



COMPARATIVE STUDY ON EFFICACY OF CARBON DIOXIDE LASER VERSUS DERMAROLLER WITH PLATELET-RICH PLASMA ON STRIAE DISTENSAE

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ABSTRACT

Introduction: Striae distensae, commonly known as stretch marks, are a widespread dermatological concern impacting various populations. These linear scars, characterized by epidermal thinning and alterations in dermal architecture, often affect individuals' psychological well-being despite being asymptomatic. Clinically, they present initially as reddish or purplish lesions (striae rubra) that progress to pale, wrinkled streaks (striae alba). The etiology involves the breakdown of elastin fibers in the mid-dermis, influenced by hormonal changes, genetic factors, and immune responses. Current treatments aim to reduce inflammation, stimulate collagen production, and improve skin hydration, yet no single modality has been proven definitively effective. This research investigates the relative effectiveness of fractional CO₂ laser therapy compared to microneedling combined with platelet-rich plasma (PRP) for the treatment of striae distensae.

Methods: A prospective interventional study was carried out at Muzaffarnagar Medical College & Hospital, where 60 patients with striae distensae were enrolled from June 2022 to December 2023. Participants were randomly assigned to either fractional CO₂ laser therapy or microneedling with PRP. Each group underwent four treatment sessions spaced one month apart. Treatment efficacy was assessed using clinical photography, the Atwal and Davey scoring system, patient satisfaction surveys, and monitoring for adverse events.

Results: Fractional CO₂ laser therapy demonstrated superior efficacy compared to microneedling with PRP. The fractional CO₂ laser resulted in a 33.9% reduction in the Atwal and Davey score for both striae rubra and alba, while microneedling with PRP achieved an 18.6% reduction. Patient satisfaction was notably higher in the fractional CO₂ laser group (59.9%) compared to the microneedling with PRP group (26.6%). Both treatments were generally well-tolerated, though fractional CO₂ laser therapy was associated with a slightly higher incidence of post-inflammatory hyperpigmentation and scarring.

Conclusion: Fractional CO₂ laser therapy proves to be more effective than microneedling combined with PRP in enhancing the appearance of striae distensae and yields greater patient satisfaction.

While there are some risks of adverse effects, fractional CO₂ laser therapy is a superior choice for treating stretch marks, delivering better clinical results and higher patient preference. Further studies with larger sample sizes and longer follow-up are warranted to confirm long-term benefits and safety.

INTRODUCTION

Striae distensae, commonly known as stretch marks, are a prevalent cosmetic concern affecting individuals across demographics.^[1] These linear dermal scars, characterized by epidermal atrophy, can significantly impact psychological well-being despite being asymptomatic.

Clinically, striae manifest as initially reddish or purplish raised lesions (striae rubra), which subsequently evolve into pale, wrinkled, and depressed white streaks (striae alba).^[1] The incidence of striae varies widely, with higher rates observed in adolescents (reaching up to 71%) and pregnant women.^[2] While the exact etiology remains elusive, the prevailing theory involves elastin fiber breakdown within the mid-dermis, triggered by immune cell-derived elastases. This disruption in connective tissue integrity, coupled with hormonal influences and genetic predisposition, contributes to striae formation.^[1]

Striae distensae show distinct changes under the microscope depending on the stage. Early lesions (striae Rubra) have inflammatory signs like fluid build-up (edema) and immune cell clusters (lymphocytic cuffing) around blood vessels.^[3] These areas also have dense collagen arranged in parallel bundles and increased glycosaminoglycans.^[4] Later stage lesions (striae Alba) show a thinner epidermis with loss of epidermal surface and hair follicles, appearing as white and depressed scars.^[4]

Given the significant psychological impact of striae distensae, effective management strategies are highly sought after. Current approaches primarily focus on reducing inflammation, stimulating collagen and elastin production and optimizing skin hydration, particularly during the early stages (striae Rubra).^[5]

Given the significant psychological distress associated with striae, various treatment modalities have been explored. These include topical medications, lasers, microneedling, and platelet-rich plasma (PRP) therapy.^[6] However, no single treatment has consistently proven to be a definitive cure. This study aims to compare the efficacy of fractional CO₂ laser therapy and microneedling with PRP in addressing this challenging dermatological condition.

Fractional CO₂ laser therapy leverages the principle of photothermolysis to target and resurface striae lesions. The laser energy creates micro-columns of tissue destruction in the dermis, stimulating collagen remodeling and neocollagenesis. This process ultimately leads to skin rejuvenation and improvement in the texture of striae.^[7]

Micro-needling creates controlled micro-injuries in the skin, promoting the release of growth factors and stimulating tissue repair. This can be observed microscopically by an increased epidermal thickness and stromal glycosaminoglycans in the dermis.^{[8][9]} When combined with PRP, a concentrated source of growth factors and cytokines is delivered synergistically to the area affected and this aims to further enhance collagen production and improve the appearance of striae.

AIMS AND OBJECTIVES

- 1) To study the efficacy of carbon dioxide laser in Striae distensae
- 2) To study the efficacy of the combined effect of derma-roller and platelet rich plasma in Striae distensae
- 3) To compare the efficacy of carbon dioxide laser versus the combined effect of derma-roller and platelet-rich plasma in Striae distensae

MATERIALS AND METHODS

This study employed a prospective, interventional design to evaluate the comparative efficacy of fractional CO₂ laser therapy and microneedling with platelet-rich plasma (PRP) in the management of striae distensae.

Patients presenting with striae distensae were recruited from the Dermatology Department of Muzaffarnagar Medical College & Hospital, India, between June 2022 and December 2023. Inclusion and exclusion criteria were applied to determine eligibility. All participants provided informed consent before being enrolled in the study.

Inclusion Criteria

- Age 16-60 years old
- Both genders
- Patients with striae distensae
- Striae developed after pregnancy

Exclusion Criteria:

- Pregnancy or lactation
- History of keloid scars
- Unrealistic expectations
- Active infection or compromised immune system
- Pacemaker or bleeding disorders
- Uncontrolled systemic diseases or mental illnesses

Data Collection

A comprehensive medical history, including demographic information, striae characteristics (location, duration, severity), and associated comorbidities, was meticulously documented. A thorough physical examination was conducted to assess overall health status and to characterize the striae lesions.

Intervention

Participants were randomly allocated to one of two treatment groups:

- Fractional CO₂ laser therapy group: Patients underwent four fractional CO₂ laser treatment sessions spaced one month apart.
- Microneedling with PRP group: Patients received four microneedling with PRP treatment sessions, with a one-month interval between each session.

Outcome Measures

Treatment response was assessed through multiple parameters:

- **Clinical photography:** Standardized photographs were captured at each visit to document visual changes in striae appearance.
- **Atwal and Davey scoring system:** This validated scoring system was used to quantify the severity of striae distensae.
- **Patient satisfaction:** A subjective assessment of treatment satisfaction was obtained through a standardized questionnaire.
- **Adverse events:** Any adverse reactions or complications associated with the treatments were recorded.

Statistical Analysis

Statistical analysis was performed using SPSS software to compare treatment outcomes between the two groups. Appropriate statistical tests were employed to determine the significance of differences in treatment efficacy, patient satisfaction, and adverse event profiles.

RESULTS

• **Patient demographics**

Out of the 60 patients enrolled in the study, the majority of the patients were young adults belonging to the 10-29 years (73.3%) of the age group. The females outnumbered males with a female to male ratio of 3:1. 31.7% of the participants were male and 68.3% were female. [Age and gender distribution illustrated in **Table 1**]

TABLE 1: Age and gender distribution in striae distensae patients

AGE GROUP	NUMBER OF PATIENTS (n=60)	NUMBER OF MALES	NUMBER OF FEMALES
10-19	11 (18.3%)	5	6
20-29	33 (55%)	8	25
30-39	11 (18.3%)	4	7
40-49	2 (3.3%)	2	0
50-59	3 (5%)	0	3

The most frequently approaching patients by occupation were the students (43.3%). This could be attributed to growth spurt (38.5%) and weight change (30.8%). The second most common affected group was housewives (31.7%) where the most common causes of striae distensae were obesity (42.1%) and pregnancy (42.1%). [Illustrated in **Figure 1**]

Out of all presenting Striae Distensae, Striae Alba (34/60; 56.7%) was more commonly seen than Striae Rubra (26/60; 43.3%). The most common sites that were treated were the abdomen (40%) followed by thighs (28.3%), arms (23.3%), and breast (8.3%). [Illustrated in **table 2**]

Table 2: Frequency distribution of striae distensae patients according to site and type

SITE	NUMBER OF PATIENTS (n=60)	NUMBER OF STRIAE RUBRA	NUMBER OF STRIAE ALBA
ABDOMEN	24 (40%)	12	12
ARMS	14 (23.3)	6	8
AXILLAE	3 (5%)	1	2
BACK	4 (6.7%)	2	2
BREAST	5 (8.3%)	4	1
BUTTOCKS	5 (8.3%)	3	2
CHEST	4 (6.7%)	1	3
KNEE	2 (3.3%)	0	2
CALVES	2 (5%)	0	2
THIGHS	17 (28.3%)	5	12

• **Striae characteristics**

Overall, the causes of striae in our study were recent weight change (25%) followed by obesity of prolonged duration (21.7%), pregnancy (18.3%), growth spurt (16.7%), prolonged intake of oral corticosteroid use (10%), prolonged application of topical corticosteroids (5%), Cushing syndrome/Cushingoid (3.3%), and intralesional steroids (1.7%). [Illustrated in **Figure 1**]

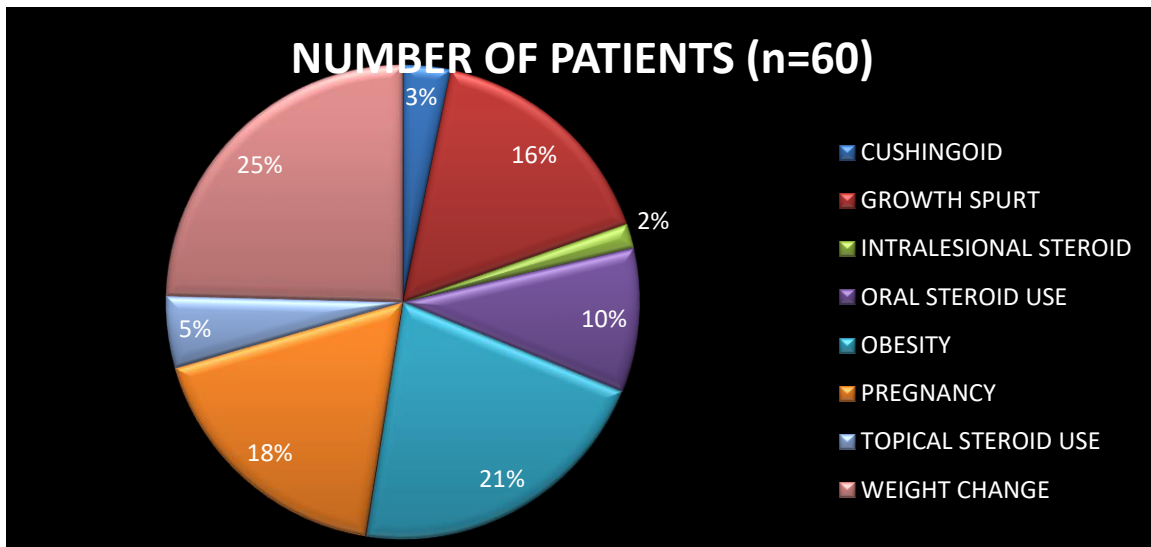


Figure1: Distribution of striae distensae patients according to causes

• **Treatment outcomes**

We assessed the severity of the Striae distensae and treatment response by using the Atwal and Davey scoring system. Fractional CO2 laser therapy on striae distensae showed a higher reduction in Striae Rubra than striae Alba. The mean Atwal and Davey score reduction in striae Rubra was from 7 to 4.2 (40% reduction) after 4 sessions of laser therapy conducted 4 weeks apart. However, the reduction in Alba was from 5.5 to 4.1 (25.5% reduction).

Micro-needling with PRP also showed a greater reduction in Striae Rubra than Striae Alba. The mean Atwal and Davey score reduction in Striae Rubra was from 6.5 to 4.9 (24.6 % reduction) after 4 sessions of laser therapy conducted 4 weeks apart. However, the reduction in Striae Alba was from 5.4 to 4.8 (17.2% reduction). (Illustrated in **Figure 2, Image 1**) Fractional CO2 laser was more effective for the overall treatment of Striae Distensae (Striae Rubra as well as Striae Alba) with overall Atwal and Davey score reduction of 33.9% compared to Micro-needling with PRP where reduction was 18.6%. (Illustrated in **Figure 2,Image 1**)

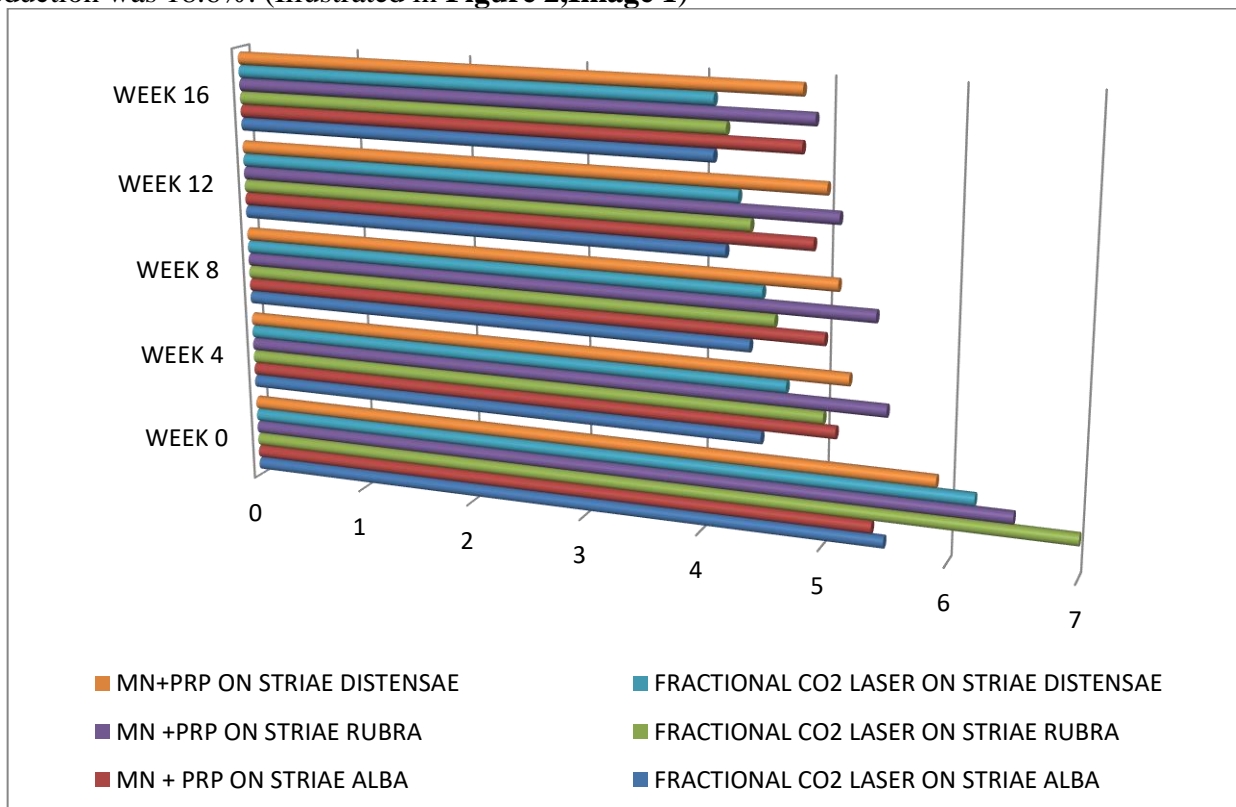


Figure 2: Bar chart showing comparison of Fractional CO2 laser versus Micro-needling with PRP on striae Alba and Striae Rubra based on Atwal & Davey scoring (0-8)

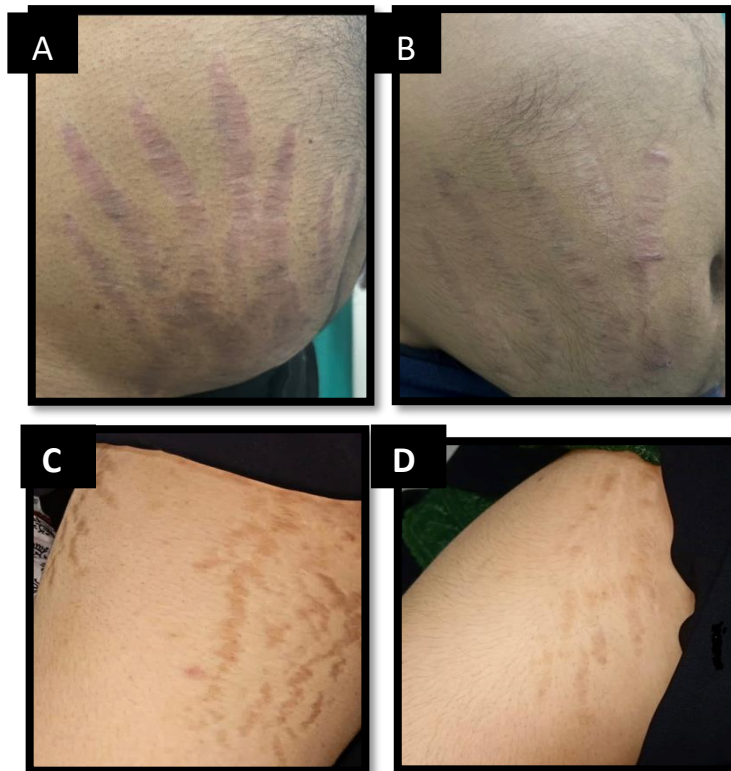


IMAGE 1: (A) Striae Alba on thighs before treatment

(B) Striae Alba on thighs after 4 sittings of treatment with Fractional CO2 Laser

(C) Striae Rubra on abdomen before treatment

(D) Striae Rubra on abdomen after 4 sittings of treatment with Fractional CO2 Laser

Patient satisfaction was recorded after the last session and was found to be almost double among the Fractional CO2 Laser group in comparison to Micro-needling with PRP group. It was 59.9% for Fractional CO2 laser and 26.6% for Micro-needling with PRP group. (P-value = .01876, significant as $p < 0.05$). (Illustrated in **Table 3**)

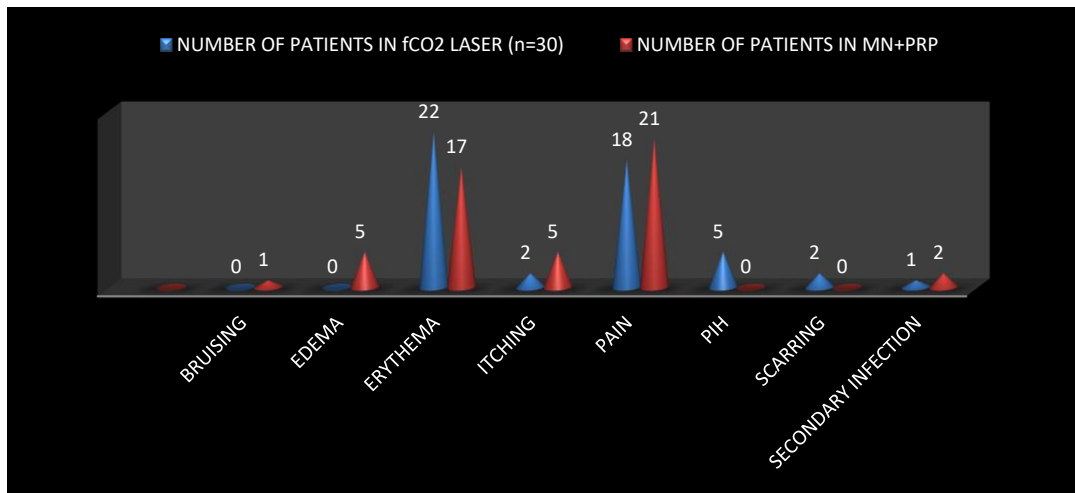
Table 3: Distribution of patient satisfaction score of Fractional CO2 laser and Micro-needling + PRP

PATIENT SATISFACTION SCORE	Fractional CO2 Laser (No. of patients) (n=30)	MN+PRP (No. of patients) (n=30)
1-Very Dissatisfied	3 (10%)	9 (30%)
2 - Dissatisfied	9 (30%)	13 (43.3%)
3 - Satisfied	5 (16.6%)	5 (16.6%)
4 - Very Satisfied	13 (43.3%)	3 (10%)

(The chi-square statistic is 9.9773. The p-value is .01876. The result is significant at $p < 0.05$)

All patients receiving Fractional CO2 laser therapy and Micro-needling with PRP experienced minor side effects. The most frequent side effects with Fractional CO2 laser were Erythema (73.3%) and pain (60%). These effects subsided in 7-10 days. Other transient side effects were itching (6.7%) and secondary infection (3.33%). Side effects that were long-lasting with this modality were Post inflammatory hyper pigmentation (16.6%) and scarring (6.7%). Patients receiving Micro-needling with PRP experienced pain (70%), erythema (56.6%), oedema (16.6%), itching (16.6%), secondary infection (6.7%) and bruising (3.3%). [Illustrated in **Figure 3**]

Figure 3: Distribution of side effects of CO2 laser and Micro-needling + PRP



DISCUSSION

This study investigated the effectiveness of two treatments for stretch marks (striae distensae): Fractional CO₂ laser and Micro-needling with PRP (platelet-rich plasma).

Patient Demographics: The study involved participants aged 14-59 years, with a predominance of young adults (20-29 years old) being 73.3% of all participants and females (F: M - 3:1 ratio). The mean age of the study participants was 26.6. (SD = 9.20). [Age and gender distribution illustrated in **Table 1**] This demographic profile is consistent to several other studies done for the treatment of Striae Distensae. [4] [26] [105] [107] [108] [109] [112] [114] [115] [125] [133]

Stretch marks were most frequent in students (due to growth spurts, weight changes) and housewives (due to obesity, pregnancy).

Causes of Stretch Marks: Recent weight changes (25%) emerged as the top culprit, followed by prolonged obesity (21.7%), pregnancy (18.3%), growth spurt (16.7%) and prolonged intake of oral corticosteroid use (10%). [Illustrated in **Figure 1**] This is consistent following the observations made by ImanSany et al [114] who also noted recent weight gain (70%) as the most common etiological factor for the development of Striae Distensae followed by pregnancy (20%), and oral steroid intake (10%). Similar observations were also made by Nasrin Saki et al where weight gain was seen in 75% and pregnancy in 25% of patients. [112]

Treatment Sites: In our study, the most frequently involved sites were the abdomen (40%) followed by thighs (25%), arms (23.3%), and breast (8.3%). [Illustrated in **Table 2**] The sites more frequently recorded in our study are similar to the studies done by Kui Young Park et al in 2012 [113] and Mohamed H Khater et al in 2016. [103] However, in a study done by Sang Eun Lee et al in 2010 the most frequent site of involvement to be calves (66.7%) unlike our study where the involvement was found to be 3.3%. [100]. They attributed the predominance of this finding to different apparel styling in formal settings like short skirts.

Types of Stretch Marks: Two types were observed: striae Rubra (red, inflammatory) and striae Alba (white, atrophic). More than half of our patients had striae Alba (34/60; 56.7%), and the remaining (26/60; 43.3%) presented with striae Rubra. A study done by Amira Ali et al in 2020 [129] and another done by Eman H. Elmorsy et al (2021) [111] had patients with similar type of distribution as in the current study. Interestingly, despite appearing first, striae Rubra was less prevalent, possibly due to a lack of awareness about its temporary nature.

Treatment Efficacy: Fractional CO₂ laser therapy demonstrated a clear advantage over Micro-needling with PRP. Striae Rubra responded better than Striae Alba to both modalities with 40% Atwal and Davey score reduction by Fractional CO₂ laser and 24.6 % Atwal and Davey score reduction by derma roller with PRP in 4 sessions conducted 4 weeks apart. The reduction in Striae Alba was also significant with the Atwal and Davey score reduction - 25.5% by Fractional CO₂ laser and 17.2% by dermaroller with PRP after completion of 4 treatment sessions. (Illustrated in **Figure 2, Image 1**) Fractional CO₂ laser was more effective for Striae Rubra and Striae Alba with

overall Striae distensae Atwal and Davey score reduction of 33.9% compared to Micro-needling with PRP where reduction was 18.6%. (Illustrated in **Figure 2, Image 1**). Patient satisfaction was recorded and was found to be 59.9% for Fractional CO2 laser and 26.6% for Dermaroller with PRP group. (p-value = .01876, significant as $p < 0.05$). (Illustrated in **Table 3**). The results following both treatment modalities where Fractional CO2 laser emerged as a more efficient modality along with a greater patient satisfaction was similar to a study done by Dr Sanjay Meena et al in 2021. ^[131]

Side Effects: Both treatments were generally well-tolerated, with temporary side effects like redness (65%), pain (65%), itching (11.7%) and oedema (8.3%). [Illustrated in **Figure 3**] Fractional CO2 laser carried a slightly higher risk of developing scarring (6.7%) and pigmentation issues (16.6%). Side effects profile was consistent with the study done by Dr Sanjay Meena et al in 2021. ^[131]

Limitations

- This study involved a relatively small sample size.
- Long-term durability of treatment effects requires further investigation.

CONCLUSION

In conclusion, this study compared the effectiveness of Fractional CO2 laser and Micro-needling with PRP for treating stretch marks. Fractional CO2 laser therapy emerged as the superior option, demonstrating a greater reduction in the appearance of both types of stretch marks (striae Rubra and striae Alba) as measured by Atwal and Davey scoring system. Patients treated with Fractional CO2 laser also reported a higher level of satisfaction compared to those receiving Micro-needling with PRP. While both treatments were generally well-tolerated, Fractional CO2 laser carried a slightly higher risk of developing scarring and pigmentation issues. Overall, Fractional CO2 laser therapy offers a more effective and patient-preferred approach for managing stretch marks.

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