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HUMAN INSULIN VIA MMP® FOR TREATING ATROPHIC ACNE SCARS: A PILOT STUDY

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Abstract: INTRODUCTION: Atrophic acne scars result from changes in the extracellular matrix during the inflammatory process and have a significant functional and psychosocial impact. Human insulin has favorable effects on tissue regeneration; however, its application via microinfusion of drugs into the skin (MMP®) to treat atrophic acne scars remains underexplored. OBJECTIVES: To evaluate the clinical effects of the application of human insulin via MMP® to treat atrophic acne scars. METHODS: this pilot, analytical, uncontrolled study included eight participants who underwent three biweekly sessions of MMP® with regular human insulin. RESULTS: The mean age of the patients was 29.3 ± 6.9 years; with six women (75.0%). A clinical improvement was observed with favorable evaluations in termos of pain and patient satisfaction. CONCLUSION: Patients exhibited clinical improvement in the appearance of atrophic acne scars following MMP® treatment with human insulin. Moreover, they reported a high degree of satisfaction.

Keywords: Cicatrix; acne vulgaris; atrophy; insulin; therapeutics; surgical equipment.

INTRODUCTION

Acne is a chronic inflammatory disease of the pilosebaceous unit that affects more than 80% of adolescents, as well as over 40% of women aged 25 years and older.[1] This disease, regardless of its severity, must be treated effectively, as it may leave scars that impact the quality of life of patients.[2] Acne scars are characterized by tissue changes in the dermis following the inflammatory process of acne.[3] The formation of atrophic scars, which account for more than 80% of this condition, is influenced by family history, disease severity, time without treatment, and manipulation of the lesions.[2,4]

Atrophy results from the destruction of extracellular matrix components at the beginning of acne inflammation. In this process, the levels of matrix metalloproteinases decrease, and the levels of their inhibitors increase, affecting collagen production.[4,5] Atrophic scars are categorized into three types, with ice pick scars being the most common, followed by boxcar and rolling scars.[6]

Insulin is a peptide hormone with several physiological functions, including the regulation of energy metabolism, protein synthesis, and cell differentiation and growth.[7,8] Studies show that insulin also acts on wound healing through direct action on keratinocytes and fibroblasts;[5] this hormone promotes thymidine aggregation in fibroblasts, which results in collagen synthesis.[6] Insulin receptors belong to a transmembrane signaling protein family that also includes insulin-like growth factor-1 (IGF-1) and epidermal growth factor (EGF) receptors, which are essencial for cell regeneration.[9] IGF-1 stimulates the production of extracellular matrix components and induces transforming growth factor beta (TGF-β) in dermal fibroblasts, which stimulates wound healing and collagen formation.[5]

The use of insulin through local injections has been previously described for treating wounds, unsightly atrophic scars, and lipoatrophy, yielding satisfactory results without presenting systemic effects.[5,7] In the context of atrophic acne scar treatment, few studies describe the use of human insulin associated with microneedling, showing satisfactory results but with a low level of evidence.[7,10]

Therapies aimed at enhancing the permeability of the skin to drugs (i.e., drug delivery) are increasingly used.[11] Microinfusion of drugs into the skin (MMP®) is a recent technique that utilizes professional tattoo machines to actively administer drugs to the dermis.[12] Unlike microneedling, MMP® can be used regardless of the chemical nature of the drug, its molecular weight, bleeding, or exudation.[13] This technique also promotes a homogeneous and controlled application, offering more consistent results than manual methods. Currently, MMP® is widely used to treat several dermatological conditions, including hypertrophic scars, keloids, androgenetic alopecia, guttate leukoderma, and verruca vulgaris.[11,14]

Treating atrophic acne scars is challenging for dermatologists due to their prevalence and the need to combine individualized interventions to achieve satisfactory results. Thus, this study aimed to evaluate the clinical improvement of atrophic acne scars treated with the application of human insulin using the MMP® technique, and to assess the degree of patient satisfaction with the results obtained, any discomfort experienced, and potential adverse effects.

METHODS

This clinical study used a convenience sample of patients treated at the general dermatology outpatient clinic of Otávio de Freitas Hospital in Recife, Pernambuco (Brazil). Eight patients of both sexes, aged between 22 and 42 years, diagnosed with atrophic acne scars, were included. Exclusion criteria included personal or family history of hypertrophic or keloid scarring; scar treatment within the six months preceding the study; diabetes; pregnancy or lactation; active infections or immunosuppression; or the presence of acne or other active facial lesions.

Three MMP® sessions were performed using 0.3 to 0.5 mL of regular human insulin (100 U/mL) on the atrophic scars, with a 2-week interval between them. A tattoo machine (Hawk Spirit, Cheyenne, Berlim, Germany) with cartridges containing seven needles (0.3 mm diameter each) was used. The endpoint was dew-like bleeding or moderate erythema. A topical anesthetic (7% lidocaine and 7% tetracaine) was applied to the area before each session.

Photographic records were obtained before treatment and thirty days after its completion. They were evaluated by two independent evaluators and by the patient. Evaluator 1 was a dermatologist with experience in the area and a member of the research team (who was not blinded), while Evaluator 2 was a dermatology resident.

The evaluations were performed using a subjective analysis, considering the perspective of the evaluators and the patients. The Global Aesthetic Improvement Scale (GAIS)[15] was used to quantify the perception of improvement; responses could be much worse, worse, no change, improved, or very much improved. A Likert scale was used to measure patient satisfaction with treatment, ranging from "very dissatisfied" to "very satisfied." The visual analogue scale was used to quantify the pain associated with the procedure.Data analysis was performed with the assistance of a statistician using the STATA/SE 12.0 and Excel 365 software. Statistical significance was set at $p < 0.05$.

The project was approved by the research ethics committee (CAAE

84375524.5.0000.5200) on November 27, 2024. All included patients signed the informed consent form.

RESULTS

The sample comprised eight patients with atrophic acne scars; most (75.0%) were women (Table 1). Their mean age was 29.3 ± 6.9 years. Regarding phototype, 75.0% of the sample had phototype III and 25.0% phototype IV.

Table 2 presents data related to the history of previous treatments for atrophic acne scars; 62.5% of patients reported previous interventions, while 37.5% had no history of treatment.

Considering the GAIS results, most patients (87.5%) reported an improvement in their appearance, while 12.5% classified it as "very much improved." According to Evaluator 1, all patients exhibited clinical improvement. Evaluator 2 identified that 87.5% showed improvement (Figures 1, 2, and 3), while 12.5% showed no changes. Regarding patient satisfaction with the result, 75.0% declared themselves satisfied, while 25.0% reported being very satisfied. The intensity of pain during the MMP® was also evaluated by the patient, with 50% (n = 4) reporting mild pain, 37.5% (n = 3) experiencing no pain, and only 12.5% (n = 1) moderate pain (Graph 1).

DISCUSSION

The mean age of the patients in this study was 29.3 ± 6.9 years, with a predominance of women (75%), reflecting the age group most affected by acne and its sequelae.[2] Our study included patients with Fitzpatrick phototypes III and IV, presenting no undesirable effects of dyschromia, only erythema and transient edema, consistent with the literature, which has shown safety for these patients. [8,16] In our study, 62.5% of the patients had undergone some previous treatment for acne scars, but not earlier than six months prior to the beginning of this study; a shorter interval could have been a confounding factor.

In the present study, the chosen treatment protocol consisted of a limited number of sessions and a shorter evaluation period. Nevertheless, a clinical improvement was observed in the atrophic acne scars. Studies associating microneedling with human insulin in the treatment of atrophic acne scars have described different protocols: four to six sessions were performed at 2- to 6-week intervals, with positive results becoming evident three months after the last session.[7,8,16] The present study demonstrated that atrophic acne scars achieved an apparent improvement, even with a reduced number of sessions and post-procedure evaluation time.

Clinical evaluation revealed a qualitative improvement in scarring, with enhanced skin texture and overall appearance observed in 100% of cases, despite varying degrees of response. These findings are consistent with the literature, which reports improved scar appearance and increased patient satisfaction.[5,8]

On the pain scale, seven patients reported "no pain" or "mild pain," and only one patient reported "moderate pain" during the procedure, which was tolerable and did not interrupt the treatment. The ability to adjust the depth of delivery may also contribute to a better patient experience, minimizing pain.[17]

Parameters	n	%
Sex		
Women	6	75.0
Men	2	25.0
Fitzpatrick phototype		
III	6	75.0
IV	2	25.0

	Mean ± SD	Median (P_{25}; P_{75})	Minimum – Maximum
Age (years)	29.3 ± 6.9	28.0 (23.3 - 34.8)	22.0 – 42.0

Table 1 – Sex, age, and phototype parameters of the sample.

Parameters	n	%
Previous scar treatment		
Yes	5	62.5
No	3	37.5

Table 2 – Personal history and treatment of atrophic acne scars.

Parameters	N	%
Improved	7	87.5
Very improved	1	12.5
GAIS Evaluator 1		
improved	8	100.0
GAIS Evaluator 2		
No changes	1	12.5
Improved	7	87.5
Patient satisfaction		
Satisfied	6	75.0
Very Satisfied	2	25.0

Table 3 – Assessment of the presence of photographic clinical improvement by evaluators and patients and the patient satisfaction with the result.

The MMP® technique was chosen because it provides homogeneous and consistent drug delivery, due to the depth of the microperforations and the speed of the machine, both adjustable parameters that enhance drug distribution.[9,12] These advantages reinforce the use of tattoo machines as a promising alternative in the transdermal administration of drugs.

Although human insulin and the MMP® technique are employed in several dermatological conditions, few studies have assessed their combined use for treating atrophic acne scars. In addition to being an easily reproducible technique, MMP® has demonstrated cost-effectiveness to date, as reinforced by this study through improvements observed in patient and evaluator assessments.

CONCLUSION

Although limited by a small sample size and the absence of a control group, this pilot study suggests that combining human insulin with MMP® may improve overall skin appearance, texture, and the quality of atrophic acne scars. Furthermore, patients reported a high satisfaction rate and good tolerability, with no significant adverse events, demonstrating a favorable safety profile. However, additional studies with larger samples, longer follow-up periods, and direct comparisons with established methods in clinical practice are needed for a more robust evaluation of the efficacy and safety of this intervention.

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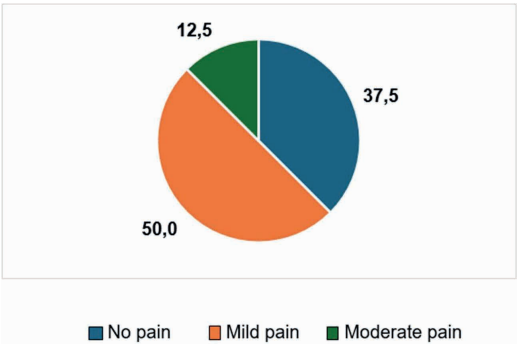
ILLUSTRATIONS



Graph 1 - Visual Analogue Scale (VAS).

Figure 1 – Atrophic acne scars before (A) and after (B) 30 days from the last MMP® session with human insulin**.** Source: Prepared by the author (2025).

Figure 2 – Atrophic acne scars before (A) and after (B) 30 days after the last MMP® session with human insulin.

Source: Prepared by the author (2025).

Figure 3 – Atrophic acne scars before (A) and after (B) 30 days from the last MMP® session with human insulin.

Source: Prepared by the author (2025).