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Current and emerging treatment strategies for hair loss in women of color☆

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ABSTRACT

Hair loss is common in women of color, and is associated with significant psychosocial complaints. Early clinical recognition and prompt initiation of intervention with medical treatment is critical to halt the disease process. In this article, we review the clinical presentations of nonscarring and scarring alopecias in women of color, use of dermoscopy for early recognition of the disease process, and medical, procedural, and surgical interventions. In conditions that result in scarring alopecia, such as late-stage traction, frontal fibrosing, or central centrifugal cicatricial alopecia, patients may benefit from procedural interventions, such as hair transplantation, platelet rich plasma injections, low-level laser therapy, or scalp therapy.

Introduction

Alopecia is a disease of the pilosebaceous unit, secondary to an underlying condition that may lead to scarring or nonscarring hair loss. The development of alopecia is common among women, and increases with age. Studies have shown its profound effect on the psychosocial aspects of a woman's life (Callender et al., 2004). The negative psychological effects of alopecia are more profound in women than in men, and affect younger women to a greater extent (Davis and Callender, 2018).

Narrowing down the correct diagnosis will guide management plans, patient expectations, and treatment outcomes. Mubki et al. (2014) delineated an approach to hair loss that that includes obtaining a history of hair loss, hair examination, the use of trichoscopy, laboratory evaluations, and scalp biopsy. Regardless of the etiology, early diagnosis and medical treatment are vital to preventing further hair loss. When these conditions become end stage, hair transplantation may be an option to restore cosmesis. In this paper, we cover the types of alopecia that affect women of color, focusing on medical, surgical, and alternative treatment strategies.

Alopecias

Nonscarring alopecias

Female pattern hair loss (FPHL) is most common in postmenopausal women (Fig. 1). The cause is multifactorial, with genetics and androgens both playing a major role. First-line medical therapy includes topical minoxidil 2% or 5%, which are both available in foam or solution over the counter. For women of color with thermally straightened (temporary) hair, this may be compounded into an ointment or oil to prevent the hair from reverting to the patient's natural curl pattern (Callender et al., 2004). Second-line medical treatments include antiandrogen agents, such as spironolactone 100 mg to 200 mg, finasteride 1 mg to 5 mg/day, and dutasteride 0.5 mg/day. Increased incidence of adverse effects, such as decreased libido, irregular menstruation, breast tenderness, dry skin, mild acne, headache, dizziness, and increased body hair, were dose-dependent and reported in patients on finasteride 5 mg/day (Dinh and Sinclair, 2007; Hirshburg et al., 2016; Kohler et al., 2007; Oliveira-Soares et al., 2013; Yeon et al., 2011). To prevent teratogenic effects, finasteride

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and dutasteride should only be prescribed to women who cannot or do not want to become pregnant.

In a recent observational pilot study of 100 women, once daily oral minoxidil 0.25 mg and oral spironolactone 25 mg resulted in a reduction in hair loss severity scores and shedding (Sinclair, 2018). The mean change in blood pressure was -4.52 mmHg systolic and -6.48 mmHg diastolic. Side effects were seen in eight women (8%), were generally mild, and included urticaria (2 cases), postural hypotension (2 cases), and facial hypertrichosis (4 cases). No patients developed hyperkalemia or other blood test abnormalities. Six women continued treatment, and the women who developed urticaria discontinued treatment. The four women who developed facial hypertrichosis did not discontinue treatment.

Traction alopecia (TA) is due to trauma of the hair shaft, secondary to hairstyling practices, particularly in women of color. The most commonly involved area is the bitemporal region (Fig. 2), but the condition can involve any area of the scalp based on hairstyling practice. TA begins with folliculitis, and ends with scarring alopecia if a traction-prone hair style is continued. Examples of these types of styles include, but are not limited to, weaves, ponytails, and braids. Patients with chemically treated hair have more risk of developing TA (Lawson et al., 2017). TA is reversible with early intervention (Lawson et al., 2017). Treatment measures include discontinuing hairstyles that are prone to traction, avoidance of chemical processing, intralesional corticosteroid agents, and topical and oral antibiotic treatments. In its acute phase, TA has an inflammatory component that affects the follicle and can be suppressed with medications to halt disease progression and hair regrowth. Khumalo et al. also reported improvement with 2% topical minoxidil (off-label; Khumalo and Ngwanya, 2007).

Acquired trichorrhexis nodosa (ATN) is characterized by loss of the hair shaft cuticle, leading to fragility and breakage (Lawson et al., 2017; Taylor et al., 2017; Fig. 3). The prevalence of ATN is unknown. Causative factors include dry/brittle hair, trauma secondary to grooming and styling practices (e.g., excessive brushing, tight braiding, heat/chemical straightening, and color processing), scratching secondary to seborrheic dermatitis, and underlying medical conditions (e.g., iron deficiency and hypothyroidism).

Treatment options are based on the cause, which may be multifactorial. Discontinuing traumatic hairstyling/grooming or at least refraining from these practices for 6 to 12 months is recommended, along with a daily hair-moisturizing routine with a silicone-based product. During this time, wearing the hair in its natural state or a protective style is encouraged. Examples of protective styles include loosely braided hair alone or with sewn-in weaves or wigs (Taylor et al., 2017). The use of sewn-in weaves for ATN is controversial due to the ability of the wefted weave hair and the tight braids to which the wefted weave hair is attached to cause TA. Sewn-in weaves are also associated with central centrifugal cicatricial alopecia (CCCA; Gathers et al., 2009). Thus, they should be used with caution, and dermatologists should educate patients on early clinical symptoms of TA and appropriate grooming practices when wearing sewn-in weaves.

Scarring alopecias

CCCA is a common and progressive form of lymphocyte predominant scarring alopecia that starts at the crown or vertex scalp, and spreads in a peripheral or centrifugal pattern (Dlova et al., 2017; Fig. 4). Along with the clinical observation of hair loss, there may be subclinical inflammation based on biopsy test results of a normal-appearing scalp (Bolduc et al., 2016). The condition commonly affects women of African descent, with the incidence in African-American women reportedly higher (5.6% and 16.2%) than in African women (2.7%; Kyei et al., 2011; Olsen et al., 2011).

Study results regarding the relationship between dermatitis and bacterial folliculitis and the development of CCCA are in conflict. One study found a possible link between diabetes mellitus type 2 and CCCA (Kyei et al., 2011), and more recently, an association with uterine leiomyomas has been suggested (Dina et al., 2018). A genetic linkage with CCCA has been proposed with an autosomal dominant inheritance with partial penetrance (Dlova et al., 2014). There is a range of signs and symptoms associated with CCCA, including the presence of hair breakage (Callender et al., 2012), papules, pustules, tenderness or pruritus of the scalp, or no symptoms at all (Lawson et al., 2017). Key findings on dermoscopy include perihilar white/gray halo, erythema, and the presence of scale (Fig. 5; Miteva and Tosti, 2014). The peripilar white/gray halo corresponds on pathology to the lamellar fibrosis that surround the outer root sheath.

In the active phase of the disease, first-line treatment includes high-potency topical corticosteroid agents, intralesional corticosteroid agents, calcineurin inhibitors, and oral doxycycline or minocycline for the anti-inflammatory effects. Hydroxychloroquine may also be used to decrease inflammation (Lawson et al., 2015, 2017). Once the disease has stabilized, maintenance is achieved with mid-potency topical corticosteroid agentss and/or calcineurin inhibitors. Disease must be quiescent on medical therapy for 9 to 12 months, and confirmed with a test biopsy before hair transplantation can be considered (Lawson et al., 2017).

Fig. 1. Female pattern hair loss

Fig. 2. Traction alopecia

Fig. 3. Acquired trichorrhexis nodosa

Frontal fibrosing alopecia (FFA) is a variant of lichen planopilaris that affects the frontoparietal hairline, and often the eyebrows (Fig. 6; Kossard, 1994). The etiology of FFA is unknown, and a possible environmental association with the use of leave-on facial skincare products and sunscreen lotions remains controversial (Aldoori et al., 2016; Dhana et al., 2017). Follicular hyperkeratosis and perifollicular erythema may also be seen. The clinical presentation of FFA in women of color and Caucasian woman varies. Table 1 highlights these differences.

FFA is reported to commonly affect postmenopausal women, but a review of FFA cases showed that the average age at the time of diagnosis in patients of African descent was 40 to 42 years old, with varying data noting 39% and 65% to 75% of patients presenting in premenopausal age ranges (Callender et al., 2016; Lawson et al., 2017). The slow progression of the disease may lead to difficulty specifying the age of onset, and present treatment challenges due to the presence of scarring at the time of diagnosis. Identifying clinical correlations may help with the diagnosis of FFA. In 2016, Aldoori et al. (2016) found an association with the use of sunscreen lotion in patients with FFA. The authors found that women with FFA patch tested positive to fragrances more frequently, and had higher rates of thyroid disease compared with women without FFA.

Reports in the literature have also demonstrated a likely positive correlation between FFA and lichen planus pigmentosus (LPPigm), with some suggesting that LPPigm may be a herald sign of FFA in patients of African descent (Dlova, 2013). In a case report of seven African-American women with FFA and LPPigm, the findings supported the theory that FFA and LPPigm likely exist on the same disease spectrum (Uwakwe et al., 2018). McMichael et al. (2003) postulate that FFA patients with darker skin types may be more likely to develop LPPigm.

First-line treatments for both conditions include topical and intralesional steroidal agents to decrease inflammation that affects the hair follicles. Oral therapies include doxycycline, minocycline, or hydroxychloroquinine for their anti-inflammation effects, and immunosuppressant treatments such a cyclosporine or mycophenolate mofetil. Five-alpha reductase inhibitors such as finasteride and dutasteride have been shown to slow the progression of FFA (Taylor et al., 2017; Uwakwe et al., 2018). Table 2 summarizes the most common forms of nonscarring and scarring alopecias in women of color.

Fig. 4. Central centrifugal cicatricial alopecia

Hair restoration: Surgical and procedural approach

According to the 2017 International Society of Hair Restoration Surgery (ISHRS) practice census results, 597,181 patient hair transplant surgeries were performed worldwide. On average, 85.7% of patients were men and 14.3% were women (ISHRS, 2017). No data are available on the ethnic breakdown of patients seeking hair transplant surgery, but the changing demographics of the United States serve as an indication that more persons with Afro-textured hair will present for surgical treatment of hair loss. As awareness of the epidemic of alopecia in patients with skin of color increases, so will the requests for hair transplantation in this population. Thus, recognizing the differences in hair morphology in patients with Afro-textured hair and its impact on surgical instrumentation and technique in hair transplant surgery is critical.

We examined different methods for hair restoration, including transplantation, platelet-rich plasma (PRP) injection, low-level laser therapy, and scalp micropigmentation. In many cases, a combination of techniques may provide the best cosmetic result for the patient.

Hair transplantation

Hair transplantation is an effective surgical treatment for women of color with FPHL, TA, and may also be considered in patients with

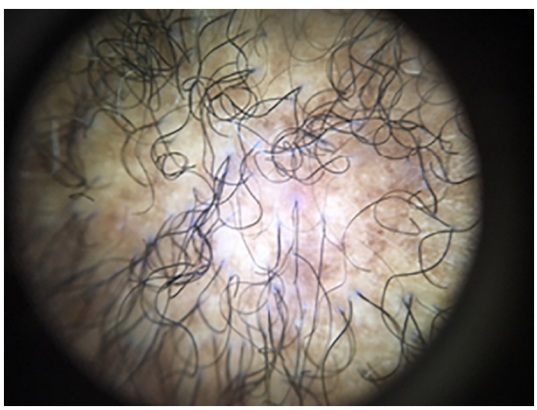

Fig. 5. Central centrifugal cicatricial alopecia on dermoscopy

Fig. 6. Frontal fibrosing alopecia

stable CCCA as determined by clinical and histologic evaluations. Options for a surgical intervention include scalp reduction, flap rotations, follicular unit transplantation (FUT), and follicular unit extraction (FUE; Callender and Davis, 2013; Rassman et al., 2002). The ISHRS reports that in 2016, FUE was the most common method of donor harvesting (52.6%).

Performing these procedures in patients with afro-textured hair is challenging, and steps to avoid transection of the hair follicle within the graft requires exceptional attention and expertise (Callender and Davis, 2013; Singh and Avram, 2013; Umar, 2016). FUE has advantages and disadvantages and, thus, requires an individualized approach depending on the severity of the hair loss, flexibility of the scalp, and shape of the hair.

Generally, patients of African descent tend to have spiraled or helical hair structures that appear clinically as tightly coiled, but there is considerable individual variation among Africans and African Americans (McMichael, 2003; Westgate et al., 2017). Additionally, patients with skin of color have a lower average hair density than whites; however, the curly morphology of the hair follicle, slightly higher number of hair groupings in each follicular unit, and less contrast between the scalp skin color and hair color may all work together to create the appearance of fullness and more coverage after hair transplantation (Callender, 2006; Pierce, 1976). The key four steps to perform a hair transplantation procedure include donor harvesting, graft preparation, recipient-site creation, and graft placement (Callender, 2016).

Table 1
Differences in frontal fibrosing alopecia presentation at the time of diagnosis in women of African descent and Caucasian women

Clinical presentation	Women of African descent	Caucasian women
Average age at diagnosis, years	40-42[†]	55.5-63[†]
Frontotemporal hair loss	+	+
Follicular hyperkeratosis	+	+
Scalp pruritus	+/-	+
Eyebrow alopecia	+	+
Perifollicular erythema[*]	+/-	+
Speckled follicular hyperpigmentation on dermoscopy[†]	+	-
Scale[*]	+/-	+
Loss of follicular ostia	+	+
Papules/pustules[*]	+/-	+/-
Lichen planus pigmentosus (LPPigm)	+	-

[*] Symptoms may not be present in women of color at the time of diagnosis because they may not be as common or as noticeable due to increased pigment in the skin (Callender et al., 2016).

[†] Sources: Callender et al., 2016; Samrao et al., 2010.

Donor harvesting

The types of donor harvesting include donor ellipse for FUT and punch technique for FUE. Donor ellipse for FUT involves excising a single strip of donor tissue from the occipital scalp in a manner that limits the transection of hair follicles, and results in a less visible scar. FUE is a modern technique for hair transplantation that utilizes small punch excisions (≤1 mm) to extract follicular units from the donor site to produce a barely perceptible (undetectable) scar (Rassman et al., 2002). FUE can be performed manually using non-motorized handheld punches or with punches mounted on a motorized, handheld piece (i.e., Neograft, https://neograft.com; Smartgraft, http://smartgraft.com).

Critics propose that, while FUE results in decreased scarring, complications include a higher rate of transection and increased time required to harvest follicular units (Callender and Davis, 2013; Harris, 2013). Singh and Avram (2013) have suggested methods to improve the transection rate of conventional FUE in Afro-textured hair, including limiting the depth of the initial score incision and increasing the punch size to a diameter that is large enough to encompass the amplitude of the subcutaneous curl wave of the follicle (greater than the diameter of the C-curve of the follicle; Fig. 7; Singh and Avram, 2013).

Umar reports that limiting the depth of the initial score increases the effort required to separate the remaining tissue attachments of the follicle, inducing more trauma to the grafts and significantly increasing surgery time (Umar, 2016). In addition, increasing punch sizes to accommodate the subcutaneous amplitude of the curl wave of the grafts can result in unacceptably large punch sizes (≥3-4 mm in some patients) with the risk of unacceptable scarring sequelae. Data from Umar's retrospective case series of 18 patients with tightly curled Afro-textured hair suggests that a curved nonrotary punch can be reliably used. This is a one-step FUE method that involves the complete separation of the follicle from its attachments in single-cutting action, with minimal need for further dissection, reducing additional trauma to the grafts (Fig. 8; Umar, 2016). The transection rate was <10%. This is the first evidence for eliminating the consideration of punch size as the cause for the difference in performance and transection rates.

Subsequently, Umar (2016) demonstrated that small textured and flared rotary punches that have been designed to minimize impaction (Intelligent Punches) are self-navigating and successful in extracting Afro-textured hair FUE, with lower transection rates than the 10% observed with the nonrotatory device (Fig. 8). Depth control is irrelevant with this device. The extraction process is further enhanced by a hydrating system that delivers physiologic fluid to the punch tip to lubricate and augment its ability to glide through the course of the hair curvature (Dr.UGraft, https://ugraft.com). With this, Umar (2016) demonstrated that both the nonrotatory and rotatory punch are capable of performing FUE in Afro-textured hair with a transection rate <10%.

Trichophytic closure is a technique used to minimize scars by trimming the epidermis of one edge of the wound before suturing the wound margins together (Rassman et al., 2002). Undermining the wound margins, which results in less tension, and limiting the width to <1 cm, also aid in minimizing the size of the donor scar (Taylor et al., 2016).

Graft preparation

During graft preparation, the donor strip from FUT is converted into individual grafts of different sizes (Rogers and Callender, 2014). Caution must be taken with curly hair to avoid transection of the hair follicle. A bendable blade, such as a DermaBlade, is often used to complement the curvature of the hair, and is very useful in the

Table 2
Most common types of alopecia in women of color

Conditions	Epidemiology	Etiology	Location	Medical treatments	Treatment pearls
Nonscarring					
FPHL	Prevalence unknown in women of African descent	Multifactorial; hereditary and androgenetic	Thinning of crown and frontal scalp with frontal hairline preserved	Topical minoxidil 2-5% solution or foam; spironolactone; finasteride	Combination therapy: PRP + HT + minoxidil (alternative vehicle formulation)
TA	No prevalence data for United States 37.1% of African women in Capetown, South Africa (Khumalo and Nagwanya, 2007)	Follicular trauma secondary to hairstyles prone to traction	Bitemporal areas; may affect other areas depending on hairstyle	Discontinue hairstyles leading to traction; avoid chemical processing; topical/oral antibiotic treatments for folliculitis; topical/intralesional steroid agents; topical 2-5% minoxidil	HT; PRP; counseling parents on appropriate hairstyles for children that reduce traction
ATN	Prevalence unknown	Loss of cuticle along hair shaft due to hair styling, grooming, and processing; secondary to CCCA; trauma/scratching due to seborrheic dermatitis; nutritional deficiencies; thyroid disease	Hair shaft	Correction of underlying medical condition (s); discontinue causative styling practices; use of protective hairstyles	HT; PRP; counseling parents on appropriate hairstyles for children that reduce traction
Scarring					
CCCA	True prevalence unknown; may vary between 5.6%-16.2% and increases with age	Unknown – multifactorial; proposed link between diabetes mellitus type 2; possible AD inheritance	Crown/vertex scalp with peripheral/ centrifugal spreading	Topical/intralesional steroid treatments; doxycycline or minocycline; hydroxychloroquine	Can coexist with FPHL; may consider HT if stable on medical treatment for 1 year
FFA	Prevalence unknown; <100 cases in the literature; may be misdiagnosed as TA	Variant of LPP	Frontoparietal hairline; eyebrows	Topical/intralesional steroid treatments; doxycycline or minocycline; hydroxychloroquine; cyclosporine; mycophenolate mofetil; finasteride	Rule out TA if in ophiasis pattern; examine eyebrows; treatment considerations: Brimatoprost, tacrolimus, HT, PRP

Abbreviations: ATN = acquired trichorrhexis nodosa; CCCA = central centrifugal cicatricial alopecia; FFA = frontal fibrosing alopecia; FPHL = female pattern hair loss; HT = hair transplantation; TA = traction alopecia; PRP = platelet rich plasma; AD = Autosomal Dominant.

dissection of individual follicular units, particularly in patients with curved C hair follicles (Fig. 9; Callender, 2011). Due to its flexibility, the curved blade decreases the transection rate of the hair follicle and the necessity for multiple cuts. The grafts that contain one to four follicular units are created, and set in saline for insertion into the recipient site. Of note, dissection of individual follicular units is eliminated with FUE.

Recipient site creation and graft placement

A number of surgical instruments can be used to create recipient sites in areas of hair loss. The selection of instrumentation is based on the degree of the curl of the hair, with sites that range from 1.2 mm to 2.0 mm in size in patients with significant curl patterns (Callender et al., 2004; Rogers and Callender, 2014).

Robotic methods for hair transplantation

Robotic methods of FUE were created and approved for use by the U.S. Food and Drug Administration. When physician-controlled, this computer-assisted device facilitates standardized, reproducible extraction of follicular units from donor sites that is safe, effective, and less operator dependent (Rashid, 2014; Rose and Nusbaum, 2014). Presently, the only robotic system is Artas (https://artas.com). This device should be used with caution in patients with Afro-textured hair due to an increase risk of transection.

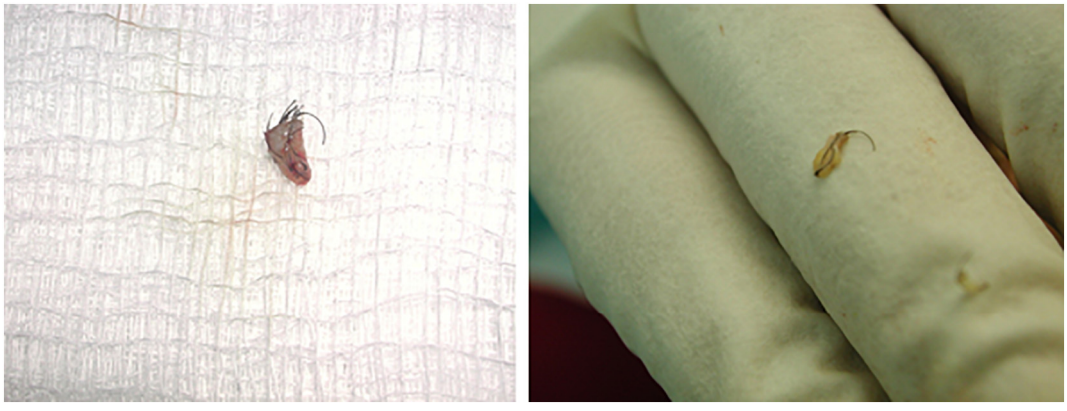

Fig. 7. C-curve hair follicle

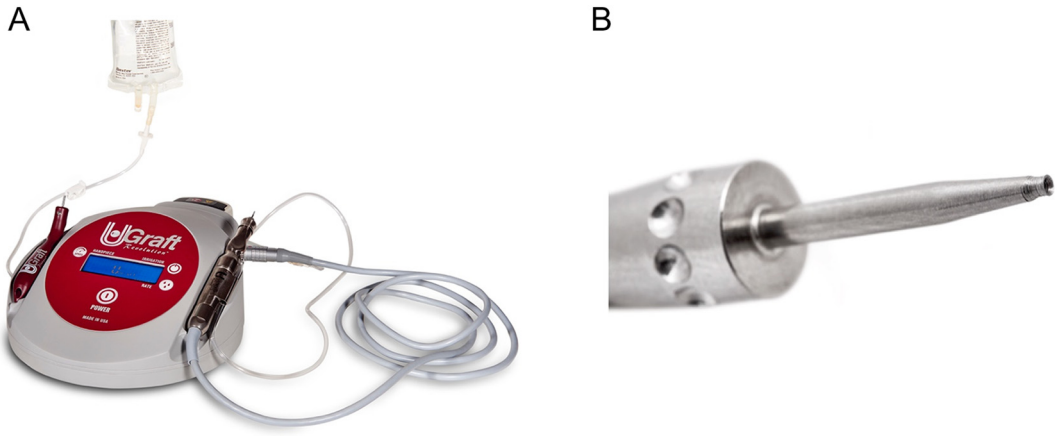

Fig. 8. (A) Dr. UGraft Hair Transplant System, and (B) Dr. UPunch Intelligent Punch

Contraindications

Contraindications for hair transplantation are similar in all racial groups, and includes keloids scarring of which patients of color have a higher incidence. A careful and detailed history of keloid formation along with a physical examination to check for scars should be performed. Active disease with signs of inflammation or scarring alopecia, such as CCCA or FFA, is also a contraindication to hair transplantation. Disease must be quiescent on medical therapy for 9 to 12 months, and confirmed with biopsy test results before hair transplantation can be considered.

Complications

Most patients with Afro-textured hair have excellent results from hair transplantation surgery and low risk of keloidal scarring. Only one case of keloids at the donor site had been reported in a patient with no prior history of keloids (Brown et al., 1990) until 2017, when the first case of extensive keloid formation at the donor site in a patient after FUE was reported (Garg, 2017).

To avoid this complication, test grafting is recommended before a hair transplant procedure. The authors surmise that, if normal healing occurs in the donor area and recipient site after 3 months, the patient is a good candidate for a full hair transplant procedure. The risk of keloid formation can be reduced with the initiation of prompt postsurgical prophylactic techniques, including topical corticosteroid agents, silicone gel sheeting, pressure therapy, or onion extract-containing gel (Callender et al., 2005; Garg, 2017; Gauglitz, 2013; Lawson et al., 2017).

Platelet-rich plasma

PRP is a biological product that is defined as a portion of the plasma fraction of autologous blood with a platelet concentration above the baseline before centrifugation (Alves and Grimalt, 2016). As a result, PRP contains not only a concentrated amount of platelets, but also a robust complement of clotting factors, enriched by a range of growth factors that are thought to stimulate hair growth. Alhough not fully understood, the proposed mechanism of action of PRP is as follows: Activation of platelets via thrombin or calcium chloride ➔ Platelets undergo degranulation➔ Growth factors are released ➔ Stimulate increased proliferation of dermal papilla cells via activation of extracellular-regulated kinase and Akt signaling➔ Antiapoptotic effects (Li et al., 2012).

PRP utilizes autologous blood that is obtained by venipuncture in an anticoagulated tube (Alves and Grimalt, 2016). The blood is centrifuged with single- or double-spin centrifugation, depending on the device (Alves and Grimalt, 2016, 2018). The settings of the centrifuge set to obtain PRP at an adjustable concentration are defined by the manufacturer, and cannot be changed by the physician. After centrifugation, the tube shows three basic layers, and the middle layer corresponds with PRP. Thrombin and calcium chloride are used to activate platelets and stimulate degranulation, causing the release of growth factors (Table 3; Anitua et al., 2017). Some investigators activate platelets, but others utilize platelets without previously

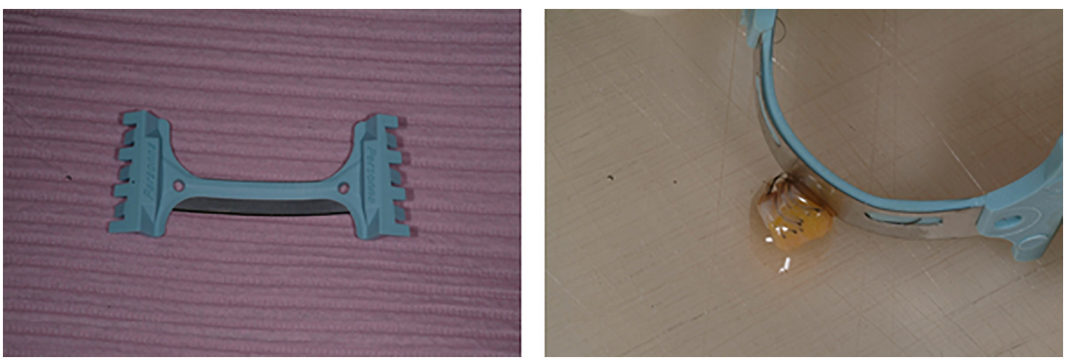

Fig. 9. DermaBlade (Persona Medical, Verona, VA)

activating them, postulating that doing so produces superior results (Alves and Grimalt, 2018). Currently, there is no consensus on the use of activators in PRP (Arshdeep and Kumaran, 2014).

The ideal volume to administer, the frequency of application, the exact site of administration, and which technique/preparation system to utilize remains highly controversial, and 12 distinct protocols are currently available. Alves and Grimalt (2018) report that PRP has demonstrated therapeutic effectiveness for androgenetic alopecia (AGA) in 10 of 12 studies, with 6 studies demonstrating a statistically significant improvement after treatment with PRP using objective measures, such as increased hair thickness and increased hair number (Dohan Ehrenfest et al., 2013; Lin et al., 2015; Mishra et al., 2012). Four additional studies showed hair improvement (e.g., hair density, diameter) with PRP, although no *p*-values or statistical analysis was described (Anitua et al., 2017; Arshdeep and Kumaran, 2014).

Although Alves and Grimalt (2018) suggest that PRP is a potential treatment option for AGA, the authors recognize that several limitations, such as lack of standardized treatment protocol for the application of PRP or standardized evaluation methods, need to be addressed to assess the efficacy of PRP on AGA before PRP can be broadly incorporated as a treatment option. The authors propose additional, large-scale, double-blind, randomized, controlled studies that treat both men and women, with standardized PRP preparation methods and administration protocols, repeated treatments, standardized objective data documentation and evaluation, physician and subject assessment, isolation of the effects of PRP in different grades of AGA, and performing long-term follow-up.

The authors also suggested protocols for PRP preparation that include a double-spin centrifugation method that consists of a first spin at 1500 to 1700 rpm for 6 to 10 minutes, followed by a second spin at 2500 rpm for 10 to 15 minutes (Alves and Grimalt, 2018). The use of an activator, preferably a Ca^{+2}-containing compound such as calcium chloride or calcium gluconate, would activate platelets for the release of growth factors and cytokines, and likely provide better results. The recommended amount of total injected PRP is an average volume of 6.2 mL (range; 3-12 mL) of pure PRP. Intradermal injections should be made in selected scalp areas using the nappage technique (i.e., multiple small injections in a linear pattern 1 cm apart to a depth of 1.5-2.5 mm). The authors recommend a minimum of three sessions at 1-month intervals.

Finally, the authors recommended anesthesia, but we prefer the use of a cryogen cooler to achieve a numbing effect prior to the injection.

Table 3
Main functions of growth factors present in platelet-rich plasma

Growth factors	Main functions
PDGF	Increases hair growth
	Vascularization
	Angiogenesis stimulator
TGF-β	Inhibits hair growth in vitro
	Hair-cell proliferation and regeneration
VEGF	Expressed in DP cells in the anagen phase
	Probably regulates perifollicular angiogenesis
	Increases perifollicular vessel size during the anagen growth phase
EGF	Angiogenesis stimulator
	Hair-cell proliferation and regeneration
HGF	Angiogenesis stimulator
FGF	Increases hair growth by inducing the anagen phase of HF
	Promotes DP cell proliferation
	Increases the HF size in mice
	Angiogenesis stimulator
IGF	Increases hair growth
	Maintains HF growth in vitro
	Angiogenesis stimulator

Abbreviations: DP = differential pressure; EGF = epidermal growth factor; FGF = fibroblast growth factor; HF = hair follicle; HGF = hepatocyte growth factor; IGF = insulin-like growth factor; PDGF = platelet-derived growth factor; TGF-β = transforming growth factor beta; VEGF = vascular endothelial growth factor.
Source: Alves and Grimalt, 2016.

Low-level laser therapy

Although the first report on low-level light therapy addressed its stimulatory effect on hair growth in 1967, the significance of this beneficial action has been reevaluated in recent years. The basic biological mechanism of low-level light therapy on the molecular level is considered the absorption of red and near-infrared light by chromophores contained in the protein of components of the respiratory chain of mitochondria. In randomized, sham device-controlled, double-blind clinical trials conducted at multiple institutional and private practices, a total of 128 male and 141 female subjects were randomized to receive either a laser comb or sham device in concealed sealed packets, and treated on the entire scalp three times per week for 26 weeks (Jimenez et al., 2014). After 26 weeks, a statistically significant increase in terminal hair density was observed in subjects using the laser comb treatment compared with the sham device. The increase in terminal hair count was comparable with that of short-term trials of a 5% minoxidil topical solution and 1 mg/day of finasteride. A higher percentage of laser comb-treated subjects reported overall improvement of hair loss conditions and thickness and fullness of hair.

Scalp micropigmentation

A form of cosmetic tattooing called scalp micropigmentation is a less invasive, more permanent option to camouflage hair loss. The medical use of tattooing was described in 1998 for alopecia areata of the eyebrows (van der Velden et al., 1998). In 2001, Traquina reported that the use of micropigmentation on the scalp is a safe and effective technique to camouflage scalp scars (Traquina, 2001).

Standard cosmetic tattoo instruments are used with a skillful and artistic technique to deposit pigment through the skin in the upper dermis, creating dots between the pores on a balding scalp (Dhurat et al., 2017; Rassman et al., 2013). Typically, two to four sessions are required, with each session lasting up to 8 hours. Risks from the procedure include infection and allergies to the pigment. Disadvantages include greying of the hair over time that may appear mismatched from the scalp, and the need for touch-ups over time due to fading and progression of hair loss (Saed et al., 2017).

Park et al. (2014) performed micropigmentation in 43 Korean patients, including 23 female patients with FPHL, 14 male patients with male pattern baldness, and 6 patients with scalp scars. The results for 41 patients were highly satisfactory, and there were no adverse effects or complications. The results for one patient with FPHL Ludwig stage I were satisfactory per the physician's assessment. The patient was dissatisfied due to a lack of appreciable difference after the procedure. The procedural interventions for hair loss are summarized in Table 4.

Conclusions

Women of color suffer from various forms of hair loss. The etiology of many of these forms of alopecia is multifactorial, and has not been fully elucidated, which makes alopecia in this population difficult to treat. Early recognition of clinical signs of hair loss is critical to halt its progression. Treatment options include medical and surgical interventions with an individualized approach. Surgical correction, such as hair transplantation, remains a viable

Table 4
Summary of surgical and procedural interventions for hair loss in women of color

Intervention	Method	Advantage	Disadvantage
Transplantation			
Follicular Unit Transplantation (FUT)	■ Separation of individual FU from linear strip of donor scalp	■ Minimal transection of hair follicles ■ 10-20 minutes to perform harvest ■ Excellent quality of resulting transplant	■ Visible linear scar ■ Time required to create grafts lengthy
Follicular unit extraction (FUE)	■ 1 mm punches used to isolate FUs	■ No visible linear scar ■ Minimal time required to create grafts ■ Variable quality of resulting transplant	■ Moth-eaten scarring of donor site ■ Variable transection rate of hair follicles ■ 30-90 minutes to perform harvest
UGraft and UPunch	■ 1-step FUE method resulting in complete separation of follicle from its attachments in single cutting action ■ Curved nonrotatary punch with tip configured to accommodate C curve of hair follicle for afro-textured hair	■ Can be used in FUE procedures for all afro-textured hair patient, including kinkiest-haired patients with coexisting acne keloidalis nuchae* lesions ■ Transection rate <10% ■ No need for pretesting	■ Small, retrospective case series limited to men
Scalp micropigmentation	■ Cosmetic tattooing used to create image of pores on balding scalp ■ Insertion of pigment in upper dermis	■ Relatively permanent results ■ Visually resembles pores on a balding scalp ■ Can be used to disguise scars after transplantation surgery	■ Risk of infection from procedure ■ Risk of allergy to pigment ■ Natural hair must be dyed to match pigment ■ May need touch-ups over time
Low-level laser treatment	■ Absorption of red and near-infrared light	■ Improved hair density and thickness per Investigator's Global Assessment	■ Headache, pain, pruritus ■ No improvement in Subject's Global Assessment

Abbreviations: FU = follicular unit; FUE = follicular unit extraction; FUT = follicular unit transplantation

option for hair loss in women of color, even in those with scarring alopecia who have demonstrated stable disease confirmed by biopsy test results.

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