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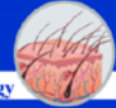
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Chemical Peeling in Skin-Aging Patients: A Retrospective Study

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ABSTRACT

Background: Skin aging is a degenerative process that involves a decrease in the structure and function of skin cells and the extracellular matrix due to intrinsic and extrinsic factors. Chemical peeling is one of the skin aging treatments that involves skin ablation using chemical agents. **Purpose:** To evaluate the profile of skin-aging patients treated with chemical peeling at the Dermatology and Venereology Outpatient Unit of Dr. Soetomo General Hospital Surabaya from January through December 2019. **Methods:** The data were obtained from patients' medical records through a total sampling technique, which consisted of age, gender, occupation, history taking, physical examination, diagnosis, therapeutic agents, follow-up frequency, and therapeutic result. **Result:** The study included 37 patients, the majority of whom were between the ages of 46 and 55 (35.1%), female (100%), and private employees (32.4%). In history taking, patients' main complaint is dull skin (94.6%), with the risk factor of sun exposure (97.3%) and the history of sunscreen usage (81.1%). Pigmentary changes were found in all patients (100%). The most common diagnoses are photoaging Glogau II and Glogau III, found in 15 patients (40.5%), respectively. The common priming agents were sunscreen (97.3%), cleanser (94.6%), and 8% glycolic acid (75.7%). The majority of patients (62.2%) received 20% glycolic acid as a peeling agent and sunscreen (86.5%) as a post-peeling agent. The majority of patients (43.2%) did not follow up. Glogau II photoaging (57.1%) was the main therapeutic result. **Conclusion:** Proper chemical peeling procedures and patients compliance are important factors to improve therapeutic outcomes.

Keywords: skin aging, photoaging, ultraviolet radiation, chemical peeling.

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BACKGROUND

Skin aging is a degenerative process that involves changes in the structure and function of skin cells and components of the extracellular matrix. Besides decreasing the skin's physiological function, skin aging can affect a person's appearance, thus people nowadays pay more attention to their skin's condition, especially women.¹ Not only a cosmetic issue, skin aging has a significant impact on patient's quality of life. Patients become more susceptible to various disorders or diseases, ranging from mild and excruciating diseases, such as pruritus, eczema, contact dermatitis, allergic dermatitis, seborrheic dermatitis,

autoimmune diseases, and keratosis, to more fatal diseases, such as basal cell carcinoma, squamous cell carcinoma, and malignant melanoma.²

The main cause of skin aging is sun exposure, which is called photoaging. Indonesian people are prone to photoaging, as Indonesia is a tropical country with constant sun exposure throughout the year.³ In Indonesia, chemical peeling has been used as a treatment option for photoaging patients. Glycolic acid peeling was performed on 72 photoaging patients, representing 15.8% of all photoaging patients (455 patients) at Medical Cosmetics Division Dermatology

23 and Venereology Department of Dr. Soetomo General Academic Hospital Surabaya between 2011 and 2013.⁴

From the explanation above that skin aging can affect the quality of life and potentially cause a fatal condition, as well as the fact that there is high public interest in skin rejuvenation therapy, especially chemical peeling, this study is expected to provide an overview of skin-aging patients who underwent chemical peeling at the Dermatology and Venereology Outpatient Unit of Dr. Soetomo General Academic Hospital Surabaya from January to December 2019. In addition, this research was conducted considering that currently there are not many research studies and data about chemical peeling in Indonesia, whereas people's enthusiasm for skin rejuvenation treatments continues to increase.

12 METHODS

The purpose of this study is to describe the profile of skin-aging patients treated with chemical peeling at Dr. Soetomo General Hospital Surabaya's Dermatology and Venereology Outpatient Unit from January to December 2019. This study involved all skin-aging patients treated with chemical peeling through total sampling using a non-probability consecutive technique from patients' medical records. The inclusion criteria were new patients with complete medical records, which include age, gender, occupation, history-taking findings, physical

examination, diagnosis, therapeutic agents, follow-up frequency, and therapeutic result.

The research was conducted at the Dermatology and Venereology Outpatient Unit of Dr. Soetomo General Hospital Surabaya from July 2021 to January 2022. The data were processed using Microsoft Excel, through editing, coding, entry, and cleaning stages, and then analyzed using the descriptive statistics method. The data were grouped based on the research variables and presented as frequency distribution tables. The Health Research Ethics Committee of Dr. Soetomo General Hospital Surabaya approved this study with the ethics number 0247/KEPK/VIII/2021.

RESULT

This study sampled new skin-aging patients who underwent chemical peeling between January and December 2019, with a total of 37 (8.9%) patients from a total of 415 skin-aging patients. Most patients were 46-55 years old, as seen in 13 patients (35.1%), with the youngest patient being 21 years old and the oldest patient being 73 years old. All patients (100%) were female. Most of them (32.4%) worked as private employees.

History-taking findings consist of the main complaint, a risk factor, and past medical history. The most common main complaint was dull skin in 35 patients (94.6%) (Table 1)

1 Table 1. Main complaint distribution of skin-aging patients treated with chemical peeling Dr. Soetomo General Hospital Surabaya's Dermatology and Venereology Outpatient Unit in January- December 2019

Main complaint	Frequency	Percentage (%)
Dull skin	35	94.6
Spots	1	2.7
Wrinkle	1	2.7
Acne scar	2	5.4

1 Table 2. Physical examination distribution of skin-aging patients treated with chemical peeling Dr. Soetomo General Hospital Surabaya's Dermatology and Venereology Outpatient Unit in January-December 2019.

Physical examination	Frequency	Percentage (%)
Pigmentary changes	37	100
Lentigines	0	0.0
Dyschromia	1	2.7
Telangiectasia	8	21.6
Keratosis	14	37.8
Wrinkle	34	91.9

Most patients had risk factors for sun exposure, as seen in 36 (97.3%) patients. Other patients also had other risk factors for skin aging, such as air pollution, either from vehicle smoke or cooking fumes, a history

of allergies, and menopause, which were found in 11 (29.7%) patients. The patients' medical histories included sunscreen usage in 30 (81.1%) patients, tretinoin in 29 (78.4%) patients, and alpha-hydroxy

acids (AHA), namely 8% glycolic acid (GA), in 23 (62.2%) patients. Other medication histories included night cream, other facial creams, hydrocortisone, benzoyl peroxide gel, and clindamycin gel, as seen in 27 (73%) patients.

In the physical examination, pigmentary changes were found in all patients (100%). According to medical records, the most significant pigmentary change was hyperpigmented macules with poorly-defined margins. The second most common

abnormality was wrinkling, which was found in 34 (91.9%) patients. The least significant physical examination result was dyschromia in 1 (2.7%) patient (Table 2).

Diagnoses of skin-aging patients were made based on Glogau's photoaging scale. The most common diagnoses were Glogau II and Glogau III, each in 15 (40.5%) patients, while the least common diagnosis was Glogau IV in 2 (5.4%) patients (Table 3).

Table 3. Diagnoses distribution of skin-aging patients treated with chemical peeling the Dermatology and Venereology Outpatient Unit of Dr. Soetomo General Hospital Surabaya in January – December 2019

Diagnoses	Frequency	Percentage (%)
Glogau I	5	13.5
Glogau II	15	40.5
Glogau III	15	40.5
Glogau IV	2	5.4
Total	37	100

Table 4. Distribution of priming agents in skin-aging patients treated with chemical peeling Dr. Soetomo General Hospital Surabaya's Dermatology and Venereology Outpatient Unit in January-December 2019

Priming agents	Frequency	Percentage (%)
0.025% Tretinoin	8	21.6
0.05% Tretinoin	25	67.6
0.1% Tretinoin	4	10.8
8% GA	28	75.7
10% GA	5	13.5
Facial cleanser	35	94.6
Sunscreen SPF 30	36	97.3
Others	3	8.1

GA: Glycolic Acid

Table 5. Peeling agent distribution in skin-aging patients treated with chemical peeling Dr. Soetomo General Hospital Surabaya's Dermatology and Venereology Outpatient Unit in January- December 2019

Peeling agents	Frequency	Percentage (%)
10% GA	2	5.4
20% GA	23	62.2
25% GA	3	8.1
30% GA	1	2.7
35% GA	3	8.1
Modified Jessner	4	10.8
20% Salicylic acid	1	2.7
Total	37	100

GA: Glycolic Acid

The chemical peeling procedure involves three stages; namely priming, peeling, and post-peeling. Priming is a preparatory procedure prior to the main peeling treatment. In this study, priming was

performed on all patients. The most common priming agent given to patients was sunscreen SPF 30 in 36 (97.3%) patients, followed by facial cleanser in 35 (94.6%) patients, 8% GA in 28 (75.7%) patients, and

tretinoin 0.5% in 25 (67.6%) patients. Another trio of priming agents administered were benzoyl peroxide, clindamycin and nutricream in 3 (8.1%) patients (Table 4).

For the peeling procedure, the most commonly used agent is 20% GA peel in 23 (62.2%) patients, while the least frequently used agents are 30% GA peel and 20% salicylic acid peel in 1 (2.7%) patient each (Table 5). In the post-peeling procedure, most patients received sunscreen SPF 30, as seen in 32 (86.5%) patients, followed by moisturizer in 30 (81.1%) patients, and hydrocortisone 1% in 25 (67.6%) patients.

The majority of patients with skin aging, as many as 16 (43.2%), did not follow up. A total of 11 (29.7%) patients had a follow-up, while only 1 (2.7%) patient had 4 follow-ups. The most frequent follow-up was 6 times, which was done by 1 (2.7%) patients (Table 6).

Among the 21 patients who did their chemical peel follow-ups, most of them (57.1%) had final diagnoses of photoaging Glogau II. One (4.8%) patient had photoaging Glogau IV, which was the least common diagnosis (Table 7).

Table 6. Follow-up frequency distribution in skin-aging patients treated with chemical peeling Dr. Soetomo General Hospital Surabaya's Dermatology and Venereology Outpatient Unit in January- December 2019

Follow-up frequency	Frequency	Percentage (%)
No follow-up	16	43.2
1	11	29.7
2	6	16.2
3	2	5.4
4	1	2.7
>4	1	2.7
Total	37	100

Table 7. Therapeutic outcome distribution in skin-aging patients treated with chemical peeling Dr. Soetomo General Hospital Surabaya's Dermatology and Venereology Outpatient Unit in January-December 2019

Therapeutic outcome	Frequency	Percentage (%)
Glogau I	3	14.3
Glogau II	12	57.1
Glogau III	5	23.8
Glogau IV	1	4.8

Table 8. Glogau's photoaging score changes in skin-aging patients treated with chemical peeling who had follow-up(s) Dr. Soetomo General Hospital Surabaya's Dermatology and Venereology Outpatient Unit in January-December 2019

Glogau's photoaging score changes	Frequency	Percentage (%)
Chemical Peeling with 20% GA	14	66.7
No changes in Glogau score	8	38.1
Improved Glogau score	5	23.8
Glogau IV → Glogau II	1	4.8
Glogau III → Glogau II	3	14.3
Glogau II → Glogau I	1	4.8
Worsened Glogau score (Glogau III → Glogau IV)	1	4.8
Chemical Peeling with another agents	7	33.3
No changes in Glogau score	5	23.8
Improved Glogau score	2	9.5
Glogau III → Glogau II	1	4.8
Glogau II → Glogau I	1	4.8

GA: Glycolic Acid

As many as 23 (62.2%) patients underwent chemical peeling using 20% glycolic acid. Among these 23 patients, there were 14 who had follow-ups. After finishing the last follow-ups, most patients (8 patients) did not experience a change in the Glogau photoaging score. There were 5 patients who had improved Glogau photoaging scores, namely 3 patients had improved scores from Glogau III to Glogau II, 1 patient had improved scores from Glogau IV to Glogau II, and 1 patient who had improved scores from Glogau II to Glogau I. There was 1 patient who experienced a worsened Glogau photoaging score, from Glogau III to Glogau IV (Table 8).

DISCUSSION

Sunlight exposure is a major contributor to premature skin aging; thus, it is called "photoaging". Based on Glogau's photoaging classification, the manifestations of skin aging begin to appear at the age of 35-50 years. At this age, fine lines and pigmentation begin to show. At around the age of 50, wrinkles and pigmentation are seen more clearly. There is a picture of complete skin wrinkles at the age of 60-75 years old (severe photoaging).⁵ This is in accordance with the research findings that the most common age group of patients was 46-55 years, with as many as 13 (35.1%) patients, while the least common age group was > 65 years old, with as many as 2 (5.4%) patients. Although the clinical manifestations of skin aging may appear in the third to fourth decade of life, the natural skin aging process (intrinsic aging) has actually begun in the mid-twenties. In the twenties, there is a decrease in sex hormone production that continues to occur as age increases. The production of estrogen and progesterone was reduced as women approached menopause. This causes collagen degradation, dry skin, epidermal atrophy, and wrinkles.⁶ This study showed that the youngest patient was 21 years old, while the oldest patient was 73 years old. The youngest patient came because of dull skin with a risk factor of sun exposure. In physical examination, there are pigmentary changes and ill-defined hyperpigmented macules, without any wrinkles at all, with the diagnosis of Glogau's photoaging I. Besides, the oldest patient came with a complaint of dull skin and a risk factor for sun exposure. In the physical examination, pigmentary changes and wrinkles were found with the diagnosis of Glogau's photoaging IV.

January to December 2019, all new skin-aging patients treated with chemical peeling were women, with a total of 37 patients (100%). Skin aging not only affects physiological functions, but also interferes with a person's appearance (an aesthetic function), so now people begin to pay attention to their skin condition,

especially women. Many women spend some money on cosmetics and anti-aging skincare.¹ Skin aging in women can affect mood, self-confidence and quality of life.³ In addition, skin aging in women is associated with decreased dehydroepiandrosterone (DHEA) hormone. It causes the reduction of type I procollagen expression, which then decreases collagen synthesis and accelerates collagen degradation. Decreased DHEA occurs both in men and women, but DHEA concentrations are lower in women than men. In postmenopausal women, estrogen deficiency causes the skin to look thinner, drier, and less elastic. This is what causes skin aging, which mostly occurs in women.⁷

The patients' occupations are related to the frequency and intensity of sun and air pollution exposure, which both contribute to skin aging. Patients who work outdoors are supposed to be exposed to direct sunlight more often than patients working indoors. Sun exposure is the main cause of skin aging, especially in the face, neck, lower arm, hand, and upper chest area. Ultraviolet (UV) radiation can cause rough skin, wrinkles, sagging, dullness and irregular pigmentation.⁸ The most common patient's occupation was private employee, as found in 12 (32.4%) patients, while the least common occupation was student, as found in 2 (5.4%) patients. Unfortunately, patients' medical records did not attach any information regarding the patients' work locations, whether they worked indoors or outdoors, as well as the frequency and intensity of sun and pollution exposure during the working hours, so this study cannot conclude a relationship between patients' occupations and the occurrence of skin aging.

Most of the patients (94.6%) came with the main complaint of dull skin, followed by the second most common complaint, which was acne scars (5.4%). Spots and wrinkles were the least common main complaints, occurring in 1 (2.7%) of patients. There are many symptoms of skin aging, such as dull skin, wrinkles, and irregular pigmentation.⁸ Dull skin is caused by a slowed skin turnover. This phenomenon is related to UVA radiation which causes a decrease in the enzymes activities that play roles in exfoliating the horns layer.⁹ Meanwhile, UVB radiation decreases skin hydration so that the skin looks dull, dry, and rough.¹⁰ Excessive sun exposure can cause acne, which then leaves acne scars after the healing process.¹¹ Skin aging also has an impact on skin dyspigmentation, especially hyperpigmentation spots, which appear due to internal and external factors. This is associated with prolonged melanosome retention in the epidermis, resulting in increased melanin production by melanocytes. Environmental factors, such as UV radiation and air

pollution, are also associated with the spots' formation through Reactive Oxygen Species (ROS).¹² Photoaging is also related to wrinkles. Wrinkles occur due to a reduction in the quantity and quality of elastin and collagen produced by fibroblasts in the dermal layer. Sun exposure causes collagen and elastin degeneration through activation of AP-1 and NF- κ B, as well as decreased production of type I procollagen. Exposure to UVA radiation induces elastin-elastin complex formation. This complex inhibits the binding of elastin, to elastase, resulting in the accumulation of elastin which is not metabolized in the skin. A decrease in the number of collagen and elastin fibers, elastin disintegration, and the retention of degenerated connective tissue all contribute to wrinkle formation and skin atrophy. In addition, UVB radiation stimulates keratinocytes to produce pro-inflammatory cytokines, thereby increasing MMP-1, MMP-3, and MMP-9 expression, which precipitate collagen and elastin degradation.⁹

Sun exposure is the most common risk factor found in skin-aging patients (97.3%), followed by other risk factors such as exposure to pollution (vehicle smokes, cooking fumes), history of allergies, and menopause, which were found in 11 patients (29.7%). Previous research also stated that sun exposure is the biggest trigger factor against skin aging (photoaging).⁸ Exposure to UV radiation causes the manifestations of skin aging, such as thick, dry, wrinkled skin and solar elastosis.¹ Skin aging also occurs in skin that is often exposed to air pollution, such as Particulate Matter (PM), Persistent Organic Pollutants (POP), gases (CO, SO₂, NO_x, VOCs, and O₃), and metals. Chronic exposure to air pollution disrupts skin homeostasis through several mechanisms, namely free radicals formation, inflammatory cascades, and changes in the skin barrier.¹³ Skin exposure to NO₂ is also associated with lentiginos formation. Cooking using solid fuels and the ventilation condition in the kitchen are related to skin aging manifestations, such as wrinkles on the forehead and upper lip, drooping eyelids, fine wrinkles on the backs of the hands, and rhomboidalis cutis. It is due to PM_{2.5}, any particle with a diameter of 2.5 μ m or less, which acts as a carrier of organic chemicals and metals which then produces reactive oxygen species (ROS) in the mitochondria. This ROS triggers collagen degradation, resulting in the appearance of wrinkles.¹⁴ In patients with allergies, chronic exposure to antigens can cause chronic inflammation. This mechanism provokes skin aging due to exposure to oxidative stress that comes from the continuous production of free radicals and toxins.¹⁵ Lastly, menopause results in a decrease in estrogen levels. Estrogen deficiency causes the skin to be more susceptible to oxidative stress, skin

atrophy, and accelerates the skin aging process. Since women experience menopause, skin thickness decreases by 1.13% and the amount of collagen decreases by 2% every year, resulting in thinner skin, reduced elasticity, wrinkles, dryness, and decreased skin vascularity.¹⁶

The patient's medical history is important in determining the success of therapy. In the period January – December 2019, most of the patient's medical history was the use of sunscreen (81.1%), followed by tretinoin (78.4%), others (73.0%), and AHAs, namely 8% glycolic acid (62.2%). Other medication history included night cream, other facial cream, hydrocortisone, benzoyl peroxide gel, and clindamycin gel. The use of broad-spectrum sunscreen with SPF 15 or higher has a photoprotective effect, so it can prevent premature skin aging. In addition to SPF, the substantiveness of sunscreens needs to be considered. Substantive is the sunscreen's resistance against water and sweat. Sunscreen with a waterproof label refers to the 40 minutes during which the photoprotective function is still maintained by immersion in water or moderate physical activity, while the label "highly waterproof" refers to the effectiveness of the sunscreen for 80 minutes of soaking. In general, sunscreen is divided into chemical and physical sunscreens. Chemical sunscreens (organic sunscreens) work by absorbing high-energy UV rays and releasing lower energy at longer wavelengths. Physical sunscreens play a role in reflecting and scattering UV rays. The greater the reflective index, the better the UV filter produced. Now there are many sunscreens with antioxidants, such as vitamin C, vitamin E, silymarin, and green tea polyphenols, which also protect the skin from UV damage, such as skin redness, sunburn, photoaging, and carcinogenesis. Proper sunscreen usage influences its effectiveness. Sunscreen should be applied evenly on the skin as much as 2 mg/cm² 15 minutes before being exposed to sunlight, then repeated every 2 hours, after sweating or swimming.¹⁷ Prior to chemical peeling therapy, patients need to discontinue the use of skin irritating agents. The use of benzoyl peroxide should be discontinued for 4 weeks prior to chemical peeling. Tretinoin cream used as monotherapy poses a risk of skin burning, redness, peeling, and pain. One study states that the use of benzoyl peroxide/clindamicin, tretinoin, and clindamicin increases the side effects of dry skin, irritation, redness, and peeling.¹⁸

Skin aging causes different manifestations in each patient. Intrinsic skin aging shows the appearance of thinner skin, fine wrinkles, dryness, skin atrophy, and lipoatrophy.¹ Meanwhile, thickened, rough skin, coarse wrinkles, dullness, sagging, and irregular pigmentation

are signs of extrinsic aging skin.¹⁹ In the physical examination, pigmentary changes were found in all patients (100%), followed by wrinkles in 34 (91.9%) patients, keratoses in 14 (37.8%) patients, telangiectasia in 8 (21.6%) patients, and dyschromia in 1 (2.7%) patient. In dyschromia, uneven skin color is found. Pigmentation changes are a prominent sign of photoaging skin. In areas that are chronically exposed to sunlight, such as Indonesia, skin pigmentation becomes more uneven with age. The hallmark of photoaging is mottled pigmentation, which is caused by the uneven distribution of melanocytes on the basement membrane. Pigmented lesions that are commonly found in aging skin are actinic lentigenes (age spots), freckles, solar keratosis, and seborrheic keratoses. In addition, the accumulation of degraded collagen fibers and decreased collagen production decrease skin strength and induce wrinkle formation. Collagen degradation around blood vessels can also lead to telangiectasia formation, which is broken-appearing blood vessels.²⁰

The diagnosis of skin-aging patients is based on the severity of photoaging using the Glogau's photoaging score. The most common diagnoses were photoaging Glogau II and Glogau III, found in 15 (40.5%) patients each, followed by Glogau I in 5 (13.5%) patients and Glogau IV in 2 (5.4%) patients. Glogau II (moderate type) shows the presence of wrinkles when there are facial movements, pigmentation spots, and palpable keratosis, whereas Glogau III (advanced type) shows wrinkles at rest, marked skin discoloration, as well as visible telangiectasia and keratosis. Generally, Glogau II occurs at the age of 35 to 50 years, and Glogau III occurs at the age of 50 to 65 years. In Glogau I (the mild type), there are no or minimal wrinkles and mild changes in skin pigmentation, which occur in patients aged 28 to 35 years. Glogau IV (severe type) is the most severe clinical picture of skin aging, namely wrinkles all over the face and changes in skin color. Glogau type IV occurs at the age of 60 to 75 years.⁵ This is consistent with the findings of this study, which show that the majority of skin-aging patients are between the ages of 46 and 55. Patients with diagnoses of Glogau I were in the age range of 17-25 years and 26-35 years, whereas patients with diagnoses of Glogau type IV were in the age range of 56-65 years and >65 years.

In this study, the majority of skin-aging patients received priming in the form of sunscreen SPF 30 (97.3%), followed by facial cleanser (94.6%), 8% GA (75.7%), and 0.05% tretinoin (67.6%). Priming is the initial action before chemical peeling therapy is carried out in patients. Priming should be done for at least 2-4

weeks before peeling and ceased 3-5 days prior, which aims to thin the stratum corneum, accelerate the penetration of the peeling agent and the wound healing process, even peeling agent penetration, detect agent intolerance, enhance patient compliance, and reduce the risk of complications. Some agents used for priming include broad-spectrum sunscreens, hydroquinone in patients at risk for PIH (postinflammatory hyperpigmentation), tretinoin, AHA, and antivirals for patients with a history of herpes simplex, as well as control of infection or dermatosis. Use of sunscreen and other photoprotective activities is important to prevent sunburn, tanned skin, and reduce melanocyte activity. Patients should wash their faces using residue-free soap and stop using makeup. Glycolic acid is the most commonly used AHA for priming. The concentration is usually 5-10%. In addition to glycolic acid, tretinoin cream with a concentration of 0.025-0.05% is also used as a priming agent. Tretinoin works by thinning the stratum corneum, thus improving the absorption of the peeling agent. Tretinoin can also increase epithelial differentiation and accelerate skin re-epithelialization after therapy.²¹

The most widely used peeling agent 20% glycolic acid in 23 (62.2%) patients, followed by modified Jessner in 4 (10.8%) patients. Glycolic acid is one of the AHAs that is often used for chemical peeling due to its keratolytic effect. At low concentrations, it reduces corneocyte cohesion. At high concentrations, AHAs trigger epidermolysis. For superficial peeling therapy, glycolic acid is used at a concentration of 20-70%. Superficial peeling reaches into the epidermis and epidermal-dermal interface, thus resulting in thinning of the stratum corneum and a more even distribution of melanin. Indications for superficial peeling therapy are mild photoaging, keratosis, fine wrinkles, lentigenes, acne vulgaris, acne scars, and skin pigmentation problems, such as dyschromia and hyperpigmentation. After the application of glycolic acid, neutralization is required to terminate the chemical reactions on the skin. Neutralization is usually carried out by using water, sodium bicarbonate, sodium hydroxide, or ammonium salt solution.²¹ Meanwhile, modified Jessner's solution acts as a keratolytic agent and can enhance the effectiveness of other keratolytic agents. This solution consists of resorcinol, lactic acid, and salicylic acid in 95% ethanol. During chemical peel therapy, Jessner's solution is applied in two to three layers until erythema and frosting appear on the skin. Jessner's solution is often used before TCA 35% as a medium-depth peeling. The combination of Jessner's solution and TCA is effective for reducing melasma, acne scars, and

post-inflammatory erythema. If applied singly, then Jessner's solution acts as a superficial peeling agent.²² In this study, a modified Jessner's solution was administered to patients with a diagnosis of Glogau's photoaging II and III.

Post-peeling procedures are important to speed up the skin recovery process and prevent complications. After the peeling procedure, the patient should avoid direct sun exposure and use broad-spectrum sunscreens and moisturizers every day on a regular basis.²¹ This can reduce the risk of complications, such as pain, burning sensation, burning, PIH (postinflammatory hyperpigmentation), erythema, and a long healing process. In addition, the use of topical steroids, such as hydrocortisone, can reduce skin inflammation, sunburn, redness, pain, and hyperpigmentation.²³ In this study, the agents used for post-peeling therapy were sunscreen SPF 30 (86.5%), moisturizer (81.1%), and hydrocortisone 1% (67.6%).

For optimal results, superficial peeling therapy requires 4-6 repetitions with intervals of 2-4 weeks.²⁴ In this study, all skin-aging patients received superficial peeling therapy, but most of the patients (43.2%) did not do any follow-up. A total of 11 (29.7%) patients made only one follow-up. In the meantime, only 1 (2.7%) patient had 4 or 6 follow-ups. Most of the patients in this study did not have regular follow-up, so it would affect the therapeutic success.

According to this study, the majority of patients who received 20% glycolic acid peeling only had one follow-up and did not experience a change in the Glogau's photoaging score. Most of the patients who experienced improved Glogau's photoaging scores had two follow-up visits. Patients who experienced worsened Glogau's photoaging scores only had one follow-up visit. In addition to follow-up frequency, the therapeutic results depend on clinical conditions, patient compliance, and the risk of complications.²⁴ Several factors that affect patient compliance include patient factors such as age, education, motivation, and the patient-physician relationship; therapeutic factors such as duration, complexity, side effects, and degree of behavior change required; health facility factors such as accessibility and services; and socioeconomic factors such as patient activity, costs, and social support.²⁵ Thus, proper chemical peeling procedures and patients compliance are important factors to improve therapeutic outcomes.

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