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Minimally Invasive Cosmetic Procedures in Ethnic Skin: A Review

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Abstract

With the growing popularity of cosmetic procedures in those with darker skin types, it is increasingly important to acknowledge differences in management, and to discuss current literature and guidelines to reach this population. This review summarizes the current primary literature on the four most commonly performed cosmetic procedures in ethnic skin, with an emphasis on safety and efficacy. These procedures include: laser hair removal, microneedling, chemical peels, and fillers or injectables. While we can conclude that these procedures are generally well-tolerated by darker Fitzpatrick skin types, best practices are still lacking, and there is limited information on the management of post-procedural adverse events. Overall, treatment should be individualized while giving special considering to the Fitzpatrick skin types III-VI patients' tendency to develop dyspigmentation, scarring/keloids, or measurable results.

Keywords: Ethnic skin; Cosmetic; Minimally invasive; Pigmented skin; Laser; Microneedling; Chemical peel; Hair removal; Skin of color

Introduction

Cosmetic procedures are defined as elective procedures intended to improve a patient's appearance. Minimally invasive cosmetic procedures cause the smallest amount of damage possible with minimal recovery time, and the number of these procedures performed in the United States has increased 158% from 2000 to 2015 [1]. The number of ethnic minorities seeking these procedures is following suit [1]. In fact, ethnic minorities are the quickest growing fraction of the cosmetic procedure market [2]. From 2014 to 2015, the number of African Americans and Hispanics seeking minimally-invasive cosmetic procedures increased 3 times more than the number of Caucasians [1]. This disproportionate growth is likely due to several factors including the increasing diversification of the US population, broader scope of advertising, and more widely available procedures [3].

The way ethnicity pertains to treatment and patient outcomes is especially important in the field of dermatology. The diagnosis and management of skin conditions first requires an understanding of the physiologic differences of ethnic skin, and second necessitates modifications for successful execution of cosmetic procedures, such as understanding appropriate settings and wavelengths better suited for pigmented skin when using lasers. Furthermore, there may be cultural differences that shape the patient's expectations and goals that should be discussed prior to any cosmetic procedure.

The most significant difference in ethnic skin is increased pigmentation, or Fitzpatrick skin types III through VI, characterized by increased production of melanin. Increased desquamation, increased lipid content, and decreased ceramide have also been identified within the stratum corneum of darker skinned individuals [4]. Fundamental differences in skin physiology for ethnic minorities results in a distinct difference in safety considerations and potential efficacy. While there is an appreciation for the fundamental differences between different Fitzpatrick skin types, there is a paucity of research and management guidelines specifying best care practices for darker skin. One possible explanation is that the original clinical studies used by medical devices when applying for FDA approval or clearance limit their patient populations to Fitzpatrick skin types I-III to minimize risk, as most dermatologic devices will predictably amount to better safety profiles. The other possibility is clinicians and providers intuitive reservation to perform cosmetic procedures on ethnic skin to minimize potentially disfiguring dyspigmentation. With the growing popularity of cosmetic procedures in those with darker skin types, however, it is increasingly important to acknowledge differences in management, acquaint oneself with the available literature, and to discuss practice management tips and guidelines to reach this population while minimizing risk to darker skin.

This review summarizes the current primary literature on the four most commonly performed cosmetic procedures in ethnic skin, with an emphasis on safety and efficacy. These procedures include: laser hair removal, microneedling, chemical peels, and fillers or injectables. Non-invasive procedures among ethnic patients for non-cosmetic use, such as treatment of acne vulgaris, were excluded from this review. There is no literature to date that reviews these procedures in the ethnic skin population.

Laser Hair Removal

Excess hair growth can impact quality of life to a degree comparable to psoriasis and eczema, and Laser Hair Removal (LHR) is currently the most commonly requested cosmetic procedure in the world [5,6]. In a cross sectional survey of 221 African American subjects, only 55.2% knew that dark-skinned individuals could be treated with LHR [6]. LHR is most effective for patients who have lighter skin with darker hair as the laser efficacy is dependent on chromophore density and optical properties of the skin [5]. The absorption coefficient of the epidermis is a key factor in the execution of the procedure and this value is affected by the volume fraction of melanosomes present in the skin [5]. There is increased nonspecific energy absorption by the melanin in the basal layer

of the epidermis leading to increased risk of adverse effects of thermal damage [7]. Variables that heavily influence laser treatments include pulse duration and energy fluence [8]. Three specific lasers have been studied substantially in dark skinned individuals: the long-pulsed diode (810 nm), the 1064 nm long-pulsed Nd: Yag (neodymium: yttrium-aluminum-garnet), and the 755 nm Alexandrite [6]. To date, multiple studies have demonstrated efficacy of all three in patients Fitzpatrick Skin Types (FST) I through VI [9-14].

The Thermal Relaxation Time (TRT) is also a key factor in determination of laser efficacy. This refers to the amount of time required for heat to dissipate 50% from within the treated area. It is essential that the pulse duration be shorter or equal to the TRT, which is ultimately related to the diameter of the hair. The energy necessary to target a hair follicle must meet the TRT of the hair follicle and exceed the TRT of the surrounding epidermal melanin. This inherently leads to difficulty when trying to treat intermediate or vellus hair in the dark skin population because the TRT of the hair follicle competes with the TRT of the surrounding melanin [15]. Alster et al. [10] observed 59 Indian women, FST IV-V, who were treated with the long pulsed 1064 nm Nd: YAG laser, 10 mm spot size, fluences of 30-50 J/cm^2 with six consecutive treatments. Patients were categorized using a modified Ferrimen Gallway system in which grade 1=fine vellus hair, grade 2=intermediate hair, grade3-4=terminal hair; they grouped results by those that achieved grade 1, those that improved, and those that failed treatment all together. Ultimately they saw that 56% achieved grade 1 (p<0.001) at a 6 week follow-up appointment.

Studies to date have confirmed efficacy of multiple laser types in the ethnic skin population. Tanzi et al. [9] compared the long pulsed 1064 nm Nd: YAG laser in 36 patients FST I-VI. Patients were divided into 3 groups: FST I/II receiving pulse duration of 10 ms, FST III/IV receiving pulse duration of 20 ms, and FST V/VI receiving pulse duration 30 ms. Hair counts were measured at 1 and 6 month follow up appointments. They found that hair count reduction peaked at 1 month with mean hair reduction of 58-62% on facial sites and 66-69% on non-facial sites. The study confirmed effective hair removal in all skin types. A study on 41 FST II-IV patients comparing 810 nm and 800 nm Diode found that hair removal of the upper lip at 6 month follow up visit was superior based on hair counts for dark haired participants who were FST III-IV compared to light haired participants FST II-III [16].

Several studies suggest that a high level of patient satisfaction can be achieved; however, this may be related to treatment location. A study on 50 patients FST VI utilizing Nd: YAG at 35 ms pulse width, 10 mm spot size, and 29-35 joules/cm^2 assessed satisfaction on a linear scale (0=not at all satisfied and 100=extremely satisfied). The majority of the patients with FST VI received therapy for unwanted facial hair with a range of two to eight treatments. The mean self-reported satisfaction score was 84.2, demonstrating meaningful contentment among patients with the appropriate laser [17]. Tahiliani et al. [18] studied 10 patients FST IV-V who underwent 5 treatments of the axilla, arm, and thigh with a 1060 nm diode laser at 4-6 week intervals. Patient satisfaction was highest for the axilla followed by the thigh. All patients experienced mild erythema that decreased in intensity at each visit.

Higher fluence levels ultimately lead to increased thermal induced damage, though are necessary for effective hair removal in darker skin types, thus a balance must be achieved. This property has been demonstrated with computer simulation, histologically, and *in vivo* [5,19-21]. We can ultimately conclude that longer pulse duration at lower fluences could be used to minimize thermal damage to the epidermis in dark skin [19]. A simulation of thermal damage with diode hair-removal lasers was performed and demonstrated increased damage with larger spot sizes and more effective damage to the hair follicle with epidermal sparing at longer pulse durations with constant fluence [22]. Ross et al. [23] determined

that the highest tolerated fluence is 100 J/cm^2 for FST IV-V and 50 J/cm^2 for FST VI. Aldraibi et al. [21] looked at safety and efficacy of the 3 ms Alexandrite laser in 37 patients FST IV-VI and observed the benefit to pre-and post-treatment with a topical corticosteroid. The patients were split into 2 groups: one group consisting of 26 patients treated with an 18 mm spot size at 8 J/cm^2, and the other group of 11 patients treated with a 15 mm spot size at 32 J/cm^2 fluence. Each patient had 2 treatment areas, one of which was treated with a topical corticosteroid 10 minutes prior to laser therapy and twice daily for 5 days post therapy. They found that a higher fluence leads to increased hyperpigmentation and minimal effect of the topical corticosteroid. Notably, they found that this laser type had more adverse effects for FST VI. Histologic observations were used to assess the 800 nm diode laser with fluences between 15-40 J/cm^2 for patients FST IV-V. Biopsies immediately post laser treatment showed mild damage of the epidermis for low fluences and full thickness epidermal damage at higher fluences [24].

The problem of excess hair can be compounded with the presence of pseudofolliculitis barbae, a common dermatologic with the highest prevalence in African American men from 45-85%, followed by Hispanic men [25]. The condition also affects black women commonly with a history of hirsutism and cannot be overcome with hair removal methods such as shaving, and depilatory creams. Greppi [26] demonstrated that LHR could effectively treat black patients with pseudofolliculitis barbae.

Adverse effects of laser hair removal include superficial burns, scarring, dyspigmentation, crusting, blistering, and epidermal changes. One comparative study on 232 FST II-IV patients undergoing treatment with an Alexandrite, Diode, or Intense Pulsed Light (IPL) was compared for presence of side effects after each treatment and at 6 month follow up found the Diode to have the most adverse effects at a rate of 28.9% (p=0.0001) [27]. Interestingly, a study using IPL for 34 patients FST II-V showed no statistical difference in occurrence of side effects between the 4 skin types, however, a split body study in 2003 comparing Nd: YAG and IPL in patients FST IV-VI found post-inflammatory hyperpigmentation in 45% of IPL sites and no side effects in the Nd: YAG treated sites [28]. Another comparative evaluation of 100 patients with FST IV-VI skin types was performed with Nd: Yag, Alexandrite, and Diode lasers; all three lasers had comparable results at 12 month follow-up with 35% reduction for the Nd: YAG, and 40% for the Alexandrite and Diode. However, the Nd: Yag laser had fewer side effects including redness (22.8%), superficial burns (14.2%), scarring (2.2%), and dyspigmentation (2.2%), while 60.6% of patients using the Alexandrite experienced superficial burns and 31% of Diode users experienced hyperpigmentation [29]. A study on 33 patients FST V-VI utilizing the Alexandrite laser gathered objective data on epidermal thickness using a skin ultrasound machine and found significant epidermal thinning and decrease in density (p<0.001) that can be considered in conjunction with histological findings the previous study [30].

Hyperpigmentation is a significant adverse event related to laser hair removal so patients should be counseled on methods of treatment and prevention. Histologically, Post-Inflammatory Hyperpigmentation (PIH) and melasma are identical entities and require clinical correlation to differentiate, thus the approach to both are similar [31]. Anti-inflammatory topicals either before or after the procedure, along with sunscreen and photoprotective clothing, can be used as a preventive measure. Treating pre-existing PIH is more difficult in ethnic skin but chemical peels and lasers, specifically the1064-nm QS Nd: YAG, have been used successfully [31,32].

A very rare but important side effect to consider is the risk of paradoxical post laser therapy hypertrichosis in the ethnic skin population [33,34]. The largest study completed on 2541 patients (17% FST II, 55% FST III, 23% FST IV, and 5% FST V) receiving laser hair removal revealed 79 patients

reporting some degree of paradoxical effect-though it is unspecified which skin types were more prevalent in this affected group [35]. Overall, most studies have demonstrated paradoxical increased hair growth in women who have had laser removal on the lower face, with increased risk in Fitzpatrick skin types FSTIII-V; thus, special consideration must be taken, with ethnic skin [33,35,36]. Of note, the emergence of paradoxical increased hair growth has been reported in FST III patients with Poly Cystic Ovarian Syndrome (PCOS) [37].

Alternative forms of laser therapy that have been successfully utilized in this population include radiofrequency with laser therapy as well as a direct insertion method involving the use of an insulated needle inserted into the hair follicle [38,39].

Microneedling

Microneedling is a technique that is used to treat many dermatologic conditions through the induction of skin resurfacing. The technique is also known as Percutaneous Collagen Induction (PCI) as it utilizes needles to induce an inflammatory cascade that triggers releases of growth factors and thus the formation of elastin and collagen. Microneedling devices are composed of rows of fine needles that are rolled onto the skin penetrating the stratum corneum and forming small puncture wounds [40,41]. Microneedling is not the only technique used for skin resurfacing, but may be one of the best for Fitzpatrick skin types IV-VI. The key difference between microneedling and more aggressive ablative techniques is preservation of the epidermis, limiting scarring and infection [40,41]. Other methods include dermabrasion, chemical peels, and lasers-though they are all associated with higher risk of dyspigmentation and post-inflammatory hyperpigmentation.

For treatment of scars, microneedling has been shown to have a consistent safety profile with minimal adverse events among all Fitzpatrick skin types. Fabbrocini et al. [42] evaluated FST I-VI skin types undergoing 3 scar treatments at 1-month intervals, with photographs at baseline and each interval. Improvement was measured using the Global Aesthetic (Improvement Scale GAIS) and silicone molds were obtained from the treated areas prior to the first treatment and after the last treatment. These molds were analyzed and demonstrated a statistically significant reduction in acne scarring (p<0.05). Additionally, there was no post-procedural dyschromia in any group at 6 or 10 months. Dogra et al. [43] conducted a study on 36 patients with FST IV-V skin types and post-acne scars who underwent five microneedling treatments at monthly intervals. Fifteen of the 36 patients who participated had a 50-75% improvement in acne scar assessment scores compared with baseline, with 40% of patients experiencing mild side effects including post-procedure erythema and swelling that resolved after 2-3 days.

A few studies have investigated the effect of microneedling to treat hyperpigmentation, a commonly occurring problem in the ethnic skin population. These studies have demonstrated efficacy though results are not consistently statistically significant. One study with 60 patients FST IV-V, using the Melasma Area Severity Index (MASI), demonstrated that patients treated with tranexamic acid topically plus microneedling had an improvement of 44% compared to 36% with topical tranexamic acid alone, though the difference was not statistically significant (p=0.299) [44]. Another study showed a significant improvement in MASI score in the serum (rucinol and sophora-alpha) plus microneedling hemi-face group compared to the serum alone hemi-face group at both one and two month assessments (p<0.05). These results were based on photographs that underwent evaluation with Spectrocolorimeter X-rite and overall support microneedling efficacy compared with topicals alone [45].

Microneedling has also been utilized in conjunction with other therapies in the ethnic skin population. In a study by Garg et al. [46] 50 patients FST III-V with atrophic scars were treated with combined therapy of microneedling and 15% tricholoracetic acid peels at 2-week intervals for 3 sessions following an initial session of subcision. The initial scars were graded as macular (grade 1), mild (grade 2), moderate (grade 3), and severe (grade 4) using the Goodman and Baron qualitative scale. Patients also graded their improvement on a 4-point scale from poor to excellent. In patients with severe scars, 62.5% reduced to mild at follow-up, and 100% of patients who completed the treatments had improvement of at least 1 grade. Post-inflammatory hyperpigmentation (PIH) occurred in 6% of patients, though it is unclear whether to attribute this to the subcision, microneedling, the peel, or multi-factorial synergistic effects.

A randomized controlled trial comparing microneedling alone (group A) to microneedling plus subcision (group B) in 70 patients with self-reported "dark skin" showed no statistical difference in improvement (p=0.35). However, the 21-25 year old patients reported efficacy of 69.2% in group A compared to 100% in group B which was statistically significant (p<0.05) [47]. Finally, a study in comparing microneedling and microneedling plus glycolic acid peel in the treatment of acne scars for 32 patients FST III-V demonstrated significant improvement in the patients receiving combination therapy (p=0.001) [48]. Ultimately, these studies show that a combination therapy potentially has superior benefit to microneedling monotherapy. However, it should be noted that these studies do not include or validate the efficacy of microneedling devices designed to be used at home by the patient.

Fractional resurfacing

Another form of microneedling is called Fractional Radio Frequency Microneedling (FRFM) that uses insulated needles to initiate changes in the epidermis while maintaining its integrity [41]. The procedure has been used for skin rejuvenation procedures in skin of color. Skin rejuvenation techniques are those that treat skin irregularities caused by sun, skin diseases, and aging [1]. The studies to date show efficacy with minimal adverse events, and efficacy is primarily based on physician assessment. Melanin is not a target of FRFM devices and thus people of color can successfully be treated in general [49]. Manuskiatti et al. [50] found histologic evidence of neocollagenesis with a single FRFM session in 2 darker skinned women at minimal energy level of 50 Watts; though there was also histologic evidence of hyperpigmentation at their highest energy setting of 80 watts [48]. Two studies on FRFM in Asian patients with acne scars FST III-V demonstrate improvement in scarring based on blinded investigator assessment with transient adverse effects including erythema and edema [51,52]. Padukan studied a somewhat larger patient population of 19 patients FST III-V with 3 FRFM treatment sessions at monthly intervals. Improvement of at least 1 acne scar grade was seen in 100% of patients at 3 months with physician assessment using the Goodman and Barons Global Qualitative Acne Scarring System [53].

Combination treatments evaluating Stem Cell Medium (SCM) plus FRFM versus FRFM alone showed that the addition of stem cell medium showed a statistically significant improvement in hydration, skin roughness, melanin and erythema index. This study did not measure improvement with SCM alone so while improved efficacy is seen with the combination treatment, it is unclear what the effect of the SCM ultimately is [54].

A study by Lee et al. [55] aimed to assess the safety and efficacy of FRFM in the treatment of periorbital wrinkles in patients FST IV-V. The study included 20 patients with varying degrees of periorbital wrinkles undergoing 3 treatments of FRFM at 1-month intervals. There was a significant improvement in wrinkling as evaluated by 2 blind clinicians, though 10% of participants experienced mild hyperpigmentation. Lu et al. [56] compared efficacy of FRFM in the superficial or deep layers of the dermis in the treatment of skin laxity and found significant improvement in the deep dermal approach in the nasolabial folds at 12 months (p=0.0057).

Chemical Peels

Chemical peels involve the application of a peeling agent that penetrates from the stratum corneum to the various depths in the dermis in order to cause re-epithelialization and collagen remodeling [57]. Indications for chemical peels include photo damage, pigment irregularities, and textural abnormalities of the skin. Chemical peels are generally perceived as fast and safe treatments when administered by trained professionals, however, their safety profile is challenged in ethnic skin due to an increased risk for post-inflammatory dyschromia and abnormal scarring [58]. Chemical peels can include a variety of agents and are broadly categorized by the skin depth that they reach. Darker skin tones better tolerate superficial or medium depth peels. Agents that are currently used to treat ethnic skin include Trichloroacetic Acid (TCA), glycolic acid, and salicylic acid at varying concentration to adjust for desired depth [59].

Trichloroacetic acid

The application of TCA has been studied in focal lesions on patients FST IV-V in an attempt to minimize the increased risk for adverse events in this population [60]. Patients were administered 10-65% weight/volume TCA which varied based on the type of lesion: 65% for Seborrheic Keratosis (SK), 50-65% for solar lentigines and freckles, and 10-50% for melasma. Patients were assessed by two blinded physicians who found good response at 12-month follow up for SK and solar lentigines. Patient satisfaction at 6 months follow up showed 80% were moderately to absolutely satisfied [60,61]. A large-scale retrospective study on 923 patients receiving 35-45% TCA peel grouped patients by ethnicity rather than FST and found that 5.9% experienced persistent hyperpigmentation that occurred primarily in the Asian and Indo-Pakistani population. The study also found a single African patient that experienced hypopigmentation [62].

Salicylic acid

Salicylic acid is a lipophilic agent that produces desquamation of the upper layer of the stratum corneum [63]. Grimes established clinical safety for salicylic acid peel in 1999. Patients in this study had a variety of conditions indicating chemical peel including melasma, acne vulgaris, and post inflammatory hyperpigmentation. Patients received two 20% and three 30% salicylic acid peels at 2 week intervals. There was moderate to significant improvement in 88% of patients and all patients tolerated the procedure well [63]. Bari et al. [64] conducted a similar study in 2005 on 268 patients with 30% solution and confirmed that salicylic acid is safe and effective for darker skin tones. Notably they saw no correlation between the facial dermatoses and the likelihood for mild side effects including irritation, burning, and erythema that were easily manageable. A study by Ahn et al. [65,66] in 2006 on 24 Asian patients receiving 6-30% peels over the course of 3 months experienced burning, redness and erythema similarly to a 2009 study on 10 patients receiving two 20% and 3 30% peels in which 100% of patients experienced burning and redness at least once in the course of their procedures.

Glycolic acid

Glycolic Acid (GA) peels have demonstrated safety, are generally well tolerated, and studies suggest improvement in the appearance of melasma and PIH. Javaheri et al. [67] looked at melasma treatment with GA in Indian women and demonstrated MASI improvement in 91% of the 25 patients studied. Lim et al. [68] conducted a split-face trial with GA 20-70% for treatment of melasma in 10 patients FST IV-V for 8 treatments, along with self-application of 10% glycolic acid and 2% hydroquinone cream for 26 weeks. Scoring was based on blinded investigator assessment. Overall, there was an improvement with glycolic acid treatments compared with baseline, but this was not statistically significant (p>0.05). Burns et al. [69] conducted a randomized control study on 19 black patients for the treatment of post-inflammatory hyperpigmentation with glycolic acid

peel. They again found a notable improvement in the group receiving glycolic acid peels, though the difference between the treatment and control group was not significant (p=0.4). A randomized controlled trial was performed on 27 patients FST II-IV receiving 3 procedures either containing 70% GA, 85% lactic acid or sunscreen as a control at monthly intervals for periorbital wrinkles. The study ultimately found that both GA and LA could significantly improve wrinkling after 3 procedures (p<0.005) [70].

Combination treatment

Several studies have looked at combination therapies with variable results. Kodali et al. [71] performed a randomized, split-face, control trial for serial salicylic acid peels as an adjunct to hydroquinone therapy for melasma in 20 FST III-V patients and they ultimately found no significant difference by blinded investigator [18]. Sarkar et al. [72] conducted a randomized control trial with 30 patients who underwent chemical peel with Modified Kligman Formula (MKF) containing hydroquinone 2%, tretinoin 0.05%, and hydrocortisone 1%. Additionally, patients were randomized into 2 groups and one group received glycolic acid (GA) in addition to the MKF. The clinical investigator evaluated the results based on the Hyperpigmentation Area and Severity Index (HASI) and found a statistically significant improvement in the MFK plus GA group compared to the MFK alone at 12 week follow up and 21 week follow up. Another study looking at combination treatment with GA included azeleic acid cream and compared to a triple combination cream (hydroquinone 2%/tretinoin 0.05%/fluocinolone 0.01%), found no significant difference between the groups [73]. A study by Vavouli et al. [74] on 30 patients FST II-IV receiving 3.75% TCA and 15% lactic acid weekly for four weeks assessed improvement of dark eye circles by 3 blinded investigators. Ultimately 93.3% of patients experienced fair, good, or excellent improvement.

Fillers and Injectables

Distinct differences in aging are apparent in the faces of ethnic minorities compared to their age matched Caucasian counterparts. For example, African American patients do not experience sagging and sinking at the same rate as their age-matched white counterparts. Ethnic minorities also tend to have more pronounced signs of aging in the periorbital and midface region and experience less signs of aging in the upper third of the face. Young African American women have relatively recessed malar fat pads when compared to their Caucasian counterparts so age related accumulation of fat in this region is pronounced [75]. Indian faces tend to get fuller and tissue descends downwards and more aggressively than other ethnic groups due to higher volumes of facial fat pad and a smaller bony framework. Excess correction to the inner circle zones will add to the bulk. Instead, replacing volume on the outer area of the face like the lateral forehead, temporal hollow, and chin rather than the inner area comprised of the bridge of the nose, midcheek junction, nasolabial fold, and angle of the mouth gives better results [76].

Other concerns pertaining to ethnic minorities include keloid formation and hyperpigmentation. While keloids are 3-18 times more likely to occur in people with skin of color, there are no known reported cases occurring as a result of dermal fillers, however, it is imperative to abstain from excess number of puncture sites due to the increased risk for hyperpigmentation in this population as well [2]. Universal rules do not apply to all ethnic minorities, however, and fillers are especially subject to genetic differences in bone structure of ethnic patients.

Placement of fillers varies with skeletal shape and soft tissue deposition, although many agree that ideals of beauty are consistent through ethnic groups. In 2014, a Global Esthetics Consensus concluded that the typical age that patients seek cosmetic procedures is between 30-50 years based

on survey results. There has also been a shift from the youthful face as the gold standard toward a more age-appropriate result. The ubiquitous concern is the restoration of volume in all ethnic groups [77].

Two studies have been performed in patients with dark skin utilizing hyaluronic acid. Both studies have demonstrated good tolerance with only mild adverse events including hyperpigmentation that ultimately resolved within 2 weeks [78,79]. Taylor et al. [78] conducted a randomized evaluator-blinded trial in which they administered small and large particle Non-Animal Stabilized Hyaluronic Acid (NASHA) fillers to the right and left side of the face of 150 African American patients; both were well tolerated. Of the patients studied, there were 17 cases of hypopigmentation: 7% FST IV, 13% FST V, and 13% FST V and FST VI. Pneumatic injection of hyaluronic acid was studied on 2 patients FST IV-V for the treatment of acne scars and was found to decrease acne scar grade 1 point in both patients without any significant adverse events [79].

Botulinum toxin is indicated for the treatment of facial aging in ethnic skin due to sun exposure, smoking, and stress. Botulinum toxin in combination with fillers is increasingly popular as they address related processes and may enhance the effects of one another. The Global Aesthetics Consensus Group recommends a patient-tailored approach in people of color acknowledging that volume loss and its sequelae is ubiquitous [77]. A study in 2012 pooled data from 6 clinical trials and compared the effectiveness and tolerability of botulinum toxin for the treatment of glabellar lines in skin of color and white patients. They found a significantly higher proportion of patients with skin of color compared to white patients experienced a greater response at day 30 post injection. Treatment-related adverse events were similar in both skin of color and white patients [80].

Conclusions

While we can conclude that these aforementioned procedures are well-tolerated by darker Fitzpatrick skin types, clear definitions for best practice are still lacking including optimal settings for lasers, concentrations for peels, frequency of microneedling, and there is limited information on management of post procedural adverse events. It is also essential to note the importance in appreciating the distinct difference in ethnic groups regardless of FST in terms of skeletal structure and fat distribution. Determining best practice for each of these groups is not a small task, but it is a necessary one to accommodate the changing demographics of the country and the evolving cosmetic procedure-seeking patient. Laser hair removal is best performed at long pulse durations and low energy fluences with an acute awareness of the risk for dyspigmentation and the rare possibility of paradoxical hypertrichosis. Microneedling can effectively treat scarring in this population with minimal risk for dyspigmentation. Chemical peels must be performed with the awareness that chemical and concentration should not reach beyond medium depth in the epidermis. Finally, fillers and injectables are most effectively performed with consideration to minimize puncture sites to decrease risk for hyperpigmentation. Overall, one should individualize treatments taking into account the patient's goals and expectations while also giving special consideration to the FST III-VI patient's tendency to develop dyspigmentation, scarring/keloids, or measurable results.

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