“TO COMPARE THE EFFECTIVENESS OF CO2 LASER VS COMBINED USE OF CO2 LASER WITH PRP (PLATELET RICH PLASMA) IN THE TREATMENT OF STRIAE DISTENSAE IN A SPLIT TRIAL”

BY
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LIST OF ABBREVIATIONS

Sr No.	Abbreviation	Full form
1.	**AHA**	Alpha hydroxy acid
2.	**CO2 laser**	Carbondioxide laser
3.	**ECM**	Extracellular matrix
4.	**HA**	Hyaluronic acid
5.	**IL-β**	Interlukin beta
6.	**IPL**	Intese pulsed light
7.	**MMP**	Matrix metalloproteinase
8.	**MTZ**	Microthermal zones
9.	**Nd:YAG**	Neodymium- doped yttrium aluminium garnet
10.	**PDL**	Pulsed dye laser
11.	**PIH**	Post-inflammatory hyperpigmentation
12.	**PRP**	Platelet rich plasma
13.	**RF**	Radiofrequency
14.	**RCM**	Reflectanceconfocal microscopy
15.	**SCBGs**	Secretoglobulins
16.	**SA**	Striae alba
17.	**SD**	Striae distensae
18.	**SG**	Striae gravidarum
19.	**SN**	Striae nigra
20.	**SR**	Striae rubra
21.	**TCA**	Trichloroacetic acid
22.	**VAS**	Visual analog scale

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ABSTRACT

BACKGROUND

Striae distensae, also known as stretch marks, is a common benign skin condition causing cosmetic concern, especially in females. They can be seen from the age of 5-50 years and can be disfiguring and psychologically disappointing to the person.

AIMS AND OBJECTIVE

The study aims to compare the change in surface area and appearance of striae distensae by CO2 laser vs CO2 laser with PRP (platelet rich plasma).

MATERIALS & METHODS

A non-randomised interventional split study was performed on both genders in the age range of 18-40 years attending department of Dermatology, Venereology and Leprosy in KLE's Dr. Prabhakar Kore Hospital and Research Centre, Belagavi from 1st January 2023 to 31st December 2023 having stretch marks, who voluntarily agreed to participate. CO2 laser was introduced on the right side and CO2 with PRP prepared by double spin method on the left side in a total of four sittings with a gap of four weeks between each sitting. High resolution digital photographs were captured at baseline and four weeks after the fourth sitting. Assessment of clinical improvement was done by calculating the change in surface area using Imito measure ® app, visual analog scale by subjects and dermatologist's assessment at four weeks after the last sitting.

RESULTS

A total of 29 subjects finished the study. The age group ranged from 18-34 years with a mean of 26.6 and SD of 3.95. Out of 29 subjects, 6 were males contributing 20.69 % and 23 were females consisting of 79.31%. Students and housewives accounted for the majority, contributing 20.69% each. There difference was statistically significant in subjective assessment of patients ($p<0.04$) and dermatologist ($p<0.0001$) between both the modalities. However, no significant difference in change in surface area was seen between the treatment modalities.

CONCLUSION

Both the modalities, CO2 only and CO2 with PRP are effective in the treatment of striae. Even though there is no significant difference in the change in surface area between them, there is a significant difference in change in appearance of the striae with CO2 and PRP.

KEY WORDS

Striae, CO2 laser, PRP (Platelet rich plasma)

INTRODUCTION

Stretch marks, also called as Striae distensae (SD), are noticeable linear scars that appear in areas where there has been dermal injury as a result of the skin being too stretched. They are found throughout the 5–50 age range and are twice as common in females. [1]

There is limited data to quote the incidence and prevalence of SD, that can range from 11% to 88%. SD usually develop during pregnancy and puberty.[2] Approximately 40% of male adolescents and 70% of female adolescents have SD.[3,4] Adolescents (incidence: 6-86%), pregnant women (43–88%), individuals who gained too much weight (43%), and those who have had adverse effects from topical steroid treatment are among the groups most likely to have SD.[4]

The main two types of SD are called striae albae and striae rubrae. The initial erythematous, edematous area that characterizes the acute stage is striae rubrae.[5] Lesions that are asymptomatic and red, stretched flat, or occasionally slightly elevated, and oriented at ninety degree to the direction of tension of skin are known as striae albae, which is the chronic stage. The chronic stage is identified when the SD has diminished and appears atrophic, wrinkled, and hypopigmented. [5]

Striae gravidarum (SG) is a frequent, deformity seen in pregnancy that affects between 55% and 90% of females.[6] Drugs like anti-retroviral protease inhibitors (indinavir) and local or systemic corticosteroid therapy may occasionally cause SD as a side effect. [7-9] Striae distensae can also result from systemic and topical corticosteroid use, obese pathologic states, Marfan's syndrome, Cushing's syndrome, genodermatoses, and other conditions.[2]

The development of SD has been linked to several factors, including hormonal influences, decreased genetic expression of collagen, elastin, fibronectin and mechanical stretching of skin.[7] The knowledge of the exact mechanisms involved in the development and maturation of striae is limited by the lack of animal models. [2]

A pink or purple band that can itch is the disorder's primary symptom. [11] SD can be distressing and manifest as atrophic linear scars, which frequently lower the quality of life. [6] Striae distensae are largely asymptomatic, however, they can cause psychological distress and be disfiguring to sufferers, particularly in women and certain professions. Striae distensae are challenging to cure because no therapy ever completely resolves the condition. Due to their widespread occurrence and influence on patients' standard of living, the need for an efficient treatment is high.

Many different methods that induce collagen synthesis have been attempted for the treatment of SDA. Dermal filler injections, fractionated microneedle radiofrequency, topical creams, chemical peels, microdermabrasion, diode lasers, pulse dye lasers, ablative and non-ablative lasers, powerful pulse light, and microneedling are a few of these.[8] While total eradication of SD is unachievable, it is possible to improve appearance while lowering physical symptoms.[7] Due to insufficient improvement of skin tone or chronic skin shrinkage, none is recommended as standard therapy.[9] Fillers have been suggested by numerous writers as an effective treatment for SD.[9–12] The lack of high-quality trials and reliable, widely accepted techniques to assess the severity of striae and therapy responses contribute to the lack of definitive recommendations for the best course of care.

AIMS AND OBJECTIVES

The study aims to compare the change in surface area and appearance of striae distensae by CO2 laser vs CO2 laser with PRP (platelet rich plasma).

REVIEW OF LITERATURE

Definition

"Striae are noticeable, linear scars that develop in areas where skin stretching causes dermal damage." Histologically, they are distinguished by a thinning of the epidermis that covers them, together with fine dermal collagen bundles that lie parallel to the surface in straight lines.[13]

Etiopathogenesis

There is disagreement over the theory put forth by many publications that striae result from stress-induced rupture of the tissue framework of connective tissue.[14] The variables that predict the formation of striae are not well understood. When early adulthood brings about a critical amount of hard cross-linked collagen in the skin, they may appear more easily.[15]

On the other hand, "elasticity" and overstretching are brought on by a lack of cross-linkage, and if the strain is too great, the skin may eventually burst. Thus, it appears that striae only appear in skin with tight cross-linking and "elastic" unlinked collagen permit striae, which are tiny intradermal ruptures. However, a variety of factors affect the creation of striae. [16] Mast cell-secreted elastase may cause elastolysis and ensuing mid-dermal atrophy. [1] Decreased expression of collagen and fibronectin, together with modifications to the extracellular matrix constituents in SD tissue might also be involved. [17]

In reality, it has been shown that the dermal connective tissue's architecture has changed, involving the extracellular matrix (ECM) in addition to damage to collagen, fibrillin, elastin, and fibronectin.[18] The first structural dermal modifications appear to be caused by the release of elastases from mast cells and macrophages, which are then followed by a new organization of collagen and fibrillin. Atrophic scarring is ultimately caused by the breakdown of collagen.[18] Localized hyperpigmented striae (striae nigra) may be caused by variations in melanogenesis and melanocytic networking density at the epidermal rete ridges. [19]

1) Hormonal factors

There is a direct correlation between striae distensae and hormonal changes. It was found that SD possesses a lot greater than that of normal skin in terms of estrogen, androgen, and glucocorticoid receptor expression. This leads to an increase in glucocorticoid activity, which suppresses the proliferation and activity of fibroblasts. This leads to a marked decrease in the formation of collagen, elastic fibres, and connective tissue. There is a reduction in tissue healing. [1] Through modifications to the cellular milieu, hormone manipulation of estrogens, androgens, and glucocorticoids and their receptors modulates cellular production of ECM (extracellular matrix components).[2] Since an imbalance in glucose hormones causes fibroblasts to respond catabolically, which reduces elastin and collagen, it is also relevant to SD for maturation. This is comparable to the impact of topical corticosteroids. [2]

Uterine contractions do not occur until late in pregnancy due to a ten-fold increase in relaxin hormone during pregnancy. These contractions also reduce the amount of

collagen by limiting the organization and density of collagen because of the decreased ability to persevere mechanical stress, which has been linked to a rise in striae gravidarum cases.[20]

2) Mechanical disorders

Microscopic observations indicate irregular connective tissue fibres that track skin-tension lines and connect mechanical stretch to their etiology. Mechanically stretched scars, known as atrophic dermal scars, are frequently filled with newly pathogenically organized collagen and elastin to fill in the holes in the dermal matrix.[2] Clinical situations that include pregnancy, a high body mass index, and a high neonatal birth weight raise the chance of SG formation support this notion. [2]

3) Genetic factors

Since monozygotic twins have been shown to exhibit striae distensae, it is thought to represent a genetic tendency. The twins were noticed when red sores suddenly appeared on both thighs. It was formerly believed that striae rubrae developed as a result of altered expression of collagen, elastin, fibronectin genes and fibroblast metabolism. [24] These patients had a genetic mutation that significantly changed fibroblast metabolism in addition to affecting the expression of the genes encoding for fibronectin, elastin, and collagen.[21] Both elastic and non-elastic tissue contain fibrillin microfibrils, albeit their precise function is still understood. The levels of procollagen mRNA in striae distensae tissues are clearly and systematically lower than in normal tissues (I) and (III). [22] Consequently, the extracellular matrix is destroyed and collagen, elastin, and fibronectin mRNA expression are reduced in the dermis.

One theory is that the low levels of fibronectin mRNA and extracellular matrix RNA are caused by the absence of striae-associated fibroblasts. Striae distensae is one of the many clinical signs associated with Marfan syndrome, an autosomal dominant connective tissue disease caused by mutations in the fibrillin-producing genes (fibrillin 1 on chromosome 15 and fibrillin 2 on chromosome 5). The abnormality leads to reduced fibrillin deposition in Marfan syndrome. It may be important for prognosis and possibly for diagnosis in some circumstances. This implies that variations in the expression of the fibrillin molecule may be involved in the formation of striae distensae. [23]

No striae are found in Ehler-Danlos syndrome which highlights the significance of hereditary variables in determining the sensitivity of connective tissue to striae. The size, irregularity, and spacing of the collagen fibres in this condition differ from those in a normal dermis. On the other hand, the number of elastic and amorphous microfibrils is significantly increased. [24] Genes expressing secretoglobulins (SCGBs) were the most highly expressed; these proteins mainly interact with different steroid hormones. SCGBs primarily mediate the anti-inflammatory actions of steroids. This could account for the strong association between the onset of SD and illnesses like long-term steroid use and Cushing's syndrome, which affects the metabolism of the steroid.[25] In SD, keratin genes are not positively regulated. Keratins, which anchor epithelial cells and surrounding tissues and provide support during mechanical stress, are a part of the cytoskeleton of epithelial cells which suggests that the skin afflicted by SD has lost some of its mechanobiological activity.[26]

4) Dermal and connective tissue changes

After going over the pathophysiology of striae distensae in detail, it became clear that the stages of the disease are quite similar to the stages of scar development. It all begins with overstretching of the skin, which results in tears and harm to the skin's surface. The extracellular matrix (ECM) is subsequently impacted by inflammatory edema, leading to the rupture of collagen, elastin, and fibronectin fibres. It has recently been found that dermal changes resulting from a malfunction in the activity of fibroblasts, a loss of fibrillin and elastin, and an inability to organize collagen fibrils into bundles induce atrophic modifications in striae distensae.[27] It was demonstrated that weakening of the connective tissue is the main component contributing to the etiology of striae distensae and a reduction in flexibility. This was made clear by recent research that found a strong association between the severity of striae gravidarum and the development of perineal tears during childbirth, as well as the development of striae distensae and pelvic organ prolapse. [28]

Four loci were identified in the largest genetic database investigation to date as being connected to their formation. However, the precise genes remain to be identified. [2] It was discovered that skin samples with SD have lower levels of collagen and fibroblast metabolism in comparison to normal skin gene expression for fibronectin and elastin. The findings of Tung et al. may indicate a significant role for specific gene polymorphisms (such as ELN-rs7787362, SRPX-rs35318931, and HMCN1-rs10798036) in the formation of striae distensae.[29]

5) Pregnancy

Stretching continuously and gradually causes damage to the extracellular matrix, which can change the structure of the elastic fibre network, especially the fibrillin component in those who are vulnerable, and show up as striae distensae. The majority of striae distensae during pregnancy are caused by a combination of mechanical skin stretching and endocrine changes, which raise blood levels of steroids.[30] According to Chang et al. (2004), primigravidas account for up to 90% of SG. The late second and early third trimesters have historically been described as the onset period; nonetheless, a study has shown that 43% of women experience SG before 24 weeks of pregnancy.[6] It is believed that the unique hormonal environment of pregnancy affects connective tissue, which is prone to SG when strained. In terms of histology, SG resembles striae distensae and is dependent on the age of the lesion. [6]

The most prevalent risk factors for SG are younger age, mother, greater birth weight, pre-pregnancy and pre-delivery weight and personal and family history of SG. It was also discovered that women who experienced these factors were more likely to drink more alcohol, drink less water, have lower blood vitamin C levels, and expect a male child. [6]Striae gravidarum was found to be strongly associated with inadequate activity, high weight increase during pregnancy, and family history. Additional characteristics linked to striae risk included weight increase, newborn weight, mother age, and basic body mass index.[31]

Studies on biology also revealed a connection between stria gravidarum and a drop in serum relaxin levels.[31] In terms of hormones, striae have been found to have double

the number of estrogen receptors and higher levels of glucocorticoid and androgen receptors than healthy skin. [6]

6) Corticosteroids

Both local and systemic glucocorticoids can induce cutaneous atrophy through a dose-related pharmacological effect. Corticosteroids inhibit the collagen genes. Topical steroids inhibit the activity of enzymes involved in collagen synthesis and lower the transcriptional, translational, and post-translational levels of collagen synthesis in fibroblast cells as well as in vivo. [22] In general, striae are benign; nevertheless, on rare occasions, larger lesions may rupture or ulcerate if they are traumatized.[13]

Ulcerated striae prefer warm, humid environments that are prone to friction. They appear as soon as three weeks after TCS application. The striae caused by steroids are broader than regular SD. [32]

More recent theories contend that non-union of the fibrils of connective tissue may result from specific hormonal imbalances, particularly those involving glucocorticoids, and may partially dissolve the supporting matrix; mechanical tension is thought to affect the location and kind of the striae formed rather than being essential to their formation. In addition to the emergence of secondary sex traits, acne, and other symptoms of puberty, the formation of striae during puberty may potentially be caused by related increased adrenal gland activity. [33]

7) Vitamin deficiency

According to recent research on vitamin D deficiency in the development of SD, normal serum levels of 25-hydroxyvitamin D are linked to a lower risk of developing SD as opposed to low serum levels.[30] This makes sense when we consider how the active form of vitamin D promotes fibroblast and keratinocyte development and activity while maintaining the integrity of the epidermal permeability barrier.

Hypovitaminosis of vitamin D causes a rise in estrogen receptors because vitamin D has a negative role in ovarian reserve and reproductive hormone production as well as a positive role in estrogen receptors. The greater incidence of SD among women with lower levels of vitamin D may likely be explained by the increase in estrogen receptors seen in hypovitaminosis D. [34]

CLINICAL FEATURES

Classification as per epidemiology or appearance:

- Striae gravidarum (following pregnancy)
- Striae atrophicans (thinned skin)
- Striae caerulea (dark blue)
- Striae albae (white)
- Striae nigrae (black)
- Striae rubrae (red)

When SD initially appears, there is a noticeable vascular component; these edematous scars, which are pink, red, and purple, are known as striae rubrae (SR). The permanent version of the disorder, striae albae (SA), is characterized by an atrophic, white look that can be attributed to a loss in vascularity over time and the localized loss of elastin and collagen. [17]

Two more types, striae nigrae and striae caerulea were discovered by Pierard-Franchimont et al. and are linked to greater melanization, particularly in patients with darker skin. The belly, buttocks, thighs, breasts, knees, calves, and lumbosacral regions are frequently affected by SD. [17]

Larger, more widely spaced striae are seen in Cushing's syndrome and systemic corticosteroid therapy. [13] The likelihood of striae in flexural and intertriginous areas is

increased by topical corticosteroids. [13] Gender and age have an impact on the frequency and anatomical areas affected. Following thelarche, SD caused by a growth spurt in puberty are commonly seen. They cover the breasts, buttocks, and thighs in girls. Boys usually develop them on the outside of the thighs and over the lumbosacral areas. [13]

The breast and abdomen are frequently affected by SG. [3] It is common to find striae SG on the belly, breasts, and thighs during the last trimester. SG lesions are commoner in younger primigravida and are associated with larger-than-average babies at term and an increased risk of cesarean birth.[13] SD typically manifests throughout adolescence, gestation, and in instances of abrupt alterations.[18] Weight (gain or decrease) particularly with protracted treatments with systemic or local corticosteroids, or other medications such as antiretroviral protease inhibitors indinavir, chemotherapy, extended antibiotic therapy, contraceptives, and neuroleptics. [18]

INVESTIGATIONS

1) Histopathology

The skin's thickness is decreased. The epidermis is flattened and thin. Straight, thin collagen bundles that are transverse to the direction of the striae and parallel to the skin's surface are noticed in the top region of the dermis. The configuration of the elastic fibers is comparable. Older lesions feature more thick elastic fibers than thin ones. Early lesions primarily have thin elastic fibers. Within the striae, there aren't many nuclei, sweat glands, or hair follicles. It’s believed that there is formation of elastic fibres initially and they progressively thicken and increase with age.[35]

2) Dermoscopy

Different types of SD result in different dermoscopic changes. The honeycomb melanotic network of the typical skin is usually changed in SD. Dermoscopy in striae alba shows a pale, fuzzy look with only a few distinguishable features.[39] The striae rubrae have a modest streaky pattern of dilated vessels directed at a right angle to the axis of the striae, whereas the striae nigrae are identified by a strong streaky melanotic pattern in continuity with the honeycomb melanotic network of the neighbouring normal skin. [36]

3) Reflectance confocal microscopy (RCM)

RCM is used to demonstrate parallel collagen bundles in the dermis as well as some characteristics, such as deformation of the dermal papillae, that are not easily identified by light microscopy.[19] The primary alteration in striae alba seen under light microscopy—thickened parallel collagen bundles aligned parallel to the skin surface is easily visualised employing RCM.[37] Papillary dermal collagen is parallelly structured and may be linked to a distortion in the architecture of dermal papillae, despite being finer than its reticular dermal counterpart. Routine histopathology makes it difficult to distinguish this as since sectioning is not typically done horizontally. Our data implies that the collagen bundles found in the dermis in striae rubrae are comparatively less coarse than those found in striae albae. [37]

Certain characteristics of striae detected by light microscopy may be easier to recognize with RCM, epidermal atrophy may be more challenging to diagnose. Specifically, edema detection may be problematic considering the low refractility of cutaneous inflammatory cells and the lack of refractility of tissue fluids, particularly if present in low density, which can make it difficult for RCM to detect them. In fact, we were unable to detect any inflammatory cells or edema in our striae rubra patient.[37]

RCM has the sensitivity and resolution necessary to identify parallel collagen at the time of first laying down. These modifications may come about right before clinical ones. We propose that the use of RCM for serial monitoring of early changes in collagen dysregulation may yield significant information into pathogenesis. [37]

TREATMENT MODALITIES

One general strategy to avoid the development of stretch marks is to avoid fast weight gain or reduction, specifically in high-risk individuals such as sports, pregnant women, and adolescents. It was thought that the best ways to lower your risk of SD were to change your diet, begin an exercise regimen, and maintain your physical fitness.

TOPICALS

Targets of treatment for various striae distensae therapies include:

1. Fibroblast activation and induction of cutaneous collagen synthesis (to increase tissue strength)
2. Lesions become less vascularized (Striae Rubra in particular).
3. Wrinkles and roughness of the skin are reduced (to improve texture).
4. Enhancements in skin hydration, blood flow, elasticity, cell proliferation, and anti-inflammatory properties. Paleness in striae albae increased. The majority of topical therapies assert that by encouraging the production of collagen and increasing skin suppleness, they might lessen the appearance of SD.

RETINOIDS

Retinoids, which are vitamin A derivatives, are used to treat acne. The usage of tretinoin has increased dramatically since the 1988 study by Weiss and Ellis, which outlined the benefits of the drug in the management of photoaging. When used topically, it acts

rapidly and majorly excreted via bile; a small amount also permeates the skin but is not yet detected systemically. Conversely, tretinoin affects a multitude of activities in epithelial cells, such as differentiation, neoplastic developments, tumorigenesis, synthesis of collagen, wound healing, immune response modulation and stimulation, inflammation, cell membrane, and numerous other processes.[38] Ash et al. (1998) state that 10% L-ascorbic acid, 0.05% tretinoin, or 20% glycolic acid administered in combination can enhance the appearance of striae albae.[39]

If a reaction suggests sensitivity or discomfort, patients should stop taking their medication. Patients taking tretinoin should be advised to wear protective clothes, apply sunscreen, and limit their exposure to the sun and sunlamps. Nevertheless, it is not recommended to use these drugs if you are nursing a baby, have sunburns or are pregnant. Genes involved in cellular differentiation and proliferation are modulated in expression by topical tretinoin. Tretinoin enhances the formation of collagen types I and III while blocking matrix metalloproteinases. It is useful to treat and lessen the look of SD by boosting the dermal production of collagen. [43]

Its effectiveness is comparable to that of lasers, according to certain studies, particularly for treating striae rubrae. Topical retinoid action may be linked to its affinity for fibroblasts and the promotion of collagen formation. Tretinoin is well known for helping to repair skin damage by promoting angiogenesis, cellular differentiation, and the synthesis of new collagen creation. More improvement was shown in striae rubrae than in striae albae while using tretinoin cream.[40] The clinical appearance of early striae rubrae is greatly improved by topical tretinoin.[41]

SILICONE GEL

It is used in atrophied scars from SD, acne, and chickenpox. Certain studies suggest that hyaluronic acid may increase fibroblast activity and collagen production. A randomized controlled trial showed that 10% of the females in the treatment cohort and 70% in the placebo group encountered SD.[42] Early scarring has been shown to benefit from silicone gel, which also improves the texture and look of keloid and hypertrophic scars.[43]

In SD, silicone gel might be useful. It is generally believed that silicone functions as an artificial stratum corneum, acting as an additional layer of skin to promote moisturization. According to published research, silicone creates a static electric field that is negative, which causes collagen, elastin, and fibrillin to realign. [43]

UV LIGHT

UVB (296–315 nm) and UVA1 (360–370 nm) were administered to the subjects twice a week for a maximum of ten treatments therapy with the MultiClear apparatus to repigment striae albae. The device has a fluence range of 45 mJ/cm2 to 400 mJ/cm2, a 23623 mm spot size, and a pulse width of 1.3–3.7 seconds. Eighty-nine percent of participants believed they had improved by at least 26% since their last treatment, compared to 78% at their 4-week follow-up visit, 56% at their 8- and 12-week follow-up visits, and 78% at their 4-week follow-up visit. For all skin types, the high-intensity UVB/UVA1 device (MultiClear) is a safe and efficient method for temporarily repigmenting hypopigmented stretch marks. Visits for maintenance could help preserve the repigmentation. [44]

CENTELLA ASIATICA

This is a common traditional medicinal herb having a wide range of uses in East Asian folk medicine. The substance's specific mode of action is the activation of fibroblastic activity, according to Velasco and Romero (1976). [48] Compared to the other managements, the supplement also caused a greater rise in skin thickness near the middle of the SD (where skin density was lower) ($p<0.05$). After six weeks, the grey scale median improved (grew) more with centellicum ($p<0.05$). When subjected to ultrasound, the skin became whiter or denser and contained more collagen. [46]

When using Centellicum®, skin perfusion as determined by laser Doppler revealed a greater improvement ($p<0.05$). Skin temperature improved more with the supplement ($p<0.05$), which is considered to be a result of nutritional and thermoregulatory dermal perfusion. The supplement enhanced elasticity as determined by elastosonography ($p<0.05$). With Centellicum®, the subjective evaluation with an analog score performed better (the SD were less noticeable and the score dropped; $p<0.05$). Fewer SD were visible. Improvement was seen in a relatively shorter period.[43]

VITAMIN C

Vitamin C, often known as ascorbic acid, is needed as a cofactor by several hydroxylases and monooxygenases. Since humans are unable to synthesize it, diet or medicinal interventions are the sources left. Enhancement of transcription increases the amount of collagen types III and I mRNA in a steady state by lengthening the transcripts'

half-life in fibroblast cultures which is evident by collagen synthesis. [45] When CO2 laser was utilized to promote vitamin C permeability at a lower fluence, epidermal layers and the stratum corneum remained intact. Higher fluences demonstrated further improvement with the CO2 laser in addition to a discernible ablation effect.

Trans epidermal water loss values indicate that microdermabrasion removed the stratum corneum layers without altering the properties of the skin barrier. In contrast to skin that has not been treated, the skin that had undergone microdermabrasion had about 20 times more vitamin C.[46] Procollagens I and III mRNA as well as the maturation enzymes produced after their translation are increased at steady-state levels when a formulation containing 5% L-ascorbic acid is applied topically once a day. The mRNA of TIMP1, a physiologic MMP inhibitor, is upregulated while the mRNA of the MMP responsible for the breakdown of extracellular matrix is not altered statistically. These changes show that an anabolic phenotype is expressed.[46]

MESOTHERAPY

Hyaluronic acid (HA) injections have emerged as a global standard technique for soft tissue augmentation and correction of soft tissue abnormalities. [47] Beyond its viscoelastic and filling qualities, the ECM formation is thought to be aided by HA, which is the potential mechanism of action for its efficacy [48,49]. Treating stretch marks with HA injections improves the appearance of SA. After two to three months of treatment, SA improved with the injection of HA using a high-velocity pneumatic injector.[50]

CHEMICAL PEELS

The three most often utilized agents are glycolic acid (GCA), retinoic acid, and trichloroacetic acid (TCA). The most frequent side effects are minor irritation and post-inflammatory pigmentary changes. One economical method for treating SD with a larger surface area is chemical peeling. There is no need to prepare the skin for a lengthy time before the peel. Very thick skin may occasionally require pre-peeling to prepare it for a standard peel.

Alpha hydroxy acid (AHA)

Treatment for early-onset stretch marks (striae rubra) involves 50% to 70% glycolic acid. Over six months, six peels of various kinds were used on the thigh of SD in a randomized control group utilizing peels with 70% glycolic acid. [51] At six months, striae albae showed comparably decreased furrow width and increased melanin levels, but striae rubrae showed dramatically lower furrow width and hemoglobin content.[51] Applying 25% AHAs (glycolic, lactic, and citric acid) topically thickens papillary dermis and epidermis, raises acid mucopolysaccharide, enhances elastic fibre quality, and increases collagen density as proven by Ditre et al. [52]

Trichloroacetic acid (TCA)

In a solution with a 15–25% TCA content, a small epithelial slough will show clinical signs of a superficial coagulation of epidermal proteins. Partial cutaneous denaturation can occur at concentrations as high as 45%, epidermal necrosis, and the reaction of cutaneous inflammatory cells. The application method can affect the degree of damage.

The solution is rubbed firmly into the skin, making sure to remove any debris that the acid has already scraped off, to enhance penetration.[53]

Jessner's peel

It contains 100 cc of ethanol, 14 g of salicylic acid, 14 cc of lactic acid, and 14 g of resorcinol. When administered alone, Jessner's solution can result in superficial peeling. [3] It can be followed immediately by the use of TCA 35% to achieve a medium-depth peel.[54]

Easy Peel solution

Consists of hydantoin, sodium laureth sulphate, citric acid, cocamide, carboxylic acid, L-ascorbic acid, saponins, hexylene glycol, and 3.2 cc 50% TCA w/w excipients. Easy Peel treatment is straightforward and has very few adverse effects. There is little pain and a quick recovery.[55]

MICRODERMABRASION

Anecdotal reports of improved striae appearance following the usage of alternative peels are occasionally seen, however, most of these comments are about vacuum-based aluminum oxide microderm abrasion. When paired with a topical therapy containing retinal, and magnesium ascorbyl phosphate and glycolic acid, microdermabrasion may yield better clinical results than when used alone. When employed in microdermabrasion, crystals of sodium chloride or aluminum oxide affect the skin and cause superficial injury. It is believed that repetitive injuries in the epidermis heal damaged skin over time by stimulating the synthesis of new collagen in the dermis and fibroblast proliferation.[56] The amount of

collagen tissue and the number of fibroblasts rose together with the epidermal thickness in the microdermabrasion with sonophoresis-treated areas compared to 50% of patients' pretreatment states. [57]

By briefly disrupting the outer epidermal barrier, microdermabrasion smoothens the skin's surface and promotes the synthesis of new dermal collagen. This allows for improved absorption of topical substances. In our study, microdermabrasion combined with sonophoresis resulted in improvement, although only in 50% of instances. [57] Increased type 1 procollagen production, matrix metalloproteinases (MMPs)-1,3,8, cytokines [tumour necrosis factor-α (TNF-α), interleukin-β (IL-β)], and transcription factors are all present even after just one therapy session.[57] Hexsel et al.'s comparison of topical tretinoin and MDA in early SD revealed that both treatments showed equally effective results. MDA, however, is linked to higher patient compliance and fewer adverse effects. [58]

LASERS

Lasers have emerged as the most popular substitute among the several techniques used to treat SD.[59] Good results were obtained when treating early immature striae distensae with a pulsed dye laser driven by a flashlamp at 585 nm. It works by causing the blood vessels to dilate and the early stages of striae to deposit more collagen. [60–62] While striae distensae skin atrophy was not improved by the 308-nm XeCl laser, its action was limited to pigmentation improvement.[63] The immature striae distensae were well treated with the 1064-nm long-pulse (Nd: YAG) neodymium-doped yttrium aluminium garnet laser by rebuilding the collagen and elastic fibres.[64]

Erbium: YAG laser

The Erbium: YAG laser is an efficient treatment for striae. It has better safety and control than CO2 laser systems because the latter seriously damages peripheral thermal structures.[65]

Short-pulsed carbon dioxide laser

The short-pulsed carbon dioxide laser is a technological advancement that may prove beneficial in the management of stretch marks. This laser device targets water with an infrared beam at 10,600 nm, causing a controlled abrasion of the skin.[66]

NON-ABLATIVE LASER THERAPY

Non-ablative lasers don't cause skin to burn like standard ablative lasers do. Depending on the wavelengths and intensity utilized during the procedure, both a rise and a fall in collagen formation have been observed after laser treatment.[67]

Furthermore, striae exposed to PDL radiation include a high concentration of local mast cells. These mast cells can release a range of cytokines that could hasten collagen remodelling.[68]

There was an initial improvement in the appearance of striae albae in preliminary light and laser therapy experiments; however, these effects were contingent upon repeated

treatment sessions every one to four months.[69] Goldberg et al. performed ultrastructural and histologic investigations after treating striae albae with either UVB radiation or a 308-nm excimer laser, and they concluded that the enhanced melanocyte production was the cause of the striae

albae's repigmentation.[70] Pigment correction following many treatments was also reported in a second 308-nm excimer research; but, by the six-month follow-up visit, these improvements had started to decline.[69] Two months after treatment, no patient showed any discernible improvement in a non-ablative 1450-nm mid-infrared diode laser research in Asians, and 64% of patients had postinflammatory hyperpigmentation (PIH).[71]

Studies using intense pulsed light (IPL) had mixed findings, however one study by Trelles et al. revealed low patient satisfaction and subpar physician assessments and a study by Hernandez-Perez et al. showed clinical improvement and good microscopic improvements. (61-62)

Using the 585-nm PDL to treat 39 striae patients with varying spot sizes and fluences, McDaniel et al. found that the 10-mm spot size and low fluence produced the greatest results. [72] Future study plans were cancelled in another small study comparing the effectiveness of the 585-nm PDL and the short-pulsed CO2 laser due to evident PIH and extended erythema in darker skin types.[73]

Along with PIH, Jimenez et al. found that the 585-nm therapy produced only modest improvements for striae rubra and no improvements for striae albae.[74] Though the study population was mostly confined to striae rubrae, a study that combined radiofrequency with 585-nm treatment for patients in Asia revealed high patient assessment scores coupled with enhanced collagen and elastic fibres.[75]

Patients with atrophic facial scars and tiny wrinkles can benefit clinically from collagen remodelling when using an infrared-controlled pulsed light source. Scar tissue can be effectively treated with the infrared light spectrum. Strong infrared systems can tighten skin and have rejuvenation-related benefits. There is now a correlation between a moderate improvement in the striae's aspect and a reduction in their roughness. Hernandez-Perez et al. used an intense pulsed light system that emits in the visible bandwidth and discovered some cutaneous edema and a betterment in the epidermal atrophy linked to SD. [76]

RADIOFREQUENCY DEVICES

Reports state that tightening the skin on the face and neck with radiofrequency (RF) devices is a safe, effective, and non-invasive therapy. A paper claims that there is immediate contraction of collagen fibrils following radiofrequency, which encourages the production of fresh collagen.[77]

PLATELET-RICH PLASMA (PRP)

Treatment modalities like topical retinoic acid or hyaluronic acid, fractional and diode lasers and radiofrequency have got the highest evidence. Platelet-rich plasma (PRP) is another potential option. [78] There a few clinical trials on PRP and its effects on SD with poor level of evidence. The centrifuged autologous blood derivative has growth factors, cytokines and peptides, which promote tissue regeneration and wound healing. [79] PRP can increase the expression of type I collagen, elastin, and matrix metalloproteinases such as MMP-1 and MMP-2 thereby accelerating wound healing. [80] Latest data suggest PRP may enhance the

quality of early scars. It also improves the quality of atrophic acne scars treated with ablative fractional CO2 laser. [81] Controlled studies have mentioned that combination of PRP and traditional therapies can minimize acne scars and facial burns, improve aesthetic results, and decrease recovery time. [82]

FRACTIONAL THERMOLYSIS

Fractional photothermolysis is a unique modality for treating striae distensae among other modalities. [83–86] In 2006, the FDA approved fractional resurfacing laser for acne scars. A portion of the skin is ablated by this method, leaving areas of normal skin to regenerate in the ablated columns. [83] Fractional photothermolysis has been shown to be effective in several trials in treating different kinds of scars. [83,85] Because scars and striae albae share similar histological traits and scars can be successfully treated with fractional photothermolysis, researchers have recently become particularly interested in using fractional photothermolysis to improve and treat SD, particularly striae albae.[83,87] The outcomes of a few investigations on fractional photothermolysis treatment of striae have been published up to this point. [83]

When compared to topical therapy with 10% GA + 0.05% tretinoin, our study demonstrated a considerably greater decrease in the surface area of striae following laser resurfacing with a fractional CO2 laser (p-value >0.001). [88] According to a Korean study, fractional photothermolysis effectively treated striae gravidarum without causing any adverse effects, both histologically and aesthetically.[84] Several earlier researches claimed that the CO2 laser was effective in treating SD. [86,88–90] Lee et al. verified that histologically by increase in dermal collagen orientation and epidermal thickness following several sessions

with CO2 laser and the clinical improvement of SD accompanied by elevated procollagen type 1 expression immunohistochemically. [86]

COSMETIC SURGERY

It is usually reserved for the severest type of stretch marks that leave scars. The stretch marks are cut very thinly along their length, and the afflicted area is cut out and sewn back together.

MATERIAL AND METHODS

Source of data: Patients attending Dermatology, Venereology and Leprosy OPD, KLE`S Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi, Karnataka.

CTRI registration number- CTRI/ 2023/04/051232

Study Design: Open- label non-randomised prospective interventional split study.

Study Period: 1st January 2023- 31st December 2023

Ethical clearance: Clearance was taken from the ethical committee of the institute.

Sample size calculation: [91]

At 95 % confidence interval & 95 % power, x is the average estimate and SD is the variation, Z is the constant for 95% confidence interval, α is type-1 error, β is the power,

The formula is given by:

$$n = \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2 (SD1^2 + SD2^2)}{(\bar{x}_1 - \bar{x}_2)^2}$$

$$n = \frac{(1.96+1.64)^2 (2.62^2 + 1.94^2)}{(6{\cdot}77-4.43)^2}$$

n = 25.2

If Attrition = 10%

n= 25.2 x 1.10 = 27.7

The study would require a sample size of **28 patients**

Statistical analysis: For quantitative variables, the data are shown as mean ± standard deviation (SD), while number and percentage (%) are used for categorical variables. To compare the changes between the baseline and follow-up, the Wilcoxon signed rank test was employed. The chi- square test was used to calculate relationship between categorical variables and treatment groups. The difference in means between the two groups was compared by Mann-Whitney U test. Assuming compliance with all statistical test regulations, a value of $p < 0.05$ was considered statistically significant. All calculations were done in IBM SPSS (Statistical Package for the Social Sciences software) Software Version 29.0.2.0 (20).

Sampling Technique: Convenient sampling.

Outcome measures:

Primary outcome- To measure the change in surface area.

Secondary measure: - To measure qualitative change in colour by visual analog scale by patients and quartile scale by a dermatologist not involved in the study.

Inclusion Criteria:

1. Age group between 18-40 years.
2. Males and females.
3. Striae present bilaterally on the body.
4. Striae due to all the physiological causes- rapid weight gain/loss, pregnancy- induced, etc.
5. Striae albae.

Exclusion Criteria:

1. Patients < 18 and > 40 years of age.
2. Striae due to bleeding disorders, autoimmune disorders, chronic liver disease, any inflammation, wound or dermatological condition over the site.
3. Took any treatment for striae in the previous one year.
4. Pregnant and lactating women.
5. Personal history of keloids or hypertrophic scars, diseases affecting elastic tissue and collagen.
6. Patients on oral anticoagulant, topical or systemic steroid use.
7. Striae rubrae.

Study Protocol: All the candidates who fulfill the inclusion criteria were be taken up for the study after counselling and obtaining consent.

Data Collection & Procedure:

1. All patients with striae distensae attending the department of Dermatology, Venereology and Leprosy in KLE's Dr. Prabhakar Kore Hospital and Research Centre, Belagavi satisfying the inclusion criteria and showing voluntary participation were recruited.

2. Informed consent was obtained from all the patients in the study.

3. A detailed history taking, general physical, systemic and dermatological examination was carried out for the enrolled subjects.

4. Topical lidocaine (2.5% w/w) + prilocaine (2.5% w/w) cream was applied under occlusion with a plastic sheet for thirty minutes and wiped off. Topical mupirocin 2% was applied twice daily for a week after every sitting on left side.

5. In this study, four treatment sessions of CO2 laser on the both sides followed by platelet rich plasma injection on the left side considering the umbilicus as the centre point of patient were introduced in every sitting, each sitting being at an interval of four weeks.

6. Sterile disposable insulin syringes were used to inject one unit of PRP (0.1cc) at a distance of 1cm deep intradermally at an angle of 30° to the skin.

7. **PRP preparation** [93]- Five to fifteen millilitre of blood was drawn from the antecubital vein under strict aseptic technique and was placed into tubes with an anticoagulant (sodium citrate at 1:10 concentration). Next, a laboratory centrifuge Remi R-8C 16 x 15 ml model ® was used. The blood sample was separated into three layers by the first centrifugation step (soft

spin), which was carried out at 1419 g for 7 min. The lower layer was made up of RBCs, WBCs in the middle layer, and the top layer of plasma. After undergoing an additional hard spin centrifugation spin at 2522 g for 5 min, the upper plasma supernatant was separated into two parts: the upper two thirds are PPP (platelet-poor plasma) and lower two third is PRP. Addition of 0.1ml of $CaCl_2$ to each ml of PRP was done for activation just before injection.

8. **CO2 laser settings**- A 10,600 nm ablative CO2 laser resurfacing system (Futura RF 50 by dermaindia ®) was used to treat both sides. A fractional mode handpiece was used for the laser session, and a one pass along the length of the SD lesions at 15 W of power, 22.5 mJ of pulse energy, 500 µm of microbeam spacing, 1500 µs duration, 3 mm x 3 mm to 20 mm x 20 mm scanning area for all sittings.

9. The site of the striae was cleaned with a mild cleanser and high-resolution digital photographs were captured using Sony DSC- H300/BC ® maintaining identical positioning and room lighting at the baseline and four weeks after the fourth sitting.
10. A readymade scale designed by Imito measure ® was placed next to the striae and the camera focused properly. The Imito measure ® app automatically detects the scale, highlighting a green box over it. A photograph is captured and surface area is measured manually by connecting dots over the striae on the app. The average area of the largest four striae was calculated on both sides.

11. Data was collected by a single examiner and recorded in a case record proforma in Microsoft Excel spread sheet.

12. Records were maintained and analysed statistically.

Data analysis

1. Photographs were analysed and surface area measurement of the largest four striae was done using an Android app Imito measure ®.

2. The average surface area was calculated at baseline and four weeks after the fourth sitting.

3. A dermatologist not involved in the study compared these photographs.

4. Dermatologist's assessment was done by a quartile scale based on the change in surface area and colour.

- Grade 1 (0-25%)
- Grade 2 (26-50%)
- Grade 3 (51-75%)
- Grade 4 (76-100%)

5. Patients were asked to express the degree of improvement by the Visual Analog Scale (VAS) in terms of change in surface area, texture and colour.

0- Not satisfied

1- Slightly satisfied

2- Very satisfied

3- Extremely satisfie

RESULTS AND OBSERVATIONS

Overall 43 subjects were recruited for the study. Seven subjects lost to follow-up after the third sitting, three after second and four after the first. So, a total of 29 subjects completed four sittings.

Table 1: Sex distribution

Gender	Number of subjects
Males	6
Females	23

Graph 1: Sex distribution

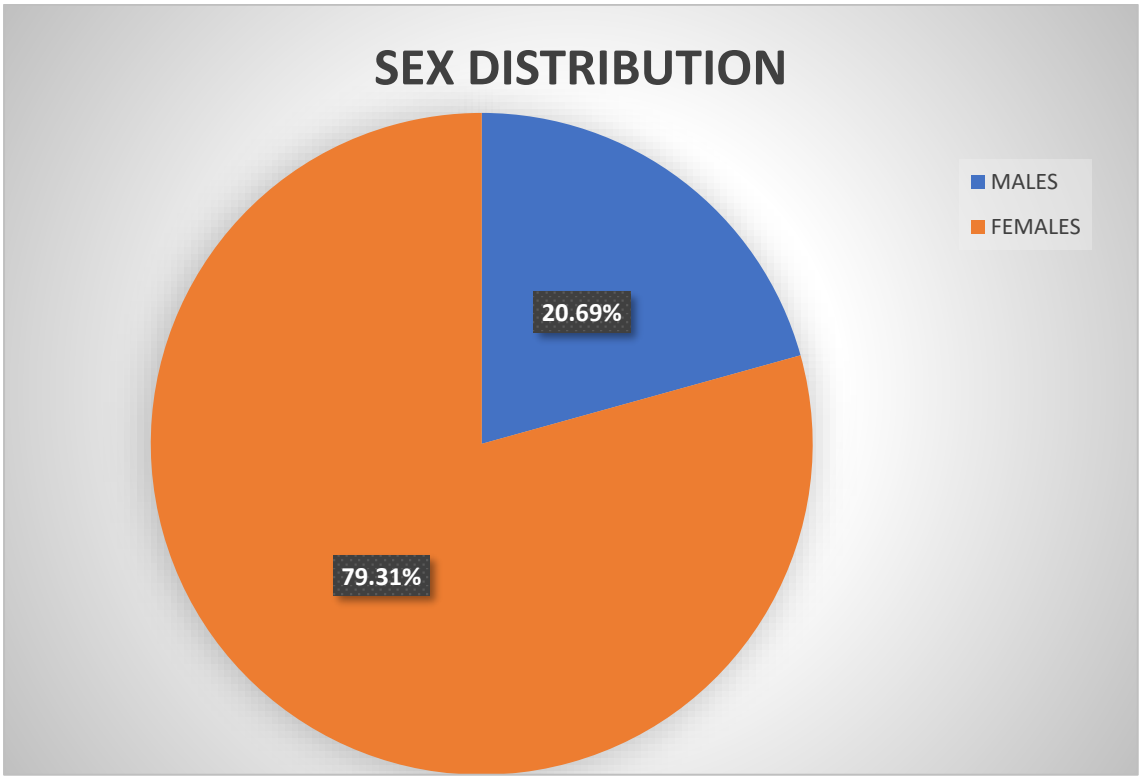
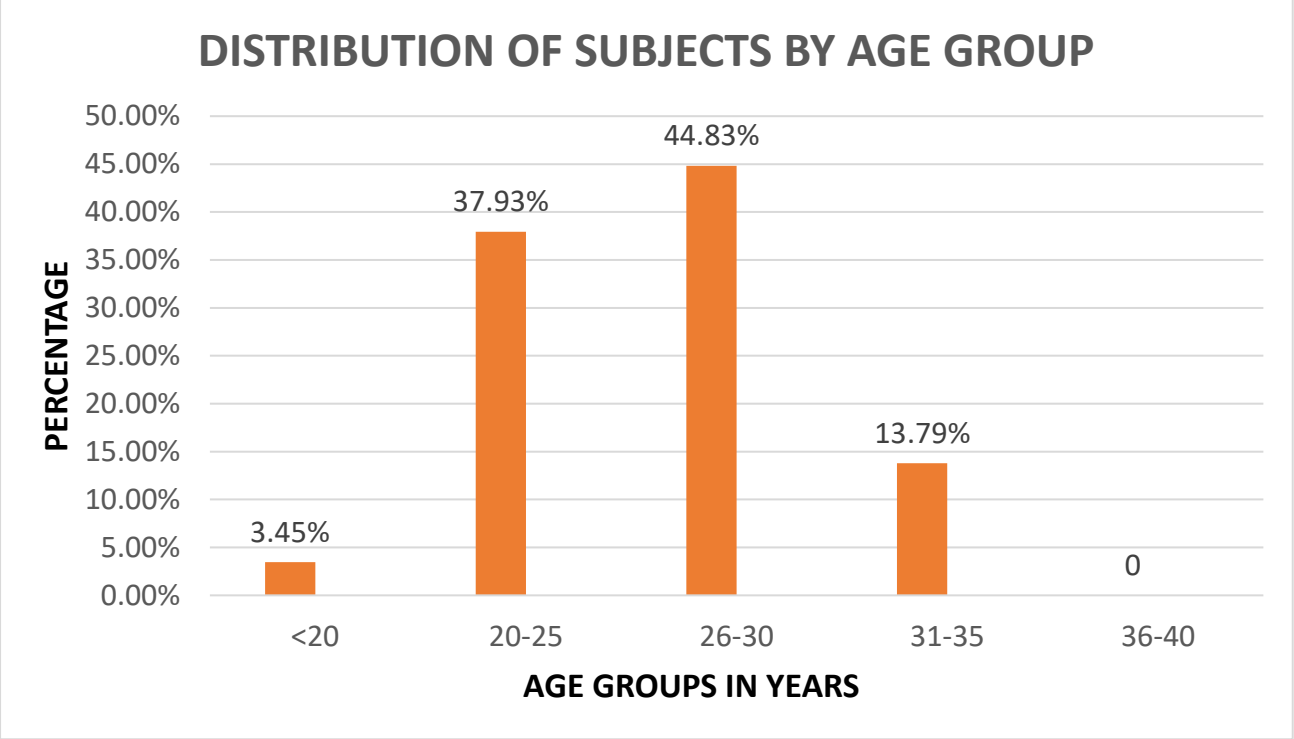


Table 2: Age distribution

Age groups in years	Number of subjects
<20	1
20-25	11
26-30	13
31-35	4
36-40	0

Graph 2: Age distribution



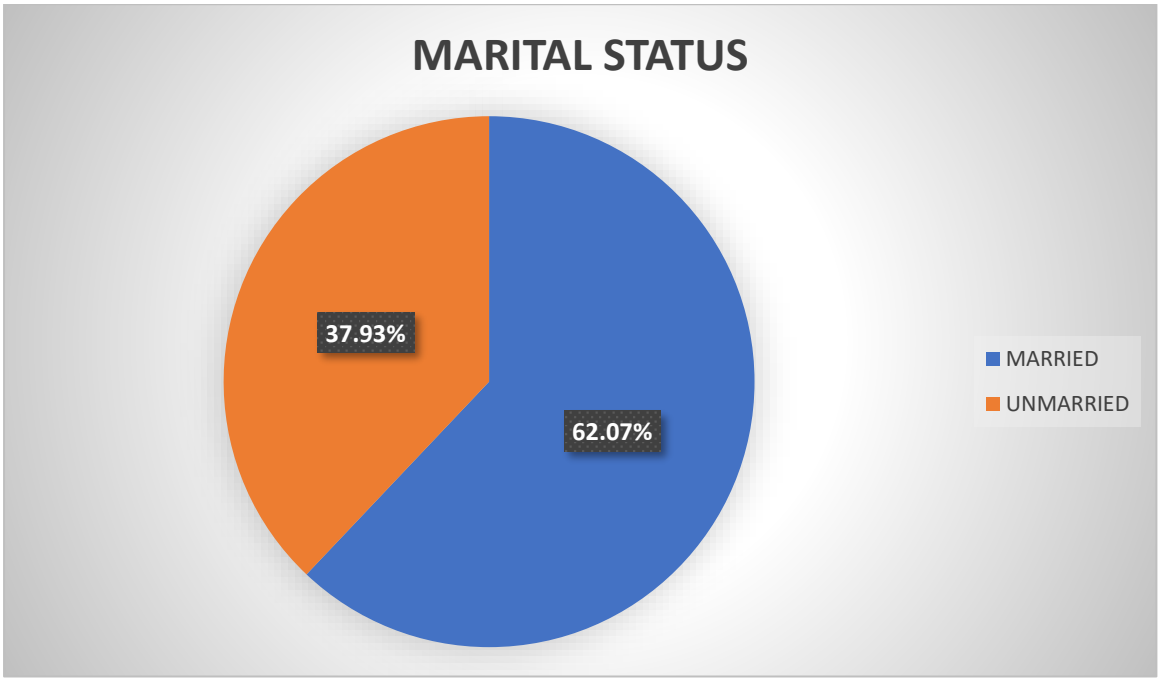
Duration of striae

The duration ranged from 1.5 to 7 years with a mean of 3.86 and SD of 1.53.

Table 3: Marital status

Marital status	Number of subjects
Married	18
Unmarried	11

Graph 3: Marital status distribution



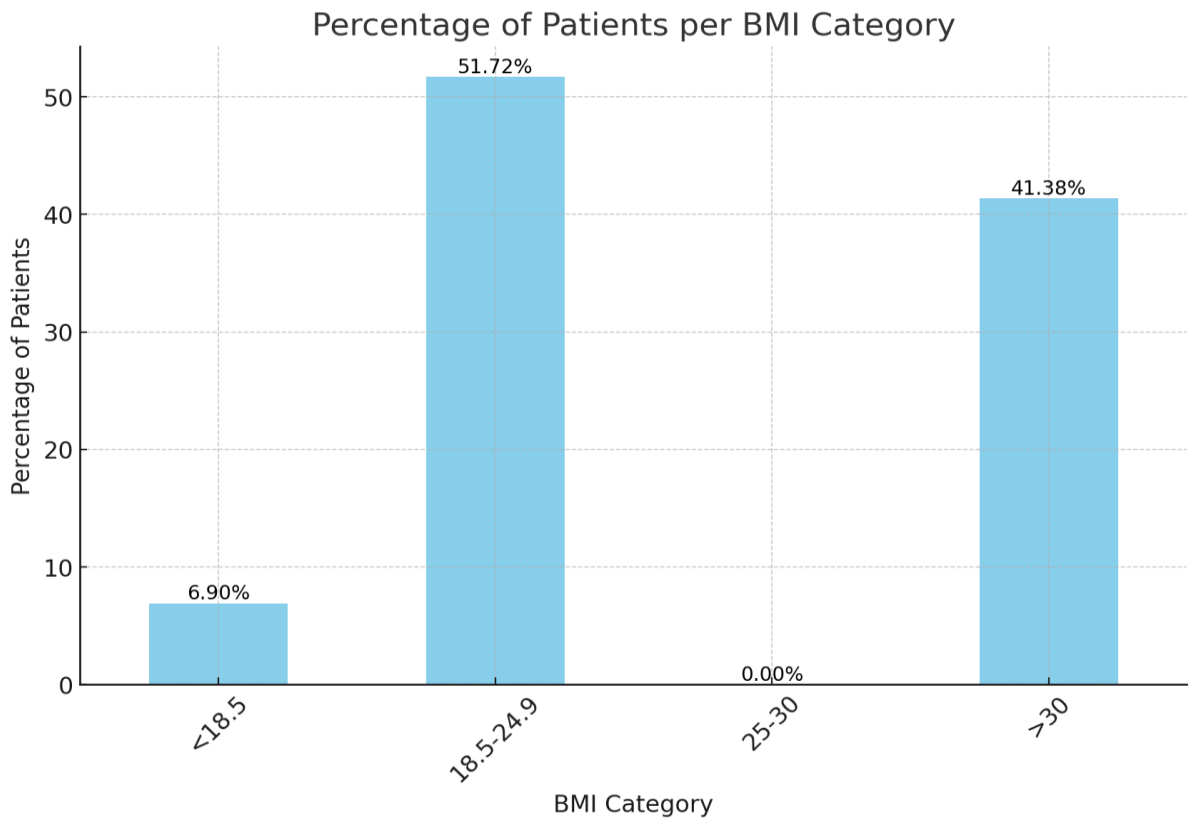
BMI

The BMI ranged from 17.71 kg/m^2 to 34.43 kg/m^2 with a mean of 25.77 ± 5.51.

Table 4: BMI distribution

BMI (kg/m^2)	Number of subjects
<18.5	2
18.5-24.9	15
25-30	0
>30	12

Graph 4: BMI distribution

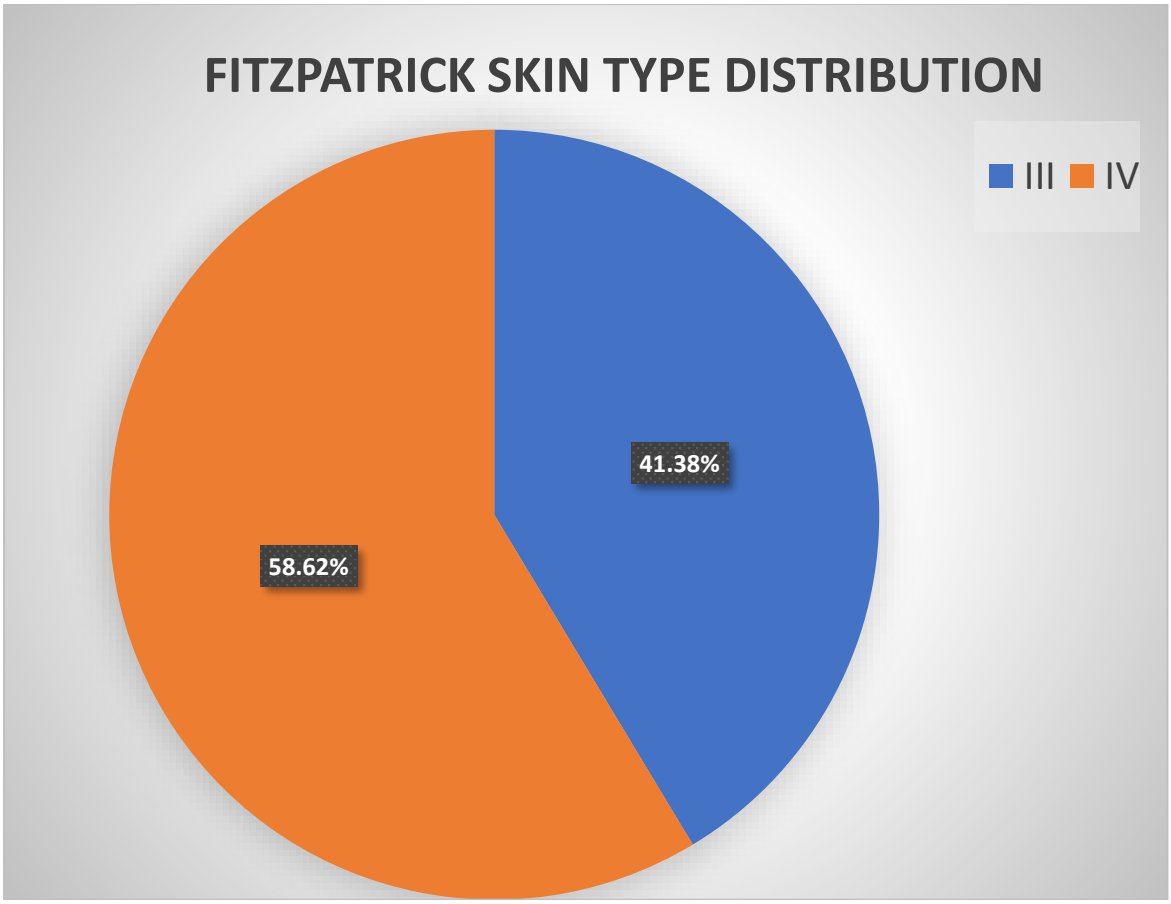


Skin type

Table 5: Skin type

Skin type	Number of subjects
Fitzpatrick III	12
Fitzpatrick IV	17

Graph 5: Skin type distribution

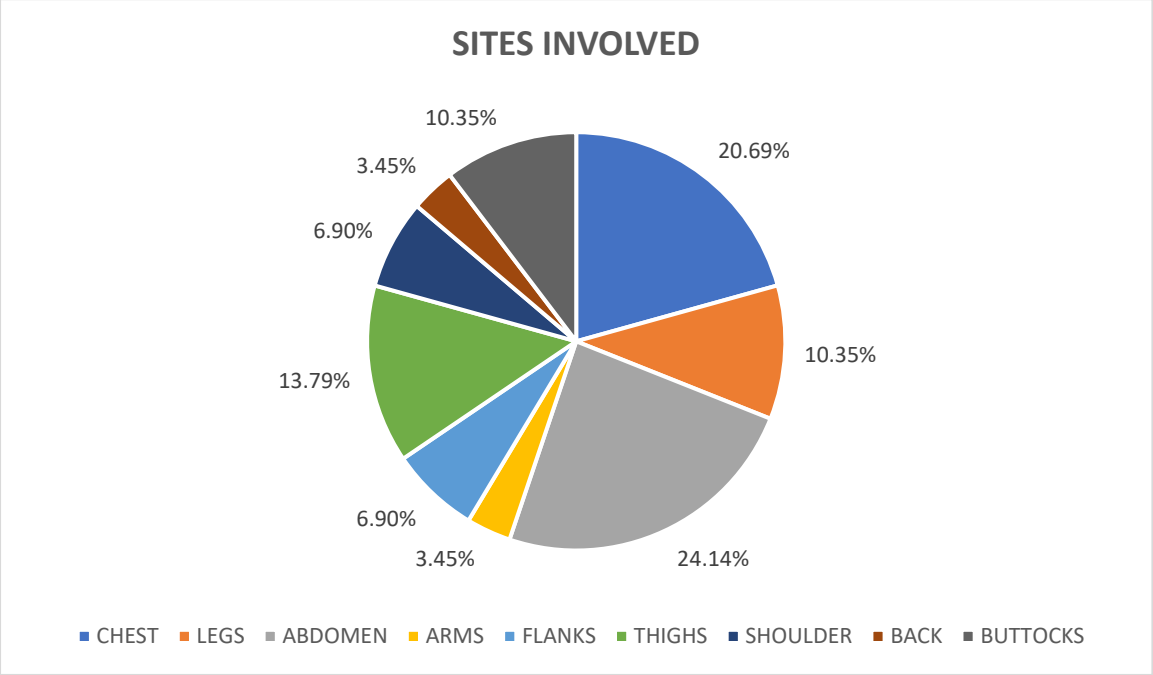


Sites involved

Table 6: Sites involved

Sites involved	Number of subjects
Abdomen	7
Chest	6
Thighs	4
Buttocks	3
Legs	3
Shoulder	2
Flank	2
Back	1
Arm	1

Graph 6: Sites involved

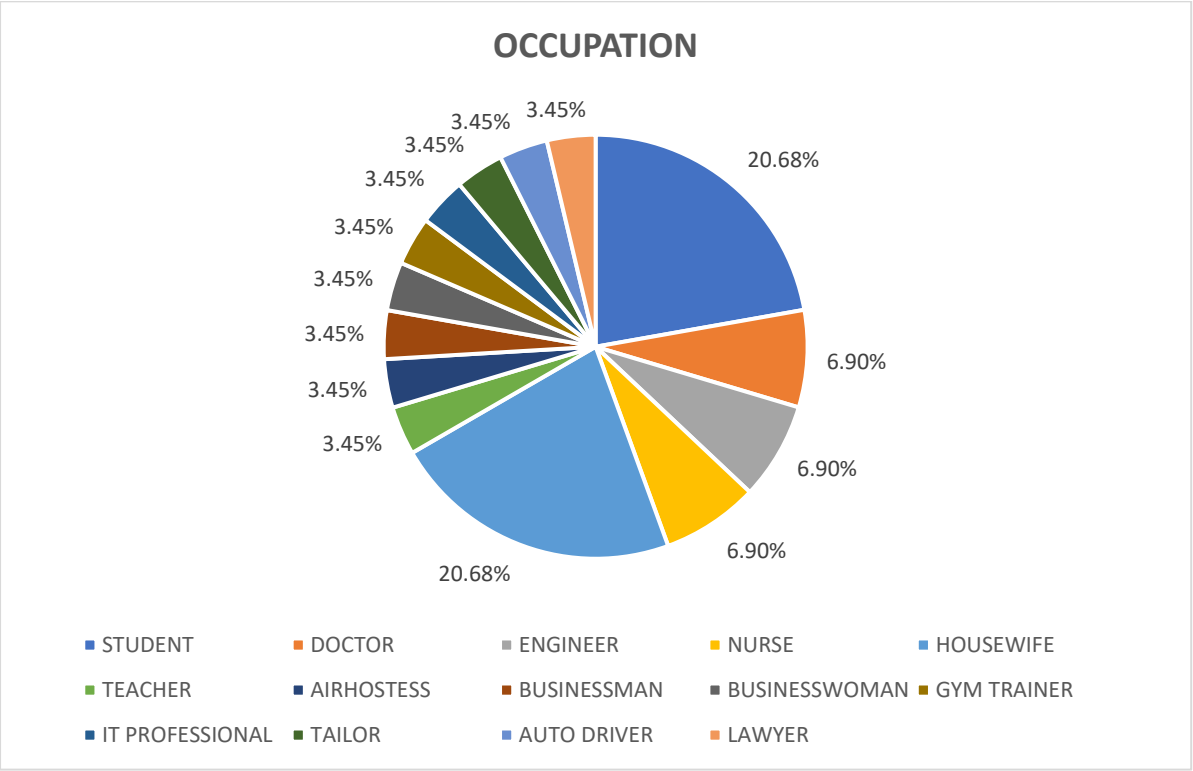


Occupation

Table 7: Occupation

Occupation	Number of subjects
Student	6
Housewife	6
Housekeeping	2
Engineer	2
Nurse	2
Doctor	2
Teacher	1
Airhostess	1
Businesswoman	1
Businessman	1
Gym trainer	1
IT professional	1
Tailor	1
Auto-driver	1
Lawyer	1

Graph 7: Occupation distribution



Etiology

Table 8: Etiology

Etiology	Number of subjects
Obesity	12
Weight loss	9
Pregnancy	6
Weight gain	2

Graph 8: Etiology distribution

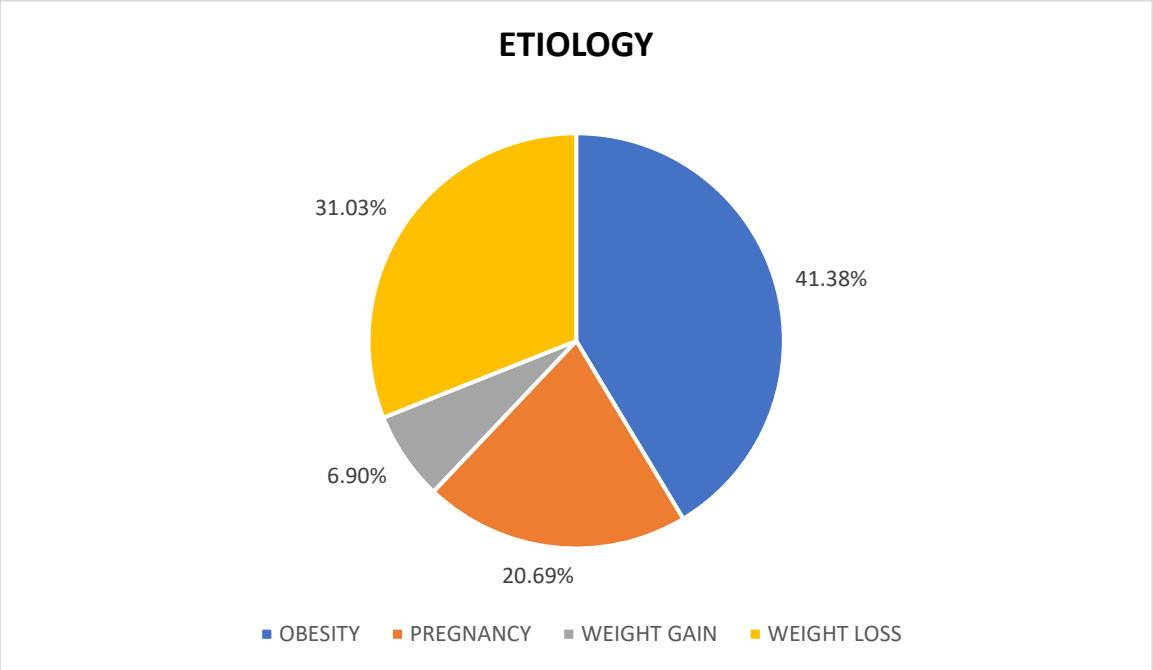


Table 9: DERMATOLOGIST'S ASSESSMENT by Chi square test

FOLLOW-UP (SITTING)	GRADES OF IMPROVEMENT	CO2 LASER		CO2 LASER+PRP		p- value
		n	%	n	%	
BASELINE VS AFTER 4TH	0-25%	0	0	0	0	<0.0001
	26-50%	23	79.31	6	20.69	
	51-75%	5	17.24	15	51.72	
	76-100%	1	3.45	8	27.59	

Table 10: PATIENT'S VISUAL ANALOG SCALE by Chi square test

FOLLOW-UP (SITTING)	SATISFACTION (SCORE)	CO2 LASER		CO2 LASER+PRP		p- value
		n	%	n	%	
BASELINE VS AFTER 4TH	Not satisfied (0)	0	0	0	0	0.04
	Slightly satisfied (1)	4	13.79	6	20.69	
	Very satisfied (2)	19	65.52	15	51.72	
	Extremely satisfied (3)	6	20.69	8	27.59	

Table 11: **Comparison of surface area before and after fourth sitting- CO2 laser by Wilcoxon signed rank test**

SITTING	**BASELINE**	**AFTER 4TH**	**p-value**
MEAN ±SD	5.89 ±5.20	4.61±4.25	<0.001

Table 12: Comparison of surface area before and after fourth sitting – CO2 laser + PRP by Wilcoxon signed rank test

SITTING	**BASELINE**	**AFTER 4TH**	**p-value**
MEAN ±SD	6.04 ± 5.38	4.22 ± 3.77	<0.001

Table 13: Comparison of surface area between CO2 laser and CO2 laser + PRP after fourth sitting by Mann-Whitney U test

INTERVENTION	**CO2 laser**	**CO2 laser + PRP**	**p- value**
MEAN ±SD	4.61±4.25	4.22 ± 3.77	0.92

DISCUSSION

This is one of the rare studies being conducted in India for striae distensae using CO2 laser and its combination with PRP. The study was conducted from January 2023 to December 2023 in the department of Dermatology, Venereology and Leprosy in KLE's Dr. Prabhakar Kore Hospital and Research Centre, Belagavi. Twenty nine out of 43 recruited subjects finished the study whereas 24 completed in a similar study by Madegowda SB et al.[92]

Sex distribution

Out of 29 subjects, 6 were males accounting for 20.69 % and 23 were females accounting for 79.31%. In a study conducted by Madegowda SB et al, 16 females accounted for 66.7% and 8 males accounted for 33.3% out of a total sample size of 24.[92] Males (n=7) and females (n=23) accounted for 23.3.% and 76.7% respectively in the study by Neinaa et al. [93] Almost similar proportion of females was found in both studies perhaps because of more cosmetic concern and regular follow-up.

Age distribution

In this, study out of 29 subjects, less than 20 years was 3.45% (n=1), 20-25 group constituted 37.93% (n=11), 26-30 group 44.83% (n=13), 31-35 group 13.79% (n=4) and none in the group of 36-40 years. The age group ranged from 18-34 years with a mean of 26.6 and SD of 3.95. The patients' age varied from 19 to 35 years, with a mean age of 25.71 and a standard deviation of 5.34 in the study by Madegowda SB et al. [92] The age ranged from 18-40 years with a mean and SD respectively of 27.90 ± 7.17 in the study by Neinaa et al. [93]

BMI

In our study, maximum subjects were in the BMI range of 18.5-24.9 (51.72%) followed by 41.38% in >30 and 6.9% in <18.5 and none in 25-30. BMI is an independent risk factor as suggested by Kasielska-Trojan et al. [1]SD is more prevalent in subjects with higher BMI as seen in our study and also in the study by Thomas et al. [94]

Skin type

Fitzpatrick skin type III and IV accounted for 41.38 % (n=12) and 58.62% (n=17) in our study. In the study by Neinaa et al. type III and IV were 33.3% (n=10) and 56.7 % (n=17) respectively and type II was 10 % (n=3). [93] Similar results were seen in our study as well.

Sites involved

The abdomen was the most common site with 24.14% (n=7) followed by the chest 20.69% (n=6). Arms and back were the least common sites accounting for just 3.45% (n=1) each. The abdomen (25%), shoulders (25%) and arms and forearms (8% each) were the most prevalent sites of lesions, followed by the thighs and buttocks (17% each) in a study by Madegowda SB et al.[92] Abdomen was the most common site (60%) and axillae and buttocks being the least (6.7%) in the study by Neinaa et al. [93]

Occupation

In this study, students and housewives accounted for 20.69% each. In a study by Madegowda SB et al, students made up the majority of the subjects (50%) while

homemakers came in second (33.3%). This variation could be due to different geographical locations. [92]

Etiology

In this study, obesity was the most common cause with 41.38 % (n=12) and weight gain being the least with 6.90% (n=2). Pregnancy contributed 20.69%. Pregnancy accounted for 45.8% of the cases of striae among the participants in a study by Madegowda SB et al.[92] Sobhi et al. saw similar results, reporting that 47.1% of women experienced striae secondary to pregnancy.[95] The study Neinaa et al. had pregnancy as the most common cause (46.7%) and excessive exercises at gym being the least (10%). [93]

Duration of striae

The duration of striae ranged from 1.5 to 7 years with 3.86 ± 1.53. According to a study by Madegowda SB et al., the lesions ranged in duration from 4 months to 60 months, with a mean of 25.92 (SD = 16.93).[92] In Neinaa et al.'s study, the range was from 0.5-7 years with 3.30 ± 1.83 mean and SD respectively which is similar to our duration of striae. [93]

Dermatologist's assessment

There was a statistically significant difference in improvement between both sides after the fourth sitting ($p<0.0001$). After the fourth sitting with CO2 laser alone, 79.31% showed 25-50% improvement, 17.24% showed 51-75% improvement and 3.45% 76-100% improvement. With fractional CO2 laser alone, at the end of 24 weeks, 25% had an

improvement of 26-50%, 58.3% had 51-75%, and 16.7% 76-100% in the study by Madegowda SB et al.[92] Clinical evaluations of the lesions on the side treated with CO2 revealed that 7.4% of patients showed >75% (grade 4), 51.9% of patients had improvement of 50–75% (grade 3), 33.3% of patients had improvement of 25-50% (grade 2), and 7.7% of patients had improvement of less than 25% (grade 1) out of 27 subjects in the study by Lee et al.[86] The more percentage of better satisfactory score in this study compared to ours could be attributed to different settings of CO2 laser used.

At the end of fourth sitting with CO2 and PRP, 20.69% showed 25-50% improvement, 51.72% showed 51-75% improvement and 27.59 % showed 76-100 % improvement. In the study by Neinaa et al, 20% showed 26-50% improvement, 56.7% showed 51-75% improvement and 23.3 % showed 76-100 % improvement which is similar to our findings. [93] Nevertheless, using fractional CO2 and PRP, 16.7% showed 26-50%, 50% showed 51-75% and 33.3% showed 76-100% improvement (P = 0.389) in the study by Madegowda SB et al.[92] The overall scores were better in the study by Madegowda SB et al. perhaps due to difference in subjective assessment by the dermatologist.

VAS patients

At the end of the fourth sitting, a statistically significant difference was seen in the satisfaction score (p = 0.04) between the two sides. On the side of CO2 laser, 51.72% were slightly satisfied, 27.59% very satisfied and 20.69% were extremely satisfied. The side treated with CO2 with PRP had 20.69% slightly satisfied, 51.72% very satisfied and 27.59% extremely satisfied, suggesting better satisfaction scores.

After the fourth sitting with greater satisfaction scores with fractional CO2 laser and PRP, the majority of patients expressed that they were very satisfied or extremely satisfied with the improvement on both sides (fractional CO2 and fractional CO2 + PRP, 66.7% and 83.3%, respectively). However, the comparison of satisfaction scores was not statistically significant (p=0.264) in the study by Madegowda SB et al. [92] One possible reason could be there were just three sittings done in this study compared to four in ours. Secondly, the fourth assessment was done three months after the last sitting, whereas it was done one month after the fourth sitting in our study. With three treatment sessions at 6-week intervals, 20% reported fair improvement, 56.7% reported marked improvement, and 23.3% reported excellent improvement in a study conducted by Neinaa et al.[93]

Change in surface area

The baseline surface area on the side treated with CO2 and CO2 with PRP was 5.89 ±5.20 and 6.04 ± 5.38 respectively with no statistically significant difference between them (p= 0.89). The change in surface area was statistically significant after the fourth sitting on each side (p<0.001). However, the change was not statistically significant after the fourth sitting when both sides were compared with each other (p=0.92). The mean change in surface area with CO2 laser after the fifth sitting was statistically significant (p<0.001) in the study by Naein et al. which is consistent with our result. [88]

Adverse effects

Side effects like erythema was seen for 2-4 days in all the subjects on both sides. Pain was seen for 2-4 days in 7 (24.13%) and 11 (47.83%) subjects on the side with CO2 and CO2 with PRP treated respectively. Burning was experienced in 12 (41.38%) subjects on the side of CO2 laser and 9 (31.03%) on the side of CO2 with PRP. Post inflammatory

hyperpigmentation was seen in 14 (48.28%) subjects with both treatment modalities. Compared to other studies, hyperpigmentation was seen in 18 subjects (75%) which was a relatively common side effect in the study conducted by Madegowda et al. [92] The study conducted by Sobhi et al. had 52.2% of the subjects with hyperpigmentation due to fractional CO_2 laser.[95] CO2 laser was significantly more likely to cause PIH. [95,96] In the study by Neinaa et al., 16.7 % subjects had PIH. [93] Transforming growth factor (TGF)-β1, a component of PRP, has a suppressive impact on melanogenesis, which lowers the risk of developing PIH on both sides. This mode of action could be the reason why PRP with either CO2 laser or PDL is thought to be better than any of the components working alone.[97,98]

Strengths of the study

The evaluation of the study was done in a comprehensive way using objective (surface area analysis) and subjective methods (patients' and dermatologist's assessment). It is the first study where change in surface area was analysed using an android which made it extremely handy and simple, thereby saving a lot of operational cost and time. A significant amount of cosmetic improvement with lower proprotions of side effects was felt by the subjects with the parameters of laser lower than many other studies. This reduced the chances of PIH which is tedious to treat.

Limitations of the study

It's an extremely long study having many follow-ups with unrealistic expectations of the subjects, so higher chances of loss to follow-up were noted. It was difficult to convince subjects as they are not usually bothered by SD even if visible in

uncovered areas of the body. It takes one to two hours approximately for every sitting which makes it cumbersome. Depth of the striae could not be measured as biopsy or ultrasonography is required which adds to the cost and time per sitting. Not many subjects showed up after six months of completion of treatment, thereby making it difficult to assess the durability of the improvement and long-term adverse effects, especially PIH, of the treatment modalities used.

CONCLUSION

SD are benign lesions with modifiable risk factors. Subjects require a lot of empathy and hand-holding by dermatologists throughout and after the treatment sessions. The study concludes that both the modalities, CO2 only and CO2 with PRP are effective in the treatment of striae. Even though there is no significant difference in the change in surface area between them, there is a significant difference of change in colour and texture of the striae with CO2 and PRP. Subjects are happy with the change in colour compared to a reduction in surface area which can be cosmetically appealing. Larger studies are needed to confirm these findings, especially with the settings of the laser used. Studies incorporating USG, biopsy or dermoscopy can be undertaken to see changes at microscopic level for long term improvement.

SUMMARY

- The present study was conducted in the department of Dermatology, Venereology and Leprosy in KLE's Dr. Prabhakar Kore Hospital and Research Centre, Belagavi from 1st January 2023 to 31st December 2023.
- A total of 29 subjects completed all the four sessions out of a total of 43 recruited subjects. Males and females were 20.69% and 79.31% respectively.
- Maximum subjects (44.83%) were present in the age range of 26-30 and none in the age of 36-40 years.
- Students and housewives accounted for 20.69% each.
- Abdomen was the most common site with 24.14% followed by the chest 20.69%. Arms and back were the least common sites accounting just 3.45% each.
- Obesity was the most common cause with 41.38 % and weight gain being the least with 6.90%.
- The duration of striae ranged from 1.5 to 7 years with a mean of 3.86 ± 1.53.
- The change in surface area was statistically significant after the fourth sitting on both the sides ($p<0.01$). However, the change was not statistically significant when both the sides were compared with each other ($p=0.92$) after the last sitting.
- In dermatologist's assessment, after the last sitting with CO2 laser alone, 79.31% showed 25-50% improvement, 17.24% showed 51-75% improvement and 3.45% had 76-100% improvement. With CO2 and PRP, 20.69% showed 25-50% improvement, 51.72% showed 51-75% improvement and 27.59 % showed 76-100 % improvement. There was statistically significant difference ($p<0.001$).
- At the end of fourth sitting, statistically significant difference was seen in the satisfaction score ($p = 0.04$) between the two sides in VAS scores of the subjects. On the side of CO2

laser, 51.72% were slightly satisfied, 27.59% very satisfied and 20.69% were extremely satisfied. The side treated with CO2 with PRP had 20.69% slightly satisfied, 51.72% very satisfied and 27.59% extremely satisfied, suggesting better satisfaction scores.

- Side effects like erythema was seen for 2-4 days in all the subjects on both sides. Pain was seen for 2-4 days in 7 (24.13%) and 11 (47.83%) subjects on the side with CO2 and CO2 with PRP treated respectively. Burning was experienced in 12 (41.38%) subjects on the side of CO2 laser and 9 (31.03%) on the side of CO2 with PRP. Post inflammatory hyperpigmentation was seen in 14 (48.28%) subjects with both treatment modalities.

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ANNEXURE I- INFORMED CONSENT FORM

Registration number of Student/Principal Investigator: BT0121002 under the guidance of Associate Professor Department of Dermatology, Venereology and Leprosy, JNMC, BELAGAVI.

Title of the study: "TO COMPARE THE EFFECTIVENESS OF CO2 LASER VS COMBINED USE OF CO2 LASER AND PRP (PLATELET RICH PLASMA) IN THE TREATMENT OF STRIAE DISTENSAE IN A SPLIT TRIAL".

Explanation of procedure

A) In this study, 4 treatment sessions of CO2 laser on the right side & CO2 laser + Platelet rich plasma injection on the left side at 4 weeks interval will be done in patients with striae distensae.

B) High resolution digital photographs will be taken of the striae using identical camera settings, patients positioning and room lighting at the baseline and after the fourth sitting

C) Data will be collected by a single examiner and recorded in case record proforma.

D) Records will be maintained and analysed statistically

Withdrawal from participation in the study:

Participation in this study is voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your

participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study:

The result of you taking part in this research would provide insight into the effectiveness of the treatment modalities used. The data gathered will help the population at large.

Possible risks from participating in the study:

There are no risks involved in participating in this study.

Alternatives:

If you decide not to participate in this study, you will still be receiving the usual standard care for your disease.

Privacy and confidentiality:

The information collected from you will be coded, to prevent any person from identifying you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives:

You will not receive any payment for participating in this study.

Authorization for publication of aggregated data:

Results obtained after processing of the aggregated data will be published for scientific purposes and or presented to scientific groups. However, your identity will never be revealed.

Legal rights:

The J N Medical College will provide, within the limitations of the laws of the State of Karnataka, facilities and medical attention to patients who suffer injuries as a result of participating in this project. By signing this consent form, we are not waving any of your legal rights.

STATEMENT OF CONSENT

I.D. | | | | NO

I , Mr / Ms/ Mrs …….. volunteer and consent to participate in this study. I am making a voluntary decision to participate in the study "TO COMPARE THE EFFECTIVENESS OF CO2 LASER VS COMBINED USE OF CO2 LASER AND PRP (PLATELET RICH PLASMA) IN THE TREATMENT OF STRIAE DISTENSAE IN A SPLIT TRIAL".

My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Participant's name:

Signature or left thumb print of the participant:

Witness's name:

Signature of the witness:

Signature of the investigator

Date:

ANNEXURE II-PROFORMA

TITLE : "TO COMPARE THE EFFECTIVENESS OF CO2 LASER VS COMBINED USE OF CO2 LASER WITH PRP (PLATELET RICH PLASMA) IN THE TREATMENT OF STRIAE DISTENSAE IN A SPLIT TRIAL"

Name :
Gender:
Age :
Date :
Case no:
Address with phone number :
Occupation:
Chief Complaint :
Duration:
Preceding Symptoms before onset of striae: ☐ Present
☐ Absent
Mention (If any) :

Associated Symptoms :-

1) Redness	Present	☐	Absent	☐
2) Burning	Present	☐	Absent	☐
3) Itching	Present	☐	Absent	☐

H/o Treatment taken :

1) Systemic	Present	☐	Absent	☐

Mention (If any)

2) Topical	Present	☐	Absent	☐

Mention (If any)

3) Laser Present ☐ Absent ☐
Details (If any)

4) Other Present ☐ Absent ☐
Mention (If any)

Past History :

1) Sudden gain / loss of weight Present ☐ Absent ☐
2) Endocrine disorder Present ☐ Absent ☐
3) Genetic disorder Present ☐ Absent ☐
4) Similar complaints in previous pregnancy Present ☐ Absent ☐
5) Treatment taken Present ☐ Absent ☐
If present, details :

6) H/o DM Present ☐ Absent ☐
7) H/o HTN Present ☐ Absent ☐
8) Any other comorbidities Present ☐ Absent ☐

Mention (if any)

Family History of striae : Present ☐ Absent ☐

Personal History :

Diet Mixed ☐ Veg ☐

Menstrual History : Regular ☐ Irregular ☐

If irregular , details

Obstetric History :

Type of delivery	Vaginal	☐	Caesarean	☐
If caeserrian	Classic	☐	LSCS	☐

General Physical Examination :

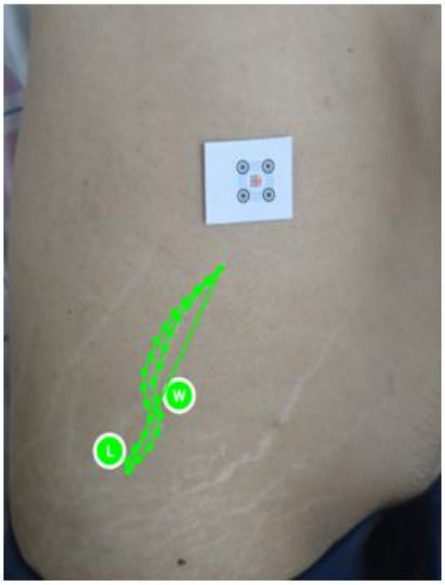
1) Weight : kg
2) Height : m
3) BMI : kg/m^2

Local examination:

1) Site of Striae :
2) Erythema Present ☐ Absent ☐
3) Tenderness Present ☐ Absent ☐
4) Other findings (if any) :

ANNEXURE III- PHOTOGRAPHS

imito measure | Measurement Report



Area: 2.53
Width: 0.56
Length: 8.08
Circumference: 17.2

Figure 1a: Right side of the abdomen - surface area (cm^2) measurement of a stria at baseline

Figure 1b: Left side abdomen - surface area (cm^2) measurement of a stria at baseline.

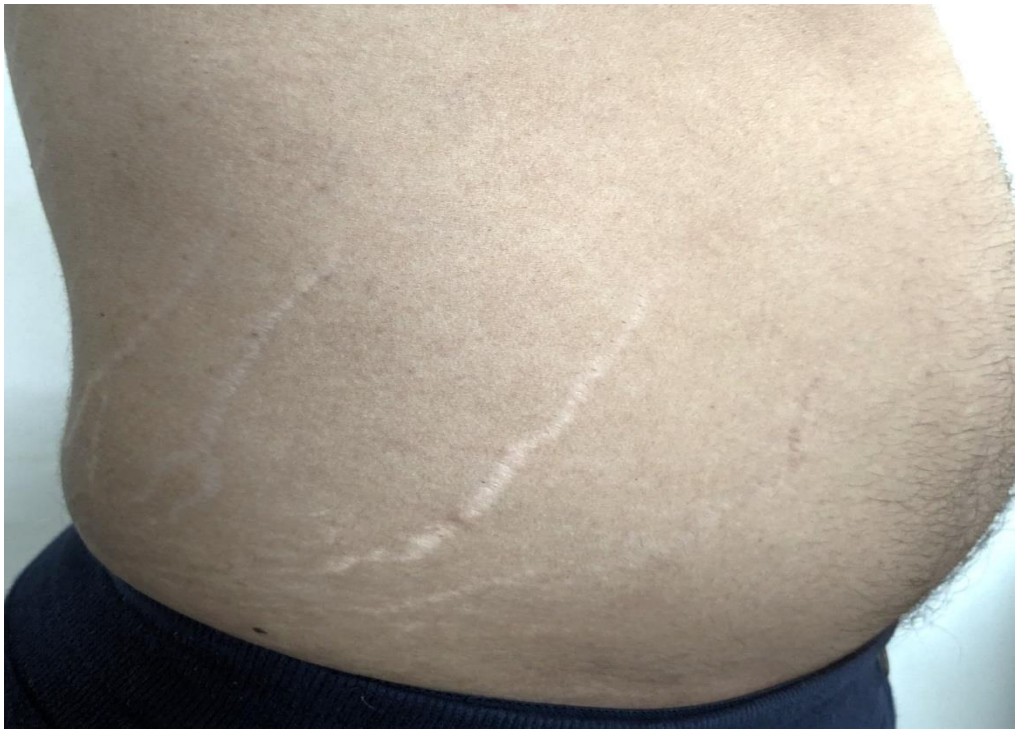


Figure 2a: Right side abdomen- baseline

Figure 2b: Right side abdomen treated with CO2 only, after fourth sitting

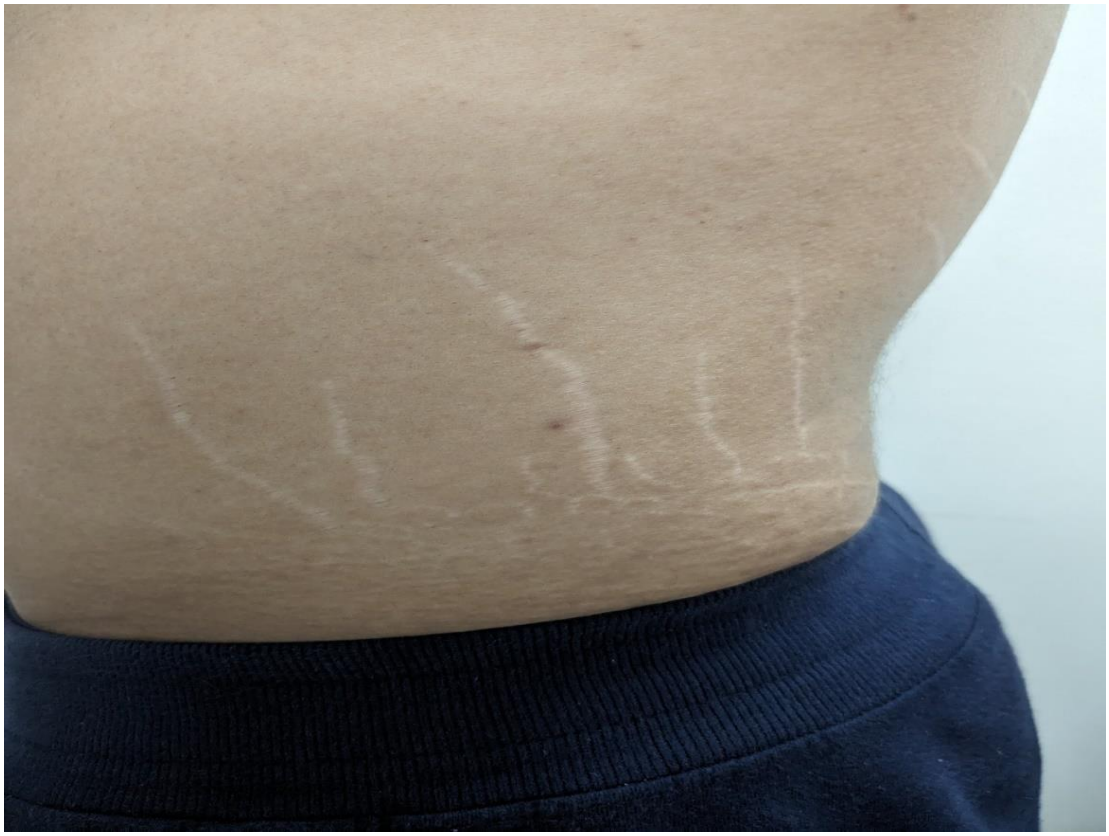


Figure 3a: Left side abdomen- baseline

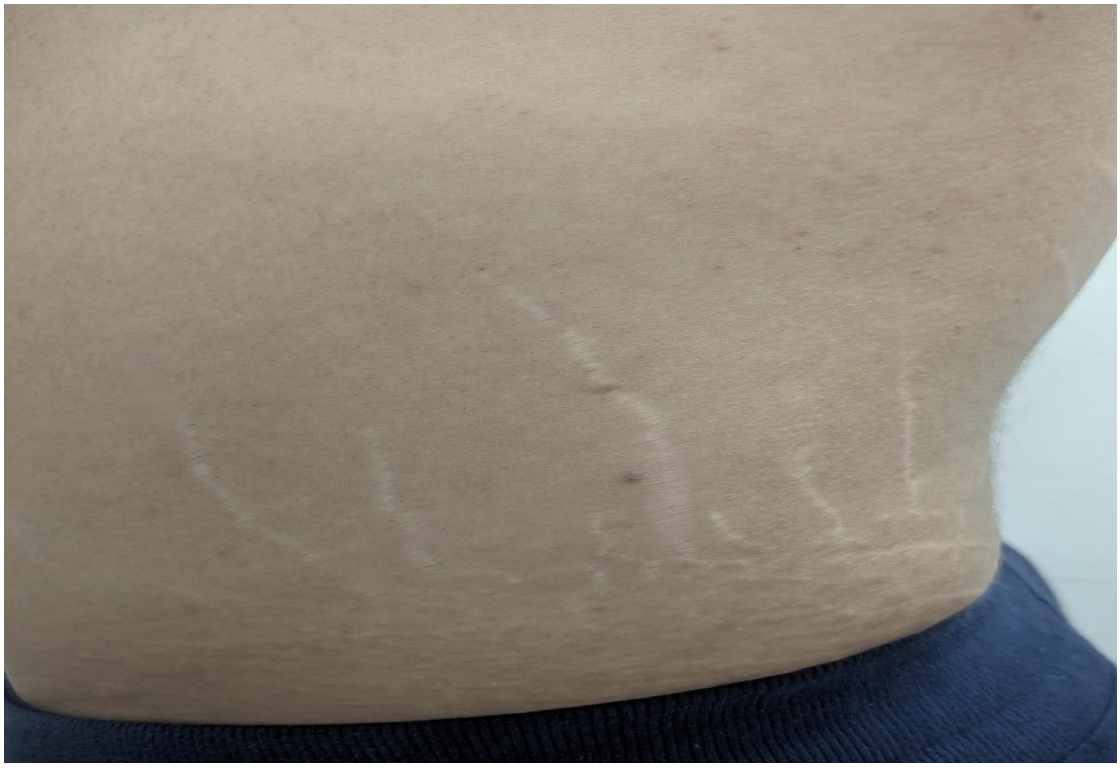


Figure 3b: Left side abdomen treated with CO2 and PRP, after fourth sitting

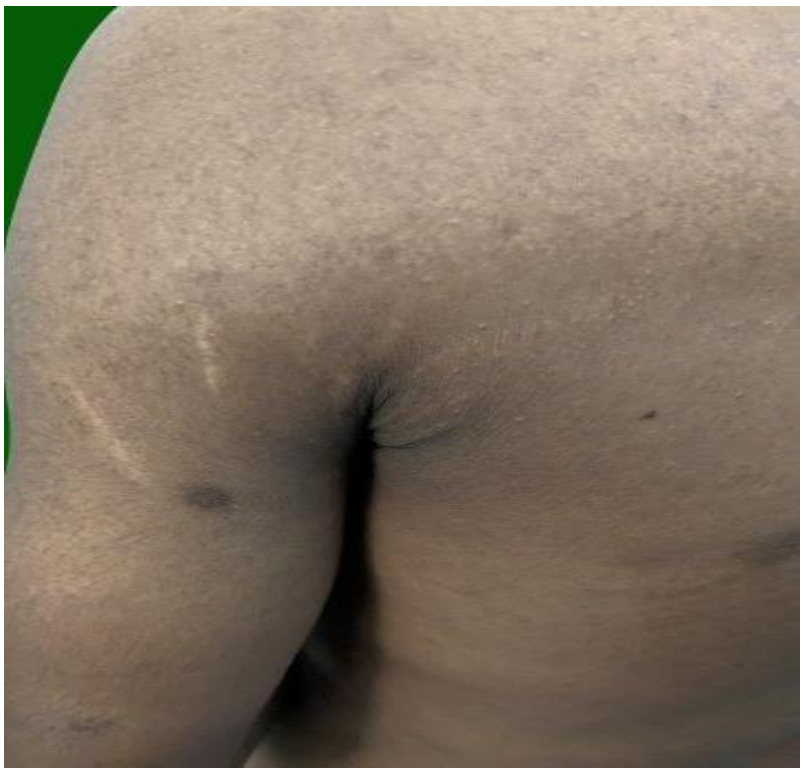


Figure 4a: Right side arm – baseline

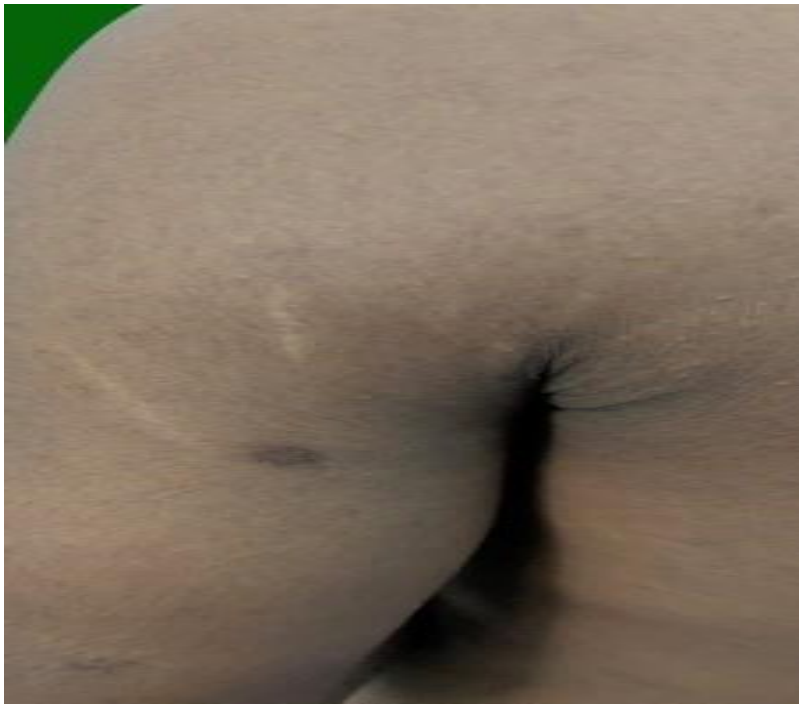


Figure 4b: Right side arm treated with CO2 only, after fourth sitting

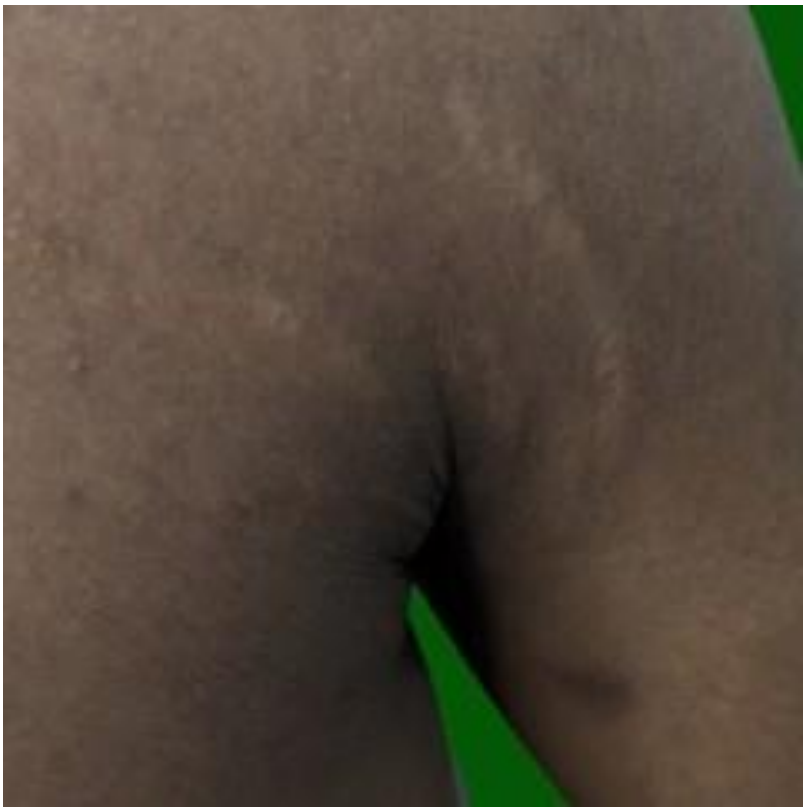


Figure 5a: Left side arm - baseline

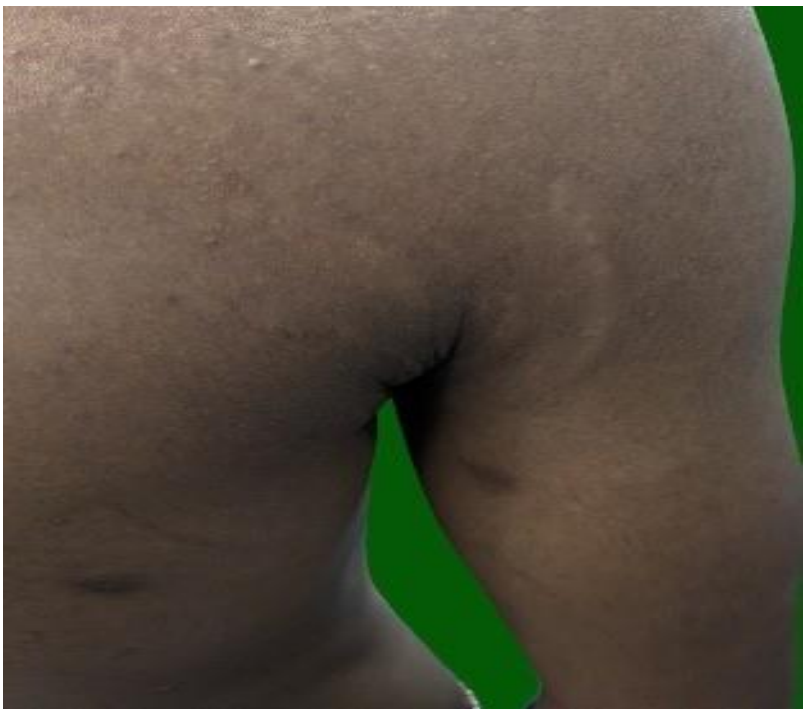


Figure 5b: Left side arm treated with CO2 and PRP, after fourth sitting

MASTER CHART

SR NO	AGE (YEARS)	GENDER	MARITAL STATUS M- MARRIED UM-UNMARRIED	OCCUPATION	SITE INVOLVED	DURATION OF STRIAE (YEARS)	ETIOLOGY	FITZPATRICK SKIN TYPE	BMI (kg/m2)
1	31	F	M	HOUSEWIFE	ABDOMEN	4	PREGNANCY	III	21.12
2	32	F	UM	TEACHER	ABDOMEN	5	PREGNANCY	III	19.21
3	30	F	M	HOUSEWIFE	ABDOMEN	2	PREGNANCY	IV	23.32
4	31	F	M	DOCTOR	ABDOMEN	4	PREGNANCY	IV	22.12
5	34	F	M	ENGINEER	ABDOMEN	7	OBESITY	III	34.43
6	26	F	M	HOUSEWIFE	ABDOMEN	2.5	PREGNANCY	IV	20.22
7	27	F	M	HOUSEWIFE	ABDOMEN	3	PREGNANCY	III	19.91
8	30	F	UM	AIRHOSTESS	ARM	5	WT LOSS	IV	21.11
9	26	F	M	HOUSEWIFE	BACK	2	WT GAIN	III	23.32
10	21	F	UM	STUDENT	BUTTOCKS	1.5	OBESITY	III	31.98
11	29	F	M	BUSINESSWOMAN	BUTTOCKS	5	OBESITY	IV	31.12
12	30	M	M	BUSINESSMAN	BUTTOCKS	4.5	OBESITY	IV	33.32
13	24	M	UM	STUDENT	CHEST	4	OBESITY	III	31.23
14	28	M	M	DOCTOR	CHEST	3	WT LOSS	III	20.03
15	23	F	UM	STUDENT	CHEST	6	OBESITY	IV	31.32
16	30	M	M	GYM TRAINER	CHEST	7	WT LOSS	IV	22.22
17	29	F	M	IT	CHEST	5	OBESITY	IV	30.98
18	25	F	UM	NURSE	CHEST	3	WT LOSS	IV	22.61
19	26	F	M	HOUSEWIFE	FLANKS	4	OBESITY	III	31.12
20	18	F	M	STUDENT	FLANKS	1.5	OBESITY	IV	30.21
21	24	F	UM	TAILOR	LEGS	3	WT LOSS	III	17.71
22	25	F	UM	NURSE	LEGS	4	WT LOSS	IV	18.32
23	25	M	UM	AUTO DRIVER	LEGS	5	WT LOSS	IV	21.45
24	30	M	M	LAWYER	SHOULDER	4	WT LOSS	IV	23.21
25	23	F	M	HOUSEKEEPING	SHOULDER	2	WT LOSS	III	24.12
26	30	F	M	ENGINEER	THIGHS	5.5	OBESITY	IV	33.33
27	23	F	UM	STUDENT	THIGHS	4	OBESITY	IV	32.45
28	22	F	M	HOUSEKEEPING	THIGHS	2	OBESITY	III	31.31
29	20	F	UM	STUDENT	THIGHS	4	WT GAIN	IV	24.45

AVG AREA-BASELINE CO2 (cm2)	AVG AREA AFTER-4TH SITTING CO2 (cm2)	AVG AREA BASELINE CO2+PRP (cm2)	AVG AREA AFTER-4TH SITTING CO2 + PRP (cm2)	PATIENT'S VAS CO2 LASER AFTER 4TH SITTING	DERMATOLOGIST'S GRADES CO2 LASER AFTER 4TH SITTING	PATIENT'S VAS CO2 + PRP AFTER 4TH SITTING	DERMATOLOGIST'S GRADES CO2 + PRP AFTER 4TH SITTING
9.43	7.44	9.39	5.98	1	2	3	4
11.76	9.64	11.67	8.12	2	2	2	3
11.35	9.57	11.30	8.11	2	2	2	4
16.69	13.35	17.00	11.39	1	2	3	3
15.63	10.75	16.23	10.22	1	2	3	3
19.92	16.93	21.23	15.92	1	2	2	4
13.47	11.05	13.98	9.7	3	2	2	2
1.29	0.95	1.41	0.9	3	3	3	4
4.71	3.34	4.65	3.67	1	2	3	4
2.37	2.01	2.37	1.61	2	2	2	3
3.32	2.76	3.65	2.77	1	1	2	2
3.60	2.98	3.98	3	2	2	2	3
1.98	1.38	1.92	1.23	3	2	3	2
3.15	2.11	3.11	1.71	2	3	2	3
1.50	1.08	1.46	0.88	2	2	3	2
3.38	2.54	4.00	2.76	2	2	2	3
4.95	3.56	5.10	4.45	1	2	3	2
1.47	1.19	1.76	1.22	1	3	3	3
7.11	5.58	7.00	4.37	1	2	2	2
3.91	2.74	3.90	2.92	3	2	2	3
1.57	1.1	1.70	1.25	3	2	2	4
1.73	1.21	1.74	1.3	3	3	3	4
0.88	0.63	0.98	0.75	1	2	3	3
3.40	2.38	3.37	2.09	1	2	2	3
2.18	1.58	2.23	1.32	1	2	3	3
6.03	4.94	6.00	4.11	2	3	3	3
7.03	5.55	7.00	5.53	1	2	2	4
3.94	3.44	3.90	2.91	1	2	3	3
3.04	2.1	3.13	2.32	1	2	1	3