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Algorithm for Pre-/Post-Procedure Measures for Facial Laser and Energy Devices Treatment

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Algorithm for Pre-/Post-Procedure Measures for Facial Laser and Energy Devices Treatment

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ABSTRACT

Background: Laser and energy devices may be used for the treatment of facial aging signs. While previous investigators have evaluated methods of reducing risks of adverse events due to the treatment procedure itself, no algorithm exists on peri-procedure measures for laser and energy device treatment.

Methods: A panel of dermatologists and plastic surgeons was convened for a meeting to develop an algorithm for peri-procedure measures for facial laser and energy devices treatment. A modified Delphi technique was used to develop the algorithm, which was based on the best available evidence, the outcome of a previous survey on the subject coupled with the panelists' experience and opinion.

Results: The four sections of the algorithm address prevention, pre-procedure, during the procedure, and post-procedure measures. Prevention includes the avoidance of excessive sun exposure before and the use of a broad-spectrum sunscreen with an SPF 30 or higher. The panel recommends the use of oral antiviral prophylaxis for patients undergoing ablative laser treatments. Products for pre- and post-procedure management that combine bacterial, antiviral, and antifungal activity while stimulating wound healing offer benefits. When used after resurfacing, the use of such products is to be followed by the application of an emollient.

Conclusions: The algorithm was designed as a tool to support an optimal treatment outcome providing physicians with guidance to choose the best pre-/post-procedure measures for their patients.

J Drugs Dermatol. 2021;20:1(Suppl):s3-11

BACKGROUND

Both internal and external factors such as solar radiation, air pollution, tobacco smoke, and poor nutrition may trigger facial aging.[1,2] Various processes are involved in skin aging, including elevated production of reactive oxygen species (ROS), thereby inducing cellular inflammatory infiltrates, and damaging the dermal extracellular matrix (ECM) and protein structures.[1,2]

Laser and energy devices are frequently used for facial rejuvenation. The choice of treatment depends on individual patient characteristics and expectations and physician expertise.[3-5] For optimal treatment outcomes, patients should be appropriately selected, screened, followed by a physical exam of the face before treatment.[6]

A previously published survey showed that currently, no guidelines or algorithms are available concerning periprocedural agents for laser skin resurfacing and their use in prevention or treatment of post-procedural side effects or complications.[6]

The current algorithm aims to be a tool for clinicians to use when treating patients with laser and energy devices for facial rejuvenation.

METHODS

The Role of the Panel and Process

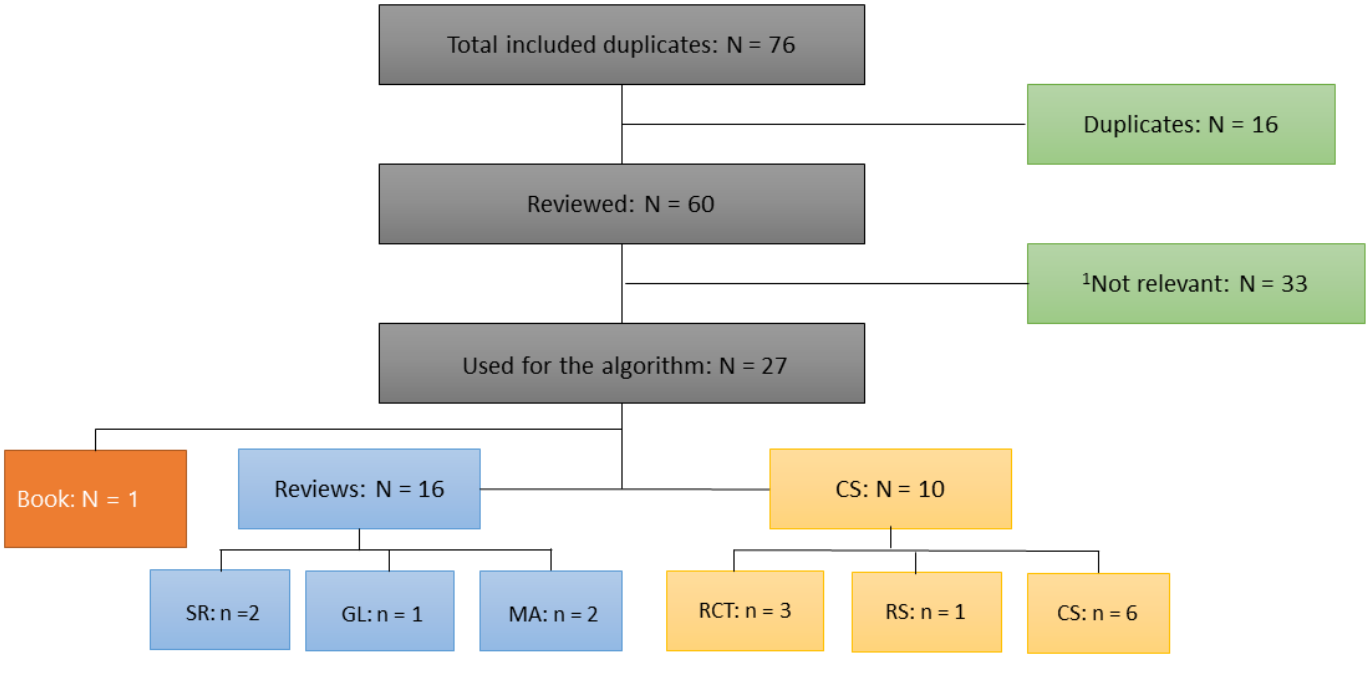
In February 2020, a panel of dermatologists and plastic surgeons who regularly treat clinical signs of facial photoaging was convened for a meeting to develop an algorithm for pre-/post-procedure measures for facial treatment using laser and energy devices. The panel members were selected from the working group on pre-/post-procedure measures for facial aging signs and are authors of the survey on these measures.[6]

For the development of the algorithm, the best available evidence, outcome of a survey[6] coupled with the panelists' opinion, was used.

The process applied for this project followed a modified Delphi technique.[7-9]

The panel, consisting of seven members, discussed the proposed design of an algorithm for pre-/post-procedure measures, which was developed based on the selected literature from the conducted searches. 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 at length. The panel then reconvened into a plenary group to define the algorithm. The panel was to reach consensus through blinded reiterations and votes as an eighty-five percent (6/7) agreement was obtained to determine the final algorithm. Reviewing, finetuning, and discussing the manuscript took place online due to the impact of the COVID-19 pandemic and the diverse geographical locations of the panel.

FIGURE 1. Results of the systematic literature searches.



[1]Not relevant: Other subject, poor quality, small number, case studies, in vitro or in vivo studies, animal studies. Clinical studies (CS); Randomized controlled trials (RCT); Retrospective studies (RS); Cross-sectional studies (CS); Systematic reviews (SR); Guidelines (GL); Meta-analysis (MA)

TABLE 1.

Systematic Literature Searches: Clinical Studies on Facial Laser/Energy Devices			
Nr	**Search Category**	**Search Term**	**Results**
1.	Treatment and treatment options		
1.1	Studies on facial laser	laser/IPL, PDL, KTP, and Nd:YAG laser procedures AND facial aging	8
1.2	Studies on complications using facial laser and treatment options	Facial laser/energy devices AND complications	6
		Total including duplicates	14
		Duplicates	4
		TOTAL	10

Total clinical studies 10; Grade A: 0; Grade B: 3; Grade C: 7
Grade A: Randomized, double-blind clinical trial of high quality, Grade B: Randomized clinical trial of lesser quality (eg, only single-blind; limited sample size, but with at least 15 patients per study arm); Grade C: Comparative trial with severe methodologic limitations.[10]
Intense pulsed light (IPL), Pulsed dye laser (PDL),Neodymium: yttrium-aluminum garnet (Nd:YAG laser); 532nm potassium-titanyl-phosphate (KTP)

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 in pre-/post-procedure measures for facial laser and energy devices treatment. Additionally, review articles, clinical trials, and other studies were selected that were clinically relevant to the algorithm addressing pre-/post-procedure measures for facial laser and energy devices treatment. Publications were in the English language dating from 2012 to January 2020. For the literature search, we used the following terms:

Pre-/post-procedure measures for facial laser and energy devices treatment; Guidelines; Algorithm; Adverse events; Complications; Prevention; Pain; Bruising; Swelling; Discoloration; Infection; Reactivation of herpes simplex virus; Antiviral medication; Scarring; Comfort; Sun exposure; Skincare; Wound healing regimen.

Exclusion criteria were lack of original data, information not specific to pre-/post-procedure measures for facial laser and energy devices treatment, 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 searches. The American Academy of Dermatology grading system was used for categorizing the selected publications.[10]

The searches yielded seventy-six articles. After removal of duplicates and those that did not meet the inclusion criteria, twenty-seven articles were included (Figure 1). Of the ten selected clinical studies, three were graded B and seven were graded C (Table 1).[10] An additional four papers were selected describing the use of antimicrobial measures.

RESULTS

The Algorithm

An algorithm is a precise, unambiguous, logical step-by-step method used to solve a problem.[9] 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. A well-designed algorithm has inputs and outputs, has uniquely defined steps and stops after a finite number of instructions.[9]

The algorithm for pre-/post-procedure measures for facial laser and energy devices treatment has four sections: prevention, pre-procedure, intra-procedure, and post-procedure.

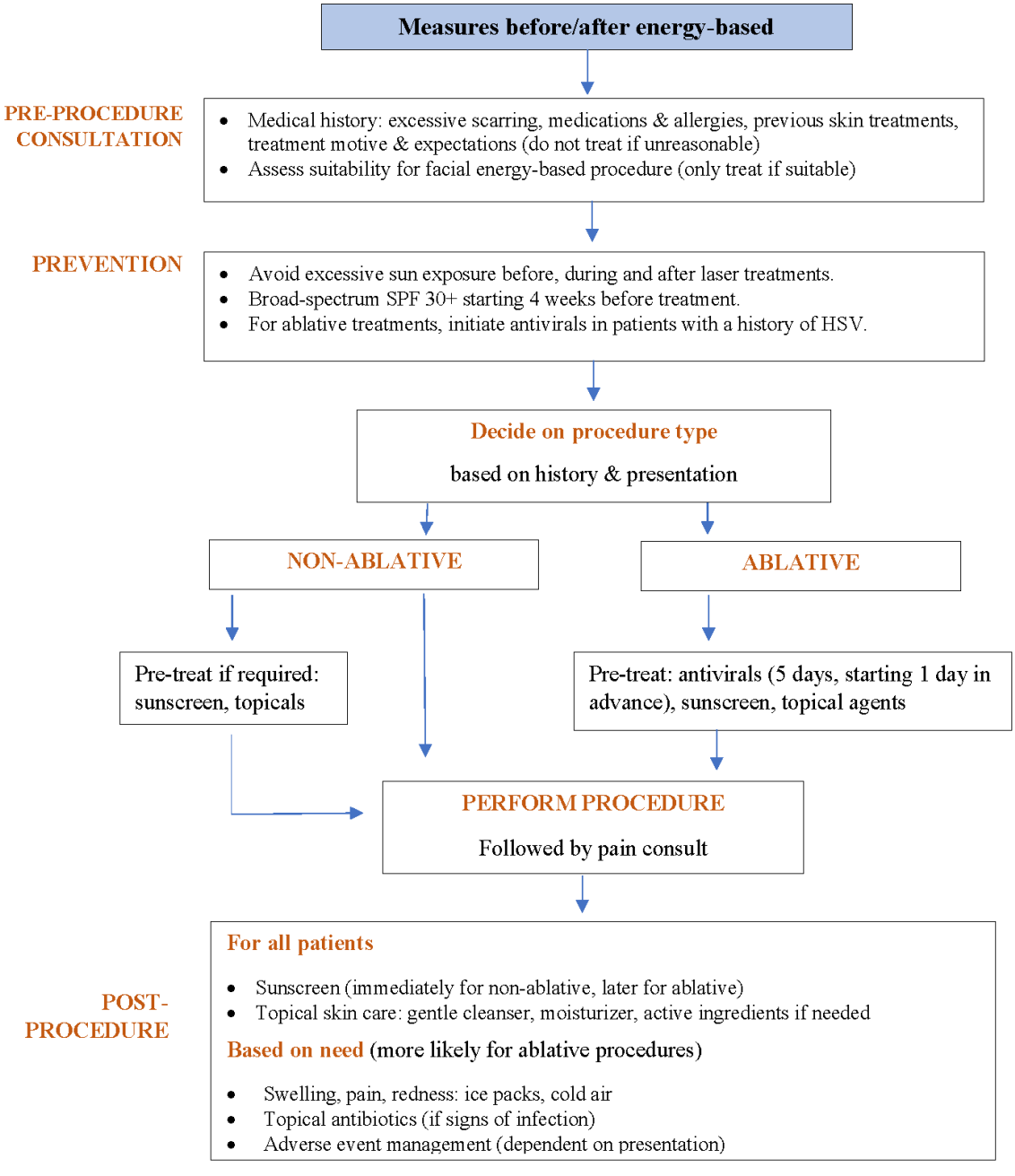
Section 1: Prevention

The patient should avoid excessive sun exposure before, during, and after treatments as sun exposure can contribute to post-inflammatory changes, or limit the effectiveness of the procedure.[5,6,11,12] To protect the treated skin from sun exposure a broad-spectrum sunscreen with an SPF 30, or higher, is to be started at least four weeks prior to the first laser or another energy device treatment.[5,6,11,12]

The literature supports universal oral antiviral prophylaxis, though, in practice, many clinicians only find this necessary/helpful in patients undergoing ablative procedures.[6] It is unclear from the literature what dose to give and when to start prophylactic antiviral treatment.[5,6,13-16] 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.[5,6,13-16]

A survey completed by fifty-six dermatologists and surgeons showed that oral prophylactic antivirals were used before treatment by 96% of the respondents.[6] Of the fifty-five

FIGURE 2. Algorithm for pre-/post-procedure measures for facial laser and energy devices treatment.



respondents, most physicians started the antiviral one day before the procedure (thirty-two [58.2%]), fifteen (27.3%) started the same day, one physician (1.8%) started the antiviral one day after the procedure, and seven (12.7%) answered "other".[6] The antiviral was typically used for five days (twenty-five [50.0%]) or seven days (seventeen [34.0%]).[6]

The panel recommends the use of oral antiviral prophylaxis for patients undergoing ablative treatments and that the oral antiviral should be used for five days, starting one day before the procedure.

TABLE 2.

Pre-procedure Measures for Laser and Energy Device Treatment	
Which Patients	**Details**
All patients	Screening of skin condition and skin type
All patients	Avoid excessive sun exposure before, during, and after treatments. Use a broad-spectrum sunscreen with an SPF 30 or higher in a sun-tanned individual. Start at least 4 weeks before the first laser or other energy device treatment.
All patients undergoing ablative laser treatment	Prophylactic oral antivirals such as acyclovir (400 mg orally three times daily) or valacyclovir (500 mg orally two times daily), starting typically one day before resurfacing and continuing for 6–10 days post-procedure.
Patients undergoing ablative laser treatment with baseline melasma or post-inflammatory hyperpigmentation	Pre-procedure hydroquinone 2–4% cream twice per day (or equivalent), in morning and evening.
Individual patients undergoing ablative laser treatment having significant or moderate risk for infection	Pre-, peri-, and post-procedure treatment using, for instance, HOCl spray is beneficial. Antibiotic prophylaxis with a broad-spectrum agent such as cefdinir is used for specific cases.
Optional	Retinoic acid 0.05–0.1% cream (0.5–1 g Retin-A) in evening.

Hyperpigmentation may occur post ablative laser resurfacing, especially in those individuals with darker skin tones.[3,5,17] A survey completed by fifty-six dermatologists and surgeons showed that topical hydroquinone was the preferred choice to be recommended for prophylaxis, together with diligent physical block sunscreen use and strict sun avoidance.[6] Other topical pigment-correction agents that may be used include retinoic, tranexamic, kojic, azelaic, and glycolic acids.[6] The panel agreed that pre-procedure hydroquinone, or equivalent, is appropriate for patients with baseline melasma or post-inflammatory hyperpigmentation, but not routinely recommended for darker skin types due to lack of evidence and medicolegal concerns.

Section 2: Pre-Procedure

Pre-screening should include a thorough discussion with the patient, including what to do after the procedure.[6] A complete medical history should be taken before a laser or other energy-device treatment is initiated, asking the patient about their history of post-inflammatory hyperpigmentation, excessive scarring, drug allergies, and medical conditions, specifically connective tissue and immune disorders.[5,6,11,12] Further, the patient should be asked about previous facial treatments, specifically chemical peels or dermabrasion, and the use of supplements and medication that could increase the risk of complications during the procedure.[5,6,11,12] These medications include aspirin, ibuprofen, and vitamin E and should be avoided for at least ten days before the procedure.[5,6,11,12]

Before the treatment, the reason(s) why the patient is seeking treatment is to be recorded, including the expectations from the procedure.[6] This is followed by a detailed discussion about possible side-effects, complications, and preventive measures and signing the consent form (Table 2).[6] Both clinical and photographic outcome measurements are used to evaluate the primary outcome of laser/intense pulsed light (IPL) procedures.[5,6,11,12]

Section 3: Choose and Perform the Intra-Procedure

Patients who don't spend time outside can start laser treatment on the same day of consultation. According to the panel, antimicrobial prophylaxis is only required in specific circumstances (eg, infection, heart disease) for ablative procedures. The use of antiseptic pre-treatment is a subject for debate since emerging antimicrobial resistance (AMR) is a growing concern, and dermatologists are among the most frequent prescribers of topical antibiotics.[21]

AMR has become one of the most important determinants of outcomes in patients with infections.[19-22] The cost of AMR is immense, both economically and for patients' quality of life. The continued rise in AMR would cost up to 100 trillion United States Dollars.[19] Global consumption of antibiotics in human medicine rose by nearly 40% between 2000 and 2010.[23]

Resistance is often associated with prolonged use of antibiotics or common strains of bacteria.[24] AMR is facilitated by various factors, including inappropriate use of medicines (eg, using antibiotics for viral infections), sharing antibiotic prescriptions between patients, low-quality medicines, inappropriately assigned prescriptions, and inadequate infection prevention and control.[24]

Antimicrobial stewardship is defined as "the optimal selection, dosage, and duration of antimicrobial treatment that results

TABLE 3.

Complications From Laser Treatment	
Adverse Event	**Details**
Pain	The snapping and burning sensation of each laser pulse can produce a minimal to moderate amount of discomfort. Pain is an essential marker of possible side-effects occurring so; generally, anesthesia should be avoided.[5,6]
Purpura, bruising	Immediately after the laser treatment, the area will, in some cases, appear grey or blue-black in color. The discoloration will fade over the next 7–10 days.[5,6,11,12,18]
Swelling	Within a few minutes after the laser treatment, erythema and 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. Parallel and post-cooling will diminish the amount of edema.[5,6,11,12,18]
Discoloration, blisters, scabs	These adverse events rarely develop and are mostly caused by overtreatment. Grey or pale white discoloration of the epidermis is a sign of early dermal damage indicating inappropriately high radiant exposures. This sign will last only a few seconds.
Blister formation, epidermal disruption and epidermal necrosis (dermal in severe cases)	Intense cooling, reduction of radiant exposure, and prolongation of the pulse duration should be considered. These can take 1–2 weeks to resolve. The findings can be immediate or delayed, so it is essential to carefully observe the treated test spot for at least 5 min before proceeding with full treatment.
Infection. Swelling, redness, crusting, pain, and fever can be an indication of an infection.	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 laser treatment.
Skin darkening (hyperpigmentation)	Fades within 2–6 months. This reaction is more common in patients with darker skin types (Fitzpatrick III–V). The darkening worsens if the laser-treated area is exposed to the sun. Topical bleaching cream, such as hydroquinone, can be used to speed up the process.
Skin lightening (hypopigmentation)	Mostly caused by overtreatment. Pale areas usually darken or re-pigment within 3–6 months. But they could be persistent, most frequently on the neck.
Skin texture changes	They are mostly caused by overtreatment – in cases when excessive radiant exposures or overlapping laser spots are used.
Scarring	It is mostly caused by overtreatment when excessive radiant exposures or overlapping laser spots are used. In general, scarring after PDL and KTP laser treatments is very rare; it is a bit more common with alexandrite laser, while the risk is highest with Nd:YAG laser due to the deepest laser light penetration. It can occur on the disruption of the skin surface. Following all advised postoperative instructions can reduce this possibility. Lesion persistence and non-responders. Some vascular lesions may not go away entirely despite the best effort made.

Gold M, Andriessen A, Cohen JL et al. *J Cosmet Dermatol.* 2020;19:289–295; Dierickx C. *Lasers Surg Med.* 2018;50(1):51–55.
Ibrahimi OA, et al. *Ablative and Non-Ablative Lasers. Part 3. Aesthetic Surgical Procedures.* London, UK: Elsevier Inc: 2015; 549-560.
Intense pulsed light (IPL), Pulsed dye laser (PDL); Neodymium: yttrium-aluminum garnet (Nd:YAG laser); 532nm potassium-titanyl-phosphate (KTP)

in the best clinical outcome for the treatment or prevention of infection, with minimal toxicity to the patient and minimal impact on subsequent resistance."[25] When choosing topical antibiotics and antiseptics, antimicrobial resistance should be taken into account, and factors such as geographic region/practice setting (outpatient vs hospital-based) which are associated with microbial epidemiology.[22-25]

Before starting the procedure, the skin is to be free of make-up and should be cleansed with a gentle facial cleanser.[17] For preparing the skin before treatment, topical agents such as isopropyl alcohol, chlorhexidine, or hypochlorous acid (HOCl) are frequently used.[6,26] Isopropyl alcohol, although inexpensive, can irritate and is flammable.[6,26] Chlorhexidine is used extensively and provides effective antimicrobial pre-surgical skin cleansing.[6,27,28] However, it has both ocular- and ototoxicity, especially to the middle ear.[27,28] When chlorhexidine is used in peri-ocular areas, it may come into contact with the ocular surface and corneal damage can occur.[27,28] Therefore dermatologists, plastic surgeons, and other healthcare providers

TABLE 4.

Post-Laser Treatment Care
To prevent or reduce swelling, post-treatment cooling with ice packs (or cold air) is advised on larger areas such as cheeks or neck after the laser 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 minutes each hour for 4 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.
Make-up can be used immediately after treatment except if blistering occurs; in this case, it can be applied until after any crusting has settled.
Showers are allowed, but prolonged bathing or sauna is not advised.
The treated area is extremely delicate and must be handled with care during the initial healing phase (7–10 days).
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.

After alexandrite, diode, or millisecond Nd:YAG lasers the skin appears mildly erythematous with oedema.[5,6]
After PDL with specific parameters, the skin appears purpuric with surrounding tissue hyperaemia.[5,6]

who treat facial areas should choose suitable alternatives that are safe for use in these areas.[26,29,30]

The use of stabilized HOCl for pre-, peri-, and post-procedure management may have several benefits.[26,29,30] Stabilized HOCl is highly active against bacterial, viral, and fungal microorganisms that have significantly harmful activity against biofilm and increases oxygenation of wound sites to improve healing.[26, 29,30]

Complications from laser treatment are reduced by operator education and experience and may include pain, purpura, bruising, and swelling.[5,6,11,12,18]

The treatment of pain and anesthesia should be at the treating physician's discretion and is dependent on the patient.

Section 4: Post-Procedure

Information on adverse events and measures that can be taken is given in Table 3. Purpura or bruising may occur immediately after the procedure but will subside over 7–10 days.[5,6,11,12,17,18]

The common areas most likely to develop post procedure edema are under the eyes and in the neck.[5,6,11,12,17,18] The edema usually subsides within 3–5 days if ice packs or cold packs are regularly applied. Parallel and post-cooling will also diminish the amount of edema.[5,6,11,12,17,18]

Discoloration, however, rare, may be caused by overtreatment, but may also occur if the treatment was without events. Grey or pale white discoloration of the epidermis is a sign of early dermal damage indicating inappropriately high radiant exposures and will last only a few seconds.[11,12]

Partial- or full-thickness wounds can result from the ablative laser treatment, whereas nonablative laser may cause small epidermal wounds.

A post-procedure infection causes pain and swelling and may delay wound healing, even leading to scarring.[16] Therefore when edema and crusting occurs, it may require an in-office evaluation.[6]

Our literature searches showed there is a lack of consistency or standard in post-care therapeutic measures such as for wound healing.[6] The panel agreed that in the case of blistering with open wounds, a healing regime should be applied

Currently, gentle cleansers or an antimicrobial spray[26] are advised for at least two weeks post-procedure.[6] Evidence suggests skincare, immediately before the procedure, and throughout the healing phase, can stimulate healing.[31] An antimicrobial spray containing HOCl can be applied during all stages of laser procedures.[26] From pre-procedure for removing excess make-up through peri-procedure (spraying on the face/cold packs) to long-term post-procedure for infection prevention and stimulating healing.[26,29-31] When used after resurfacing, the spray is immediately post-procedure applied and combined with an emollient.[26] For at-home care, the spray may be applied 3–4 times a day during the first-week post-procedure.[26]

The use of a clear amorphous antimicrobial gel containing ionic silver with high solubility designed to provide a moist wound healing environment while controlling bioburden with broad-spectrum antimicrobial protection without risk for resistance (US8568711; CA2692094; EP2170081) has been suggested for at-home, post-procedure care. Silver has a strong antimicrobial activity, and there is longstanding experience with its use in wound treatment.[32-34] There are various types of silver formulations used, of which sulfadiazine is shown to slow wound healing, whereas nanocrystalline silver has been shown to have benefits.[32-34] There is some evidence showing the benefits of silver containing products for short-term use in infected wounds.[32-34] However, most of the studies lack robustness.[32-34]

According to the panel, there is an ongoing debate on the use of antimicrobial prophylaxis, which may be necessary for individual cases when the risk for postoperative infection is significant.[6] Antimicrobial stewardship is needed while taking into account the patient's condition. Details on post-laser care are provided in Table 4.

For post-procedure treatment, at home, a purpose-designed topical treatment option is currently lacking that may reduce inflammation and potentially the amount of downtime, and even maybe manage scarring outcomes.[6]

LIMITATIONS

The current algorithm aims to be a tool for clinicians to use when treating patients with laser and energy devices for facial rejuvenation. For preparing the skin frequently, products are used that are not purpose-designed for laser and energy devices treatment of the face. At the same time, the choice does not take into account antimicrobial stewardship. More research is needed to develop and evaluate measures that are suited for the purpose and reduce the risk of antimicrobial resistance.

CONCLUSION

The algorithm designed to support optimal treatment outcomes addresses prevention, pre-procedure, during the procedure, and post-procedure measures. 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 ablative laser treatments. Stabilized HOCl 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.

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The pre-/post-procedure measures project group (authors) produced three published surveys: 1) Laser and energy devices, 2) Non-energy devices, and 3) Injectables.

The information obtained from the survey on laser and energy devices is used for the algorithm.

REFERENCES

1. Krutmann J, Bouloc A, Store G, et al. The skin aging exposome. *Dermatol Science.* 2017;85(3):152-61.
2. Porcheron, A, Latreille, J, Jdid, R, Tschachler, E, Morizot, F. Influence of skin ageing features on Chinese women's perception of facial age and attractiveness. *Int J Cosmet Sci.* 2014;36:312-20.
3. Dierickx C. Using normal and high pulse coverage with picosecond laser treatment of wrinkles and acne scarring: Long term clinical observations. *Lasers Surg Med.* 2018;50(1):51-55. doi: 10.1002/lsm.22763. Epub 2017 Nov 15.
4. Wu DC, Fitzpatrick RE. Facial rejuvenation via sequential combined use of multiple laser modalities: Safety and efficacy. *Lasers Surg Med.* 2016;48(6):577-83.
5. Ibrahimi OA, Saedi N, Kilmer SL. Laser-based treatment of the aging face for skin resurfacing: Ablative and nonablative lasers. Part 3. *Aesthetic Surgical Procedures* 2015;Elsevier Inc:549-560. DOI:10.1016/B978-0-323-26027-5.00034-6
6. Gold M, Andriessen A, Cohen JL, Goldberg DJ, Grover K, Hu S, et al. Pre-/post-procedure measures for facial laser and energy devices treatment: A survey. *J Cosmet Dermatol.* 2020;19(2):289-295. https://doi.org/10.1111/jocd.13259
7. McMillan SS, King M, Tully MP. How to use the nominal group and Delphi techniques. *Int J Clinical Pharmacy.* 2016;38(3):655-662.
8. Søndergaard E, Ertmann RK, Reventlow S, Lykke K. Using a modified nominal group technique to develop general practice. *BMC Family Practice.* 2018;19(1):117.
9. Evans GW. Artificial intelligence: Where we came from, where we are now, and where we are going. University of Victoria. 11 July 2017. Available at: https://dspace.library.uvic.ca/handle/1828/8314 (accessed 2020).
10. Smith Begolka W, Elston DM, Beutner KR, et al. American Academy of Dermatology evidence-based guideline development process: responding to new challenges and establishing transparency. *J Am Acad Dermatol.* 2011;64(6):e105-12.
11. Adamic M, Pavlovic MD, Troilius Rubin A, Palmetun-Ekbäck M, Boixeda P. Guidelines of care for vascular lasers and intense pulse light sources from the European Society for Laser Dermatology. *J Euro Acad Dermatol Venerol.* 2015;29(9):1661-1678; PMID: 25931003 DOI: 10.1111/jdv.13177
12. Jonson D, Paletta F. Skin resurfacing procedures of the upper face. *Atlas Oral Maxillofac Surg Clin North Am.* 2016;24:117.
13. World Health Organisation. Globally, an estimated two-thirds of the population under 50 are infected with herpes simplex virus type 1, 2015. http://www.who.int/mediacentre/news/ releases/2015/herpes/en/
14. Balasubramaniam, R, Kuperstein, AS, Stoopler, ET. Update on oral herpes virus infections. *Dental Clinics of North America.* 2014;58(2):265-80.
15. Beeson WH, Rachel JD. Valacyclovir prophylaxis for herpes simplex virus infection or infection recurrence following laser skin resurfacing. *Dermatol Surg.* 2002;28(4):331-36.
16. Nestor MS. Prophylaxis for and treatment of uncomplicated skin and skin structure infections in laser and cosmetic surgery. *J Drugs Dermatol.* 2005(Nov-Dec);4(6 Suppl):s20-5.
17. Alster TS, Lupton JR. Prevention and treatment of side effects and complications of cutaneous laser resurfacing. *Plast Reconstr Surg.* 2002;109:308-16.

18. Tremaine, AM, Avram MM. FDA MAUDE data on complications with lasers, light sources, and energy-devices. *Lasers Surg Med.* 2015;47(2):133-140. https://doi.org/10.1002/lsm.22328
19. O'Neill J. Antimicrobial resistance: Tackling a crisis for the health and wealth of nations. *Rev Antimicrob Resist.* 2014;1-16 3.
20. Bassetti M, Poulakou G, Ruppe E, Bouza E, Van Hal SJ, Brink A. Antimicrobial resistance in the next 30 years, humankind, bugs and drugs: A visionary approach. *Intensive Care Med.* 2017;43:1464-1475.
21. Thum D, Seidl HP, Hein R, et al. Current resistance patterns of Staphylococcus aureus towards topical antibiotics and relevant antiseptics in patients with atopic dermatitis and impetigo. *J Dtsch Dermatol Ges.* 2013;11(9):875-8. doi: 10.1111/ddg.12111.
22. Wernli D, Jørgensen PS, Harbarth S, et al. Antimicrobial resistance: The complex challenge of measurement to inform policy and the public. *PLOS Med.* 2017;(8):1-9. https://doi.org/10.1371/journal.pmed.1002378
23. Van Boeckel et al. Global antibiotic consumption 2000 to 2010: an analysis of national pharmaceutical sales data. *Lanc Infect Dis.* 2014;14(8): 742-750.
24. World Health Organization (WHO). Antimicrobial resistance [internet]. Media Center. 2018. Available from: https://www.who.int/news-room/fact-sheets/detail/antibiotic-resistance
25. Doron S, Davidson LE. Antimicrobial stewardship. *Mayo Clin Proc.* 2011;86(11):1113-23.
26. Gold MH, Andriessen A, Batia AC, Bitter P, Chilukuri S, Cohen JL, Robb CW. Topical stabilized hypochlorous acid: The future gold standard for wound care and scar management in dermatologic and plastic surgery procedures. *J Cosmetic Dermatol.* 2020;19(2):270-277. https://doi.org/10.1111/jocd.13280
27. Steinsapir KD, Woodward JA. Chlorhexidine keratitis: Safety of chlorhexidine as a facial antiseptic. *Dermatol Surg.* 2017;43(1):1-6.
28. Bever GJ, Brodie FL, Hwang DG. Corneal injury from presurgical chlorhexidine skin preparation. *World Neurosurg.* 2016;96:610 e1-e4.
29. Chapman I, Hsu, J, Stankiewcz K, Bhatia, A. Use of hypochlorous acid as a pre-operative antiseptic before placement of dermal fillers: an alternative to standard options. *Dermatol Surg.* 2018(4):597-599. doi: 10.1097/DSS.0000000000001245.
30. Bhatia AH, J, Schlesinger, T, Weiss, R. Optimizing wound healing for cosmetic and medical dermatologic procedures. *Practical Dermatol.* 2018;1:42-5.
31. Biesman B, Cohen, JL, Gold, MH. Integrating HOCl into wound care: The new paradigm for patient management. *Practical Dermatol.* Special Section: Clinical Insights. 2017;7:1-2.
32. Khansa I, Schoenbrunner AR, Janis JE. Silver in wound care – friend or foe? A comprehensive review. *Plast Reconstr Durg Glob Open.* 2019;7(8):e2390.
33. Dissemond J, Böttrich JG, Braunwarth H, et al. Evidence for silver in wound care - meta-analysis of clinical studies from 2000-2015. *J Dtsch Dermatol Ges.* 2017;15:524-535.
34. Li HZ, Zhang L, Chen JX, et al. Silver-containing dressing for surgical site infection in clean and clean-contaminated operations: A systematic review and meta-analysis of randomized controlled trials. *J Surg Res.* 2017;215:98-107.

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