Review

Microneedling: Is it still a good treatment for acne scars? A literature review (2020-2024)

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Abstract. *Background:* Acne is a highly prevalent condition that leads to both psychological distress and physical consequences, such as scarring. Several techniques have been used to treat acne scars, with microneedling (MN) being one of the most prominent methods. MN has been extensively studied for its efficacy and safety. *Aims:* To compare MN with other techniques for the treatment of acne scars. *Methods:* A literature review was conducted on PubMed using the terms "microneedling," "micro-needling," "percutaneous collagen induction," "cicatrix," "acne vulgaris," "acne," and "scar," focusing on articles published between 2020 and 2024. Relevant studies were selected after screening their title, abstract and full text. *Results:* Fifteen articles were selected, all of which assessed the efficacy and safety of MN in treating acne scars compared to other treatment modalities. The results consistently demonstrated that MN alone and combined with other techniques is a safe and effective option for improving acne scars. *Conclusion:* In this literature review, several techniques were shown to be effective in improving acne scars, including MN, chemical peels, laser therapy, radiofrequency, and platelet-rich plasma. MN is particularly noted for its safety in individuals with darker skin types, and is well-tolerated and effective for the treatment of acne scars. The studies suggest that combining multiple techniques to enhance skin texture yields better results than a monotherapy treatment.

Key words: Acne Vulgaris, Cicatrix, Percutaneous Collagen Induction

Introduction

Acne *vulgaris* is a highly prevalent condition, affecting over 80% of adolescents and 50% to 60% of women between 20-25 years old. This condition frequently results in bad scarring[1,2,3]. The pathogenesis of acne begins with an abnormal keratinization of the pilosebaceous duct, an increase in sebum production, bacterial colonization, and inflammatory and hormonal conditions of the skin[2]. While acne is rarely severe or life-threatening, it is estimated that 95% of individuals with acne develop scars due to inflammation and collagen damage[1].

The aesthetic consequences of this pathology can be relevant, with persisting scars and post-inflammatory hyperpigmentation, which can greatly impact the self-esteem of the affected individuals[1,3]. *Microneedling* (MN), a percutaneous collagen induction technique, can be applied to various dermatological conditions, including melasma, acne scars, fine lines, skin texture improvement, alopecia and pigmentation issues[1,4,5].

Given its minimally invasive nature, microneedling was anticipated to be widely utilized. However, it has been supplanted by other techniques. This review aimed to synthesize recent evidence-based literature to evaluate the efficacy and safety of microneedling compared to other treatments for acne scars, with the goal of addressing gaps in the existing literature and assessing its relevance in contemporary clinical practice.

Methodology

A literature search was conducted in PubMed using the keywords "microneedling," "micro needling," "percutaneous collagen induction," "cicatrix," "acne vulgaris," "acne," and "scars." The search was restricted to articles published between 2020 and 2024 written in English and included clinical trials and systematic reviews. The selection was made based on scientific relevance and currency. Relevant studies were identified through a rigorous screening process, which included the evaluation of titles, abstracts, and full-text articles. Duplicate data and articles that did not fall within the scope of the review were excluded. Following this methodology, fifteen articles were selected for review.

Discussion

A scar is a skin lesion that results from chemical, mechanical or thermal damage. The scarring process involves an inflammatory phase, followed by healing and remodeling. Scars can form after inflammatory skin conditions such as acne[2]. During acne healing, the abnormal production or breakdown of collagen can result in different types of scars, classified by their cause and time of onset[2]. There are three types of acne scars described:

- *IcePick* scars represent 60-70% of atrophic scars. These scars are deep and narrow, measuring less than 2mm in width. When viewed in a transverse section, they have a 'V' shape and can extend into the dermis and subcutaneous tissue. The skin appears as though it has been repeatedly punctured with a small, sharp object[2].
- *Boxcar* scars represent 15-20% of atrophic scars. These are round, wide, and superficial, resembling the letter 'U' when viewed in a transverse section, with very sharp borders[2].
- *Rolling* scars are the largest, reaching up to 5mm in width, and they represent 15-25% of all atrophic scars[2].

The effect of MN has been investigated across all types of scars, and it has been proven effective for all except Ice-Pick scars[6].

This technique creates multiple micro-channels in the dermis[7]. Following treatment, some genes associated with the production of collagen I, glycosaminoglycans, vascular endothelial growth factor (VEGF), fibroblast growth factor (FGF-7), epidermal growth factor (EGF), and transforming growth factor (TGF-beta) are overexpressed. Over a period of weeks to months, type III collagen is gradually replaced by type I collagen, which strengthens the epidermis. As a result, the appearance of wrinkles and scars is diminished. Presently, there are several MN devices available, including rollers, stamps, and pens. These devices vary in terms of the needle size, diameter, density, or material. Disposable needles are considered safer due to a lower risk of infection[6].

Demir G et al. used elastography to measure the mechanical properties of the skin following MN treatments in patients with acne scars and the results showed significant improvements in skin elasticity, suggesting that this technique aids in a deeper structural recovery of scarred skin[7].

A split-face comparative study, by El-Domyati et al., evaluated different MN penetration depths for treating acne scars. It was observed that deeper needle penetration led to scar improvement, but also slightly increased the risk of temporary side effects such as redness and swelling. The authors, similarly to Minutilli et al., emphasize the importance of adjusting needle depth based on scar type and the patient's skin tone to achieve better results and minimize complications[8, 9].

MN can be combined with drug delivery, enhancing the deeper penetration of therapeutic substances. De Souza LG et al. concluded this technique significantly improved the texture and appearance of scars, proving to be safe and well-tolerated by patients, with a quick recovery period[8,10].

Several studies have been conducted comparing microneedling as a monotherapy with its use in combination with other techniques.

In a meta-analysis by Shen et al., which compared twelve controlled clinical trials, six of these trials compared MN to laser treatments (control group), while the other six compared MN to other techniques, such as chemical peelings, radiofrequency (RF), fractional microplasma radiofrequency (FRF), topical tazarotene or plasma, for the treatment of acne scars[1]. Monotherapy

MN conducted better results than RF-MN[1]. This meta-analysis reported no case of abnormal scarring or infection following the MN technique. After all treatments, side effects such as swelling, erythema, post-inflammatory hyperpigmentation and pain were noted. However, no cases of post-inflammatory hyperpigmentation were reported after monotherapy with MN, indicating that this technique has a lower risk of this particular side effect[1]. Non-ablative laser therapy caused less pain than MN. On the other hand, ablative laser therapy induced more pain than MN[1]. Other reported side effects included crusting, pustule and vesicle formation and skin dehydration, though these were not directly associated with the MN technique[1].

Visible results were reported six weeks after starting MN monotherapy. Final results were observed after three months of treatment. However, studies indicated that skin quality continued to improve for up to twelve months. Although the number of microneedling sessions is tailored to the individual's skin quality and collagen levels, current literature suggests a minimum of three sessions, each spaced four weeks apart. Overall, this study demonstrated better outcomes with MN monotherapy rather than MN combined with RF[1].

Another meta-analysis, by Chilicka et al., gathered clinical trials of several techniques to treat acne scars. Regarding MN, El-Domyati et al. observed, over the course of three months, every two weeks, significant scar improvement and increased levels of collagen types I, III, and VII in ten individuals[2]. Tirmizi et al. studied fifty individuals with moderate to severe acne scars (scoring 3-4 on the Goodman and Baron quantitative global acne scar grading system). After three MN sessions over four weeks, there was a significant improvement in the scars, with the score dropping to 2 on the mentioned scale. Schoenberg et al. comprared monotherapy MN to MN combined with platelet-rich plasma (PRP) and concluded that results were better when both techniques were applied together. The authors concluded that laser, RF, MN and PRP are effective techniques to improve acne scars, and that combining these treatments yields even better results. Examples include MN combined with non-ablative 1540 nm laser and 20% trichloroacetic acid (TCA) peel, MN with PRP, and MN with 15% TCA peel. The choice of technique should always be tailored to the patient and their specific characteristics[2].

In another trial, by Ishfak et al., involving sixty individuals, the efficacy of microneedling (MN) was compared to a 35% glycolic acid peel. MN demonstrated significantly better results for treating atrophic scars. Most participants were between IV-VI on the Fitzpatrick scale. According to Cohen et al., chemical peels are associated with longer recovery times, depigmentation, abnormal scarring, and higher dissatisfaction rates compared to MN, particularly in individuals with higher phototypes. MN is considered safer because it preserves the cutaneous barrier, has a lower risk of infection, and generally offers a safer profile[3].

Regarding the risk of hyperpigmentation, MN is considered a better option compared to other minimally invasive techniques such as non-ablative laser. These can activate melanocytes through high temperature, causing a change in pigmentation[3].

Another trial compared monotherapy MN to MN combined with a 70% glycolic acid peel, demonstrating that the combined techniques were more effective in improving skin texture. In this study, the authors highlight that not all atrophic scars respond equally to the same treatments. In fact, a systematic review by Gozali et al. suggests chemical peelings for Ice-pick scars, MN for Rolling scars and a combination of both techniques for Boxcar scars[3].

Another systematic review by Sitohang et al. searched for cicatricial tissue reparation after MN or MN combined with another technique. Moreover, they evaluated the subjective improvement in skin texture and the MN adverse effects reported by individuals. Nine clinical trials were analyzed, demonstrating that MN is a well-tolerated technique for treating acne scars, comparable to Fractional RF Microneedling (FRF-MN) and to the Chemical Reconstruction of Skin Scars (CROSS) technique using 100% TCA. Authors suggest a bigger clinical trial should be performed, to guarantee the long-term cost-efficacy ratio[4].

Casabona et al. performed two MN sessions, with twenty micro-needling passages each session, with a four-week interval. The twenty-two individuals in the study experienced improvement in their acne scars. A small percentage of adverse effects were reported, such

as erythema and pain. The authors suggest that MN can be performed safely, and the depth of the needles should be individualized according to the scar type[5].

In a systematic review Juhasz and Cohen analyzed fifty-eight trials, comparing MN and FRF-MN to other techniques. These two techniques were more effective in improving acne scars, keloid scars, varicella scars, and others. The adverse effects were not significant, with the most common being pain and bleeding during the procedure. Nineteen of the gathered studies showed post-inflammatory hyperpigmentation with MN as well as with FRF-MN. A case of simplex herpes virus reactivation after MN, treated with oral valacyclovir was recorded. One of the individuals had an allergic reaction to the nickle present in the needles, treated with oral prednisolone and topical corticosteroids. In one trial, four out of fifty-eight individuals had an acne reactivation. Overall, MN showed a better penetration of topical products such as anesthetic, PRP or hyaluronic acid fillers[6].

In another trial, Sirithanabadeeku et al. tested three FRF-MN sessions in twenty-nine individuals with moderate to severe acne scars in Goodman and Baron's Scale. Not only did they achieve improvements in the scars, they also found a statistically diminished sebum production and sebaceous gland size[8]. Regarding FRF-MN adverse effects, most individuals had erythema. Less than a third of them reported pain, swelling, or a burning sensation, which disappeared within a week. Despite being reported as post-inflammatory hyperpigmentation, there was not a significant increase of melanin levels throughout the study[11].

Pakla-Misiur et al. performed a study which evaluated efficacy and quality of life after treating acne scars. There were one hundred and eighteen individuals in the trial, divided into three groups: one had monotherapy MN, other had monotherapy chemical peeling (of TCA acid, kojic acid and hydrogen peroxide) and the last group had both techniques combined. The combination of both techniques was more efficient when treating atrophic scars. Female individuals of all three groups reported improvements in their quality of life. On the other hand, only male individuals who were submitted to both techniques combined reported a better quality of life. Therefore, authors recommend both techniques combined to treat atrophic post-acne scars[12].

A systematic review by Nobari et al. compares the efficacy and safety of different needling techniques (RF-needling, meso-needling, and MN) with ablative fractional lasers (CO2 and erbium YAG) for the treatment of atrophic and hypertrophic scars. Results indicate both techniques are effective in reducing the appearance of scars. However, the type of scar - whether atrophic (depressed) or hypertrophic (raised) - can influence the choice of treatment. The authors suggest that lasers, especially CO2, are more effective for deeper atrophic scars, while needling techniques are considered safer with shorter recovery times, making them a viable option for various types of scars, including hypertrophic ones. Overall, both approaches have their advantages, and the choice between them should consider factors such as the scar type, the patient's tolerance for downtime, and the safety profile of each technique[10,13].

Li H et al. conducted a network meta-analysis to compare the efficacy and safety of MN, alone and in combination with other treatments, for acne scars. The analysis of randomized controlled trials concluded that MN combined with other therapies, such as laser or topical treatments, resulted in superior improvements in scar appearance compared to microneedling alone. Additionally, both monotherapy MN and combined techniques revealed a safe profile, suggesting that combining treatments does not significantly increase the risk of adverse effects[14].

Lopez Q et al. explored the treatment of acne scars using a combination of MN and the CROSS technique with a mixture of phenol and croton oil. The combination was effective in treating deep and resistant acne scars. The CROSS technique helped resurface damaged skin, while MN boosted collagen production, significantly improving skin texture. The combination was well-tolerated with minimal side effects and good aesthetic outcomes[15].

Conclusion

Acne is a highly prevalent condition that significantly impacts the self-esteem of those affected. Numerous techniques have been studied for the treatment of acne scars, all of them showing promising results.

This review concludes that methods such as laser therapy, radiofrequency, chemical peels, MN, and PRP are effective options for scar treatment.

Microneedling, in particular, has emerged as a safe and effective technique, with a superior profile regarding adverse effects, such as post-inflammatory hyperpigmentation. This makes MN especially suitable for individuals with higher phototypes.

Additionally, evidence suggests that combining different treatment modalities often yields better outcomes in improving skin texture compared to a monotherapy.

However, despite the existing research, there is a need for a comprehensive, large-scale trial that includes a diverse sample. Such study would allow a more accurate comparison of the efficacy and safety of MN across various phototypes, skin types, and scar types, ensuring consistent conditions, including the use of the same device, standardized treatment protocols, and consistent treatment durations.

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