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APPLICATION OF A SERIES OF TRICHLOROACETIC ACID TREATMENTS AND ITS EFFECT ON SEBUM LEVELS AND ACNE SCARS: A CASE REPORT

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A – study design, **B** – data collection, **C** – statistical analysis, **D** – interpretation of data, **E** – manuscript preparation, **F** – literature review, **G** – sourcing of funding

ABSTRACT

Background: Acne vulgaris is a condition that most often appears during adolescence and can last from a few to over a dozen years. Unpleasant remnants of acne include post-inflammatory hyperpigmentation and acne scars, which often result in a reduced quality of life and can interfere with sufferers' ability to function in society.

Aim of the study: Assess the effectiveness of trichloroacetic acid (TCA) in reducing skin sebum levels (oiling) and smoothing acne scars.

Case report: A 35-year-old female reported excessive oiliness of the skin and acne scars on both cheeks. Before and after TCA treatment, sebum levels were measured on the surface of the skin using a Sebumeter®. In addition, the cheek scars were graded using the Goodman and Baron scale.

Conclusions: After a series of five treatments with TCA, there was a large reduction in sebum on the epidermal surface, and acne scars were reduced on both cheeks.

KEYWORDS: acne vulgaris, TCA, Goodman and Baron scale, acne scars

Background

Acne vulgaris is a dermatosis that most commonly occurs in adolescence and is a problem that affects the majority of young people. However, late forms of this particular disease are starting to be seen more frequently and it occurs in 12 to 51% of adults (acne tarda). It is a chronic skin disease in which the overreactivity of the sebaceous glands, hormonal problems, genetics, inadequate skin care, and the bacteria *Cutibacterium acnes* play an important role. The consequence of the disease is post-inflammatory hyperpigmentation, as well as scars, which affect up to 95 % of acne patients. An additional problem is a reduction in the quality of life, which is associated with a reluctance to live or interact with peers. It can also lead to the development of depressive states, as well as suicidal thoughts [1-7].

Scars of varying depths are formed depending on the type of acne and the wound healing processes. Destruction of collagen in the skin occurs in about 80-90% of cases, which often leads to atrophic scars. Less frequently, there is an overproduction of collagen, which leads to adhesion scars. However, both atrophic and hypertrophic scars can occur in the same patient [8-10]. A scar is a lesion formed on the skin as a result of wound healing processes and can be caused by various types of trauma, such as chemical, thermal, or mechanical. However, in the case of acne, the most common scars are those that occur after the healing of inflammation [11,12]. Various scars, hyperpigmentation, and skin discoloration oc-

cur as a result of long-lasting ill-adapted treatment, improper care, or scratching of pimple lesions. Scarring is most common in juvenile acne, phlegmonous acne, acne conglobata, keloid acne, acne fulminans, and necrotic acne (acne rodens) [13].

Depending on their appearance, scars are classified as decolorized, atrophic, or hypertrophic. Meanwhile, atrophic scars are further divided into ice-pick, boxcar-shaped, rolling, and shallow [14]. Ice-pick scars are deep but narrow, with sharp edges and a narrowing that goes deep into the skin, and have a V-shaped cross-section. The skin looks as if it has been pierced with a skewer or some sharp instrument. Boxcar scars are round and oval in shape. They are also wide and flat, have outlined edges, and a sharply demarcated rim, and are not usually close together. They are most common on the jaw and cheeks and have a square or U-shaped cross-section. Rolling scars are shallow and wide, with a soft edge and gently defined margins. They can merge with other rolling scars and most often form clusters. The cross-section of this kind of scar is similar to the letter M. Shallow-atrophic scars have outlined borders and are most commonly found on the cheeks. Discolored scars are very difficult to remove and they are hyperpigmented, with little or no melanin. They appear as white discoloration of the skin [11-13,15].

Trichloroacetic acid (TCA) is one of the strongest and most effective acids used in cosmetology. Depending on the concentration, it can be used for superficial, medium, or deep peels. The beneficial effects of the acid include improving the appearance and condition of the skin, reducing the intensity of discolorations, and eliminating signs of skin aging. It is also applied as an anti-acne treatment [16].

Scientific research conducted over the years in the areas of acne and scar reduction has demonstrated a need for further investigation of treatment options. In this regard, TCA has been shown to have a positive effect by improving the appearance of the skin (Table 1). It also seems reasonable to use specialized research tools to measure selected skin parameters, such as those applied in the current study.

Abdel et al. compared the effectiveness of 25% TCA and 30% salicylic acid in reducing acne vulgaris and showed that TCA was more effective in the treatment of patients [17].

Argawal et al. used the chemical reconstruction of skin scars (CROSS) technique, applying 100% TCA in the treatment of atrophic scars. Sixteen patients were enrolled at the beginning of the study, but only thirteen of them completed the study. The 100% TCA solution was applied using a toothpick over four sittings at two-week intervals. The results were assessed at a 3-month follow-up visit, and more than 69% of patients responded that the technique was excellent, while 31% reported good improvement [18].

Puri et al. compared 20% TCA and Jessner's solution with 20% TCA alone, for the treatment of acne scars. The study enrolled fifty patients, who were divided into two groups. Group I was treated with Jessner's solution containing 20% TCA, and group II was treated with a 20% TCA peel. Although both groups showed a reduction in scarring, there was no statistically significant difference between the two [19].

Table 1. Details of articles investigating trichloroacetic acid for the treatment of acne

Author	Publication year	Type of study	Number of patients	Treatment	Study limitations
Alba et al. [17]	2015	Single-center, double-blind, split-face RCT.	20	Compared the therapeutic efficacy of 25% TCA peels with 30% salicylic acid peels in patients with acne vulgaris. In all patients, 25% TCA was applied to the right half of the face and 30% salicylic acid to the left half at 2-week intervals for 2 months	Possible occurrence of skin discoloration in people with a dark complexion.
Agarwal et al. [18]	2013	Open-label pilot study	16	The study assessed the efficiency of a technique using 100% TCA in the treatment of post-acne atrophic facial scars. Treatment was over a total of four sittings at 2-week intervals and the results were evaluated at a 3-month follow-up	Lack of a control group and small sample size.
Puri et al. [19]	2015	RCT.	50	Group I had chemical peeling with Jessner's solution followed by 20% TCA. In Group II, chemical peel with 20% TCA alone	Lack of control group.
Kaur et al. [20]	2014	Pilot study	10	Subcision followed by 50% TCA CROSS for three sessions at 4-week intervals. Patients were followed-up monthly for six months	Lack of a control group and small sample size.
El-Domyati et al. [21]	2018	Split-face RCT.	24	Twenty-four volunteers with post-acne atrophic scars were randomly divided into three equal groups. Procedures on each side of the face included microneedling by dermaroller alone or combined with platelet-rich plasma or a 15% TCA peel. Six bi-weekly sessions.	Lack of a control group.

Kaur et al. conducted an important pilot study that included 10 female patients. The study used subcision and 50% TCA CROSS to treat acne scars. Participants were treated three times, with a four-week interval between treatments, and were followed up monthly for six months. Scar grading improved from grade 4 to grade 2 (Goodman and Baron scale) in all the patients, and acne scars were reduced [20].

El-Domyati et al. enrolled twenty-four patients in their study and randomly divided them into three groups (8 persons per group). Procedures were performed on each side of the face, which included microneedling by dermaroller alone or in combination with platelet-rich plasma (PRP) or a 15% TCA peel. Participants received six bi-weekly sessions of treatment. The combination of dermaroller and 15% TCA was found to be more effective in the treatment of post-acne atrophic scars than the use of dermaroller and PRP or dermaroller alone [21].

Aim of the study

The study aimed to assess the effects of TCA on the secretion of sebum on the epidermal surface and the smoothing of acne scars.

Material and methods

The study was carried out between February 2021 and May 2021 at Opole University in Poland. The participant was informed of the purpose of the study and that she could abandon the study at any time, after which she provided written consent to participate. This study was approved by the Human Research Ethics Committee of the Opole Medical School (KB/57/NOZ/2019) and was conducted according to the principles of the Declaration of Helsinki.

Case report

Patient information

The participant was a 35-year-old female, who struggled with excessive facial skin oiliness, and acne scars located on both cheeks. She had been struggling with acne since the age of 15, and at the age of 29 developed severe acne lesions, including papules, nodules, pustules, and cysts with fistulas. As a result of such severe acne symptoms, scarring remained on the woman's cheeks. The patient was treated with isotretinoin for one year.

Inclusion criteria for this study were as follows: no dermatological treatment within 12 months, no current hormonal contraception, age 20-40, and the presence of acne scars.

The study had several contraindications: oral isotretinoin within the last year, other medications that could exaggerate the inflammatory reaction of the disease (corticosteroids, anabolic steroids, and contraceptive pills), sun exposure after the procedure, skin cancers, pregnancy, breastfeeding, viral, bacterial or fungal skin diseases (hepatitis, herpes simplex, warts or molluscum contagiosum), hypersensitivity to acids, skin irritation, active inflammation, psoriasis, atopic dermatitis, damage to the skin, allergy to preparations used in the treatment, surgical treatments of the face or neck, previous radiotherapy or chemotherapy, heart, kidney or liver diseases, tendency to develop keloids, dark brown skin type, outdoor working, bleeding tendency, photosensitivity, immunosuppression, melasma, unable to care for their wounds, and unavailable for follow-up.

Therapeutic interventions

TCA (15%) was used in the study, which included five treatments at 14-day intervals. First, the patient's facial makeup was removed, the treatment area was degreased, and then sensitive areas of the face such as the eye area, the area around the nostrils, the lips, and pigmented moles raised above the skin surface, were protected with Vaseline. Following this, TCA was applied to the entire facial area three times. Once the frost effect (coagulation of proteins) was achieved, the area was washed with cold water. At the end of the treatment, sunscreen with a sun protection factor (SPF) of 50+ was applied to the face. The selected skin parameter measured was sebum on the epidermal surface, which was achieved using the Derma Unit SCC3 (Courage + Khazaka electronic GmbH, Koln, Germany). Among other things, the unit has a Sebumeter®, which measures sebum levels. Measurements were taken before the treatment series and one month after the last treatment. The patient was informed that makeup should be removed from the face, neck, and neckline, and a skincare cream should be applied if necessary, on the evening prior to treatment. On the day of the measurements, washing the face and applying any preparations to the area where the Sebumeter® was to be used was prohibited. The conditions in the measurement room were constant, with a temperature of 22 C° and humidity of 40-50%. The patient was allowed 20-30 minutes to acclimatize to the conditions of the room. Sebum was then measured between the eyebrows, on the chin, on the right nostril, on the left nostril, on the right cheek, and on the left cheek.

For home care, a gentle micellar lotion, a regenerating cream, and an SPF 50+ sunscreen were recom-

mended. The patient was informed that in the first week after the acid treatment, it was necessary to wash her face every 2-3 hours and apply a regenerating cream. Applying foundation to the face was not recommended for the first 7-10 days, as the epidermis peeled very heavily and came off in patches of skin.

The participant was asked not to use new cosmetics or have other cosmetic or dermatological treatments during the study and for 30 days after its completion. Additionally, she was advised to not use a solarium, sauna, or swimming pool, or to take any dietary supplements that might affect the test results.

In addition to measuring sebum levels, the Goodman and Baron scale (Table 2), which utilizes a four-point rating system, was used before and after the treatment series. The patient was classified in the third grade on the scale before the study.

Table 2. The Goodman and Baron scale

Severity of acne scars	Type of acne scars	Number of skin lesions from 1 to 10	Number of skin lesions from 11 to 20	Number of skin lesions over 20
1	Mild atrophic acne or existing skin erythema and skin hyperpigmentation at the site of injury	1 point	2 points	3 points
2	Shallow and extensive atrophic scars up to 5 mm deep	2 points	4 points	6 points
3	Deep, extensive atrophic scars	3 points	6 points	9 points
4	Hypertrophic scars and keloids	6 points	12 points	18 points

Follow-up and outcomes

After applying a series of five cosmetic treatments using TCA (15%), the skin parameters improved very well (Table 3) and the Goodman and Baron scale improved from 3 to 2. There was also a reduction in the amount of sebum on the surface of the epidermis: between the eyebrows from 160 to 111 (μg/cm^2), on the chin from 198 to 139 (μg/cm^2), on the right nostril from 187 to 123 (μg/cm^2), on the left nostril from 192 to 130 (μg/cm^2), on the right cheek from 205 to 132 (μg/cm^2), and the left cheek from 201 to 139 (μg/cm^2).

Table 3. Sebum levels before and after the treatment

Area of measurement	Sebum level before the treatment [μg/cm^2]	Sebum level 30 days after the end of the treatment (μg/cm^2)
Between the eyebrows	160	111
On the chin	198	139
On the right nostril	187	123
On the left nostril	192	130
On the right cheek	205	132
On the left cheek	201	139

Figure 1. The patient's face before starting trichloroacetic acid treatment

Figure 2. The patient's face after trichloroacetic acid treatment

Discussion

TCA is the strongest organic acid used to exfoliate the epidermis and reduce acne scars. It exfoliates deeply after several layers of it have been applied, and then penetration into the papillary layer of the dermis occurs. Coagulation of the epidermal proteins then occurs, resulting in a visible whitening of the surface of the skin, the so-called frost. The skin is erythematous for a few days and may also be swollen, and there is strong exfoliation (flakiness) of the epidermis. In addition to acne scar reduction, TCA is used to improve the quality of mature skin, smoothing out fine wrinkles, and reducing discoloration. Kubiak et al. compared the effects of glycolic acid (GA) and 35% TCA in a study conducted on 40 women. They found that TCA was more effective in reducing wrinkles and improving the quality of mature skin [22]. Garg et al. compared the effectiveness of different acid peel combinations in reducing melasma. They divided 30 patients into group A, who were treated with a 35% GA full-face peel, and groups B and C, who were treated with a 35% GA full-face peel followed by a 10% or 20% TCA spot peel, respectively, once every 15 days. At the end of the study, they found no difference between any of the groups, although the acids had a positive effect on reducing melasma in the test subjects [23].

Many researchers have used combined methods, such as microneedling and the application of cosmetic acids. Kontochristopoulos et al. used microneedling and 10% TCA on infraorbital dark circles, in 13 female patients. They were treated with a handheld automatic microneedle therapy system along with the topical application of a 10% TCA solution to each infraorbital area for five minutes. The study showed very promising results and very few side effects were recorded [24]. Al-Hamamy et al. used a 25% TCA superficial peel and dermasanding on thirteen patients (nine females and four males) with acne scars, and the treatments provided good results [25]. Bhardwaj et al. used 100% TCA on twelve patients with predominant atrophic ice pick post-acne scars. Eight out of ten patients were evaluated and the results were positive, with a 50 – 70% improvement and no significant side effects observed [26]. Garg et al. used microneedling and 15% TCA on 50 patients with atrophic acne scars, which are particularly difficult to treat. The treatments were performed over six sessions with a 2-week interval and the results were very good. Of 16 patients with Grade 4 scars, 10 (62.5%) improved to Grade 2, and 6 (37.5%) improved to Grade 3 [27]. Mumtaz et al. compared intra-dermal PRP (group A = 46 persons) with 50% TCA (group B = 46 persons) using the CROSS technique on atrophic acne scars. The study showed that the PRP was better than 50% TCA in reducing atrophic acne scars [28].

Limitations

The study was limited to a single female, which should be extended in the future to include more participants and genders, as well as a placebo group. Also, the study included only one concentration of TCA. Future studies should encompass a range of TCA concentrations, and use acid treatment in combination with other treatments such as radiofrequency microneedling, hydrogen purification, and microdermabrasion. This would allow for the assessment of a combination of two treatments and would help to determine if such an approach would improve acne scar reduction.

Conclusions

Treatment with TCA had a positive effect on reducing and smoothing out acne scars. There was also a reduction in sebum on the epidermal surface of the patient's skin. Nonetheless, it should be highlighted that cosmetic treatments cannot replace dermatological treatment under any circumstances.

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