified as important topics by thematic content analysis. Results Most participants had facial scars (55%), were female (62%), and were young adults (78%). Scar texture (68%) and pigmentation (61%), according to the patients, have improved. Enhanced social acceptance (57%) and psychological advantages (74%) were frequently reported. In general, 79% of patients expressed satisfaction or high satisfaction with their care. Erythema (70%), swelling (52%), crusting (25%), and hyperpigmentation (10%) were among the mild and temporary side effects; 15% of patients reported no negative side effects. Conclusion For cutaneous leishmaniasis scars, fractional CO₂ laser with PRP seems to be a potential minimally invasive treatment that offers notable social, psychological, and esthetic benefits with little recovery time. To produce evidence-based guidelines and validate long-term efficacy, more controlled trials with defined techniques are required. Keywords: Cutaneous leishmaniasis; Scars; Fractional CO₂ laser; Platelet-rich plasma (PRP)

INTRODUCTION

Cutaneous leishmaniasis (CL) is a skin infection of a parasitic disease called *Leishmania* spp. transmitted by infected sand flies. Even though most lesions heal either spontaneously or following antileishmanial treatment, they often create atrophic, depressed, or dyschromic scars that continue to be a significant contributor to long-term morbidity and psychosocial anguish in endemic areas. (1) The high load and varied clinical manifestation of CL, and the continuing cosmetic sequelae, is well represented in recent clinical reviews.

The traditional use of CL is aimed at eradicating parasites (topical or systemic antimonial, amphotericin B, miltefosine, etc.); but the scarring resulting following lesion clearance is not always avoided or reduced using traditional interventions. As a result, reconstructive and adjuvant dermatological methods, which revolve around the modification of the scar and improving aesthetics, have become popular. (2)

Platelet-rich plasma (PRP), an autologous preparation of platelets and growth factors (PDGF, TGF- β , VEGF, and EGF), when used on injured skin, has been found to stimulate fibroblast activity, angiogenesis, decrease inflammation, and accelerate wound healing. The biologic properties of PRP make it a rational addition to ablative therapies that involve more tissue regeneration; it has been studied as a single treatment agent and as an adjunct to energy-based modalities in ablative therapy of acne and post-traumatic scars (3).

Combining fractional CO₂ laser and PRP stem from the synergism of their both offerings; PRP accelerates healing, enhances collagen remodeling and decreases downtime, and fractional CO₂ laser induces microchannels for deeper penetration of PRP. In a randomized controlled trial for acne scar patients comparing fractional CO₂ laser with and without PRP, Gawdat et al. noted that statistically, the combination group healed faster and had more patient satisfaction, with noticeably better scar improvement (4). Similarly, Abdelghani et al found that using PRP with fractional CO₂ laser improved acne scars by 60–70%, as opposed to an improvement of 30–40% when laser was used alone (5).

The reason for combining fractional CO₂ laser and PRP is that the fractional CO₂ laser has a synergistic effect by providing microchannels for PRP to penetrate deeper skin layers and PRP induces collagen remodeling and speeds up healing and decreases downtime. In a randomized controlled trial comparing fractional CO₂ laser with and without PRP in patients with acne scar, Gawdat et al. found that the combination group had a faster healing, more patient satisfaction, as well as much better scar improvement (4). Simonarten Abdelghani et al. found that the use of PRP with fractional CO₂ laser improves acne scars by 60–70% compared to 30–40% when using the laser alone (5).

Medical professionals consider ablative laser resurfacing as the primary technique for treating atrophic acne scars to date. Traditional ablative laser treatment generates both hypertrophic scarring and persistent hyperpigmentation as new side effects on the skin. A new form of treatment called fractional laser emerged to reduce the damaging effects. These therapeutic advantages generally have short life spans because the surviving epidermis helps speed up recovery while remaining in place. Even though high-energy laser treatment raises therapeutic efficacy it does not protect patients from potential adverse effects (6).

Research findings indicate that fractional CO₂ lasers can successfully treat moderate atrophic scars by 81 % (8). The fractional CO₂ laser represents a modern version of fractional lasers that have recently entered the market. Fractional CO₂ lasers obtained FDA approval for surgery purposes and acne scars treatment in 2006. The functional operation of these lasers duplicates older invasive systems with reduced recovery time and fewer adverse effects than older versions (7). The effect of fractional CO₂ laser shows similar results with atrophic acne scars and leishmaniasis scars because acne scars are recognized as atrophic scars. The assessment of CO₂ laser effect on leishmaniasis scarring appears only twice within existing literature through research using continuous CO₂ laser and a single case study (7, 9).

Thus, this study aims to evaluate the efficacy and safety of fractional CO₂ laser combined with platelet-rich plasma (PRP) in improving cutaneous leishmaniasis scars compared to fractional CO₂ laser alone.

The management of atrophic cutaneous scars, particularly those arising from cutaneous leishmaniasis (CL), remains a clinical challenge. Over the past decade, dermatologic research has increasingly investigated the use of fractional ablative CO₂ lasers and platelet-rich plasma (PRP) both alone and in combination — for remodeling these scars and improving cosmetic outcomes.

The foundation of fractional CO₂ laser resurfacing is the creation of small columns of controlled thermal injury, or microthermal zones, which promote collagen neogenesis and dermal matrix remodeling while protecting intervening tissue to hasten healing. Depending on energy settings, scar

type, and treatment intervals, studies on atrophic acne scars have shown clinical improvements of 50–80% (10, 11)

According to Cho et al. (Asia), after several sessions, around half of the patients demonstrated improvement of greater than 50%; the crusting and erythema were modest and temporary. (12)

The majority of patients who used fractional CO₂ lasers experienced a 30–70% improvement in scar appearance, according to a larger systematic study. Common but self-limiting adverse effects included temporary erythema, edema, and post-inflammatory hyperpigmentation. (11)

The information is somewhat sparse but encouraging in the particular area of cutaneous leishmaniasis scarring. According to Banihashemi et al., fractional CO₂ lasers are very effective and safe for CL scars; no serious side effects were observed. (12)

In a study comparing fractional CO₂ and ablative CO₂ lasers for leishmaniasis scars, fractional CO₂ produced better results in terms of healing parameters and scar size reduction ($P < 0.05$) than continuous ablative CO₂. (13,14)

Furthermore, a case study titled "Successful Treatment of Atrophic Scars from Cutaneous Leishmaniasis Using a Fractional Laser" detailed how a fractional laser significantly improved the patient's appearance for a CL scar. (15)

Nevertheless, not every study consistently demonstrates additional effect. In a comparison study, the PRP + laser and fractional CO₂ laser groups both showed considerable improvement, but the difference between them was not statistically significant ($p = 0.793$) according to the Patient and Observer Scar Assessment Scale (POSAS). (16)

Similar to this, the IJDVL split-face experiment revealed improved clinical results with PRP + CO₂ laser; however, there was a trade-off, as the PRP side experienced longer erythema and edema. (17)

Twelve studies that employed fractional CO₂ laser, either alone or in conjunction with PRP, to treat atrophic acne scars were examined in a systematic narrative review (2024). Although results varied depending on research design, scar types (rolling, boxcar, ice-pick), and skin phototypes, the authors found that incorporating PRP frequently resulted in superior clinical outcomes and fewer adverse effects, especially in terms of reducing downtime. (18)

Although fractional CO₂ laser and PRP have an appealing mechanistic synergy, little research has been done on how to use this strategy to cutaneous leishmaniasis scars. Although there is currently a dearth of peer-reviewed research, the only direct reference to CL comes from a media or conference release implying that laser-based combination therapy may hasten healing and lessen scarring in leishmaniasis. (19)

Another trial was conducted by Juan C. Jaffary et al. in order to evaluate the influence of combining PRP with CO₂ laser on atrophic facial scars, including the CL scar subgroup. PRP also reduces post-laser erythema and edema according to the authors, speeding recovery and subjectively and objectively improves scar scores (20).

The risk of post-inflammatory hyperpigmentation in darker skin types, which is common in endemic regions, the lack of standardized protocols (laser fluence, PRP preparation, number of sessions) for CL patients, and differences in scar biology—CL scars may have deeper dermal destruction, local immune changes, and pigmentation alterations—are some of the challenges in this field. Furthermore, few trials use objective imaging methods to measure structural changes in the scar or long-term follow-up to evaluate durability.

To determine the effectiveness, safety, and ideal parameters for fractional CO₂ laser + PRP in CL scars, more controlled clinical trials are therefore necessary. By using a rigorous design, objective and

subjective outcome measures, and an emphasis on CL-endemic communities with darker phototypes, this study aims to close that gap.

This study aims to assess the effectiveness of fractional CO₂ laser alone and fractional CO₂ laser with platelet-rich plasma (PRP) for cutaneous leishmaniasis scars. The specific goal of this study is to ascertain whether, in comparison to monotherapy, the combination method improves scar appearance more clinically and cosmetically, increases patient satisfaction, and shortens recovery and recovery time. The research is also aimed at assessing the safety of the combined modality and exploring the potential synergistic actions of PRP-mediated tissue healing and collagen remodeling caused using fractional CO₂ laser. Through these aspects, the research will provide evidence-based knowledge on a state-of-the-art, least invasive method of cutaneous leishmaniasis scar treatment.

METHODS

This qualitative investigation took place at the dermatology department of Quetta tertiary care hospital. The 100 patients with cutaneous leishmaniasis (CL) scars were recruited based on purposive sampling. Eligible patients were aged 18–50 years who had CL scars that were initially clinically identified, which endured for at least six months, and they agreed to receive treatment and follow up. We did not include individuals with coagulopathies, active leishmaniasis, keloidal propensity or systemic retinoids within the previous six months. Individuals received laser therapy with fractional CO₂ and autologous platelet rich plasma (PRP). PRP was made by centrifuging the patient's own blood in accordance with the same procedure normally used to concentrate platelets. The fractional CO₂ laser was applied over the scar area using defined parameters (i.e., energy, density, number of passes) that were varied based on individual skin type and scar characteristics. Following laser therapy, PRP was topically given to the treated area in the case of greater absorption.

However, the patients were monitored for six months and at regular intervals. The data collected included in depth patient interviews, patient reported outcome measures and clinical photography, and the main topics included improvements in scar appearance, texture, pigmentation, psychological impact and patient satisfaction. I have also recorded many negative incidents or side effects. Qualitative data were examined using thematic content analysis in order to identify themes, patterns and patients' perception regarding efficacy and satisfaction with treatment.

RESULTS

Table 1: Demographic Characteristics of Participants (n = 100)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–30	42	42%
	31–40	36	36%
	41–50	22	22%
Gender	Male	38	38%
	Female	62	62%
Duration of scars	6–12 months	28	28%
	13–24 months	46	46%
	>24 months	26	26%
Scar location	Face	55	55%
	Upper limbs	27	27%
	Other body areas	18	18%

Table 2. Thematic Analysis of Patient-Reported Improvements

Theme Identified	Number of Patients Mentioning (n)	Example Patient Quote
Improved Scar Texture	68	The scars became smoother and less visible.
Reduction in Pigmentation	61	The dark spots lightened significantly.
Psychological Benefit	74	I feel more confident meeting people now.
Improved Social Acceptance	57	My friends noticed the change, and I feel less stigmatized.
Satisfaction with Treatment	79	I am satisfied and would recommend it to others.

Table 3. Patient Satisfaction and Perceived Efficacy

Satisfaction Level	Frequency	Percentage (%)
Very Satisfied	42	42%
Satisfied	37	37%
Neutral	12	12%
Dissatisfied	6	6%
Very Dissatisfied	3	3%

Table 4: Reported Side Effects and Recovery Experience

Side Effect	Number of Patients (n)	Percentage (%)	Recovery Description
Mild erythema (redness)	70	70%	Resolved within 3–5 days
Mild swelling	52	52%	Resolved within 2–4 days
Crusting	25	25%	Resolved within 7 days
Hyperpigmentation	10	10%	Improved over follow-up period
No side effects	15	15%	N/A

DISCUSSION

This article incorporated qualitative methods to gather patient-reported outcomes, clinical observations, and theme analysis as part of determining the effectiveness of fractional CO₂ laser plus platelet-rich plasma (PRP) on cutaneous leishmaniasis (CL) scarring. Besides a high level of satisfaction and psychosocial benefits, the findings reveal that the majority of the patients also experienced visible changes in scar texture, pigmentation and general esthetic appearance.

As shown in Table 1, most participants were young adults (18–40 years, 78%), consistent with the high incidence of CL in younger populations living in endemic regions. Female participants (62%) slightly outnumbered males, reflecting higher aesthetic concerns and care-seeking behavior in women, which has also been noted in scar treatment research (10,11). The predominance of facial scars (55%) underscores the psychosocial burden of CL, as disfigurement in visible areas directly affects self-esteem and social interactions (12).

Significant benefits indicated by patients were found by thematic content analysis (Table 2). Reduction in pigmentation (61%) and improved scar texture (68%) were commonly reported, confirming previous findings that PRP improves melanocyte regulation and vascularization, whereas fractional CO₂ lasers promote collagen remodeling (13,14). Crucially, the impact of treatment went beyond physical results, addressing the stigma and emotional discomfort frequently associated with CL scars, as evidenced by psychological improvements (74%) and increased social acceptance (57%). In the literature on acne

scars, similar psychosocial benefits have been documented, with patients reporting notable enhancements in their quality of life following fractional laser and PRP treatment (15,16).

Nearly 80% of patients reported being satisfied or very satisfied, which is indicative of high levels of satisfaction (Table 3). Just 9% of respondents voiced unhappiness, which could be related to things like scar chronicity or individual differences in healing response. These satisfaction levels are in line with findings from studies on acne scars, which showed that combination therapy continuously produced better patient-reported results than laser monotherapy (4,5,17).

Most of the mild and temporary adverse effects listed in Table 4—such as erythema (70%), swelling (52%), and crusting (25%), all of which went away in a matter of days to a week. Just 10% experienced transient hyperpigmentation, which gradually subsided. These results are in line with earlier research that indicates fractional CO₂ lasers, in conjunction with PRP, tend to improve healing and decrease downtime when compared to lasers alone (18–20). Interestingly, 15% of patients said they had no negative side effects, indicating good tolerance. For individuals in CL-endemic areas, where darker skin types are more likely to develop post-inflammatory hyperpigmentation, this safety profile is essential.

Our study applies these findings to CL scars, an area with little published evidence, whereas most of the research on fractional CO₂ laser with PRP has been on acne scars. Although there is still a lack of solid evidence, Banihashemi et al. (12) and other case studies have demonstrated that fractional CO₂ lasers are useful for CL scars. Our results support the idea that the pathophysiologic characteristics of CL scars and atrophic acne scars are similar, enabling treatment extrapolation. Additionally, by documenting patient experiences—which are sometimes underrepresented in strictly quantitative designs—the qualitative aspect of this study provides richness.

A strength of this study is its focus on patient-centered outcomes, which reflect both clinical and psychosocial dimensions of scar improvement. Moreover, the use of PRP with fractional CO₂ laser in a CL-endemic population provides novel regional data. However, limitations include the lack of a randomized control group, reliance on self-reported perceptions, and the absence of objective scar assessment tools such as imaging or standardized scar scales (e.g., POSAS or Vancouver). Future studies should incorporate comparative designs with longer follow-up to validate the durability of outcomes.

CONCLUSION

This qualitative study shows that platelet-rich plasma (PRP) and fractional CO₂ laser are a safe, efficient, and well-tolerated treatment for cutaneous leishmaniasis (CL) scarring. Significant psychological and social advantages were noted by most patients, who also claimed improvements in scar texture, pigmentation, and overall look. There were relatively minor, temporary adverse effects and high satisfaction levels with the therapy. Larger controlled trials with objective scar assessments are necessary to evaluate and generalize these findings across a variety of groups, even though they offer useful patient-centered evidence.

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