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REVIEW ARTICLE

Expert recommendations on supportive skin care for non-surgical and surgical procedures

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Abstract

A thorough knowledge of non-surgical procedures (laser, peelings, injections, threads) and surgical procedures (combined surgeries and skin grafts), including contraindications and potential risks and side effects, (e.g. infection, hypopigmentation, hyperpigmentation, and scarring) is essential to be able to reduce their incidence and ensure the patient receives the most benefit from the procedure. Individuals with darker skin and of high Fitzpatrick phototype are at higher risk of dyschromias, notably melasma and post-inflammatory hyperpigmentation, which may be treated using aesthetic procedures but may also arise as a complication of some procedures. A group of experts in cosmetic surgery and dermatology reviewed the published literature and discussed recommendations for optimizing outcomes with practical advice on supportive skincare before, during and after non-surgical or surgical procedures. A broad-spectrum sunscreen with a high sun protection factor against UVB and high protection against UVA, especially long UVA, is essential for all treatment modalities for the prevention and potential improvement of pigmentation disorders. Supportive skin care management to prepare, cleanse and protect the skin and post-procedure skin care with healing and anti-inflammatory ingredients are recommended to speed up regeneration and wound healing whilst minimizing scarring and downtime. Additionally, adjunctive skin care to procedures with antioxidant, anti-ageing and lightening properties may enhance skin benefits.

INTRODUCTION

Aesthetic procedures may be performed for therapeutic or cosmetic reasons, for example skin ageing, acne scars, pigmentation disorders and rosacea, in an attempt to improve self-esteem.[1] Recent surveys have shown that the fastest growing demand for aesthetic treatments is from Millennials (born between 1982 and 2000) and from men.[2] Practitioners should be aware of social media-induced dissatisfaction with appearance or dysmorphia to know how to manage these patients.[3] Aesthetic surgeons should consider psychological aspects and the influence of sociocultural factors on the interest and acceptance of cosmetic surgery, especially in young women.[4]

To obtain maximal benefit from a procedure and manage patient expectations, understanding the skin type, skin phototype and extent of issues that need correcting (e.g. Glogau scale), as well as clinical and psychosocial needs, is required.[5] Also, in the pre-operative consultation, patients undergoing surgery should be informed about the size and position of the expected scar and individual factors that may influence healing.[6]

Supportive skin care management can help protect the skin barrier, control inflammation and enhance natural healing and final outcome, which can influence the success of a surgical or nonsurgical aesthetic procedure.[7] Supportive skin care to prepare, cleanse and protect the skin and optimize treatment outcomes, patient satisfaction, wound healing and scar management should ensure the patient receives the most benefit from the procedure whilst minimizing the downtime period and preventing

complications. Thorough knowledge of potential risks and side effects (e.g., infection, hypopigmentation, hyperpigmentation, and scarring), and proper use of appropriate safety devices will reduce their incidence and optimize their management should they occur.[5] Dyschromias, notably melasma and post-inflammatory hyperpigmentation (PIH), are common reasons for aesthetic consultation, especially for darker skin colour or high Fitzpatrick phototype (FPT IV to VI) and, paradoxically, may even be caused by aesthetic procedures performed by poorly trained physicians.[8,9]

The objective of this review was to provide an overview of existing literature and provide expert recommendations to optimize outcomes and prevent complications of non-surgical and surgical procedures with practical tips on supportive skin care.

SEARCH STRATEGY

Following the advisory board initiated by the International Society of Reconstructive and Aesthetic Dermatology experts, recommendations were discussed and validated in June 2021 by international experts from eight countries who formulated important clinical questions on the management of non-surgical (lasers, peelings, injections and threads) and surgical aesthetic procedures (combined surgeries and skin grafts) and supportive skin care. A literature search, using PubMed as the primary search engine and Google Scholar as a secondary source, retrieved evidence from recently published literature to form the basis of the discussions.

PART 1: NON-SURGICAL PROCEDURES

Generally, all patients should be advised to continually use daily broad-spectrum (UVB/UVA) high-factor photoprotection to prevent skin damage.[10] The sun protection factor (SPF) of a sunscreen is a universal quantitative index of protection against sunburn from UVB, but UVA, especially long-wave UVA (UVA1; 340–400 nm) is known to play an important role in pigmentation, photoageing, skin cancer, DNA damage and photodermatoses.[10] The formulation recommended will depend on the type of procedure and the skin phototype of the patient (evaluated using the FPT classification or by colourimetry measurements of individual typology angle).[11] Avoidance of sun exposure (UVB, UVA, visible light) and adequate daily application of broad-spectrum UVB photoprotection (SPF 50+) with a high UVA-protection factor (SPF/UVA-PF ratio of <3; according to local regulations UVA logo or PA++++) both before and after the procedures is essential for all treatment modalities to optimize results for the prevention and potential improvement or limiting recurrences of pigmentation disorders (see Table 1).

Expert recommendations and practical recommendations for different types of non-surgical procedures are described below and the preparation and supportive skin care (e.g. broad-spectrum photoprotection, prophylactic antiherpetic treatment, cleansing with physiological pH micellar water, anaesthesia, and disinfectants) are summarized in Tables 1 and 2. The invasiveness of the procedure will influence the recovery time, as indicated in a recent publication proposing an algorithm on the time required for skin barrier repair before corrective makeup can be used.[12]

Laser

Non-ablative lasers target collagen, water, blood vessels and pigment within the skin, and may be used for pigmented lesions (e.g. ephelides, solar lentigines) and PIH, vascular anomalies and tattoo removal, whilst ablative lasers vaporize tissues, modulating scar tissue.

Any laser therapy should be planned carefully, especially in the treatment of patients with darker skin types as they are at greater risk for laser energy absorption by melanin, PIH, and loss of pigment due to laser effects on melanin production leading to hypopigmentation.

Ablative fractional resurfacing techniques

Ablative fractional resurfacing techniques using, for example, carbon dioxide (CO_2) lasers, and erbium yttrium aluminium garnet (Er:YAG) are mainly used to treat sun-damaged skin and improve marked wrinkles, scars and rhinophyma, as well as remove lesions, such as epidermal nevi and seborrheic keratosis.[13] Small islands of healthy skin are left between the microthermal zones by the use of fractional lasers and these result in faster healing and fewer side effects.

Ablation should be accompanied by photocoagulation to avoid bleeding. Oedema can persist for up to 48 h after ablative techniques and infection is a potential risk until the epidermis has healed. After the procedure, small scabs/crusts form on the microscopic wounds giving the skin a dry, brownish appearance which peels after around 10 days, whilst erythema can persist for several days to several weeks. Reducing the laser-associated tissue ablation depth and degree of thermal necrosis, using single-pass CO_2 laser skin resurfacing, can reduce the incidence of prolonged erythema and dyschromia in individuals of skin FPT I-VI.[14]

Pre-procedure, peri-procedure, and post-procedure supportive skin care are summarized in Table 1. Topical agents (thermal spring water, conjugated linolenic acid, vitamin C/vitamin E/ferulic acid serum, tripeptide/hexapeptide products, growth factor serum and gel, recombinant human epidermal growth factor ointment and gel, mesenchymal stem cell extract cream and serum, silicone-based gel, and microparticulate [1-3, 1-6 beta-glucan] gel) have been used following laser treatments for improved recovery and cosmesis.[15] Immediately

TABLE 1 An overview of supportive skin care recommendations for pre-, peri-, and post-procedures.

	Pre-procedure prepares the skin before treatment	**Peri-procedure cleans and protects the skin**	**Post-procedural care heals and protects the skin and improves skin outcome**
Non-surgical procedures involving large surfaces of skin	Apply broad-spectrum high-protection factor sunscreen[a] for at least a month prior to the procedure The skin must not be tanned at the time of treatment for vascular laser procedures, laser tattoo removal, laser pigmentation removal, laser hair removal For ablative fractional resurfacing techniques, anti-viral treatment should be started the day before treatment of the perioral region, even if no prior herpetic infection For laser hair removal, medium-depth peels, mesotherapy and platelet-rich plasma, percutaneous collagen induction, microneedling, thread lift devices, hyaluronic acid injections, start anti-herpetic treatment the day before treatment for ≥1 week if the previous history of recurrent herpes simplex infections	High tolerance cleansing milk or micellar solution to remove make-up Avoid alcohol solutions Mist with thermal water or ice packs to cool and soothe the skin Consider applying a repair cream with anti-redness or soothing ingredient immediately after the procedure	Healing and/or calming/moisturizing balm adapted to the treatment type Apply broad-spectrum high-protection factor sunscreen[a] daily ≥15 min before sun exposure and re-apply every 2 h or after sweating Avoid direct sun and wear a wide-brimmed hat Avoid applying sunscreen to scabs/crusts Apply high tolerance, perfume-free corrective make-up if necessary after the appropriate recovery time depending on the invasiveness of the procedure[12] Remove make-up with a high tolerance cleansing milk or micellar water Use adjunctive post-procedure skin care adapted to the cosmetic objective (depigmenting, antioxidant, hydrating)
Localized non-surgical procedures: superficial peelings, injections, and threads	Apply broad-spectrum high-protection factor sunscreen[a] Skin cleansing cannot be overemphasized to ensure the peeling solution penetrates uniformly to give an even result Avoid any skin irritation such as exfoliation Use daily cosmetics adapted to the problem Disinfect area to be treated using appropriate aseptic technique and products	High tolerance cleansing milk or micellar solution to remove make-up Consider protecting sensitive skin zones with barrier cream Consider misting with thermal water	Healing or calming skin care adapted to the treatment type Apply broad-spectrum high-protection factor sunscreen[a] daily Use post-procedure adjunctive skin care adapted to the cosmetic objective (depigmenting, antioxidant, hydrating)
Surgical procedures: combined surgeries and skin grafts	Disinfect the skin with a cleansing solution Rinse and dry	Disinfect the treatment area using appropriate aseptic technique and products (e.g. povidone-iodine, chlorhexidine, hypochlorous spray) Clean the closed wound with a cleansing solution Apply an appropriate dressing	Apply silicone sheets and gels Massage the wound with a repairing balm Wash the wound with thermal spring water Apply broad-spectrum high-protection factor sunscreen[a] daily Corrective makeup may be applied after the appropriate recovery time[12,75]

[a]Broad-spectrum high-protection factor sunscreen (SPF 50+ and UVA protection SPF/UVA-PF ratio of <3).

postoperatively of fractional ablative laser, and then daily during the healing process, laser-assisted delivery of vitamin C, E and ferulic acid correlated with more rapid wound healing and elevated expression of basic fibroblast growth factor, suggesting this may play a role.[16] A moisturizer, containing repairing and anti-inflammatory ingredients (5% panthenol and madecassoside), and antibacterial agents (copper-zinc-manganese), was shown to reduce laser downtime by avoiding adverse effects and improving the wound healing process and lower PIH.[17,18] In a study on postoperative treatment of laser-treated skin with a dexpanthenol-containing ointment, a significantly faster wound closure, especially during the early phase of wound healing, and the better cosmetic result was observed in comparison to routinely used petroleum jelly.[19,20]

Vascular lasers without purpura

Pulsed-dye laser treatment (PDL) is considered the gold standard therapy for vascular lesions without purpura.[13] PDL, YAG Laser, KTP Laser, intense pulsed light (IPL) in vascular mode, deliver laser energy in pulses of varying duration and is preferentially absorbed by haemoglobin in dermal vessels. By targeting both melanin and vascularization, and at least in part, elastosis, PDL might provide, in combination with blanching cream (hydroquinone, 4%; tretinoin, 0.05%; fluocinolone

TABLE 2 Expert recommendations and advice for patients for preparation and supportive skin care for non-surgical aesthetic procedures

Non-surgical procedure	Invasiveness and recovery period[a]	Preparation[b]	Immediately after procedure	Post-procedure care[c]	Continuous supportive skin care[d]
Ablative Fractional Resurfacing Techniques (CO_2 lasers, Erbium YAG, Sub-Ablative), Dermabrasion Roller	*Moderately invasive* with 2–3 days recovery period: low settings ablative fractional laser [CO_2/Erbium YAG]. *Invasive* with 3–7 days recovery period: high settings ablative fractional laser (CO_2/Erbium YAG), *Highly invasive* with 10–12 days recovery period: resurfacing using ablative lasers (CO_2/erbium YAG), mechanical dermabrasion	Start anti-viral treatment the day before any invasive procedure treatment of the perioral region If needed, anaesthetise the skin with topical anaesthetic cream or intralesional lidocaine injection or appropriate nerve block procedures Disinfect the area to be treated and classic *Staphylococcal* foci (nostrils, ears, perioral region) Wear eye protection In the case of ablative fractional resurfacing techniques, use smoke evacuator and good ventilation to prevent laser "plume" materials and biohazards. Submicrometer surgical filter masks provide some protection	Mist with thermal water or apply icepacks to soothe and refresh Dab any weeping and reduce risk of infection Apply soothing spray or lotion Apply repairing balms or ointment to repair the epidermis or in some cases antibiotic ointment to prevent infection Apply a sterile, non-woven compress or dressing if the treatment is deep or requires protection from rubbing and the sun Avoid makeup application until skin barrier is repaired	Strict photoprotection for 2 months Gentle cleansing every day Apply repairing balms or ointments to repair the epidermis or in some cases antibiotic ointment to prevent infection, twice daily for 5 days Continue anti-herpetic treatment on the lips for 5 days High-tolerance, perfume-free corrective makeup can be applied if necessary when skin barrier has recovered[12]	Gradually reintroduce topical antioxidants to avoid irritation Resume dedicated skin care to improve skin benefits depending on the indication (e.g., antioxidant serum, antiageing cream) during the day, exfoliating serum in the evening, or a depigmenting cream if associated with pigmentation problems
Vascular Lasers (Pulsed Dye Laser, YAG Laser, KTP Laser, IPL in Vascular mode)	*Non-invasive* with no recovery period except for patients with risk factors (ie, delayed wound healing)	Avoid topical anaesthesia as it often causes vasoconstriction which would reduce the target Start anti-redness or soothing cream, anti-oedema enzymes[90] or dietary supplements for oedema prophylaxis the day before treatment Remove makeup and cleanse the skin (high tolerance micellar water) just before the procedure Long-pulse, near-infrared laser lights can penetrate through the eyelid to damage the eye. An opaque laser eye shield covering the patient's cornea will not prevent damage if IPL impacts exposed sclera Wear eye protection and provide eye protection for the patient Apply ice packs just before laser therapy onto the treatment region to minimize pain	Mist with thermal water or use icepacks to soothe, refresh and prevent oedema Apply an anti-redness or soothing cream High tolerance, perfume-free, makeup can be applied	Strict photoprotection is essential for 1 month Apply anti-redness or soothing cream morning and evening until the oedema has disappeared Apply icepacks Continue oedema prophylaxis for 4–5 days and follow a low-salt diet Recommend adding pillows to avoid sleeping completely flat High-tolerance, perfume-free, makeup can be applied	Apply anti-redness cream in the morning High-tolerance, perfume-free, corrective makeup can be applied Gentle makeup removal with high tolerance cleansing milk or micellar water For vascular lasers with purpura, apply anti-redness cream in the morning

TABLE 2 (Continued)

Non-surgical procedure	Invasiveness and recovery period[a]	Preparation[b]	Immediately after procedure	Post-procedure care[c]	Continuous supportive skin care[d]
Laser Tattoo Removal (Nanosecond Q-Switched Lasers, Picosecond PIC Lasers)	*Moderately invasive* with 2–3 days recovery period	Apply a thick layer of anaesthetising cream ≥45 min before the procedure or anaesthetise with subcutaneous xylocaine injections Remove makeup completely and cleanse the skin (high tolerance micellar water) Disinfect the area to be treated Wear eye protection and provide eye protection for the patient	Mist with thermal water or use cold pulsed air to soothe and refresh Apply a high-tolerance repair cream Apply a simple dressing or compress if the treated area is under clothes, in a friction zone or blisters after the initial session Consider applying medium/strong corticosteroid cream 24–72 h postoperatively if severe inflammation occurs to prevent post-inflammatory hyperpigmentation	Apply a restoring balm or cream morning and evening for 1 week Apply a simple dressing or compress morning and evening if the treated area is under clothing, in a friction zone or blisters until the blisters and scabs have gone (3 days to 1 week) Strict photoprotection for 15 days	Apply broad-spectrum (UVB SPF 50+ and UVA protection SPF/UVA-PF ratio of <3) sunscreen daily, especially between sessions if treatment is ongoing
Laser Pigmentation Removal (Nanosecond Q-Switched Lasers, Picosecond PIC Lasers, IPL in Pigment Mode)	*Moderately invasive* with 2–3 days recovery period	Do not use topical depigmenting products or dermocosmetics for ≥1 month before the procedure Remove makeup and cleanse the skin (high tolerance micellar water) Disinfect the area to be treated Local anaesthesia may be required for larger or dermal pigmented-lesions Wear eye protection and provide eye protection for the patient Near-infrared Q-switched lasers have the highest risk of eye injury and blindness Obtain a medical history prior to treatment and inform patients about the potential outcomes	Mist with thermal water or apply icepacks to soothe and refresh Apply a high-tolerance repair balm or cream High tolerance makeup can be worn followed by gentle makeup removal to ensure the scabs are not removed	Strict photoprotection for 1 month Cleanse normally with soap and water or a mild cleanser Apply high tolerance moisturizing repair cream morning and evening for 7–10 days High tolerance makeup can be worn	Gradually reintroduce antioxidant serum on clean, dry skin in the morning, and an exfoliating serum or a depigmenting cream in the evening High-tolerance, perfume-free, corrective makeup can be worn
Laser Hair Removal (Alexandrite or YAG Long-Pulse Laser, Laser Diode, IPL)	*Non-invasive* with no recovery period except for patients with risk factors (i.e. delayed wound healing)	Prophylactic antiherpetic treatment if previous history If active cutaneous inflammation, infection or active sunburn, do not treat until the area has resolved A history of keloids and hypertrophic scars should be carefully examined Warn that the effect of hair removal treatment can be limited in patients taking hormonal medication The targeted areas should not be epilated using wax or tweezers for ≥6 weeks prior to the treatment The hair should be shaved the day before the session Disinfect the area to be treated Remove makeup and cleanse the skin (high tolerance micellar water) Wear eye protection and provide eye protection for the patient Apply a topical anaesthetic agent 1 h before the procedure	Mist with thermal water or use icepacks or cold air to soothe and refresh Apply soothing, high tolerance moisturizer for perifollicular erythema High tolerance, perfume-free, makeup can be applied	Strict photoprotection for 15 days Advise gentle cleansing without rubbing Apply high tolerance moisturizer morning and evening until the oedema and itching have disappeared High-tolerance, perfume-free, corrective makeup can be applied	Continue to apply moisturizer if needed Gentle exfoliation is possible after around 1 week to remove remaining hair debris if necessary

TABLE 2 (Continued)

Non-surgical procedure	Invasiveness and recovery period[a]	Preparation[b]	Immediately after procedure	Post-procedure care[c]	Continuous supportive skin care[d]
Photodynamic Therapy (PDT)	*Moderately invasive* with 2–3 days recovery period: photodynamic therapy, photodynamic rejuvenation	If PDT is performed to treat non-melanoma skin cancers such as basal cell carcinoma (BCC) or Bowen's disease, a pre-treatment biopsy is required. Sub-optimal treatment of malignancy can lead to local recurrences Ask patient about the use of any topical products on the treatment areas Gently remove overlying crust and scale for moderate thickness/hyperkeratotic actinic keratosis, Bowen's disease and superficial BCC Apply a keratolytic ointment or cream the night before treatment to facilitate easier crust removal Tape stripping, microdermabrasion or laser ablation or gentle curettage can also be used to reduce hyperkeratosis and prepare the skin for the photosensitizing agent	Strict avoidance of sun exposure (driving or walking in the sun) for 48 h Exposure to intense visible light (e.g. surgical lighting or a high-power dentist lamp) should be avoided for 48 h Apply soothing spray or lotion, mist with thermal water, or apply icepacks to soothe and refresh Dab any weeping to reduce risks of infection Apply repairing balms or ointments to repair the epidermis or in some cases antibiotic ointment to prevent infection Avoid make-up application immediately after the procedure	Strict photoprotection for 15 days Cleanse gently every day with a mild cleanser or micellar water Apply repairing balms or ointments to repair the epidermis or in some cases antibiotic ointment to prevent infection morning and evening for 5 days Continue anti-herpetic treatment in case of lip treatment for 5 days	Gradually resume antioxidant serum and antiageing cream routine (to avoid irritation) Apply an exfoliating serum in the evening or a depigmenting cream if there are associated pigmentation problems High tolerance, perfume-free corrective makeup can be applied if necessary
Superficial and Depigmenting Peels, Microdermabrasion	*Minimally invasive* with recovery after clinical signs have disappeared: Superficial and Depigmenting Peels *Moderately invasive* with 2–3 days recovery period: microdermabrasion	Use broad-spectrum high-protection factor sunscreen (SPF 50+ and UVA protection SPF/UVA-PF ratio of <3) for ≥15 days beforehand to rest melanocytes prior to the procedure Apply glycolic acid cream or azelaic acid gel/cream morning and/or evening for ≥15 days Combine with vitamin C, antioxidant or depigmenting serum in the morning, if required Apply moisturizing, antiageing or vitamin C cream in the morning For depigmenting peels, apply hydroquinone depigmenting preparation, Kligman depigmenting triple combination or hydroquinone cream in the evening Do not proceed if there is an infection or pustulous acne Carefully and gently cleanse the skin and remove makeup Apply a pre-peel lotion without rinsing Protect any irritated zones with repairing balms or creams (alae nasi, corners of the eyes) Use truncal block anaesthesia if required Use a fan for cooling	Mist with thermal water, especially if tingling sensation persists Apply high tolerance healing cream Combine with cystic treatment if there is acne Makeup can be worn immediately after the peel if the skin is not exfoliating	Strict photoprotection is essential Apply a high tolerance healing and anti-inflammatory cream for several days Keep the skin hydrated throughout the healing process Scratching or exfoliating any scabs/crusts should be avoided Mist with thermal water	Apply glycolic acid cream in the evening and/or the morning once the scabs/crusts have disappeared Combine gradually with depigmenting active ingredients if required or antioxidant or vitamin C serum in the morning Apply moisturizing, antiageing or vitamin C cream in the morning Resume hydroquinone application in the evening. Advise repeating 4–6 times to improve complexion and skin texture

TABLE 2 (Continued)

Non-surgical procedure	Invasiveness and recovery period[a]	Preparation[b]	Immediately after procedure	Post-procedure care[c]	Continuous supportive skin care[d]
Medium Depth Peels	*Invasive* to *highly invasive* with 3–7 or up to around 12 days recovery period depending on the invasiveness	Start depigmenting creams ≥1 month prior to the procedure to rest melanocytes if necessary Apply glycolic acid or azelaic acid cream/gel or retinol cream for 15 days (evening) prior to the procedure Apply hydroquinone or glycolic acid and depigmenting cream for 15 days especially in darker phototypes at risk of post-inflammatory hyperpigmentation Apply hyaluronic acid, vitamin C or antioxidant serum with vitamin C, depigmenting or antiageing cream in the morning (if hydroquinone used in the evening) Prophylactic anti-herpetic treatment if the patient is at risk. Cleanse the skin and remove makeup with high tolerance cleansing milk or micellar lotion Remove grease from the skin with alcohol Do not perform the peel if there is an infection Apply a glycolic acid pre-peel lotion Use truncal block anaesthesia if required Use a fan for cooling	Apply soothing cool compresses Apply calming repairing balm	Strict photoprotection is essential Apply calming repairing balm several times per day until epidermal regeneration Mist with thermal water Apply topical corticosteroid cream in prolonged erythema or risk of post-inflammatory hyperpigmentation Advise patient not to remove scabs/crusts Consider possible complications, irregularities, post-inflammatory hyperpigmentation, hypopigmentation, persistent erythema and scarring	Apply glycolic acid or retinol cream skin care in the evening with a hydroquinone preparation or cream with active depigmenting ingredients if pigmentation Apply hyaluronic acid, vitamin C, or antioxidant serum and cream skin care in the morning with glycolic acid and depigmenting active ingredients if required
Mesotherapy And Platelet-Rich Plasma (PRP)	*Minimally invasive* with 2–3 days recovery period	Antiplatelet drugs are contraindicated within the week prior to injection Do not inject if any local signs of infection Prophylactic anti-herpetic treatment if the patient is at risk Advise taking arnica granules leading up to the injection Apply glycolic acid cream for ≥2 weeks if the patient has oily skin with dilated pores Remove makeup carefully using a high tolerance cleansing milk or micellar lotion Disinfect thoroughly	Perform manual compression if bleeding Massage with anti-redness or soothing cream, vitamin K derivative or a healing cream to evenly spread the product Cleanse and moisturize the treated area Apply vitamin K cream if hematoma appears	Strict photoprotection and sun avoidance for 24 h	Apply antiageing skin care in the evening with serum (hyaluronic acid or antioxidant) and cream (glycolic acid or retinol cream for normal to mixed skin; cream containing hyaluronic acid or other antiageing skin care for dry skin) Apply antiageing skin care in the morning of serum (hyaluronic acid, vitamin C, or antioxidant) with vitamin C cream or other antiageing active ingredients

TABLE 2 (Continued)

Non-surgical procedure	Invasiveness and recovery period[a]	Preparation[b]	Immediately after procedure	Post-procedure care[c]	Continuous supportive skin care[d]
Percutaneous Collagen Induction (PCI), Microneedling	*Moderately invasive* with 2–3 days recovery period: microneedling with short needles *Invasive* with 3–7 days recovery period: microneedling using long needles	Start 1 week of anti-herpetic treatment the day before treatment if the patient is at risk. Apply a lightening cream beforehand Use an appropriate cleanser Apply retinoic acid or alpha hydroxy acids cream or gel for ≥1 week prior to the procedure Apply 4% liposomal lidocaine and massage. Apply a second application 30 min later and massage again. After 1 h, remove with 2% chlorhexidine	Avoid cleansing the treated area as the serous exudate is beneficial for healing Apply an absorbent dressing to the treated area for 12 h following deep treatments Apply a regenerating balm, silicone gel or dexpanthenol gel for 5–7 days following deep treatments Makeup can be worn the day after less invasive procedures	Strict photoprotection for 1 week following shallow or medium depth treatments and for 1 month following deep treatments Do not use topical corticosteroids or topical antibiotics Apply a bio-cellulose mask Apply retinoic acid or alpha hydroxy acids cream or gel, or vitamin C cream Increase vitamin C consumption in the diet Apply a lightening cream such as hydroquinone Patients should avoid scratching or exfoliating any scabs/crusts that appear	Apply vitamin C cream
Threads					
Thread lift devices	*Minimally invasive* with recovery after clinical signs have disappeared	Prophylactic anti-herpetic treatment if the patient is at risk Prophylactic antibiotic treatment is generally not recommended Do not insert the threads if there is local infection or multiple pustulous acne Ensure rigorous antisepsis Disinfect the classic Staphylococcal foci (nostrils, ears, perioral region) beforehand Avoid antiplatelet drugs and products the week before the injection Position sterile drapes	Apply small adhesive sutures to the entry points Avoid rubbing	Apply an anti-bruising cream along the thread pathways if necessary Suggest supportive scar healing creams Advise sleeping on two pillows for the first two nights as oedema can worsen when lying down but will decrease within a few hours of getting up	Apply antiageing skin care in the evening with serum (hyaluronic acid or antioxidant) and cream (glycolic acid or retinol cream for normal to mixed skin; cream containing hyaluronic acid or other antiageing skin care for dry skin) Apply antiageing skin care in the morning of serum (hyaluronic acid, vitamin C, or antioxidant) with vitamin C cream or other antiageing active ingredients Prescribe vitamin K cream if hematoma occurs

(Continues)

TABLE 2 (Continued)

Non-surgical procedure	Invasiveness and recovery period[a]	Preparation[b]	Immediately after procedure	Post-procedure care[c]	Continuous supportive skin care[d]
Botulinum Toxin	*Minimally invasive* with recovery after clinical signs have disappeared	Antiplatelet drugs, aspirin, or other anti-inflammatory agents should be avoided for 1 week prior to the procedure Cleanse the face Remove makeup using a product with physiological pH (micellar water) Disinfect (avoid using alcohol or acetone)	Apply careful pressure if localized bleeding occurs Avoid makeup application or massage immediately after the procedure	Apply anti-redness or soothing balm or cream if bruising	Apply antiageing skin care in the evening of glycolic acid or retinol for normal to mixed skin, or hyaluronic acid serum and cream or other antiageing active ingredients for dry skin Apply skin care in the morning of serum (vitamin C, or antioxidant) with vitamin C cream or other antiageing active ingredients
Hyaluronic Acid Injection	*Minimally invasive* with recovery after clinical signs have disappeared	Apply glycolic acid cream for ≥2 weeks for oily skin with dilated pores Avoid antiplatelet drugs, aspirin, or other anti-inflammatory agents the week before the procedure Prophylactic anti-herpetic treatment if the patient is at risk Advise taking arnica granules for 3 days before the injection Do not give injections if there is a local, dental, or distant focus of infection Remove makeup carefully using a high tolerance cleansing milk or micellar lotion Disinfect thoroughly	Apply pressure if bleeding occurs Massage to distribute the product with an anti-redness or soothing cream, vitamin K derivative or healing cream Avoid makeup application for several hours after the procedure	Strict photoprotection is essential at least 1 week or more (if ecchymosis are present) Advise gentle massaging with anti-redness or soothing cream or vitamin K derivative, morning, and evening, for several days High-tolerance, perfume-free, makeup can be applied	Apply antiageing skin care in the evening with hyaluronic acid serum with glycolic acid or retinol cream for normal to mixed skin or cream containing hyaluronic acid or other antiageing skin care for dry skin Apply antiageing skin care in the morning or serum (vitamin C, or antioxidant) with vitamin C cream or other antiageing active ingredients

Abbreviation: SPF, sun protection factor.

[a]The invasiveness of each procedure was adapted from Araviiskaia et al.[12]

[b]In addition to advising daily broad-spectrum (UVB/UVA) high factor photoprotection (SPF 50+ and UVA protection SPF/UVA-PF ratio of <3) for at least 1 month prior to the procedure.

[c]Strict photoprotection can be achieved with an opaque dressing or compress if the area is limited, otherwise sun exposure should be limited and adequate amounts of broad-spectrum high-protection factor sunscreen applied every 2 h.

[d]In addition to advising seeking shade and wearing sunglasses, along with adequate broad spectrum UVB photoprotection (SPF 50+) and UVA protection (SPF/UVA-PF ratio of <3; adapted to the skin type) to be applied daily over the long term to optimize results and limit recurrences.

TABLE 3 Expert recommendations for preparation and supportive skin care for surgical aesthetic procedures and the management of potential complications.

Surgical procedure	Preparation	Postoperative	Immediately after procedure	Long term
Plastic surgery Excisions, general surgery incisions, excision and direct closure in tension areas and hairless skin, oncologic reconstructive surgery with flaps	Prepare the surgical field: • Disinfect the skin with a cleansing solution • Chlorhexidine provides prolonged suppression of bacterial growth; however, keratitis and cochlear damage can occur if applied near eyes and ears • Rinse and dry	Clean the wound with a cleansing solution Affix large adhesive sutures Plastic surgery excisions, general surgery incisions and excisions and direct closure in tension zones: • Apply an absorbent secondary dressing • Hold in place with a compression bandage • Immobilize and/or elevate the limb where appropriate Excision and direct closure in hairless skin and flaps: • Apply a hydrocellular, hydrocolloid or polyurethane surface dressing • Fix with clear microporous tape	Check the dressing after 48 h Change dressing every 2 days if serosanguineous discharge is present Manage infection and hemorrhagic complications	Continue with pad dressings for 3 months (depending on the case) Gently massage with a healing and soothing balm from day 15 for 3 months in the evening Apply a healing balm with broad-spectrum high factor photoprotection in the morning to zones exposed to the sun, especially in darker skin phototypes Apply eye contour balm for the eyelids Apply high tolerance makeup to any persistent erythematous areas Consider a dressing (thin silicon or hydrocolloid) to immobilize the scar in any tension zone for 3 months Consider LED or fluorescence therapy postoperatively if severe inflammation or oedema occurs Evaluate scar abnormalities early to decide if further treatment is required
Excision and Direct Closure in Hairy Skin and the Scalp	Disinfect the skin with a cleansing solution Rinse and dry	Clean the skin with a cleansing solution Apply a healing ointment	Clean once or twice daily with a cleansing solution until suture removal Remove sutures on day 10–15	Continue to apply a healing ointment until complete healing
Full Thickness and Split Thickness Skin Grafts	Disinfect the skin with a cleansing solution Rinse and dry	Apply a paraffin dressing held in place with a bolster dressing from day 1 to 5 to immobilize grafts, using anchoring stents to ensure direct contact between the graft and its bed Apply a secondary dressing Fix with clear microporous tape Immobilize the graft	Change dressing on day 5 Wash and dry the wound Change the dressing until the sutures or staples are removed As specific care, immobilize heel grafts without weight bearing and cover with a protective heel cap Immobilize fingers for a short time	Advise gentle massage with a soothing balm twice daily for 3 months after complete healing Apply broad-spectrum high factor photoprotection to areas exposed to the sun especially in darker skin types (risk of post-inflammatory hyperpigmentation) Makeup can usually be applied 3–4 weeks after graft placement Advise applying high tolerance makeup on any persistent red areas

acetonide, 0.01%), an effective and complete therapeutic approach for melasma without relapses in light-skinned individuals.[21] Combining topical therapy with procedures such as chemical peels, IPL, fractional non-ablative lasers or radiofrequency, pigment lasers (microsecond, picosecond, Q-switched) and microneedling, may be required to treat melasma and PIH.[9] A combination treatment of YAG laser and hydroquinone cream, whilst showing good efficacy and skin rejuvenation effects for telangiectatic melasma, should be used cautiously in individuals with FPT IV-V to avoid laser-induced pigment alteration, PIH and rebound hyperpigmentation.[22,23] It is recommended to perform a test before doing the complete procedure. A long pulse duration coagulates the target without bursting the vessels and the vessels often disappear after the first laser pass leaving erythema and oedema. The burning sensation should disappear after several minutes and the oedema decrease within a few hours. Topical anaesthesia should be avoided as it often causes vasoconstriction thus reducing the target just before the session.

Vascular lasers with purpura

Vascular lasers with purpura (PDL, YAG Laser, KTP Laser, IPL in vascular mode) deliver energy preferentially absorbed by vascular targets in the skin. Low-level light therapy or vascular laser treatment is used to treat radiodermatitis, a common side effect from radiation exposure during cancer treatment, whilst PDL has been shown to be beneficial in clearing radiation-induced telangiectasia.[24]

For targets large enough to be seen by the naked eye (telangiectasia, spider veins, rosacea), a long pulse duration is applied to coagulate the target without bursting the vessels. However, for very thin targets or diffuse redness (port wine stain, erythrosis), energy is applied over an extremely short duration (0.45–3 ms) resulting in the breakdown of the target and therefore purpura (selective photothermolysis).

Purpura appears immediately for at least 10 days and will disappear following the colours of heme degradation, although rarely will scab. Although slightly less effective, longer pulse durations (6–10 ms) with multiple passes or "pulse stacking" to achieve "purpura-free" treatment can be quite effective and less noticeable. Ice packs should be applied just before laser therapy onto the treatment area to minimize pain whilst the treated area remains tender for the following few days.

Prescribe vitamin K cream, if needed, for hyperpigmentation on dark skin with high FPT that is more frequently due to a temporary hemosiderin deposit than true PIH.

Laser tattoo removal

For laser Tattoo Removal (Nanosecond Q-Switched Lasers, Picosecond PIC Lasers), laser energy is delivered over an extremely short duration and is preferentially absorbed by the tattoo pigment. The ink is broken up and gradually eliminated as ink dust through an inflammatory reaction as the sessions progress. During the initial sessions, the tattoo ink is dense, and the target is large, so the results are more significant. Yellow and orange pigments are more difficult to remove as the currently available laser lights poorly target these colours.

The laser reaction is seen as immediate epidermal whitening due to water component vaporization within the epidermis. Mechanical damage results in cell membrane rupture and the release of exogenous pigment into extracellular space. Inflammatory-related oedema can cause spongiotic bullas/blisters leading to scabs/crusts which fall away occasionally accompanied by itching. Ink elimination will continue after the healing phase therefore there should be at least 1 month between sessions for picosecond lasers and 2 months for nanosecond lasers. Compared to conventional Q-switched lasers, picosecond lasers have been shown to be more effective for blue and green tattoo pigments.

In light-skinned individuals, Q-switched lasers have proved effective in removing pigmented lesions and tattoos without scarring. Complications to tattoo removal include both hyper- and hypopigmentation. Whilst hypopigmentation can be observed with ruby and alexandrite lasers, hyperpigmentation commonly occurs in more darkly pigmented patients, such as Asians. The treatment of tattoos and pigmented lesions produce a greater risk of complications in the skin of FPT V-VI due to an increased incidence of adverse pigmentary changes and keloidal scarring.[25] In darkly pigmented patients, Q-switched laser treatment of tattoos can be performed successfully and the longer wavelength Q-switched neodymium-doped yttrium aluminium garnet (Nd:YAG) laser is recommended.[25,26]

Ablative fractional CO_2 laser therapy is an alternative treatment for allergic tattoo removal as treatment with conventional quality-switched lasers may not completely remove allergenic particles and itchiness, but generalized eczematous hypersensitivity reactions have been reported.[27,28]

Laser pigmentation removal

To treat hyperpigmentation, nanosecond Q-switched lasers or picosecond PIC lasers may be used.[29,30] These lasers deliver energy preferentially absorbed by endogen pigment over an extremely short duration causing the destruction of the target. The target can be epidermal such as lentigines, café-au-lait macules, Becker's nevus or dermal such as a nevus of Ota. The use of QS or PIC lasers is still controversial for melasma. IPL is not considered a first-line treatment for melasma or PIH but may be used in pigment mode.[31,32] Certain lasers, such as a diode, Q-switched Nd:YAG, and erbium-doped lasers, tend to have higher rates of PIH, whereas IPL and radiofrequency have minimal risk, which is important in patients with darker skin colour or FPT IV to VI.[33]

Laser parameters depend on the particular laser, the patient's skin FPT, and the type of lesion.

Occasionally light energy is absorbed by dermal capillaries causing mild purpura if the fluence is too high. Pigment destruction induces local inflammation with erythema and scaling. After several days, the erythema is replaced by small scabs with a darker appearance until the scabs come away over 1 to 2 weeks.

A case report of type III minocycline-induced patchy slate blue/grey hyperpigmentation (from 8 years of minocycline use for arthritis) treated with Qs755 nm alexandrite laser reported immediate pigment resolution after only 1 treatment, repeated on multiple occasions over 13 years, and no significant postoperative complications.[34]

Laser hair removal

Lasers (Alexandrite or YAG Long-Pulse Laser, Laser Diode, IPL) for hair removal preferentially target pigment, but with long energy application duration the energy is conducted along the hair shaft to the bulb which becomes damaged (photocoagulation). Finer hairs regrow as the regenerated bulb gets smaller after each session until it is completely destroyed.

The burning sensation improves quickly. Oedema around the hair gives the impression of erythematous "goose bumps" which disappear within a few hours. Carbonized hair residue will be eliminated when the hair regrows after around 1 week.

Information regarding the potential side effects of laser hair removal of the eyebrows should be provided and the use of appropriate safety devices (corneal shields and wavelength-specific goggles) is essential due to the risk of irreversible eye damage.[35]

Laser epilation has been used to decrease the risk of delayed healing and recurrences following surgery for pilonidal cysts.[36] A postsurgical recurrence rate of 8.3% was observed after laser hair removal with alexandrite laser and or with Nd:YAG (median number of 4.2 and 5 laser sessions), compared to 51.7% for the surgery alone control. Furthermore, two patients in the surgery alone control group had abnormal healing or persistent sinusitis versus none who underwent a laser procedure after surgery.[36] Laser depilation was found to be a safe and effective adjunct to surgery in minimizing the recurrence of pilonidal disease.[37]

Variable outcomes in laser hair removal depend on patient factors (e.g. FPT, hair colour, thickness and density, hormonal status) and the laser system used (e.g. wavelength, fluence, spot size, pulse duration). As laser hair removal targets melanin in the hair shaft, poor responses and an increased risk of hyperpigmentation and burn may occur in patients with dark skin (FPT IV to VI).[38] When patients with skin types IV to VI and brown or black hair were treated with the 3-msec alexandrite laser with the 18-mm or 15-mm spot size fluences between 8 and 32 J/cm^2, hyperpigmentation was higher in the 15-mm group as a result of using higher fluence; hypopigmentation lasted up to 3 months and was generally preceded by crust formation.[39] The procedure was less safe in skin type VI but topical corticosteroid cream (twice a day for 5 days post-procedure) minimized erythema and oedema, and decreased the duration of PIH.[39] In 150 subjects with FPT IV-VI skin, laser-assisted hair removal using long-pulsed Nd:YAG laser (mean of 8.9 treatments and mean maximum fluence 26.8 Joules/cm) was reported to be effective and all complications were transient, mainly hyperpigmentation.[40] Recent reviews indicate that long-pulsed Nd:YAG, PDL, alexandrite, and ruby lasers, as well as certain IPL sources, are effective and safe for epilation of darker skin types FPT IV-VI as long as appropriate energy settings and wavelengths are used.[41,42] Multi-pass low fluence, high-frequency 755-nm Alex laser practice was found to be safe and effective for hair removal in dark skin FPT compared to the high fluence, low frequency 1064-nm long-pulsed Nd:YAG laser.[43] In subjects with FPT III-VI, a systematic review and meta-analysis found that alexandrite laser was superior to IPL in reducing hair count and risk of PIH was lower with long-pulsed Nd:YAG laser, whilst both PDL and alexandrite lasers exhibited a comparable safety profile to IPL, despite higher pain scores with lasers.[44]

Photodynamic therapy

Photodynamic therapy (PDT) is a treatment of actinic keratosis (AK), non-melanoma superficial skin cancers, such as Bowen's disease (BD) or superficial basal cell carcinoma (BCC). Although surgery is the mainstay of treatment for non-melanoma skin cancer, PDT is a good non-surgical alternative to superficial BCC and BD avoiding large scars. PDT has also been used off-label in condyloma acuminata, moderate and severe acne, and sun-damaged skin and uses a photosensitising agent combined with a specific wavelength of light (LED light or daylight in the case of AK).[45,46]

Pain is frequent with conventional PDT although it is significantly reduced with the use of daylight for AK. Oedema and oozing settle within a few days. Blistering and ulceration may occur.[45] Patients should be informed to contact their physician if the reaction worsens beyond 2 days as this may indicate a bacterial infection. Allergic contact dermatitis to the topical photosensitizing agent (e.g., methyl aminolevulinate (MAL) or 5-aminolevulinate) has been reported.[47]

Techniques have recently been developed to enhance the photosensitizer uptake and thus response rate in patients with multiple AKs and NMSC such as ablative fractional laser (AFL) combined either with conventional PDT or daylight dPDT, but AFL pretreatment is associated with intensified local skin reactions, including instances of *Staphylococcus aureus* infection.[48] However, compared with microdermabrasion-dPDT, AFL-dPDT was preferred due to lower pretreatment-related pain ($p = 0.002$) and superior cosmesis ($p = 0.035$) and efficacy.[48]

Ablative fractional laser-assisted low-irradiance PDT (18.5 mW/cm^2) is more effective than conventional MAL-PDT (61.67 mW/cm^2) for the treatment of AK on the face

and scalp in organ transplant recipients, using a red light-emitting diode lamp at a total light dose of 37 J/cm^2.[49,50] Low-irradiance PDT combined with Er:YAG pretreatment achieved a significantly superior lesion response rate (mean ± standard deviation 77.3 ± 23.6%) compared with conventional PDT (61.8 ± 21.4%; $p = 0.025$) in intra-individual fields at 3 months without negatively impacting pain ($p = 0.777$) or cosmetic outcome ($p = 0.157$).[49]

Photodynamic therapy has been combined effectively with other topical agents for field-directed therapy of AKs. Topical calcipotriol (a vitamin D analogue) twice daily for 2 weeks before AFL-assisted PDT was more effective than a placebo cream before AFL-assisted PDT in treating AK, particularly for thick-layered, moderate-to-severe AK lesions, in subjects of FPT III-V.[51]

Peelings

Chemical peeling is a skin resurfacing procedure intended to regenerate normal skin from the application of exfoliative agents. The induced exfoliation is followed by dermal and epidermal regeneration from the adjacent epithelium and skin adnexa, which results in improved surface texture and appearance of the skin. The basic methods for skin peeling, the variety of chemicals used, the potential side effects, and how to avoid them have been reviewed.[52] Some peels are contraindicated in pregnant and breastfeeding women.

Superficial and depigmenting peels

Superficial peels, which exfoliate superficial skin layers without crossing the basal membrane, are indicated for sun-damaged skin to even out complexion and reduce pigmentation, inflammatory or retentional acne, PIH or to improve skin complexion in smokers. Superficial and medium-depth chemical peels are increasingly used by dermatologists in the management of acne vulgaris.[53] The peel action can be enhanced by combining with an LED session or with microneedling, e.g. Jessner's solution peeling and microneedling was effective for treating atrophic acne scars.[54]

Depigmenting peels are a combination treatment regimen of depigmenting active ingredients to correct hyperpigmentation. Oral tranexamic acid was an effective treatment for moderate-to-severe melasma with minimal side effects.[55] Potential complications are temporary tingling, mild erythema, oedema, exfoliation with scabs/crusts and PIH.

It is generally considered that superficial peels are safe in darker skin (FPT III–VI). Both salicylic acid (20% and 30%)[56] and glycolic peels (10%, 68% maximum concentration)[57] have been reported to be safe in patients with FPT IV to VI but should be used with precaution to avoid complications. Side effects patients with FPT III-VI may be less frequent if the procedure is performed in the winter months.[58]

Mandelic acid (45%) or trichloroacetic acid (25%) peels may have similar efficacy but better safety and tolerability than salicylic acid (30%) peels in mild-to-moderate acne patients.[59,60] In acne patients, isotretinoin treatment should be discontinued for 6 months before the procedure, whilst retinoic acid, adapalene and benzoyl peroxide application should be discontinued for the week beforehand. Other medications such as minocycline and oral contraceptives, frequently used in patients with acne, can cause photosensitivity and predispose to hyperpigmentation. Current infections, either bacterial, fungal or viral or pustulous acne are contraindications.[53] Advise avoiding exfoliating or irritating the skin the week beforehand.

Medium-depth peels

Medium peels are used to even out or lighten complexion, reduce wrinkles and increase skin firmness through collagen synthesis. These peels reach the dermoepidermal junction and can extend to the superficial or mid-dermis. Adding 10% phenol to the active ingredient (20%–30% trichloroacetic acid) can make application less painful. Peel kits with buffered solutions allow more homogeneous penetration.

Deeper peels for improved results have more potential complications.[61] Medium peels should be avoided or only used after careful preoperative preparation in dark-skinned patients (FPT IV–VI), who are at higher risk of post-procedure PIH, or those with a tendency to develop hypertrophic or keloid scars.

Herpes simplex virus can be reactivated after peeling and delay wound healing if prophylaxis is not done prior to intervention. Also, immunocompromised patients should be carefully evaluated, as the benefits of skin resurfacing do not outweigh the risk of infection and altered wound healing with scarring seen in these patients.[53]

Injections

Mesotherapy and platelet-rich plasma

Mesotherapy improves skin hydration and collagen production with injections of hyaluronic acid (HA) mixed with vitamins and/or amino acids. Platelet-rich plasma (PRP) is a supernatant of platelet-enriched plasma isolated from autologous blood. Tissue regeneration can be further stimulated using PRP to produce growth factors. Erythema, oedema, mild injection site bruising, secondary infection and papules can occur if the product is injected too superficially.

Although used for hair restoration, soft-tissue remodelling, resurfacing, and rejuvenation, there is a lack of standardization and classification of PRP.[62,63]

A recent meta-analysis concluded that combined treatment of microneedling with PRP may be more effective than without PRP for resurfacing acne scars, whilst both techniques had similar incidences of erythema and oedema severe adverse events.[64] Following deep treatments, substantial oedema forms over the first 24–72 h then regresses and

exfoliation can occur within the first 72 h. Scabs/crusts will form following treatment.

Percutaneous collagen induction

Percutaneous collagen induction (PCI) uses fine needles to puncture the skin creating micro-orifices. This triggers an inflammatory reaction and encourages collagen and elastin production. Advantages of over laser resurfacing include preserving the epidermis, thicker skin, and a shorter healing phase (the serous exudate is beneficial for healing). Several PCI treatments may be required to obtain the desired result. PCI is indicated for skin rejuvenation and conditions such as acne scars, acne, scars and stretch marks.

Percutaneous collagen induction should be avoided if a history of PIH, allergies to metals or topical or systemic anaesthetics, in individuals with autoimmune disease or with hypersensitivity to pain in the presence of neuropathies.

Threads

Facial thread lifting with absorbable threads

Polylactic acid, caprolactone or polydioxanone threads are used to correct moderate sagging of skin and superficial fat tissue by repositioning it upwards. The pullout strength of the thread-less anchor is greatest when inserted at 45° to the bone surface compared to 90° or 135° from the surface.[65]

Erythema, oedema, bruising, infection along the thread, temporary small cutaneous folds at the superior section (several weeks), thread extrusion and extrusion of a small notch if thread is placed too superficially, can occur post-procedure. Advise sleeping on two pillows for the first two nights as oedema can worsen when lying down but will decrease after getting up.

Botulinum toxin

Botulinum Toxin (BoNT-A) blocks the neuromuscular junction to reduce muscle activity responsible for glabellar lines.[66] A more natural, less rigid appearance may be achieved using BoNT-A combined with other aesthetic procedures, tailoring the dose of toxin to the patient's muscle mass or using novel injection and application techniques.[67] Other uses are to improve signs of acne, rosacea, and psoriasis, and to reduce neuromuscular pain.[67] It can also be used to reduce depressor muscle strength in the inferior part of the face. The action is temporary, lasting 4–6 months, and efficacy should be evaluated after 10 days to allow adjustment if necessary.

Complications such as eyelid ptosis are generally caused by local diffusion of the toxin to non-targeted muscles. These can be minimalized by using concentrated doses and careful techniques.

Advise the patient to avoid massaging the injection sites, not to wear a hat or helmet, not to drink alcohol, and to avoid sports, saunas and hammams for at least 6 h after the procedure.

Potential complications include erythema, oedema, injection site bruising, temporary headaches, treatment irregularities or inadequacy, risks linked to toxin diffusion (e.g. palpebral ptosis, diplopia, ectropion), risks linked to diffusion if treatment in the inferior part of the face (e.g. dysphagia, smile asymmetry, speech disorders), malaise, nausea, fatigue and flu-like syndrome.

Avoid in people with hypersensitivity to one of the components (albumin botulinum toxin), in people with neuromuscular transmission abnormalities (myasthenia, Lambert-Eaton syndrome), and in pregnant and breastfeeding women.

Hyaluronic acid injection

Hyaluronic Acid Injections are used for various indications including simple hydration, wrinkle treatments, superficial atrophic scars, and facial volume restoration. Correction lasts for 6–18 months.

Potential complications include erythema, oedema, injection site pain, bruising lasting several days to 1 week, overcorrection, Tyndall effect with bluish colour if injected too superficially, secondary infection, papules, nodules, herpes simplex reactivation and delayed inflammatory reaction. Patients should avoid sporting activities, saunas and hammams for at least 3 days after the procedure. The most serious complications, albeit rare, are vascular and include blindness so an understanding of the vascular anatomy along with key prevention and management strategies to address them immediately is critical.[68–70] Using a careful low-pressure and low-volume injection technique should help prevent adverse events, whilst acute vascular embolic events due to HA fillers can be managed by the use of hyaluronidase in repeated high doses.[71,72] A rare option for uncomfortable and unaesthetic granulomatous foreign body reactions to fillers is low doses of methotrexate.[73]

PART 2: SURGICAL PROCEDURES

Combined surgeries

Expert recommendations and practical recommendations for different types of plastic surgery, excisions and incisions, and skin grafts are described below, and both the preparation and supportive skin care are summarized in Table 3. Early massage using moisturizers (e.g. cosmeceuticals containing thermal waters with hydrating and anti-inflammatory properties) may be beneficial for the healing process and prevention of scar formation,[74] whilst corrective makeup can improve the appearance of scars, erythema, and pigmentation.[75] The most important criterion for successful

skin surgery is minimal scarring as they have an impact on quality of life.[6,7,76] Identifying a high risk of scarring is paramount to hypertrophic scar prophylaxis, as is clean surgery and good wound care.[77] Keloid scars extend beyond the wound borders and can be more difficult to treat; they are more common with some genetic backgrounds (dark skin, Hispanic, Asian) and with incisions contrary to the relaxed skin tension lines. Medical, surgical, topical and light treatment approaches for scar prevention and treatment have been reviewed.[78,79]

Plastic surgery excisions, general surgery incisions, excision and direct closure in tension areas and hairless skin, oncologic reconstructive surgery with flaps

Plastic surgery excisions generally remove redundant excess tissue, most commonly face lifts, arm lifts and breast reduction surgery, whilst general surgery (e.g. horizontal caesarean, thyroidectomy and sub-umbilical laparotomy incisions) for access to deep organs do not generally remove the skin. General surgical tips are to follow relaxed skin tension lines and place incision lines and scars in an area of low visibility.

Excision and direct closure in tension areas, are typically basic oncologic skin surgery procedures to remove tumours on the face (midfacial apertures) and other areas of the body with skin tension.[80] The horizontal stretching principle guarantees the lack of impact on the three major apertures of the midfacial frame (namely, the eyes, nostrils and mouth).[81]

Excision and direct closure in hairless skin and flaps can be repaired by various advancement, rotation, or transposition flaps techniques, using available skin from the adjacent donor site to cover primary defects.

Infection and hemorrhagic risks are significant, and recovery is marked by oedema and possible bruising for 8 days. The healing period is approximately 7–15 days after which any non-absorbable sutures are removed.

Scar formation can be minimized before, during and immediately after surgery by optimal surgical management by reducing skin tension, as well as providing taping, photoprotection, and hydration.[82] Limiting inflammation and microbiome imbalance can improve wound healing and reduce the amount of scarring. Silicone sheeting or gel is considered the first-line prophylactic and treatment option for hypertrophic scars and keloids. Taping elliptical torso wounds for 12 weeks after dermatologic surgery improved scar appearance at 6 months.[83] Region-specific differences in skin tension may determine incisional scar formation.[84] Use horizontal sutures to avoid vertical tension on the free edge of the lower eyelid to prevent scar retraction and ectropion. Perform a vertical elliptical excision and direct horizontal closure on the forehead to avoid disturbing the horizontal alignment of the eyebrows. In tension zones (muscular or articular), deep fascial and vertical mattress sutures are essential to prevent wound dehiscence. Early hypertrophic scars (trapdoor deformity) can occur, especially with nasal surgery and transposition flaps when incisions are contrary to relaxed skin tension lines, and this may be treated by injection of triamcinolone acetate (10–40 mg/ml) into the scar, only after allowing enough time for settling, or early injection of corticosteroids.[6,85] To prevent/treat hypertrophic scars: apply a pad dressing, gel, or silicone pads, massage,[86] continue compression for 6 months, inject triamcinolone acetate every 4 weeks for 6 months if scar continues to thicken; combined treatments with vascular lasers and pulsed light therapy, ablative lasers, and laser-assisted corticosteroid delivery may be required. Use the same treatment for keloid scars, and if this fails, use revision surgery, radiotherapy, or cryosurgery.[87] For potential complications of erythematous scars or telangiectasia, use a vascular laser or IPL.[6] If ectropion occurs, correct with surgery. If PIH occurs, apply active photoprotection, soothing, healing and anti-inflammatory emulsions/balms and sometimes it will require strong or very strong topical corticosteroids and/or depigmenting agents, or even corrective procedures such as Nd:YAG laser toning if indicated.[88] If lymphoedema occurs, use massage/petrissage/drainage, avoid using a high pillow and apply a low-salt diet.

Excision and direct closure in hairy skin and the scalp

The excision extends to the hypodermal plane or beyond and the defect is closed directly with superficial sutures using non-absorbable monofilament. For large defects on the scalp, aponeurosis (galea) sutures are used. Perform trichophytic closure to prevent a hairless scar.

Skin grafts

Full-thickness and split-thickness skin grafts

Full-thickness or split-thickness skin grafts are a classical oncologic repair technique where skin from a distant donor tissue site is used to repair the primary defect. Early hypertrophic scars can form and potential complications are erythematous scars or telangiectasia (treat with vascular laser or IPL), ectropion (correct with lower eyelid surgery) and dyschromia (achromia or PIH in dark FPT; prevent with UV protection).[6] A combination of Er fractional resurfacing, topical bimatoprost, and tretinoin or pimecrolimus, may be effective for the treatment of hypopigmented scars.[89] For atrophic scars, use an ablative or non-ablative fractionated laser, combined with topical corticosteroids, to promote skin graft integration.[6] A white graft within the week after graft surgery is a sign that the graft has not revascularized, whilst a black graft signals necrosis. Hematoma and seroma formation can be avoided by applying pressure dressing and postoperative cautions.

The vascular supply of the graft remains fragile for several weeks so patients should be advised to avoid high-pressure showers and strenuous physical activity for at least 1–2 weeks.

CONCLUSIONS

Wound healing skin care management and recovery time required for non-surgical procedures will generally depend on the degree of invasiveness of the procedure. For non-surgical procedures (PDT, laser, peelings, injections, threads) and surgical procedures (combined surgeries and skin grafts), optimizing skin preparation and post-procedure supportive skin care management is important to protect the skin to speed up regeneration and wound healing, prevent complications, minimize scarring and downtime and ensure the patient receives the most benefit from the procedure to achieve maximum patient satisfaction. Post-procedure skin care with healing, anti-inflammatory ingredients and adjunctive skin care with antioxidant, anti-ageing and lightening properties may enhance the skin benefits of procedures.

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DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analysed in this study.

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