



The effectiveness of Jessner's solution in combination with retinol in reducing acne lesions – a pilot study

Skuteczność roztworu Jessnera w połączeniu z retinolem w redukcji zmian trądzikowych – badanie pilotażowe

ABSTRACT

Chemical peels are widely used in cosmetological and dermatological treatments. Salicylic acid and Jessner's solution are often used in acne therapy. Moreover, both of these peels in combination with retinol are used in the therapy of hyperpigmentation, wrinkles, photodamage, and acne.

The aim of this research was to evaluate the effectiveness of Jessner's solution and retinol treatment to reduce acne lesions. Two 23-year-old women with acne vulgaris and acne lesions participated in the study. Each of them received 3 treatments with modified Jessner's solution and retinol.

After a series of treatments, in both women, a significant improvement in the skin appearance was observed - the level of inflammations and postinflammatory hyperpigmentation was reduced. Jessner's solution in combination with retinol seems to give a positive effect in reducing acne lesions.

Keywords: Jessner's solution, salicylic acid, retinol, chemical peel, acne vulgaris, acne scars

STRESZCZENIE

Peelingi chemiczne są szeroko stosowane w zabiegach z zakresu dziedziny kosmetologii i dermatologii. W terapii trądziku często stosowany jest kwas salicylowy, a także roztwór Jessnera. Oba te peelingi w połączeniu z retinolem wykorzystywane są w terapiach skór z przebarwieniami, płytkimi zmarszczkami, fotouszkodzeniami oraz w terapii trądziku.

Celem pracy była ocena skuteczności kuracji z zastosowaniem roztworu Jessnera i retinolu w redukcji zmian trądzikowych. W badaniu udział wzięły dwie 23-letnie kobiety z objawami trądziku pospolitego oraz zmianami potrądzikowymi. U każdej z nich przeprowadzono 3 zabiegi z użyciem zmodyfikowanego roztworu Jessnera oraz retinolu.

Po przeprowadzonej serii zabiegów u obu kobiet zaobserwowano znaczną poprawę – zmniejszenie ilości stanów zapalnych i rozjaśnienie przebarwień pozapalnych. Roztwór Jessnera w połączeniu z retinolem przynosi dobre rezultaty w redukcji zmian trądzikowych.

Słowa kluczowe: roztwór Jessnera, kwas salicylowy, retinol, peeling chemiczny, trądzik pospolity, blizny potrądzikowe

INTRODUCTION

Acne vulgaris is a chronic disease of the hair follicles and sebaceous glands. It occurs as often in females as in males, mostly between the ages of 12 and 25 [1, 2]. Acne lesions are divided into non-inflammatory (e.g., blackheads and

whiteheads) and inflammatory (e.g., pimples, cysts, papules). These lesions are most often located on the face, back, and chest. Acne has a negative impact not only on the appearance of people, but also on their psyche and self-esteem [3, 4].



The pathogenesis of acne is multifactorial. Internal factors include: genetic predisposition, hyperactivity and overgrowth of sebaceous glands, the proliferation of anaerobic bacteria *Cutibacterium acnes* caused by abnormal keratinization of hair follicle. While the external factors include: over - skincare, unhealthy diet and medicines [3]. Acne vulgaris has different forms and degrees of severity. Severe acne is usually treated with antibiotics or isotretinoin therapy - a derivative of vitamin A. Mild acne is mostly treated topically with benzoyl peroxide ointments or chemical peels [5].

Chemical peels are a safe method of treating skin disorders used in dermatology and cosmetology. The universality of organic acids is determined by their variety, easy availability, and effectiveness [6, 7]. The procedure consists of controlled exfoliation of dead skin cells, their regeneration and renewal [8, 9]. Due to their antibacterial properties, they have also been used in acne vulgaris therapy [10]. The organic acids can be divided according to the depth of action. It depends on the concentration, the type of substance and the time of contact with the skin [11]. There are very superficial, superficial, medium-depth and deep peels [8]. The most popular peels in acne treatment are almond acid, salicylic acid, pyruvic acid and Jessner's solution (JS).

Jessner's solution, depending on the formulation, may belong to the group of superficial chemical peels acting within the epidermis from the *stratum corneum* to the *stratum basale* or to the group of medium - depth chemical peels acting within the epidermis and the upper part of the dermis reticular layer. The classic version of Jessner's solution is a mixture of 4 ingredients: 14 g salicylic acid, 14 g resorcinol, 14 g lactic acid and ethanol [12-14].

Salicylic acid or ortho-hydroxybenzoic acid belongs to the group of beta-hydroxy acids [15]. The chemical formula is $C_7H_6O_3$. In structural form, one hydroxyl group (-OH) and one carboxyl group (-COOH) are attached to the benzoyl ring in the ortho position [16, 17]. Salicylic acid can be extracted synthetically from phenol, but the main source is naturally occurring willow bark or birch leaf [17]. It has the form of a white crystalline powder or colorless needle-shaped crystals [18]. Salicylic acid shows keratolytic properties because it dissolves intercellular cement. The lipophilic nature determines the solubility in lipids, which allows for deep penetration into the sebaceous glands. This acid does not require neutralization and its small molecule facilitates penetration through the *stratum corneum* [8, 19]. Due to the structure which is similar to that of benzoic acid, ortho-hydroxybenzoic acid exhibits antibacterial properties, which has allowed to be used in acne vulgaris therapies.

Lactic acid or 2-hydroxypropanoic acid belongs to the group of alpha-hydroxy acids. The chemical formula is $C_3H_6O_3$. Lactic acid is produced by bacteria from the family *Lactobacteriaceae*. It is one of the main components of NMF (Natural Moisturizing Factor). In a low concentration up to 10%, it has moisturizing properties thanks to which it causes the encapsulation of

ceramides, stimulates the production of collagen and elastin fibres. In higher concentrations of 30-50%, it shows exfoliating properties. Thanks to its antibacterial properties, lactic acid has found application in cosmetology. It is used in acne treatments and the reduction of skin discoloration and acne scars. As a result, the skin is brightened and smoothed [20, 21].

Resorcinol contains two hydroxyl groups and thus belongs to the group of phenols. The chemical formula is $C_6H_6O_2$. It is a substance well soluble in water and ethanol. In addition, due to its strong exfoliating, anti-inflammatory, antifungal, and antibacterial properties, it is used in the treatment of acne, scars and acne hyperpigmentation. In a concentration of 1-5%, it softens the epidermis, in a concentration of 5-15% it has a keratolytic effect, and in a concentration above 15%, it has a strong exfoliating effect. Most often it comes in the form of solutions or ointments [22-24]. It is used in the concentration of 14% in Jessner's solution [25].

However, due to the toxic effect of resorcinol, there are few modifications of JS where pure resorcinol has been replaced with 8% citric acid. Salicylic acid in the product causes the precipitation of crystals during the procedure and the appearance of skin whitening (this is not "frost") [25]. The product can be used as a stand - alone product or in combination therapies such as retinol.

In dermatology and cosmetology JS it is used for seborrheic, thick skin with symptoms of acne vulgaris, especially papulopustular acne, stretch marks, hyperpigmentation, scars, wrinkles and signs of photoaging [25]. However, when using this peeling there may be side effects caused by resorcinol or salicylic acid e.g.: thyroid disease, or salicylism [26].

Retinol is also an ingredient used in various skin therapies. Vitamin A (retinol) and chemical compounds of similar structure (retinol derivatives) that perform similar functions are determined as retinoids. These compounds regulate the processes of keratinization and differentiation of keratinocytes, and reduce their adhesion, which leads to the exfoliation of dead epidermal cells. Retinol is used in cosmetics in different forms: retinol (vitamin A), retinaldehyde (retinal) formed as a result of the oxidation of retinol and retinoic acid, which is the most oxidized derivative of retinol [27]. The effectiveness of cosmetics with retinol, apart from its chemical form, is also determined by its appropriate concentration [28]. Studies have shown that even a low concentration of 0.1% retinol strengthens the skin, and reduces signs of aging, without causing skin irritation [29]. Retinoids can be used locally or systemically, depending on the severity of the lesions. Local topical retinoids are an important group of drugs in the treatment of acne vulgaris. Their action is to reduce the formation of comedones, as well as keratinization of the outlets of the sebaceous glands, which leads to a reduction in inflammation and prevents their formation [27, 30, 31]. Retinoids are used in the treatment of papulopustular dermatoses. Indications for their use are plaque psoriasis, lichen planus, and follicular red

dandruff. Vitamin A and its derivatives also show a beneficial effect in cases of chloasma, lentigines and postinflammatory hyperpigmentation, favorably influencing the process of melanogenesis. Retinoid therapy has helped people suffering from severe forms of psoriasis: pustular, generalized and limited [32]. Despite the many positives of using vitamin A and its derivatives, side effects and contraindications are possible. [31, 33]. When used orally, may occur: dry mouth, redness, dryness and itching of the skin, and the severity of changes depending on the dose used. Adverse reactions should resolve when it is reduced or the drug is discontinued [27, 34].

AIM OF THE STUDY

The aim of the study was to assess the effectiveness of series treatments Jessner's solution and retinol to reduce acne lesions in selected cases.

MATERIAL AND METHODS

The treatments were performed in a series of 3 procedures on 2 women. Before the procedure, a consultation was conducted, during which contraindications were excluded, the client's expectations were set and the course of the procedure was discussed. Participants signed an informative consent to the procedure. Then the condition of the skins was assessed visually and by palpation. In both cases, numerous hyperpigmentation and acne scars as well as acne lesions were diagnosed.

Both of the women were educated about skin care before the treatment started. Treatments were performed using a modified JS solution consisting of 25% 4N-butylresorcinol, 8% salicylic acid, 5% lactic acid, 5% citric acid and 0.2% glycolic acid. To intensify the exfoliation effect some of the procedures were finished with the application of the 4% retinol mixture of three different retinoids with a concentration of 4%: retinol, retinaldehyde and retinyl propionate. Peeling was applied from 1 to 3 layers using sterile gauze. Whenever retinol was applied, it was massaged until completely absorbed into the skin and left for 8 hours. After that time, it was supposed to be removed with water. There is no need to neutralize the solution [35]. Treatments were performed at 4 weeks intervals.

In the first case, peeling was applied in the following order: the first meeting - two layers of JS and retinol; the second meeting - two layers of JS were applied to the entire face of the client, and a third layer was added to the forehead and cheeks, which had the most acne lesions, scars and hyperpigmentation, retinol was applied; the third meeting - three layers of JS were used.

In the second case, the series was performed in order: the first meeting - two layers of Jessner's solution were applied on the woman's skin and the retinol was massaged; in the second meeting - two layers of Jessner's solution were applied to the entire face, and a third thin layer was applied to areas with visible acne lesions, scars and hyperpigmentation, for instance, the forehead and cheeks. At the end of the procedure, retinol was massaged in; and in the third meeting - three layers of JS

and retinol were applied. Both women were instructed to wash the skin eight hours after the treatment with water only, and after starting the exfoliation process (about 2-3 days after the treatment), use a photoprotective cream for daily care.

RESULTS

In the first case during the JS application, a significant erythema was observed. Visible superficial desquamation appeared after 3 days. During the second and third treatments, the skin reacted more intensively due to the fact that more layers of JS were applied. Skin condition after a series of treatments with JS improved significantly (Fig. 1). The number of open comedones decreased and the hyperpigmentation became less visible (Fig. 2). Skin tone was improved.

In the second case, a significant erythema appeared. After three days the skin around the chin and cheeks began to peel off. As in the first case skin condition after a series of treatments with JS has improved significantly. The appearance of postinflammatory hyperpigmentation and acne scars was reduced (Fig. 3).

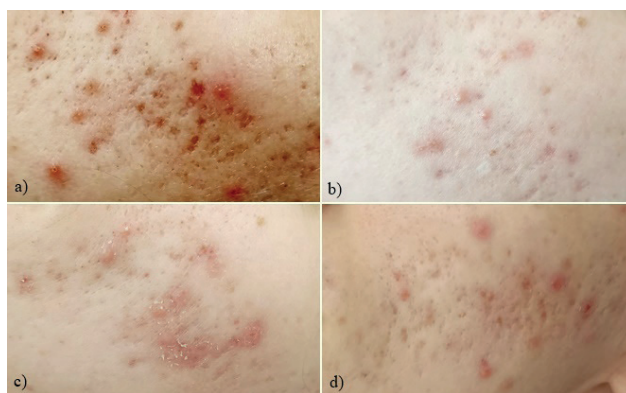


Fig. 1 Woman underwent a series of four treatments with Jessner's solution in combination with retinol; a) the condition of skin on the left cheek at the first visit b) four weeks after the first treatment c) four weeks after the second treatment d) four weeks after the third treatment.

Source: Own source

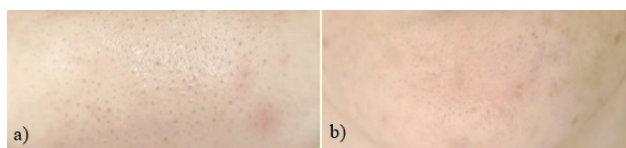


Fig. 2 Comparison of the skin condition in the chin area; a) before the 1st session b) 4 weeks after the 3rd session

Source: Own source

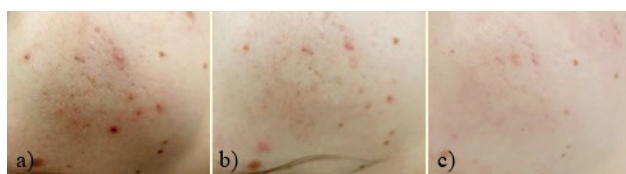


Fig. 3 The woman underwent a series of three treatments with Jessner's solution in combination with retinol; a) the condition of skin on the right cheek at the first visit b) four weeks after the first treatment c) four weeks after the second treatment d) four weeks after the third treatment.

Source: Own source

DISCUSSION

Chemexfoliation is one of the most popular treatments used in dermatology and cosmetology. They are used in the treatment of skin defects aimed at reducing the visibility of hyperpigmentation, the symptoms of photoaging, melasma, improving the appearance and color of the skin, they are also used in the treatment of acne vulgaris and rosacea [8, 25].

One of the most popular mixture intended for exfoliation treatments is Jessner's solution. It is a mixture consisting of salicylic acid, lactic acid, citric acid (formerly resorcinol which has been replaced due to its toxicity) and ethanol [25]. JS has been shown to be an effective superficial chemical peeling agent when used alone, while in combination therapy with, for instance, 35% trichloroacetic acid, its effect is medium-deep [36]. JS as a superficial peeling which exfoliates the *stratum corneum*, while as a medium-deep peeling it can even reach the papillary layer of the dermis. The intensity of the JS treatment depends on the method of application, the number of applied layers and the pressure used during application. Spreading the JS with gauze ensures that a smaller amount of the solution is spread than in the case of brush application. In most procedures, JS is applied in one to three layers - depending on the desired depth of skin penetration. During the first treatment, it is recommended to apply one layer of the solution and gradually increase the number of layers with each treatment [25, 35]. The most important element of a properly conducted therapy is knowledge of the procedure, thorough consultation, proper diagnosis of the skin, sterility and hygiene of the treatment as well as qualifications and knowledge of the person performing the peeling.

In order to intensify the effects of the treatment of various chemical peels, it is possible to apply retinoids. Retinoids are a group of compounds containing vitamin A, its derivatives and others compounds activating retinoid receptors. Mostly known examples of retinoids are retinol, retinal, retinyl palmitate, retinyl acetate, and retinoic acid. Tretinoin's mechanism of action is based on thinning the *stratum corneum*, which results in a smoother skin. Moreover, tretinoin induces the dispersion of melanin granules into the epidermis, which reduces skin hyperpigmentation. Retinol is the alcohol formulation of vitamin A. This compound is very stable, seeing that it is the most used vitamin A analog in cosmeceuticals. Compared to retinoic acid, retinol is better tolerated by the skin, but the effect of retinoic acid is stronger. The effect of retinol is to improve the skin structure, lighten discoloration and smooth fine lines. The effects of retinyl palmitate and retinyl acetate are the weakest of all vitamin A analogs. It is caused by the fact they first need to be converted to retinol and then to retinoic acid. Despite this fact, retinyl esters have been shown to increase the epidermal thickness but this effect is much weaker compared to retinoic acid. Retinal is the aldehyde analog of vitamin A. The effect

caused by this compound is also weak. Retinal is characterized by gentle improvement of the fine lines and it is less irritating than retinoic acid [37]. The local action of retinoids is based on accelerating the turn-over-time process and exfoliating the *stratum corneum*, in order to which the process of epidermal cell renewal is regulated. Retinoids show anti-aging properties by stimulating the synthesis of collagen I, III, and VII and inhibiting the activity of enzymes that degrade collagen and elastin. They are also used in the treatment of acne skin because they normalize the processes of exfoliation in the ducts of the sebaceous glands and facilitate the release of gland secretions. What is more, they improve the epidermal barrier and stimulate the process of blood vessel formation, which improves blood circulation in the skin [30].

The combination of the JS treatment with retinol causes a deep reconstruction of the skin, improvement of tension, density and color, which results in decreasing skin defects, such as hyperpigmentations, melasma, signs of photoaging, acne vulgaris and scars. In the conducted study with the use of Jessner's solution and 4% retinol, satisfying results were obtained in both cases. In the literature, there is a research presenting combination treatments using JS associated with physical or mechanical methods. Basma A. et al. [38] conducted a comparative randomized clinical study on microneedling and JS peeling in the treatment of acne atrophic scars. In the study, participants were divided into three groups. Group I was treated with microneedling group II was treated with peeling in Jessner's solution, and group III was treated with microneedling and Jessner's solution. Clinical evaluation of patients was performed before and after treatment according to Goodman and Baron's global quantitative scar rating system. The greatest reduction in the appearance of scars was found in group III and it was concluded that the combination technique showed the best clinical improvement with the lowest number of sessions.

An example of a therapy involving the combination of JS with a physical method was described by Lee et al. [39]. The aim of the therapy was to evaluate the additional therapeutic effect and side effects of JS in combination with a low-frequency 1064 nm Q-switch Nd: Yag laser (QSNYL, *Q-switched neodymium-doped yttrium aluminum garnet laser*) in melasmic persons. The study involved 52 people divided into two groups. Group A were persons who underwent 10 sessions of 1064 nm QSNYL and a chemical peel with placebo at a two-week interval, while group B were persons who underwent 10 sessions of 1064 nm QSNYL and chemical peeling with JS. Responses were assessed using the Melasma Area and Severity Index (MASI), Physician Global Assessment (PGA) and subjective self-esteem. After eight weeks, the mean MASI decreased more in Group B. Negative side effects of additional use of JS were not reported. It was concluded that the JS combined with a low power 1064 nm Nd: YAG laser is a safe and effective method in the early treatment of melasma.

CONCLUSIONS

The use of chemical peels in cosmetology and dermatology is common. They are used to improve the appearance of the skin, for example, skin tone, but also due to their anti-inflammatory and comedolytic properties in the treatment of acne and acne lesions. Combination procedures of various chemical peels are known of better effectiveness. Jessner's solution in connection with retinol gives a positive effect in reducing acne lesions.

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