Original Article

Comparative histological evaluation of the effectiveness of trichloroacetic acid and subcision (isolated or combined) in the treatment of abdominal striae

Avaliação histológica comparativa da eficácia de ácido tricloroacético e subcisão, isolados e combinados, no tratamento de estrias abdominais

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ABSTRACT

Introduction: Abdominal striae(i.e. stretch marks) are considered scars, for which there are no known treatments.

Objective: To compare the effectiveness of three treatments: subcision, 20% trichloroacetic acid, and subcision + 20% trichloroacetic acid in the treatment of stretch marks.

Methods: The lower abdomens of 11 patients with stretch marks were divided into four quadrants. Each patient had one stria selected for a single treatment session; the three treatments (subcision, 20% trichloroacetic acid, and subcision + 20% trichloroacetic acid) were administered in 3 quadrants, and the 4th quadrant served as a control. Each selected stria was biopsied before and after 12 weeks. The Wilcoxon test was used to evaluate the efficacy of the treatment. The Kruskal-Wallis test was used to evaluate the differences between the treatments.

Results: In all treatments there was a reduction in the mean value after treatment, however the 20% trichloroacetic acid treatment was statistically significant for the epidermal parameter and the collagen fiber staining. The subcision associated with 20% trichloroacetic acid presented a statistically significant result in the superficial dermis parameter, while the isolated subcision was significant in the superficial dermis parameter only.

Conclusions: These treatments are safe and present low operating costs, which make them a great alternative for treating abdominal striae. Future studies should conduct a clinical-histological evaluation after a greater number of sessions.

Keywords: *striae distensae; dermatology;ambulatory surgical procedures; surgical procedures, minor; chemexfoliation.*

RESUMO

Introdução: *estrias são consideradas cicatrizes, não sendo conhecidos tratamentos resolutivos para essa condição.*

Objetivo: *comparar a resposta de três modalidades terapêuticas: subcisão, subcisão + ATA 20% e ATA 20% no tratamento de estrias.*

Métodos: *11 pacientes portadoras de estrias em abdômen inferior, dividido em quadrantes: uma estria de cada quadrante foi submetida a: subcisão, subcisão + ATA 20% e ATA 20%, respectivamente. O quarto quadrante foi utilizado como controle. Cada estria selecionada foi biopsiada antes e após 12 semanas. Para avaliar a eficácia, utilizou-se o teste de Wilcoxon. Para avaliar comparativamente as diferenças entre os tratamentos foi aplicado o teste de Kruskal-Wallis.*

Resultados: *Em todos os tratamentos realizados houve redução da média pré e pós-tratamento; no entanto, o tratamento com ATA 20% mostrou-se estatisticamente significativo no parâmetro epidérmico e na coloração de fibras colágenas. A subcisão associada ao ATA 20% teve resultado estatisticamente significativo no parâmetro derme superficial enquanto a subcisão isolada mostrou-se significativa apenas na derme superficial. Realizou-se uma sessão de tratamento, sendo necessários estudos subsequentes para avaliação clinico-histológica após número maior de sessões.*

Conclusões: *Os tratamentos propostos são seguros e de baixo custo operacional, sendo ótima opção para estrias abdominais.*

Palavras-chave: *estrias de distensão; dermatologia; procedimentos cirúrgicos ambulatórios; procedimentos cirúrgicos menores; abrasão química.*

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INTRODUCTION

Abdominal striae (more commonly known as stretch marks) are considered to be scars by most dermatologists due to their atrophic appearance, evidenced clinically and histologically. To date, there is no cure or gold standard treatment for this condition.

Stretch marks appear as linear or fusiform lesions of varying length and width. They are more frequently located in the breasts, abdomen, buttocks, and thighs, depending on the circumstances in which they have developed. Pregnancy stretch marks are predominantly located in the abdomen and breasts, while those located in the arms and underarms are linked to variations in body weight.[1-4] In general, striae are asymptomatic lesions that may cause a burning sensation and itching, however the main concern is aesthetic.[1]

The literature describes a prevalence of 40-70% among adolescents and 90% after pregnancy, however the incidence of stretch marks, the age at onset and prevalence by gender depend on the population studied. For example, distensible stretch marks in adolescents have previously been reported as more common in women (72%), nevertheless a study that focused on Korean teenagers suggested predominance in men.[2]

Striae are classified according their color: white (*alba*), erythematous (*rubia*), bluish (*cerulean*), or blackened (*nigra*).[5-7] Their color depends on both the microvascular component and the melanocytes' size and activity.[5,6] In Caucasians they begin as reddish lesions with a smooth and tense surface (red stripe) that lose pigment over time, becoming white and atrophic.[1,6]

Histologically, striae appear as scar damage in the dermal collagen, elastic tissue, and extracellular matrix. The degranulation of mast cells, and macrophage-activated elastolysis and elastophagocytosis, take place early in their formation. Afterwards, there is a flattening of the epidermis and an attenuation of epidermal cones, and the formation of thin and grouped collagen bands in the papillary dermis, which can reach deeper planes horizontally to the epidermis. Special staining for elastic fibers have shown that they are thin, occur in small amounts, and are oriented parallel to the epidermis in the papillary dermis, and are absent in some areas. There is also a reduction of vertical fibrillins and fibrillins in the reticular dermis, which become more parallel to the dermoepidermal junction. This may occur because patients who develop stretch marks are predisposed to structural or functional deficiency of fibrillins. As they become chronic, progressive thickening and increased glycosaminoglycans occurs.[8]

While the distensible striae etiology remains unknown, endocrine and genetic factors, in addition to the stretching of the skin, are cited as accelerators.[1,3,4] Stretch marks are caused by or associated with diverse physiological such as: pregnancy, adolescent growth spurts, obesity, use of steroids, Cushing's syndrome, Marfan syndrome, and diabetes mellitus.[8]

One study has demonstrated that the main risk factors for pregnancy stretch marks seem to be associated with the mother's age, body mass index, weight gain and weight of the newborn. Young mothers were found to be most at risk for developing pregnancy stretch marks. An evaluation of the prevalence of stretch marks in pregnant women treated in the Brazilian public and private health systems concluded that patients treated in the public health system developed more stretch marks during pregnancy because the public system treats more patients belonging to the younger age group.[9]

In 1974, Liu described the possible role of relaxin, combined with estrogen and corticosteroids, in the genesis of stretch marks. Relaxin is a generic designation for a group of hormones that are produced during pregnancy that are related to the softening of the pubic symphysis and the inhibition of uterine contractions; they also interfere with collagen synthesis. The association with estrogen and corticosteroids would increase the proportion of mucopolysaccharides, the retention of which would influence the tension between collagen fibers, leading to their cleavage. More recently, a study with 32 pregnant women noted that the occurrence of stretch marks under that condition seemed to be related to lower serum levels of relaxin, which would interfere with the decreased elasticity of the connective tissue and, consequently, cause its rupture. A study with mice showed that the presence of relaxin modulates collagen's catabolism during pregnancy. Other important hormones in pregnancy, such as glucocorticoids, also seem to play a role in the development of stretch marks. A recent study showed a significant increase in the expression of glucocorticoid, estrogen, and androgen receptors in areas of the skin with stretch marks, compared to normal skin in healthy individuals who are not pregnant.[10]

With only a few treatment alternatives for stretch marks, laser therapy and other technologies have gained popularity and become therapeutic options. Clinical and histological differences have been verified after treatment with 585 nm pulsed dye laser (PDL).[11,12] Other treatments that combine 585 nm PDL with radiofrequency[13] 308 nm excimer laser[14,15] and intense pulsed light (IPL)[16] have been described.

The first study describing the use of 585 nm PDL for treating stretch marks was published in 1996 by McDaniel and colleagues. The study included 39 female patients (38 with *striae alba* and one with *striae rubia*) were included. The patients received a single 585 nm PDL application, and four protocols with different fluences were used. An untreated stria was used as control. Evaluations were performed four and eight weeks after the procedure (researcher subjective analysis, objective analysis through photography and profilometry, and histological analysis in two patients). Clinical and histological improvements were observed in all groups, with more pronounced results in the group in which a high energy and a larger spot were used.[11]

In 2003, Jimenez and colleagues published another study on 585 nm PDL, which included 20 female patients with skin types II to VI with *striae rubia* (9) and *alba* (11) Two treatments, with a six-week interval, were performed. A moderate benefit due to the reduction of *striae rubia* erythema was demonstrated,

with no improvement in the clinical appearance of the *striae alba*. Nevertheless, there was an increase in collagen.[12]

In 2007, Suh and others evaluated the combination of 585 nm PDL with radiofrequency in the treatment of striae in patients with high phototypes. Patients (n = 39) were treated with radiofrequency (Thermage®, Solta Medical Inc., Hayward, CA)and 585 nm PDL in the first session and with 585 nm PDL only in two additional sessions in weeks four and eight. After treatment, 89.2% of patients classified their overall appearance as good to very good, and 59.4% characterized the improvement in elasticity as good to very good. Of the nine patients who were biopsied, all presented an increase in collagen fibers, and six demonstrated an increase in elastic fibers.[13]

Striae have also been treated with 308 nm excimer laser. Goldberg published a study in 2003 involving 75 patients with *striae alba*. Initial fluences of 150-250 J/cm2 and final fluences of 200-900 J/cm2 were used. The treatments were discontinued after 15 sessions or when there was improvement equal to or greater than 75%. An improvement in the pigmentation of striae equal to or greater than 76% was found after an average of 8.4 treatments. Improvement in appearance was observed in 80% of patients.[14]

In 2004, Macrene and colleagues evaluated the same laser in the correction of scars and hypopigmented striae. Twenty-two patients with scars and nine with *striae alba* were included. Ten twice weekly treatments were conducted. The results showed excimer laser was safe and effective in repigmenting the treated lesions, with a 60-70% repigmentation rate when using the visual scale and a 100% repigmentation rate when analyzed using spectrometry after nine sessions. However, those results were of short duration, returning to their initial appearance during the six-month follow-up. Thus, maintenance treatments are necessary every one to four months (phototype I), every one to two months (phototype II) and every two to four months (phototype > III).[15]

IPL has also been used to treat stretch marks. In 2002, Perez published a study involving 15 phototype III and IV women with abdominal *striae alba*. Five IPL sessions were carried out at 15-day intervals. A 645 nm filter and an initial fluence of 30 J/cm2 (increased by 10-20% at each session) were used. The clinical improvement was assessed by the patient, a nurse, and a researcher physician. The histology was assessed by two dermatopathologists. All patients presented statistically significant clinical improvement (40% moderate, 20% good, and 40% very good) and microscopic improvement (increased thickness of the epidermis and dermis, decreased collagen damage, and absence of alteration in elastic fibers), suggesting that IPL is a promising alternative for treating stretch marks. There were no serious adverse effects and a short recovery period.[16]

In 2008, in a study conducted by Goldman and colleagues in Brazil, 1064 nm Nd:YAG laser was used to treat *striae rubia* in 20 patients. A 2.5 mm spot and fluences between 80 and 100J/cm2 were used, and overlapping was avoided. The average number of sessions was 3.45 per patient, with intervals ranging from three to six weeks. The analysis consisted of comparing before and after treatment pictures. The response was considered excellent by the physician's and the patients' evaluation in 40% and 55% of cases, respectively. The favorable response suggests that Nd:YAG laser is a good alternative in the treatment of *striae rubia*.[17]

Some studies have demonstrated that there is no benefit in using 1450 nm diode laser to treat striae.[18] The adverse effects of these treatments are usually limited to post-inflammatory hyperpigmentation or transient purpura.

There are also reports in the literature describing improvement of *striae rubia* with the application of topical 0.1% tretinoin.[19]

If we consider cutaneous striae to be scars, subcision could be an option for their treatment. Orentreich first described the technique for treating scars and wrinkles in 1995. There are few reports about using this technique, most of which have inconclusive results.[20, 21] A pioneering study analyzes 14 patients, only seven of whom completing the three-month follow-up. Three approaches were evaluated: subcision, subcision plus 0.1% tretinoin, and 0.1% tretinoin daily. Each patient had three *striae alba* treated. The analysis was performed by two researcher physicians, who conducted blind evaluations of the pictures. Improvement was observed in the three approaches, with no statistical difference (subcision: 35% improvement, subcision + tretinoin: 38%, daily tretinoin: 41%). Three patients had necrosis in the striae treated with subcision. Considering the reduced size of the sample, the subjectivity of the assessment, and the high complication rate, subcision was not recommended as a treatment option for cutaneous striae by this pioneering study, which suggested further investigation was needed to verify its findings.[21]

A study by Ash and others showed improvement of striae with the use of 20% glycolic acid combined with 0.05% tretinoin or 10% L-ascorbic acid. Ten patients with *striae alba* applied tretinoin + glycolic acid on half of a stria and glycolic acid + L-ascorbic acid on the other half for 12 weeks. The blind evaluation of results was performed after four and 12 weeks, using visual, profilometric, and histopathologic analysis. The study revealed that both variants improved the stretch marks' appearance. The patients' evaluation suggested an improvement of approximately 50% in both variants, with no statistically significant difference. Four surgeons evaluated the improvement through pictures and found no statistically significant difference. The profilometric method presented a tendency to normalization, converging towards the parameters of normal skin. The digitalized histopathology's histogram assessed the percentage of elastin; the treatment containing tretinoin demonstrated an average increase in elastin of 107% compared to untreated areas, while L-ascorbic acid did not improve the papillary dermis' elastin. Nevertheless, both treatment variants induced alterations in the thickness of the epidermis and dermis. Seventy percent of patients reported mild irritation with both treatment variants. One patient had dermatitis that required the suspension of treatment for one week.[22]

Attempts to treat striae with trichloroacetic acid (TCA) at

concentrations of 35-50% have yielded mixed results and complications when applied to large areas. TCA could stimulate a fibroblastic reaction.

One study described the use of manual dermabrasion followed by the application of a patented 15% TCA occlusive cream (fatty acids, vitamin C, E and H, tretinoin precursors, algae and oligoelements – selenium, silicon, and methionine) for six to 24 hours. Patients (n = 69) of various phototypes were treated, and after an average of 4.2 treatments (range 1-8) there was improvement in 70% in the appearance of stretch marks, according to the physician's and patients' evaluations.[23]

The present study's objective was to histologically evaluate alterations in the skin with stretch marks after low-cost treatments of: 20% TCA only, subcision only, or subcision combined with 20% TCA. This study also investigates whether there are differences between these treatments and whether there is a correlation between the clinical and histopathologic improvements. A previous study by the same authors evaluated the response to the same clinical procedures, and demonstrated improvement in the width and length of striae.[24]

METHODS

A comparative, experimental, prospective and longitudinal study including 11 patients previously evaluated at the general dermatology outpatient clinic of the Hospital de Clínicas - Curitiba (PR), Brazil was carried out.

The study included females aged 18 or older with striae located in the lower abdomen, with no history of previous treatment. Exclusion criteria included: history of hypertrophic scars or keloids, use of topical or systemic medication during the previous year, pregnancy, and an inability to understand or follow the course of the treatment. All signed a term of informed consent, and the study was approved by the institution's ethics committee.

The patients' lower abdomens were divided into four quadrants, with the navel considered the upper limit. Each quadrant was 10 cm long by 5 cm wide.

A stria from each quadrant was selected to undergo one of four procedures:

1. Subcision only: the area was cleansed with 70% alcohol and the stria's periphery was marked and anesthetized with 2% lidocaine with epinephrine. A BD Nokor 18 G needle was then inserted up until the deep dermis, and moved forward and backward until dissection of the plane was achieved without resistance.

2. Subcision + 20% TCA: the area was cleansed with 70% alcohol and the stria's periphery was marked and anesthetized with 2% lidocaine with epinephrine. The subcision was performed according to the technique described above, and 25% TCA was applied on the stria in two passes with a cotton swab.

3. TCA (20%) only: the area was cleansed with 70% alcohol and the stria's periphery was marked. The 20% TCA was applied on the stria in two passes with a cotton swab.

4. Control stria: did not receive treatment.

Each stria selected for the study was biopsied before and 12 weeks after the single treatment session. In the control quadrant (not treated) a normal skin biopsy was performed for comparison purposes.

The analysis of the histologic sections was performed by a senior dermatologist, a dermatologist specializing in dermatologic surgery, and a dermatology resident. The slides underwent blind evaluations simultaneously, and the evaluators were unaware of whether the material contained on each slide was collected before or after the procedure.

Regarding the statistical methodology, a quantitative scale was established for measuring the evaluators' observations. Following this recoding, the average ratings for each patient were calculated to formulate a reliable index. Next, the descriptive statistical analysis of the indices was computed (mean, median, minimum, maximum, and standard deviations). Given that the data did not present normal distribution, the Wilcoxon nonparametric test was used to detect the presence of significant effects for each treatment. The effect (post-pre) index was used to compare the treatments. The nonparametric Kruskal-Wallis test was applied at a significance level of 5%.

RESULTS

Eleven female patients with Fitzpatrick phototypes II-IV (20-48 years old, mean 30.6), with untreated pregnancy striae in the lower abdomen, were included. Ten patients had *striae alba*, and one, *striae nigra*. One stria was classified as having severe intensity; seven as moderate intensity, and three as mild intensity. The duration of the striae ranged from eight to 480 months (mean = 153.1 months). One patient did not complete the study due to a loss of the follow-up, while another underwent laparoscopic surgery for an ovarian cyst during the study, yet still concluded the study.

The results from hematoxycilin and eosin (HE) staining showed that there was a reduction of the mean value in the epidermis at the post-procedure time point compared to the pre-procedure time point in all treatments. Notwithstanding, a significant effect was found only in the treatment with isolated 20% TCA (Table 1). The same results were found in the evaluation of the superficial dermis for all treatments, however a significant effect was found only in the treatment with isolated subcision (Table 2). As for the comparative evaluation of the reticular dermis, there was a reduction of the mean values at the post-procedure time point compared to the pre-procedure time point in all treatments, yet none of the treatments presented a significant effect (Table 3). Therefore, treatment with isolated 20% TCA presented statistically significant effects for the epidermal parameter, whereas in the superficial dermis evaluation, only the isolated subcision treatment was statistically significant. When both techniques were combined, those results were not sustained.

The color of the elastic fibers was also evaluated, with results clearly showing alterations after the combined subcision plus 20% TCA treatment. Nevertheless, there were no significant effects in any of the treatments (Table 4).

In the overall assessment with the staining of collagen fibers, the three treatments again presented a reduction in the

Table 1: Wilcoxon test – presence of significant effects in treatment with isolated 20% TCA (p = 0.0346)

Treatment	n	T	p- value
Subcision	9	6	0,17631
20% TCA + subcision	10	7	0,46308
20% TCA	9	1,5	0,03462

Evaluation of effects in the epidermis before and after treatment

Table 2: Wilcoxon test – presence of significant effects in treatment with isolated subcision (p = 0.011) and 20% TCA + subcision (p = 0.0007)

Treatment	n	T	p- value
Subcision	9	0	0,01172
20% TCA + subcision	10	1	0,00691
20% TCA	9	5	0,24887

Evaluation of effects in the superficial dermis before and after treatment

Table 3: Teste de Wilcoxon - não existe efeito significativo nos tratamentos propostos na derme reticular.

Treatment	n	T	p- value
Subcision	9	4,5	0,05872
20% TCA + subcision	10	9,5	0,12354
20% TCA	10	25	0,79886

Evaluation of effects in the reticular dermis before and after treatment

Table 4: Teste de Wilcoxon - não existe efeito significativo para as fibras elásticas nos tratamentos propostos

Treatment	n	T	p- value
Subcision	9	17,5	0,94418
20% TCA + subcision	10	18	0,59395
20% TCA	10	11,5	0,36273

Evaluation of effects in the elastic fibers before and after treatment

Table 5: Wilcoxon test – proposed treatments' absence of significant effects in the collagen fibers

Treatment	n	T	p- value
Subcision	9	6	0,09290
20% TCA + subcision	10	15	0,67442
20% TCA	10	4,5	0,03297

Evaluation of effects in the collagen fibers before and after treatment

Table 6: Kruskal-Wallis test – absence of significant effects between treatments in the epidermis, superficial dermis, and reticular dermis

	Epidermis	
Treatment	**n**	**Sum of ranks**
Subcision	9	119
20% TCA + subcision	10	166,5
20% TCA	9	120,5
	According to the Kruskal-Wallis test, there is no significant difference between treatments (p = 0.577)	
	Superficial dermis	
Treatment	**n**	**Sum of ranks**
Subcision	9	99,5
20% TCA + subcision	10	135,5
20% TCA	9	171
	According to the Kruskal-Wallis test, there is no significant difference between treatments (p = 0.104)	
	Reticular dermis	
Treatment	**n**	**Sum of ranks**
Subcision	9	125,5
20% TCA + subcision	10	133
20% TCA	10	176,5
	According to the Kruskal-Wallis test, there is no significant difference between treatments (p = 0.104). no significant difference between the treatments (p = 0.464)	

Comparison between the treatments in the epidermis, superficial dermis, and reticular dermis

mean value at the post-treatment time point compared to the pre-treatment time point, however a significant effect was observed only with treatment with 20% TCA (Table 5).

The Kruskal-Wallis test was used to compare the differences between treatments. Evaluations of the epidermis, dermis, and superficial reticular dermis (in HE staining), and elastic and collagen fibers did not show significant differences between the treatments (Tables 6-8).

DISCUSSION

There are few publications on cutaneous striae; some assess their pathophysiology and others relate to therapeutics. In the first group, more emphasis is given to only one of the factors associated with the appearance of stretch marks (the mechanical factor). Although stretch marks are disfiguring aesthetic dermatologic alterations, they are innocuous, so there are restrictions on obtaining material for biopsies in more comprehensive studies – particularly in recent stretch marks and in comparative studies with healthy skin.[4] Perhaps this difficulty explains the lack of systematic studies on the subject.

Many treatments have been proposed in the literature, however the vast majority relies on individual case studies or evaluations of a small number of patients, without pre- and post-treatment comparative biopsies. Those studies' photographic assessments have subjective bias and lack defined standardization criteria. Deficiency can also be found in the comparative histological evaluation of pre- and post-treatment time points, with the absence of standardized and objective methods to evaluate elastic and collagen fibers.

In the work of Perez, who describes the treatment of striae

Table 7: Kruskal-Wallis test – absence of significant effects between treatments in the elastic fibers

Treatment	n	Sum of ranks
Subcision	9	140
20% TCA + subcision	10	160,5
20% TCA	10	134,5

Comparison between the treatments in the elastic fibers

Table 8: Kruskal-Wallis test – absence of significant effects between the treatments in the collagen fibers

Treatment	n	Sum of ranks
Subcision	9	117,5
20% TCA + subcision	10	167,5
20% TCA	10	150

Comparison between the treatments in the collagen fibers

with IPL, all patients showed an increased thickness of the epidermis and dermis, a decrease in collagen damage, and an absence of statistically significant alterations in elastic fibers.[16]

The results obtained from the histological evaluation in the present study were more specific. The epidermis showed improvement, especially when treated with TCA. This result is aligned with the fact that 20% TCA promotes the superficial exfoliation of lesioned skin by increasing the epidermis' thickness, forming new epidermal cones, and improving the epidermis' overall texture.

In the superficial dermis, the best result was obtained with the isolated subcision and subcision + 20% TCA treatments, when there was formation and reorganization of new elastic fibers, which became perpendicular to the epidermis. This effect occurs through the formation of hematomas following the procedure and the initiation of the healing process, with the release of inflammatory mediators that trigger the production of new elastic fibers in the extracellular matrix's cells.

In the reticular dermis, however, similar results could not be verified. It seems, though, that what is likely taking place in that area is the late synthesis of thicker elastic fibers parallel to the epidermal axis – a typical characteristic of this portion of the skin. Since the post-procedure biopsies were performed 12 weeks after each treatment, those elastic fibers would not be mature – and visible – at the time of the specific stainings.

Nonetheless, Ash and others compared glycolic acid to tretinoin or L-ascorbic acid for treating stretch marks, and demonstrated through histopathology a great increase of elastin in the papillary dermis using tretinoin.[22]

Although statistically insignificant, treatment with 20% TCA plus subcision presented a clear improvement in the global evaluation of elastic fibers in the present study. Both the 20% TCA and the subcision promoted superficial cutaneous inflammation and the stimulus for new elastic scar tissue formation.

In the overall evaluation of collagen fibers, there was a statistically significant improvement with the use of isolated 20% TCA because at this concentration, TCA promotes the induction of the skin's fibroblastic response. Despite the responses obtained in individual treatments, those results were not observed in the comparative analysis of those treatments. Evaluations of the epidermis, dermis, and superficial reticular dermis with HE staining and elastic and collagen fibers did not show a significant difference between the treatments.

CONCLUSION

This study found that 20% TCA, in isolation or combined with subcision, can be used to treat stretch marks. From a histological point of view, there was a proven alteration of the skin following all described procedures, however results were statistically significant when 20% TCA was used in isolation for improving the epidermis and the subcision was used alone for improving the superficial dermis. None of the treatments was found to be superior to the others. It is important to note that only one session of each treatment was carried out, raising the possibility that clinical and histological improvements might take place with a greater number of sessions. The proposed treatments are cost effective and proven to be safe. ●

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