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ALGORITHM FOR PRE-/POST-PROCEDURE
MEASURES FOR FACIAL NONENERGY-BASED
AND INJECTABLE SKIN TREATMENTS

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Algorithm for Nonenergy and Injectable Treatment Pre-/Post-Procedure Measures

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ABSTRACT

Background: Nonenergy and injectable treatments are frequently used for facial rejuvenation. Many publications have addressed methods to reduce adverse events related to the procedure; however, no algorithm exists on temporal before, during, and after measures for nonenergy and injectable treatments.

Methods: A panel of dermatologists and plastic surgeons convened a virtual meeting to develop an algorithm for measures before, during, and after nonenergy and injectable treatments based on the best available evidence and the panelists' experience and opinion. For the project, a Delphi method was applied, which was adapted from face-to-face meetings to a virtual meeting to discuss the outcome of literature searches to reach a consensus on the algorithm.

Results: The four sections of the algorithm address measures for optimizing outcome before, during, and after the procedure. Prevention includes avoiding excessive sun exposure and the use of a broad-spectrum sunscreen with an SPF 30 or higher. Before nonenergy-based and injectable treatments, the avoidance of alcohol, retinol peels, and agents such as acetylsalicylic acid and non-steroidal anti-inflammatory drugs, amongst other agents, is advised. Isopropyl alcohol, chlorhexidine, or hypochlorous acid (HOCl) prepare the skin before nonenergy and injectable treatments. The advisors recognize HOCl as particularly useful as it is active against bacterial, viral, fungal microorganisms and biofilm. The literature is inconsistent about the use of topical agents and skincare before and after the procedure.

Conclusions: The algorithm aims to support an optimal treatment outcome for their patients, providing physicians with guidance on measures before, during, and after nonenergy and injectable treatments.

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INTRODUCTION

Altered facial skin appearance due to photo- and chronological aging may be considered aesthetically displeasing to some patients and negatively impact the quality of life.¹⁻³

Depending on individual patient characteristics, expectations, and physician expertise, various treatment modalities are used for the aesthetic improvement of the aging face.

Nonenergy devices for aesthetic and cosmetic treatments include microdermabrasion, microneedling, threads, and chemical peels.⁴⁻⁸ Patients frequently choose these treatments due to the minimally invasive nature, reduced risks, and associated shortened downtime compared to ablative laser treatments and surgical modalities.^{7,8}

Nonenergy device-based treatments may improve skin condition inducing cutaneous changes that remodel the skin matrix.⁹ Potential adverse events (AEs) may occur, prolonging the duration and severity of the wound healing process also affected by the patient's existing systemic health condition, the type of treatment, and the settings of the device (eg, intensities, depth of passes).⁴⁻⁸ Signs and symptoms may resolve in a few days or up to several weeks.⁷

Nonsurgical procedures in the United States (US) were among the top five minimally invasive rejuvenation treatments and chemical peels performed in 2020, with a combined total of over 13.3 million yearly treatments.¹⁰ In addition, the American Society for Dermatologic Surgery reports that the number of

cosmetic procedures in 2018 amounted to over 12.5 million in the US alone.¹¹ With the inclusion of calcium hydroxylapatite and poly-L-lactic acid (31,821 and 28,036, respectively), the total amount of injectable treatments surpassed 2,671,130 procedures in 2018.¹¹

Injectables are a further fast-expanding treatment option for signs of facial aging. The American Society for Aesthetic Plastic Surgery (ASAPS) reported that over \$1 billion USD were spent on injectables in 2020. Together, botulinum toxin and soft tissue fillers such as hyaluronic acid injections made up the top two nonsurgical treatments performed in 2020, with 4.4 million and 3.4 million procedures, respectively; and with Botox® Cosmetic being the number one aesthetic procedure performed by plastic surgeons since 1999.¹⁰

Further injectable treatments include biodegradable facial lifting sutures.

Common injectable treatment-related AEs include bruising, erythema, inflammation, and pruritus.¹²⁻²³ Moderate-to-severe AEs such as infection (including biofilms), granulomas, nodules, skin necrosis, scarring, and vision loss or blindness occur less; however, these serious AEs will impact a significant number of patients given the many procedures performed annually worldwide by dermatologists/plastic surgeons/aesthetic medicine physicians.¹⁷⁻²³ Over 5,000 patients will experience an infection per year in the US as indicated by the ASAPS and the reported infection rates (including biofilm) in the literature.^{11,21} Therefore, there is a need for reducing the risks of injectable-related AEs.

Guidance and consensus documents describe best practices for performing nonenergy-based and injectable procedures; however, few discuss specific pre-and post-procedure measures.^{4-8,12-23} Two previously published surveys reported that no guidelines or algorithms are currently available concerning pre-and post-procedure measures and agents for nonenergy-based and injectable facial treatments and their use in preventing or treating post-procedural side effects or complications.^{24,25}

The current algorithm aims to provide clinicians with guidelines when treating patients with nonenergy-based and injectable treatments for facial rejuvenation to improve treatment outcomes.

METHODS

The Process

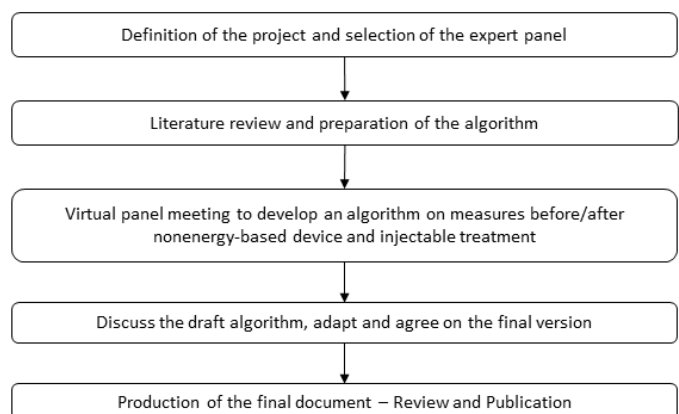
Following two highly successful face-to-face algorithm-generating events in September 2018 for alignment on the current standards for procedure-based therapy and February 2020 energy-based treatments for anti-aging, in April 2021,

a panel of dermatologists and plastic surgeons convened a virtual meeting to develop an algorithm on measures before and after facial nonenergy-based and injectable treatments. The panel members previously published two surveys^{24,25} on before and after measures for nonenergy-based and injectable facial treatments to prevent or treat post-procedural side effects or complications.

For the project, a modified Delphi, an interactive decision-making technique for medical projects, was applied.^{26,27} The method was adapted from face-to-face meetings to a virtual meeting to discuss the outcome of literature searches, including the two surveys to reach a consensus on the algorithm.^{26,27}

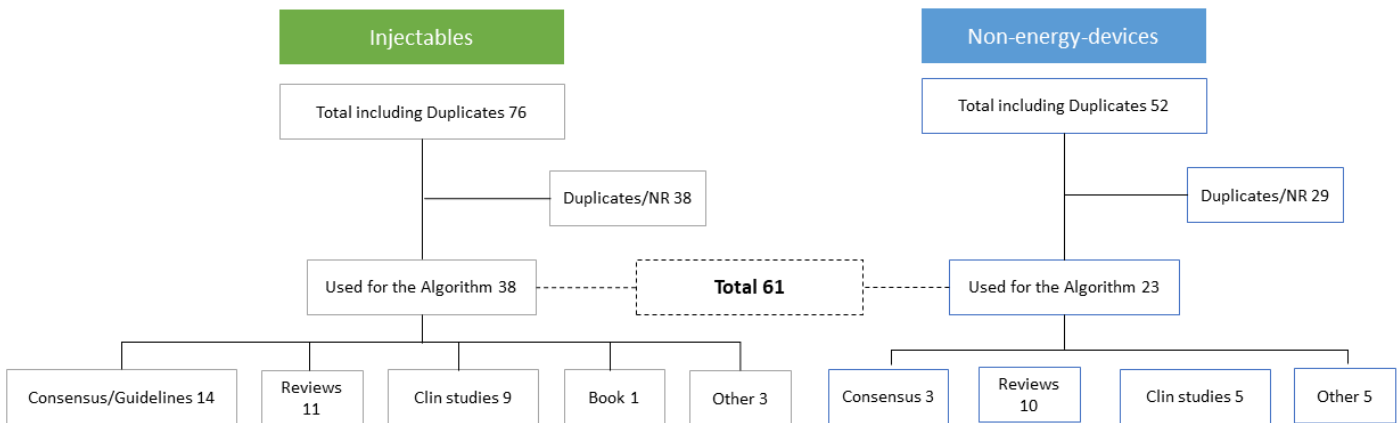
Based on literature searches, including two surveys, the panel discussed the proposed design of the algorithm.^{24,25} After presentations of the summaries of the literature searches and the proposed algorithm, the panel worked in small groups, advising their algorithm, editing, and revising it. They then reconvened into a plenary group to reach consensus through blinded reiterations and votes to determine the final algorithm. The panel obtained consensus through unanimous votes. Reviewing, finetuning, and discussing the manuscript, took place online due to the impact of the COVID-19 pandemic and the diverse geography represented by the panel (Figure 1).

FIGURE 1. Process.



Literature Searches

Before the expert panel meeting, a systematic literature review was conducted, selecting present clinical guidelines, algorithms, and evidence-based recommendations describing the current best practice measures before/after facial nonenergy-device and injectable treatments. Additionally, review articles, clinical trials, and other studies were selected that were clinically relevant to the algorithm. Publications were in the English language dating from 2015 to March 2021 and were searched on PubMed and Google Scholar as a secondary

FIGURE 2. Results of the systematic literature searches.

PubMed and on Google Scholar, as a secondary source, were searched on March 1 and 2, 2021 for English-language literature (2015–2021)

Not relevant: Other subject, poor quality, small number, case studies, in-vitro or in-vivo studies, animal studies

Not relevant (NR), clinical studies (clin studies)

Only two articles addressed explicitly before and after measures for nonenergy-based-device and injectable aesthetic treatments

source. For the literature search, we used the following terms: *Pre-/post-procedure measures for facial nonenergy-device and injectable treatments; Guidelines; Algorithm; Adverse events; Complications; Prevention; Pain; Bruising; Swelling; Discoloration; Infection; Reactivation of herpes simplex virus; Antiviral medication; Scarring; Comfort; Sun exposure; Skincare.*

Exclusion criteria were lack of original data, information not specific to facial nonenergy-device and injectable treatments, and publication in a language other than English. A dermatologist and a physician/scientist conducted the literature searches. Two reviewers independently evaluated the results of the literature searches.

Literature grading with the American Academy of Dermatology grading system was not relevant as only two articles addressed explicitly before and after measures for nonenergy-based-device and injectable aesthetic treatments.²⁸

The searches for nonenergy facial treatments yielded fifty-two articles. After removing duplicates and those that did not meet the inclusion criteria, twenty-three articles remained. For the injectable facial treatments, the searches yielded seventy-six articles. After removing duplicates and those that did not meet the inclusion criteria, thirty-eight articles remained, making a total of sixty-one articles for both nonenergy-based and injectable facial treatments (Figure 2).

RESULTS

The Algorithm

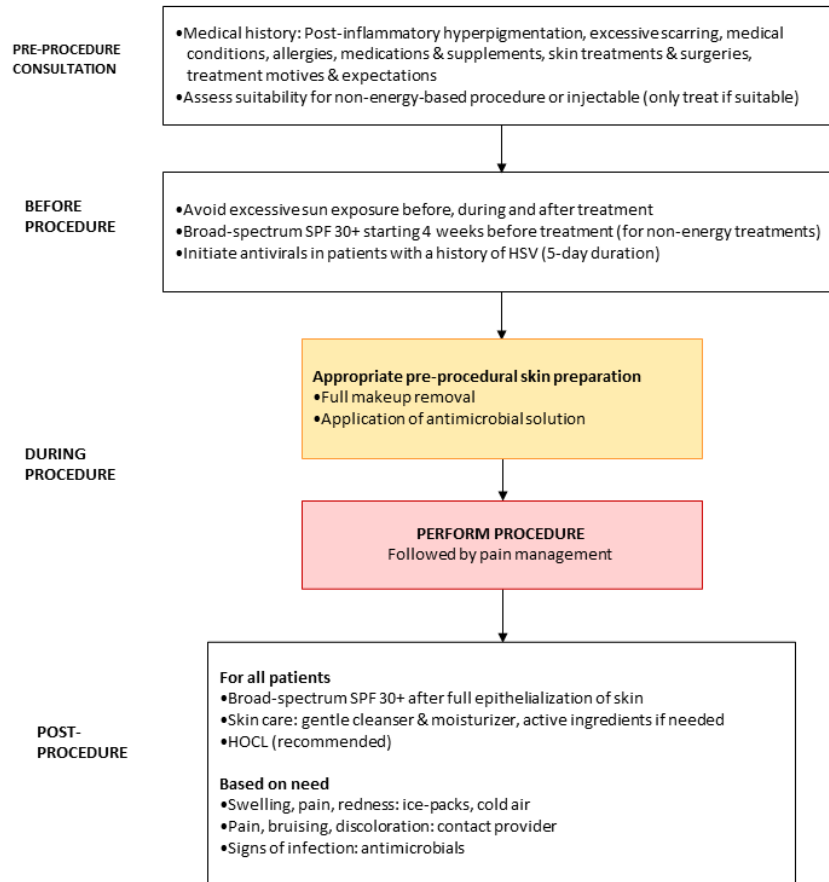
A clinical algorithm aims to support medical decision-making, such as standardizing the selection and use of treatment regimens, thereby improving adherence to evidence-based recommendations.^{28,29} A well-designed algorithm has inputs and outputs, has uniquely defined steps, and stops after a finite number of instructions.²⁹

Before and after measures for nonenergy and injectable facial treatments, the algorithm has four sections: prevention, before the procedure, during, and after the procedure (Figure 3).

Section 1: Prevention

The two previously published surveys showed that almost 95% of clinicians advised patients to avoid excessive sun exposure before, during, and after facial nonenergy-based and injectable treatments as sun exposure can contribute to post-inflammatory pigment alterations or limit the effectiveness of the procedure.^{24,25} To protect the face from sun exposure, broad-spectrum sunscreen with an SPF 30, or higher, is to be used and can be combined with protective measures such as wearing a wide-brimmed hat and sunglasses.^{24,25}

Before nonenergy-based and injectable treatments, the avoidance of alcohol, retinol peels, and agents such as acetylsalicylic acid and non-steroidal anti-inflammatory drugs (NSAIDs) amongst other agents is recommended (Table 1).^{24,25}

FIGURE 3. Measures before/after facial non-energy-based and injectable treatments.**TABLE 1.****Actions and Products Clinicians Advise Before Nonenergy-Based and Injectable Treatments (Adapted from Gold et al.^{24,25})**

Measures/Products Avoidance	Nonenergy Treatments		Injectables	
	Percentage (%)	Frequency (n)	Percentage (%)	Frequency (n)
Avoid sun exposure	94.5	103	81.3	91
Acetylsalicylic acid (i.e., Aspirin)	43.1	47	66.1	74
Ibuprofen	38.5	42	--	--
Naproxen (and other NSAIDs)	35.8	39	60.7	68
St. John's Wort	22.0	24	38.4	43
Vitamin E	24.8	27	42.9	48
Omega-3 fatty acids supplements/chondroitin	19.3	21	46.4	52
Flaxseed oil	12.8	14	27.7	31
Ginseng, garlic, ginger, Glucosamine	22.0	24	35.7	40
Fish oils	26.6	29	50.9	57
Alcohol	43.1	47	52.7	59
Retinol peels	48.6	53	--	--
^Other	11.0	12	10.7	12
Respondents	100	109	97.4*	112*

*Note: Sum does not equal 112 (97.39%) as some respondents selected multiple responses. ^Other included echinacea, feverfew, turmeric, prescription medications (eg, selective serotonin reuptake inhibitors), ice, dental work including dental cleaning, vaccination, anything that may cause bacteremia, local or systemic infection, inflammation, or increased immune response, exercise, water intake, caffeine, facials in previous 7 to 8 days and exercise.

TABLE 2.

Preparation of the Skin Before the Nonenergy and Injectable Treatment (Adapted from Gold et al. ^{24,25})				
Measures/Products	Nonenergy Treatments		Injectables	
	Percentage (%)	Frequency (n)	Percentage (%)	Frequency (n)
Isopropyl alcohol	70.6	79	84.4	97
Hypochlorous acid	17.4	16	13.9	16
Betadine	5.5	9	9.6	11
Chlorhexidine	45.0	39	47.0	54
Chloroxylenol	0.9	1	2.6	3
Acetone	26.6	22	7.8	9
Other	10.1	22	5.2	6
Respondents	100.0	109	100	116

Most clinicians who responded to a survey indicated not to use antiviral prophylaxis for nonenergy-based and injectable treatments.^{24,25} The literature supports universal oral antiviral prophylaxis, though, in practice, many clinicians only find this necessary in patients undergoing ablative procedures or those with a history of frequent herpes simplex virus outbreaks.^{24,25} The literature is inconsistent on what dose to give and when to start prophylactic antiviral treatment. Some authors recommend acyclovir (400 mg orally three times daily) or valacyclovir (500 mg orally two times daily), starting one day before the procedure and continuing for 6–10 days post-procedure.^{24,25}

Outside the algorithm's scope, the panel recommends using oral antiviral prophylaxis for patients undergoing ablative treatments. For those patients requiring antiviral prophylaxis, the oral antiviral should be used for five days, starting one day before the procedure.^{24,25}

As a pre-treatment before nonenergy and injectable procedures topical arnica/bromelain or products to prevent hyperpigmentation, especially in darker skin types (ie, Fitzpatrick Skin Types 4 to 6), have been recommended.^{24,25} Products applied for prevention and treatment of hyperpigmentation include topical hydroquinone (HQ), non-HQ agents to impact melanogenesis.^{24,25}

Section 2: Before the Procedure

Pre-screening for nonenergy and injectable treatments should include a thorough discussion with the patient, including the reason(s) for treatment, the patient's expectations of treatment outcome, and what to do after the procedure.^{24,25} This is followed by a detailed discussion about possible side-effects, complications, preventive measures, and signing the consent form before the treatment (Table 2).^{24,25} Both clinical and photographic outcome measurements are used to evaluate the primary outcome of the treatment.^{24,25}

The advisors agreed to take a complete medical history before

the nonenergy-based, or injectable treatment is initiated, asking the patient about their history of post-inflammatory hyperpigmentation, excessive scarring, drug allergies, and medical conditions. Further, the patient should be asked about previous facial treatments/surgeries, specifically chemical peels or dermabrasion, and the use of supplements and medication that could increase the risk of complications during the procedure.^{24,25} These agents include acetylsalicylic acid, ibuprofen, and vitamin E and should be avoided at least ten days before the procedure, unless prescribed for specific medical conditions.^{24,25}

The literature is inconsistent about the use of topical agents and skincare before and after the procedure.³⁰⁻³⁹

Section 3: During the Procedure

Before starting the procedure, the skin is free of makeup and should be cleansed with a gentle facial cleanser.¹⁶ Agents such as isopropyl alcohol, chlorhexidine, or hypochlorous acid (HOCl) are frequently used for skin preparation for nonenergy and injectable treatments.³⁶⁻⁴⁵ Isopropyl alcohol, although inexpensive, can irritate the skin and is flammable.^{24,25} Chlorhexidine is used extensively and provides effective antimicrobial skin cleansing.^{40,41} However, it has both ocular and ototoxicity, especially to the middle ear.^{40,41} When using chlorhexidine in peri-ocular areas, it may contact the ocular surface, and corneal damage can occur.^{40,41} Therefore, a suitable alternative that is safe to use in these areas should be selected.^{24,25,42-45}

The use of stabilized HOCl for skin preparation and after nonenergy or injectable procedures may have several benefits.^{24,25,42-45} Stabilized HOCl is highly active against bacterial, viral, and fungal microorganisms that have significantly harmful activity against biofilm and increases oxygenation of treatment sites to improve healing.^{24,25,42-45}

When choosing topical antiseptics, antimicrobial resistance should be taken into account, and factors such as geographic

TABLE 3.

Adverse Events and Measures	
Adverse Event	Percentage (%)
Pain	Pain medication is dependent on the patient and is at the discretion of the physician. Pain is an important marker of possible AEs and should be followed-up.
Purpura, bruising	After the treatment, the area will, in some cases, show a hematoma. The discoloration will fade over the next 7–10 days.
Swelling	Within a few hours after treatment, erythema or edema may occur over the treatment area. Areas most likely to swell are under the eyes and neck. The swelling subsides within 3–5 days if ice is regularly applied.
Infection. Swelling, redness, crusting, pain, and fever can be an indication of an infection.	In office follow-up is required and based on the findings topical antiseptics or oral antibiotics should be used.
Reactivation of herpes simplex on the face.	Prophylactic oral virostatic therapy (acyclovir, valacyclovir, famcyclovir) is recommended when the patient has frequent herpetic recurrences (more than 6 per year), starting the day before treatment.
Skin darkening (hyperpigmentation)	Fades within 2–6 months. This reaction is more common in patients with darker skin types (Fitzpatrick 4–6). The darkening worsens if the treated area is exposed to the sun. Topical bleaching cream, such as hydroquinone, can be used to speed up the process.

region/practice setting (outpatient vs hospital-based) associated with microbial epidemiology.^{24,25,46-48}

The treatment of pain and anesthesia for nonenergy and injectable procedures should be at the treating physician's discretion and is dependent on the patient and the type of treatment administered.⁴⁹⁻⁵³

Section 4: Post-Procedural Care

Operator education and experience reduce complications from nonenergy and injectable treatments.^{5-8,12-25} The duration and severity of nonenergy treatment-related AEs duration and severity are affected by many factors, such as the patient's preexisting systemic health conditions, the type of treatment performed, and the settings of the device (eg, intensities, depth of passes).²⁴ Many clinicians may not be aware of proper techniques and critical anatomy. Common AEs are purpura, hematoma and edema.²⁴ Common areas most likely to develop edema after treatment are under the eyes and in the neck.^{24,30,33,36,50} The edema usually subsides within 3–5

days and regular use of icepacks may help.²⁴ AEs signs and symptoms may be resolved in a few days or take up to several weeks (Table 3).³⁶ The lack of consistency or standard for post-care protocols may contribute to the variability in AE severity and healing times.^{24,36}

Epidemiological studies on injectables-related AEs report significant variations in incidence.^{20,25,54-60} After injectable treatments, hematoma has been reported to occur in 19% to 68% of cases.^{23,54} Other common complications compiled from the MAUDE database between January 2007 and July 2017 associated with dermal fillers are nodules (2952), infection (2575), inflammation (711), and allergic reactions.⁵⁶ More severe AEs include vision loss, blindness, and facial skin necrosis.^{54,56-60} The rates of AEs may be much higher as many disciplines are involved in the administration of injectables and may not be fully aware of the proper techniques and risks associated with each product.⁵⁶

Another study found that infections, including biofilms,

TABLE 4

After Nonenergy and Injectable Treatment Care
After Treatment Care
To prevent or reduce swelling, post-treatment cooling with ice packs (or cold air) is advised on areas such as cheeks or neck after treatment until any pain or redness has disappeared. The ice or frozen cold pack should be wrapped in a soft cloth and applied for 10–15 min each hour for four hours.
If treatment has been performed close to or around the eye, there will be a risk of periocular swelling. Patients should be instructed to sleep with an extra pillow to encourage gravitational removal of leaked edema fluid.
Patients should be instructed to avoid sun exposure (along with sun-protection measures like filters with SPF 50 plus UVA block) to prevent post-inflammatory hyperpigmentation.
Explain the importance of not picking or scratching in treated areas.
A mild, non-irritating cleanser can be used twice daily on the treated areas.
Makeup can be used immediately after treatment except if blistering occurs; in this case, it can be applied until after any crusting has settled.
Patients should avoid swimming and contact sports while the skin is healing.
In the case of blistering with open wounds, a healing regime should be applied.

were reported anywhere from 0.04% to 0.2%.³⁷ Biofilms are particularly problematic as they are challenging to treat.³⁶ Most post-procedure infections are associated with pain, swelling, delays healing, and may lead to scarring and require an in-office evaluation.^{37-39,51-56}

Few injectors regularly use prophylactic therapy before or after injectable treatment. When products were used to avoid or manage AEs, the heterogeneity of the measures prohibited identifying or establishing a standard.⁶¹

Given the large amount of aesthetic injectable treatments performed per year, the incidence rates of AEs, and the lack of any standard before, during, and after treatment measures, AE risk reduction must direct efforts at validating and standardizing these measures.^{24,25}

Post-procedure, the advisors recommend avoidance of sun exposure, topical retinoids, and ascorbic acid/hydroxy acids to reduce the risk of proinflammatory pigment alteration or inflammation. They further advised to delay hair removal (eg, shaving, depilatories) between 24-hours post-procedure to two weeks post-procedure, depending on the procedure and specific patient requirements. Patients are advised to keep the treated site clean using a gentle cleanser and to keep the skin moist using a fragrance-free moisturizer (Table 4).

Various products are provided by clinicians to patients or recommended to use at home post-aesthetic nonenergy and injectable procedures. These products include white petrolatum, topical antiseptic cream or ointment, HOCI containing products, or products containing arnica or bromelain.^{24,25}

Currently, there are no standards of practice for clinicians when using before, during, and after procedural measures for nonenergy and injectable treatments.^{24,25} Given the large amount of nonenergy and injectable treatments performed per year, the incidence rates of AEs, and the lack of standard before, during, and after procedural measures, AE risk reduction must direct efforts at validating and standardizing these procedural measures.

LIMITATIONS

Statements used in the algorithm were based on a mix of data and expert opinion. While alternatives for before and after measures for nonenergy-based-device and injectable treatments could exist, the statements suggest best practices developed from a panel of expert clinicians supported by peer-reviewed literature. However, there is a lack of literature that explicitly addresses before and after measures for nonenergy-based-device and injectable treatments.

CONCLUSIONS

The algorithm designed to support optimal treatment outcomes addresses measures for prevention before, during, and after nonenergy and injectable facial treatments.

Prevention includes sun avoidance and the use of a broad-spectrum sunscreen with an SPF of at least 30. Oral antiviral prophylaxis is recommended for those with a history of HSV-1. Stabilized HOCI has benefits for pre-, peri-, and post-procedure management combined with an emollient. A purpose-designed antimicrobial option for preparing the skin, as well as a topical post-treatment option, would be welcome.

CONCLUSIONS

Swiss American, LLC supported the research and development of the algorithm with an unrestricted educational grant.

The pre-/post-procedure measures project group (authors) produced three published surveys: 1) Laser and energy devices, 2) Nonenergy devices, and 3) Injectables and one algorithm on laser and energy devices. The current algorithm addresses pre-/post-procedure measures for nonenergy-based and injectable skin treatments.

The information obtained from the survey on nonenergy devices and injectables is used for the algorithm.

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