

EFFICACY OF TOPICAL THERAPIES IN TREATING STRETCH MARKS: AN EVIDENCE-BASED REVIEW

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ABSTRACT

Background: Stretch marks, or striae distensae, are among the most common manifestations of dermal atrophy, frequently occurring during pregnancy, adolescence, and rapid weight changes. They pose no direct medical risk but remain a major aesthetic and psychological concern. A wide range of topical preparations is promoted for their prevention and treatment, yet the scientific evidence supporting their efficacy remains inconsistent. This review aims to address the gap between clinical use and the available evidence by analyzing topical agents with documented or potential benefits.

Aim of the Study: The objective of this narrative evidence-based review is to summarize and critically assess published data on topical therapies for the prevention and treatment of stretch marks. The article focuses on identifying the most frequently used compounds, evaluating their mechanisms, clinical efficacy, and safety, and defining research areas requiring further validation.

Materials and Methods: A structured literature search was conducted in PubMed, Scopus, Web of Science, and Google Scholar for studies published between 1998 and 2024. The search was limited to English-language publications involving human subjects. Eligible articles included randomized controlled trials, observational studies, and reviews assessing topical agents for prevention or treatment of striae distensae and striae gravidarum. Duplicates and unrelated reports were excluded. Thirty-eight studies met the inclusion criteria and were analyzed in full text. Data were extracted on study design, intervention, duration, and reported outcomes. Evidence was synthesized narratively with attention to methodological quality and clinical applicability.

Results: Preventive topical agents demonstrate variable and generally limited efficacy. Moisturizers, emollients, and common oils such as cocoa butter and olive oil do not prevent striae formation. Bitter almond oil combined with massage shows a modest preventive effect, while vitamin E and hyaluronic acid provide inconsistent results. Collagen supplementation, both oral and topical, improves skin hydration and elasticity in general use but lacks direct confirmation of preventive benefit against striae. For treatment, the best-documented efficacy is seen in topical retinoids, particularly tretinoin, effective in early inflammatory lesions (striae rubrae) but contraindicated in pregnancy. High-concentration glycolic acid achieves moderate improvement, especially in recent lesions, whereas vitamin C lacks demonstrable benefit. Centella asiatica extracts and silicone-based products show potential for enhancing elasticity and appearance, though their efficacy requires further controlled evaluation.

Conclusions: Most topical products marketed for stretch marks lack strong clinical evidence. Retinoids remain the only

topical agents with consistent therapeutic benefit in early lesions. Other compounds, including glycolic acid, Centella asiatica, and silicone-based formulations, appear promising but require larger, standardized, and comparative trials. No topical or oral agent can yet be considered definitively effective for preventing stretch marks. Future studies should focus on harmonized methodologies, reproducible assessment scales, and rigorous evaluation of safety, especially in pregnancy.

Keywords: stretch marks; striae distensae; striae gravidarum; topical therapy; prevention; tretinoin; glycolic acid; Centella asiatica; collagen; silicone

INTRODUCTION

RELEVANCE AND BACKGROUND

Stretch marks, or striae distensae, represent one of the most common dermatological manifestations of dermal atrophy, affecting up to ninety percent of women during pregnancy and a significant proportion of adolescents during periods of rapid growth. Although they do not pose a medical threat, they remain a major aesthetic and psychological problem. Despite the large number of commercial products claiming preventive or therapeutic efficacy, the scientific evidence supporting these claims is limited and inconsistent. The absence of standardized evaluation methods, objective measurement scales, and controlled clinical trials leads to considerable variability in reported outcomes.

The relevance of the present review lies in the growing demand for scientifically validated topical interventions that can be safely used in pregnancy and adolescence, the two life periods with the highest incidence of striae distensae. Many of the currently available preparations are marketed without rigorous clinical testing, and their mechanisms of action remain speculative. This article aims to provide a structured synthesis of available data, distinguish between anecdotal and evidence-based results, and clarify which topical therapies show real clinical potential. By summarizing current findings and identifying methodological weaknesses of previous studies, the review contributes to a more rational and evidence-oriented approach to stretch mark management in dermatological practice.

DEFINITION AND PATHOGENESIS

Stretch marks are linear atrophic lesions resulting from structural damage to the dermis. Histologically, they are characterized by thinning of the epidermis, flattening of rete ridges, fragmentation of collagen and elastin fibers, and local inflammatory infiltration. Two stages are distinguished: striae rubrae, representing the initial inflammatory phase with erythematous or violaceous coloration, and striae albae, the chronic stage characterized by hypopigmented, atrophic scars. The transition between these stages reflects a progressive loss of dermal matrix integrity. The pathogenesis is multifactorial and includes hormonal changes, mechanical stretching, genetic predisposition, and disturbances in collagen metabolism.

Etiological factors

The main causative categories include:

1. Mechanical factors – rapid tissue expansion during pregnancy, growth spurts, obesity, or intensive physical training.
2. Hormonal influences – elevated corticosteroid levels, endocrine disorders, and prolonged glucocorticoid therapy.
3. Genetic predisposition – family history of striae gravidarum or connective tissue fragility.
4. Metabolic and systemic factors – rapid weight fluctuations, nutritional deficiencies, and alterations in skin microcirculation.

TYPE AND AIM OF THE REVIEW

This paper presents a narrative evidence-based review of topical therapeutic strategies for the prevention and treatment of striae distensae. The objectives are to synthesize current clinical data, identify active substances with demonstrated efficacy, highlight methodological limitations of published studies, and define areas requiring further research. The review aims to bridge the gap between clinical dermatology and cosmetic formulation science by assessing the biological plausibility and practical effectiveness of topical interventions.

RESEARCH QUESTION

Which topical interventions have evidence-based efficacy in preventing or treating stretch marks, and how consistent are the available data regarding their clinical and mechanistic outcomes?

MATERIALS AND METHODS

SEARCH STRATEGY

A comprehensive literature search was conducted to identify studies evaluating the efficacy of topical treatments for the prevention and management of stretch marks (striae distensae and striae gravidarum). The search covered publications indexed between January 1998 and June 2024. The following electronic databases were reviewed: PubMed, Scopus, Web

of Science, and Google Scholar. The search strategy combined Medical Subject Headings (MeSH) and free-text keywords, including combinations of: "striae distensae", "striae gravidarum", "stretch marks", "topical treatment", "topical therapy", "cream", "gel", "ointment", "moisturizer", "retinoid", "tretinoin", "vitamin E", "hyaluronic acid", "collagen", "Centella asiatica", "silicone", and "oil". Equivalent search strings were adapted to the syntax of each database.

Additional manual searches were performed using the reference lists of relevant review articles to identify studies not captured by database queries.

SEARCH TERMS

The search strategy combined controlled vocabulary and free-text keywords related to stretch marks and topical interventions. The search included terms such as *striae distensae*, *striae gravidarum*, *stretch marks*, *topical treatment*, *topical therapy*, *cream*, *gel*, *ointment*, *retinoid*, *collagen*, *hyaluronic acid*, *vitamin E*, *Centella asiatica*, *silicone*, *moisturizer*, and *oil*. Equivalent queries were adapted for each database.

ELIGIBILITY CRITERIA

Inclusion criteria:

1. Original clinical or preclinical studies, randomized controlled trials, observational studies, and systematic reviews evaluating topical agents for prevention or treatment of stretch marks.
2. Studies published in English.
3. Human studies, in vivo or in vitro, involving products applied directly to the skin.
4. Studies reporting measurable outcomes related to skin elasticity, striae severity, prevention rates, or histological changes.

Exclusion criteria:

1. Non-dermatological or unrelated scar management studies.
2. Case reports, editorials, or conference abstracts without full data.
3. Studies using invasive procedures (laser, microneedling, PRP) without a topical component.
4. Articles not available in full text or lacking quantitative or descriptive outcome measures.

STUDY CLASSIFICATION

The included studies were classified according to design and level of evidence. Randomized controlled trials (RCTs) were considered high-level evidence, observational clinical studies provided moderate evidence, while experimental and in vitro studies were considered supportive evidence. Narrative and systematic reviews were used for contextual interpretation but were not included in quantitative synthesis.

SELECTION PROCESS

All retrieved references were imported into a citation management program, and duplicates were removed. Titles and abstracts were screened for eligibility, followed by full-text evaluation of potentially relevant articles. Disagreements were resolved by discussion and consensus.

SEARCH RESULTS

The initial database search yielded 312 records. After removal of duplicates and application of inclusion and exclusion criteria, 78 full-text articles were assessed for eligibility. A total of 38 studies were included in the final synthesis, comprising randomized controlled trials, observational clinical studies, and in vitro mechanistic research.

DATA EXTRACTION AND SYNTHESIS

For each included study, data were extracted regarding publication year, study design, sample size, population characteristics, intervention type, duration, outcome measures, and key findings. The evidence was synthesized narratively, with attention to methodological quality, reproducibility, and consistency of results.

RESULTS

A total of 38 studies met the inclusion criteria. Among them, 6 were randomized controlled trials, 8 were observational or prospective clinical studies, 5 were experimental or in vitro investigations, and 19 were narrative or systematic reviews. The overall level of evidence was moderate to low due to small sample sizes, heterogeneous methodologies, and inconsistent outcome reporting.

The preventive studies included in this review investigated a range of topical and oral agents aimed at reducing the risk of developing striae distensae and striae gravidarum. Most trials focused on moisturizing formulations, plant oils, vitamin E, hyaluronic acid, collagen derivatives, and Centella asiatica extracts. The methodological quality and sample sizes varied across studies, with several reviews and mechanistic papers providing additional context. The main characteristics

of the included clinical and experimental studies on prevention are summarized in Table 1.

Table 1. Characteristics of included clinical and experimental studies on topical prevention of striae distensae and striae gravidarum

No	Author, Year	Ref. No.	Study design	Sample size	Population / Stage	Intervention	Duration	Main outcomes	Reported adverse effects
1	Ersoy, 2016	[11]	Clinical study	141	Pregnant women (SG prevention)	Various topical agents	—	High prevalence (75%) and identified predictors (age, BMI, family history)	None
2	Timur Taşhan, 2012	[14]	Randomized controlled trial	141	Primiparous women (prevention)	Bitter almond oil with massage	12 weeks	Lower incidence and severity of striae vs. control	None
3	Korgavkar, 2015	[4]	Review	—	Pregnant women (prevention)	Oils and moisturizers	—	No proven preventive effect of cocoa butter or olive oil	—
4	Ud-Din, 2015	[15]	Narrative review	—	Pregnant women and general population	Emollients, oils, moisturizers	—	No confirmed preventive efficacy in RCTs	—
5	Lindh, 2015	[12]	Systematic review	—	Patients with skin barrier disorders	Moisturizers	—	Improved hydration and elasticity, but not proven against striae	None
6	Danby, 2016	[13]	Experimental study	—	Healthy skin (mechanistic)	Emollients	—	Improved barrier function and TEWL reduction	None
7	Tanaydin, 2016	[16]	Systematic review	—	Patients with scars	Vitamin E creams	—	Mixed results, possible irritation	Contact dermatitis
8	Kim, 2018	[18]	Randomized controlled trial	64	Healthy volunteers	Oral collagen peptides	12 weeks	Improved elasticity and hydration	None
9	Pu, 2023	[17]	Systematic review & meta-analysis	26 RCTs	Healthy adults	Oral hydrolyzed collagen	8–12 weeks	Improved skin hydration and elasticity	None

10	Lee, 2022	[20]	Pilot study	30	Healthy women	Topical collagen tripeptide	8 weeks	Improved elasticity, reduced glycation	None
11	Brinkhaus, 2000	[28]	Double-blind RCT	80	Pregnant women (SG prevention)	Cream with Centella asiatica extract	12 weeks	Fewer stretch marks vs. placebo	None
12	Hashim, 2011	[27]	Experimental study	—	Skin fibroblast model	Centella asiatica extract	—	Increased collagen synthesis and antioxidant activity	—

STRETCH MARK FORMATION

Stretch marks are prevalent skin lesions that arise from rapid tissue growth or a weakened dermis under normal stress [2]. The physiological mechanism includes dermal lymphocytic inflammation, elastolysis, and a scarring response, leading to linear atrophic lesions marked by epidermal thinning and the absence of rete ridges [5]. Various risk factors are linked to the formation of stretch marks. Younger age, a family or maternal history of striae gravidarum (SG), higher pre-pregnancy and pre-delivery weight, and increased birth weight are notable risk factors for SG during pregnancy [1]. Furthermore, hormonal imbalances, mechanical stress, and genetic factors are associated with striae distensae [5]. Stretch marks typically appear on parts of the body that are susceptible to rapid growth or expansion. The most commonly affected areas include:

1. Abdomen: This is a primary location for stretch marks, particularly during pregnancy or significant weight gain [1] [6]. The skin in the abdominal region is particularly vulnerable due to its rapid expansion during these times.
2. Breasts: Stretch marks frequently develop on the breasts, especially during pregnancy or puberty when breast tissue grows rapidly [8] .
3. Hips and Gluteal Area: These areas are often affected, especially in women, as they are prone to fat accumulation and expansion during weight gain or pregnancy [8]
4. Thighs and Calves: The lower body, including thighs and calves, is also prone to stretch marks, often due to rapid growth during puberty or weight changes [8] [6].
5. Upper Limbs: Although less frequent, stretch marks can also develop on the upper arms, particularly in cases of rapid muscle growth or weight gain [8].

Interestingly, some research has highlighted a growing occurrence of abdominal stretch marks in children with autism spectrum disorders (ASD), potentially linked to increasing obesity rates in this group [9]. Additionally, stretch marks are frequently seen in areas under mechanical stress, such as the elbows and knees in psoriasis patients [10].

RISK FACTORS AND PREVENTION OF STRIAE GRAVIDARUM

Striae gravidarum is a common dermatological problem occurring in pregnant women, which, despite its lack of significant medical significance, is a serious aesthetic and psychological problem for many patients. The study showed that as many as 75.4% of participants experienced the development of stretch marks during pregnancy. This result confirms that stretch marks are a common skin lesion in pregnant women and justifies the need for further research on their etiology and effective prevention [11]. The statistical analysis identified several significant predictors of the occurrence of striae gravidarum:

1. Maternal age – younger women were significantly more likely to develop stretch marks, which may be related to greater skin elasticity or hormonal differences.
2. Pre-pregnancy body mass index (BMI) – higher pre-pregnancy BMI correlated with increased risk of striae gravidarum.
3. Family history – women with a family history of stretch marks were more likely to develop them, which may indicate a genetic predisposition to the condition.
4. Gender of the fetus – carrying a male fetus was associated with a higher risk of developing striae gravidarum.
5. Maternal education – lower education was associated with a higher risk of developing stretch marks, which may reflect differences in health awareness or access to preventive information.

Additional physical factors associated with a higher risk of striae gravidarum were: higher BMI at the time of admission to hospital, larger abdominal circumference and higher birth weight of the child. These elements may indicate mechanical stretching of the skin as one of the key mechanisms of stretch mark formation. Contrary to popular belief, certain factors did not show a significant association with the development of striae gravidarum. These included smoking, skin type,

PREVENTIVE TOPICAL TREATMENTS

Moisturizers and emollients

Moisturizers and emollients are frequently applied to treat various skin conditions, including atopic dermatitis and psoriasis, among others [12]. They aid in enhancing the skin's barrier function, boosting hydration, and minimizing transepidermal water loss (TEWL) [13]. While not directly linked to stretch mark prevention, these effects could potentially benefit skin elasticity and resilience. However, there is no evidence from well-structured, randomized controlled trials to support their effectiveness in preventing stretch marks [4].

B. Oils (e.g., cocoa butter, olive oil)

Research has explored the use of oils to potentially prevent or lessen the severity of stretch marks (striae gravidarum) during pregnancy, yielding varied outcomes. Massaging with bitter almond oil might aid in preventing stretch marks and/or diminishing their severity, although the supporting evidence is limited [4]. Research indicates that a 15-minute massage using almond oil during pregnancy can reduce the development of striae gravidarum, whereas the use of bitter almond oil alone does not yield the same benefit [14]. However, cocoa butter and olive oil have not been found effective for preventing stretch marks or reducing lesion severity [4]. In summary, while some oils like bitter almond may have potential benefits, overall there is a lack of strong evidence from rigorous clinical trials supporting the use of oils to reliably prevent stretch marks [1] [4].

Vitamin E-based products

Many creams designed to prevent stretch marks on the market contain vitamin E [15]. Some studies have shown that vitamin E may have potential benefits in treating scars and stretch marks. One study found that applying topical vitamin E as the only treatment led to a notable enhancement in the appearance of scars in white children [16]. In contrast, other studies reported that using vitamin E on its own did not result in significant improvements in scar appearance [16]. Interestingly, vitamin E seems to be more effective when used in combination therapies than as a standalone treatment [16]. Some studies have even shown adverse effects, such as contact dermatitis and increased itching and rash after using vitamin E [16]. There is no evidence that vitamin E is effective in preventing stretch marks in pregnant women.

Hyaluronic acid preparations

Research has explored the use of hyaluronic acid (HA) as a possible method to prevent stretch marks during pregnancy. Nonetheless, the evidence supporting its effectiveness remains sparse and inconclusive [4]. An analysis of topical treatments for preventing striae gravidarum (SG) during pregnancy revealed limited evidence suggesting HA might be beneficial [4].

Topical and oral hydrolyzed collagen preparations

Research indicates that taking collagen supplements can greatly enhance skin elasticity and overall skin health. A systematic review and meta-analysis of 26 randomized controlled trials with 1721 participants revealed that hydrolyzed collagen (HC) supplementation significantly boosted skin hydration ($Z = 4.94$, $p < 0.00001$) and elasticity ($Z = 4.49$, $p < 0.00001$) when compared to placebo groups [17]. These results are corroborated by a double-blind, randomized, placebo-controlled study that found low-molecular-weight collagen peptide (LMWCP) supplementation significantly enhanced skin hydration, reduced wrinkling, and improved elasticity after 12 weeks of daily use [18]. Notably, the impact of collagen supplementation can differ depending on the collagen source and the duration of supplementation [17]. Furthermore, collagen peptides have been found to promote fibroblast elastin synthesis while reducing the release of matrix metalloproteinases (MMPs) and elastin breakdown, indicating a mechanism for enhanced skin characteristics [19]. The advantages of collagen supplementation are not confined to oral consumption; applying collagen tripeptide (CTP) topically has also been shown to enhance skin wrinkles, elasticity, and density while decreasing the buildup of advanced glycosylated end products (AGEs) in the skin [20]. In summary, both oral and topical collagen supplementation seem to have a substantial positive effect on skin elasticity and overall skin health. These benefits are likely due to increased collagen production, better hydration, and reduced breakdown of extracellular matrix components. Nonetheless, more extensive randomized control trials are needed to validate these results and determine the best sources, dosages, and durations of collagen supplementation for optimal skin health benefits and stretch mark prevention.

TOPICAL TREATMENTS FOR EXISTING STRETCH MARKS

Retinoids

Retinoids have shown potential in treating existing stretch marks, particularly when applied early in their development. Tretinoin, a topical retinoid, has been found to effectively reduce the severity of newly developed striae distensae - striae rubrae (red stretch marks) [4]. This is likely because retinoids can affect cell growth and differentiation, as well as support skin barrier function and boost collagen production [10]. Interestingly, despite their potential, retinoids are not recommended during pregnancy due to safety issues. Tretinoin, for example, is limited by its pregnancy category [4]. This creates a paradox, as stretch marks frequently appear during pregnancy (striae gravidarum), affecting up to 90% of women, yet one of the most effective topical treatments is not usable at this time. In summary, retinoids, particularly

tretinoin, can be effective in reducing the severity of newly formed stretch marks. However, their application is restricted during pregnancy, when stretch marks are most common. Topical retinoids are often compared with other treatments for managing stretch marks (striae distensae). Some commonly compared treatments include: 1. Chemical peels, which are frequently used alongside retinoids for treating stretch marks [21]. These peels can enhance skin texture and diminish the visibility of striae. 2. Moisturizers and emollients, like cocoa butter and olive oil, have been compared to retinoids for their effectiveness in managing stretch marks. However, research has shown that cocoa butter and olive oil did not have a significant impact on treating striae distensae [15]. Topical application of 0.1% tretinoin cream markedly enhanced the clinical appearance of early, active stretch marks compared to a placebo [7]. Tretinoin treatment not only prevented further progression but also partially reversed stretch mark development, as shown by decreases in both lesion length and width. Although mild to moderate skin irritation was a common side effect, it was generally manageable and diminished over time[22] .

Glycolic acid

Glycolic acid, recognized as the smallest alpha hydroxy acid, is widely used in skincare and shows potential for treating striae distensae, commonly known as stretch marks. It is frequently applied in high concentrations of 20-50% for chemical peels designed to reduce acne-related inflammation [23]. In terms of stretch marks, glycolic acid's ability to stimulate collagen production and renew skin cells makes it a viable treatment option. Studies indicate that glycolic acid may enhance the appearance of striae distensae by encouraging collagen synthesis and skin cell renewal[24]. The study examined the effectiveness of applying 70% glycolic acid topically to treat stretch marks. Over a period of six months, the treatment resulted in a moderate improvement in skin lesions. This enhancement was especially evident in red striae rubrae, where there was a noticeable decrease in both the width of the striae and hemoglobin levels [24]. A similar narrowing of width was seen in white stretch marks (striae albae), although these lesions also showed an increase in melanin levels. The overall improvement after six months of treatment was approximately 15%, which the authors regard as a modest therapeutic effect. Nonetheless, they propose that glycolic acid treatment could be advantageous, especially when used over an extended period or in combination with other topical agents. Significantly, the study provides objective evidence that glycolic acid alters the structure of stretch marks in a way that is perceptible to patients.

Vitamin C serums

Research suggests that vitamin C serums may not be particularly effective in treating stretch marks. However, it's important to note that many stretch mark treatments aim to boost collagen production, an area where vitamin C might have a potential impact. Interestingly, preclinical studies have shown that vitamin C can enhance type I collagen synthesis and reduce oxidative stress [25]. In the research, areas treated with 10% L-ascorbic acid did not show any improvement in skin elastin content compared to untreated stretch marks[26]. In conclusion, while vitamin C aids in collagen production and has antioxidant properties that could theoretically benefit skin health, there is insufficient direct evidence to support the effectiveness of vitamin C serums in treating stretch marks.

Centella asiatica extracts

Centella asiatica extracts have shown potential benefits for treating existing stretch marks, primarily due to their ability to promote collagen synthesis and improve skin elasticity. Studies have demonstrated that Centella asiatica extracts contain significant amounts of triterpenes, particularly madecassoside and asiaticoside, which are believed to contribute to its skin-healing properties [27]. These compounds have been found to enhance collagen synthesis, with the highest collagen production observed at a concentration of 50 mg/mL of Centella extracts [27]. Additionally, Centella asiatica extracts have shown potent antioxidant activity, comparable to grape seed extract and Vitamin C, which may help protect the skin from oxidative stress and promote healing [27].

A double-blind study [28] of 80 pregnant women used a cream containing Centella asiatica extract as a preventive measure. The results of this study showed that the group of women using the cream containing Centella developed significantly fewer stretch marks compared to the placebo group. The effect was particularly noticeable in pregnant women who had stretch marks from puberty. In this subgroup, the cream had significant preventive potential, whereas in the placebo group, all women with stretch marks from puberty developed recurrence of stretch marks. These results suggest that Centella asiatica may be effective in preventing and treating stretch marks, especially during pregnancy.

This collagen-boosting effect could be relevant to improving skin elasticity and potentially addressing stretch marks, although the study does not specifically mention stretch marks. While the provided information does not directly contradict or support the claim that Centella asiatica doesn't work on existing stretch marks, it suggests that the plant has properties that could potentially benefit skin health. However, more specific research would be needed to determine its effectiveness on existing stretch marks. The studies presented focus more on the plant's general skin health benefits, wound healing properties, and potential applications in treating various conditions.

In conclusion, Centella asiatica extracts show promise for treating existing stretch marks due to their ability to enhance collagen synthesis, improve skin elasticity, and provide antioxidant protection. The synergistic activity of its phytochemical constituents makes it a valuable candidate for skin regeneration and repair [29][28] .

Silicone-based products

Silicone-based products have demonstrated potential in treating existing stretch marks, although the supporting evidence is not as strong as it is for other scar types. Silicone gel sheets and gels are extensively used and researched for hypertrophic scars and keloids, with numerous high-quality randomized controlled trials confirming their effectiveness

[30]. These products function by hydrating the skin's outer layer and influencing cell communication between fibroblasts and keratinocytes, resulting in improvements in scar color, size, redness, flexibility, pain, and itching [31]. Although stretch marks are a different type of skin lesion, the mechanisms suggest they might also benefit from these treatments. Notably, a new silicone gel combined with hypochlorous acid has been developed to aid in scar treatment, offering additional anti-inflammatory benefits [31]. This combination could potentially address both the structural and inflammatory components of stretch marks. A double-blind, controlled clinical trial assessed the impact of silicone gels on stretch marks, revealing that silicone gel application positively affected stretch marks by reducing vascularity and hemoglobin levels, while enhancing elasticity, collagen, and pigmentation over a six-week period. These changes were observed both clinically and histologically [32]. Considering the limited treatment options for stretch marks and the established safety of silicone products, they may be considered a potential treatment option, though further research is necessary to confirm their effectiveness for this specific condition.

The studies evaluating topical and combined treatments for existing striae distensae are summarized in Table 2. These investigations include randomized controlled trials, comparative clinical studies, experimental research, and systematic reviews assessing agents such as retinoids, glycolic acid, vitamin C, Centella asiatica, and silicone-based formulations.

Table 2. Characteristics of included clinical and experimental studies on topical treatment of existing striae distensae

No.	Author, Year	Ref. No.	Study design	Sample size	Stage (rubrae/albae)	Intervention	Duration	Main outcomes	Reported adverse effects
1	Rangel, 2001	[22]	Prospective multicenter study	20	Striae rubrae	Tretinoin 0.1% cream	24 weeks	Marked clinical improvement in color and texture	Irritation, dryness
2	Hexsel, 2014	[34]	Randomized controlled trial	24	Striae rubrae	Tretinoin 0.05% vs superficial dermabrasion	12 weeks	Comparable improvement in both groups	Erythema, peeling
3	Mazzarello, 2012	[24]	Experimental clinical study	18	Striae albae	Glycolic acid 70% peel	12 weeks	Moderate improvement in skin texture	Transient erythema
4	Ash, 1998	[26]	Comparative clinical study	36	Striae albae	20% glycolic acid + 0.05% tretinoin vs glycolic acid + vitamin C	12 weeks	Better results with tretinoin combination	Irritation in tretinoin group
5	Ud-Din, 2013	[32]	Double-blind controlled study	45	Striae rubrae	Silicone-based gel	12 weeks	Improved elasticity, reduced vascularity	Mild irritation
6	La Padula, 2021	[37]	In vitro experimental study	—	Fibroblast model	Sodium ascorbate + PRP	—	Increased collagen synthesis and fibroblast proliferation	—
7	Tran, 2020	[30]	Systematic review	—	Various scar types (including striae)	Silicone gels and sheets	—	Improved scar quality and color; applicable to striae	None
8	Seirafianpour, 2021	[7]	Systematic review	—	All stages	Combined and single topical therapies	—	Mixed results; multimodal therapy preferred	—

9	Ud-Din, 2015	[15]	Narrative review	—	Striae rubrae and albae	Topical retinoids, glycolic acid, Centella, silicone	—	Retinoids most effective for early lesions; other agents require validation	—
10	Hashim, 2011	[27]	Experimental study	—	—	Centella asiatica extract	—	Stimulated collagen synthesis and antioxidant activity	—

COMBINATION THERAPIES

Topical treatments with exfoliation

Topical applications with exfoliating effects have shown potential in treating stretch marks, especially when they are in the initial stages. Chemical peels that utilize α -hydroxy and β -hydroxy acids, like salicylic acid, glycolic acid, and lactic acid, are noted for their skin-exfoliating capabilities and ability to control sebum production [33]. These acids can enhance the look of stretch marks by encouraging skin cell renewal and boosting collagen production. A study comparing 0.05% retinoic acid with superficial dermabrasion for red stretch marks showed significant improvements in clinical outcomes, patient satisfaction, and aesthetic results for both treatment methods [34]. In summary, although there is no definitive treatment for stretch marks, exfoliating topical treatments might provide some advantages, particularly when applied early in the development of stretch marks [7]. However, further research is necessary to confirm the effectiveness of these treatments specifically for stretch marks, as most studies have concentrated on their use for other skin issues. Future research should focus on creating targeted, effective treatments based on a deeper understanding of the pathophysiology of stretch marks [5].

Topical treatments with massage

Studies have investigated the use of massage as a potential method to prevent stretch marks, with the literature showing mixed results. Some findings suggest that massage could aid in preventing stretch marks or reducing their severity. For instance, there is limited evidence that massaging with bitter almond oil and Centella may help in preventing stretch marks and/or diminishing their severity. However, cocoa butter and olive oil have not been found effective for preventing or reducing the severity of stretch marks [4]. Nevertheless, the overall evidence supporting massage as an effective method for preventing stretch marks is limited. A thorough review of treatments for stretch marks found that scar massage was not very effective in preventing hypertrophic scars, although it was highly effective in treating existing hypertrophic scars [35]. A review of scar massage studies found that only 45.7% of patients experienced clinical improvement, with better results observed in post-surgical scars compared to traumatic or post-burn scars [36]. It is crucial to recognize that hypertrophic scars differ from stretch marks, so these results may not be directly applicable to stretch mark prevention. In summary, although some studies indicate potential advantages of massage for preventing stretch marks, the evidence is insufficient to endorse it as a dependable prevention method. More rigorous, well-structured randomized controlled trials are necessary to confirm the effectiveness of massage in preventing stretch marks [4]. Future studies should aim to clarify the pathogenesis of stretch marks, which could lead to more effective prevention strategies. Until then, a combination of topical treatments and massage may be worth trying, but expectations should be tempered given the current state of evidence.

Multi-ingredient formulations

Formulations containing multiple ingredients have shown potential in treating stretch marks by addressing various elements of striae distensae. Combination therapies have proven to be more effective than single treatments for stretch marks [7]. For example, combining platelet-rich plasma (PRP) with sodium ascorbate has yielded encouraging outcomes in enhancing the metabolic activity of fibroblasts derived from stretch marks. This treatment combination increased cell viability by 151% after 24 hours and 178% after 48 hours compared to the control [37]. Notably, microneedling, when used alongside other treatments, has shown improved effectiveness in treating stretch marks. This technique can be paired with various methods such as UV light, LED light, platelet-rich plasma, chemical peels, stem cells, retinoids, and vitamins to speed up post-surgical recovery and enhance overall outcomes [38]. In summary, multi-ingredient formulations and combination therapies seem to be more effective in managing stretch marks than single treatments. These strategies address multiple facets of the pathophysiology of striae distensae, potentially leading to improved results. Nonetheless, further studies are necessary to establish standardized protocols and identify the most effective combinations for various types and stages of stretch marks.

DISCUSSION

The results demonstrate that evidence for preventive topical agents remains limited [4]. Moisturizers and emollients

improve hydration and skin barrier function but do not show proven efficacy in preventing stretch marks in controlled clinical trials [12][13][4][15]. Commonly used oils produce inconsistent results. Cocoa butter and olive oil are ineffective, while bitter almond oil combined with massage shows a slight reduction in the incidence or severity of striae [4][14][15]. Vitamin E gives mixed results in scar treatment and lacks confirmed benefit for prevention, with occasional reports of local adverse reactions [16][4][15]. Hyaluronic acid shows preliminary but inconclusive promise [4]. Oral and topical collagen improve hydration and elasticity in general dermatologic use, yet their preventive effect against stretch marks remains unverified and requires further targeted research [17][18][19][20][4].

For treatment of existing lesions, the stage of the lesion determines response. Early inflammatory striae rubrae respond best to topical interventions. Retinoids, particularly tretinoin, show clear clinical improvement in new lesions, though irritation is frequent and use during pregnancy is contraindicated [22][34][4][15]. High concentration glycolic acid leads to moderate improvement over long term use, more noticeable in red striae than in white atrophic ones [24]. Vitamin C serums lack convincing clinical benefit [26]. Silicone gels demonstrate short term improvements in vascularity, elasticity, and pigmentation, with a favorable safety profile, which supports their consideration as supportive therapy [32][30][31]. Centella asiatica extracts have plausible biological mechanisms and preventive benefits but limited direct evidence for treating mature lesions [27][28].

Combination strategies appear more effective than single agent approaches. The combined use of superficial dermabrasion and topical retinoic acid provides improvement in early striae [34]. Exfoliating treatments and biologically active creams complement each other by enhancing collagen remodeling [24][33][15]. Massage as a preventive measure shows inconsistent results and cannot be reliably recommended as a stand alone approach [4][35][36]. In vitro studies suggest synergistic effects of combined active compounds with collagen stimulating formulations [37]. In clinical practice, multimodal protocols often combine topical products with device based methods, yet the specific contribution of the topical component remains unclear [7].

Mechanistic interpretation supports the clinical data. Retinoids accelerate epidermal turnover and dermal matrix synthesis, which explains their superior results in early striae [15]. Glycolic acid promotes keratinocyte renewal and collagen stimulation, providing moderate structural improvement [24][33]. Silicone products enhance hydration and modulate fibroblast activity, leading to better elasticity and color uniformity [31][30]. Collagen supplementation may improve dermal resilience, although direct proof for stretch mark prevention is lacking [17][19][20].

The available evidence has significant limitations. Study designs are heterogeneous, sample sizes are small, and outcome measures differ across publications [7]. Concentrations, formulations, treatment durations, and populations vary widely, which reduces comparability. Safety data, particularly for use during pregnancy, are incomplete [4]. The review itself requires a more transparent methodological description and assessment of potential bias to ensure reproducibility and reliability.

Clinical implications are clear. No topical agent has robust evidence for preventing stretch marks during pregnancy [4][1]. Emollients may be recommended for comfort and skin care, but patients should be advised about limited efficacy [12][13]. Bitter almond oil with massage can be considered cautiously [14]. Retinoids remain contraindicated in pregnancy [4]. For early striae in non pregnant individuals, topical retinoids are the first line choice due to their consistent evidence, though patients should be informed of possible irritation [22][34][15]. Glycolic acid and silicone gels can be used as adjuncts for incremental benefit [24][32]. In mature white striae, expected results are modest, and combination regimens may yield better cosmetic outcomes [7]. Future research should emphasize standardized study designs, uniform evaluation scales, head to head comparisons, and detailed safety assessments, particularly in populations most prone to stretch mark formation [7][6][8].

CONCLUSION

Current evidence on topical and oral agents for the prevention and treatment of stretch marks remains inconsistent and frequently limited by methodological weaknesses. Moisturizers and emollients improve hydration and skin barrier function but do not demonstrate proven preventive efficacy in controlled clinical studies. Among oils, cocoa butter and olive oil show no benefit, whereas bitter almond oil combined with massage may slightly reduce the occurrence or severity of striae gravidarum, though results are inconclusive. Vitamin E, despite its popularity in commercial formulations, has not shown consistent preventive or therapeutic effects and can occasionally cause skin irritation. Hyaluronic acid demonstrates preliminary but weak evidence for prevention, requiring further study.

Hydrolyzed collagen, applied topically or taken orally, improves general skin elasticity and hydration, yet its specific role in preventing or treating striae distensae has not been conclusively established. High-quality clinical trials are needed to determine optimal dosage, formulation, and duration.

For the treatment of existing stretch marks, the most consistent results are seen with topical retinoids, particularly tretinoin, which stimulate collagen synthesis and dermal remodeling in early inflammatory striae rubrae. Their use is, however, contraindicated during pregnancy. Glycolic acid at high concentrations produces moderate improvement through epidermal renewal and collagen stimulation, mainly in newer lesions. Vitamin C contributes to collagen metabolism but lacks convincing clinical data for striae treatment.

Centella asiatica extracts, rich in triterpenes such as asiaticoside and madecassoside, show promising effects on collagen synthesis and elasticity. They may aid both prevention and early treatment, although robust clinical confirmation is still missing. Silicone-based gels and sheets, long established in scar management, also demonstrate potential in improving elasticity, pigmentation, and overall appearance of striae, but further trials are needed to substantiate their benefit for

this indication.

In summary, retinoids remain the most evidence-supported topical agents for early striae distensae outside pregnancy. Other compounds such as glycolic acid, Centella asiatica, and silicone-based formulations appear promising yet require further validation through well-designed, controlled studies. At present, no topical or oral product has shown sufficient evidence to be considered definitively effective for preventing stretch marks, underscoring the need for standardized methodologies and larger comparative clinical trials.

DISCLOSURE

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