Trichoscopy for the Hair Transplant Surgeon—Assessing for Mimickers of Androgenetic Alopecia and Preoperative Evaluation of Donor Site Area

Naiem T. Issa[1] Antonella Tosti[1]

[1] Dr. Phillip Frost Department of Dermatology & Cutaneous Surgery, University of Miami Leonard M. Miller School of Medicine, Miami, Florida, United States

Address for correspondence Naiem T. Issa, MD, PhD, Dr. Phillip Frost Department of Dermatology & Cutaneous Surgery, University of Miami Leonard M. Miller School of Medicine, Miami, FL 33136, United States (e-mail: nti4@med.miami.edu).

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Abstract

Preoperative diagnostic confidence and donor site assessment are important for all hair transplant surgery patients. While the majority of patients seek hair transplantation for male or female pattern hair loss (androgenetic alopecia [AGA]), there are mimickers that must be differentiated from patterned hair loss, as they alter the candidacy of the patient for transplantation. They are termed mimickers as they also can present with patterned hair loss. The use of trichoscopy has become increasingly popular for such use. Patterned hair loss mimickers, which include the underappreciated alopecia areata incognita (AAI) and fibrosing alopecia in patterned distribution (FAPD), can be identified clinically with key trichoscopic findings such as yellow dots and peripilar casts, respectively, that correlate with their histologic diagnosis. Donor hair density and putative hair pathology of the safe donor area can also by assessed via trichoscopy. This article discusses the use of trichoscopy, particularly for diagnosing mimickers of patterned hair loss as well as preoperative donor site assessment.

Keywords

- trichoscopy
- patterned hair loss
- androgenetic alopecia
- fibrosing alopecia
- alopecia areata

Introduction

Trichoscopy, also known as "scalp dermoscopy," is a noninvasive methodology for evaluating hair loss using magnified visualization.[1,2] A dermatoscope traditionally consists of a magnifier (typically ×10), a nonpolarized light source, a transparent plate, and a liquid medium between the instrument and the scalp. Modern dermatoscopes use polarized light instead of a liquid medium to eliminate skin surface reflections. Some instruments, such as the digital epiluminescence dermatoscopes, digitally capture and process the images. Digital dermatoscopy offers the advantage to store the images that can be compared with those obtained during the patient's next visit, which is very important in case of hair disorders. Instruments for digital dermatoscopy reach magnifications ranging from 20 to 1000X. Most studies on scalp dermoscopy have been done with magnifications ranging from 20 to 70X. Instruments can also be equipped with software to measure relevant trichological parameters. Trichoscopy has been utilized for the diagnosis of numerous hair loss disorders, including nonscarring alopecias, scarring alopecias and hair shaft disorders.[3,4] Its use also helps guide the clinician as to whether a biopsy is needed to confirm a diagnosis and where to perform the biopsy for the greatest yield.

For the hair transplant surgeon, the use of trichoscopy may be invaluable in preoperative assessment and planning. A normal dermatoscope attached to the smartphone or to the

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camera is enough for properly evaluating the recipient and the donor sites. Patients suffering from patterned hair loss (androgenetic alopecia [AGA]) comprise the greatest population of hair transplant candidates. While diagnosis for patterned hair loss is generally straightforward, the increased recognition of other hair loss disorders in the patterned distribution has prompted surgeons to become more aware of such conditions and diagnose them appropriately. This is important as these disorders, which mimic patterned hair loss, affect the candidacy of the patient for hair transplantation or may alter the timing of surgery.

Assessment of the donor hair site is also critical. Trichoscopy can be used to determine donor site hair density and the amount of hair follicles and follicular units (FUs) available for transplantation. It can also help assess for anisotrichosis or hair shaft variability, which may indicate androgenetic involvement of the donor site and render that area a poor choice for follicular extraction. Trichoscopy can also aid the hair transplant surgeon in identifying other causes of hair loss in what is otherwise deemed the safe donor area (SDA).

This paper aims to discuss the trichoscopic features of patterned hair loss and its two infamous mimickers—alopecia areata incognita (AAI) and fibrosing alopecia in a patterned distribution (FAPD). It is not uncommon for patterned hair loss to predate and/or coexist with these other conditions; trichoscopy helps to delineate this as well. Furthermore, this paper will discuss the use of trichoscopy for donor scalp assessment in preparation for hair transplantation.

Trichoscopic Features of Normal Hair and Patterned Hair Loss

Prior to assessing hair and scalp pathology, understanding of the normal nonalopecic scalp trichoscopic features is first required. Hair shafts and follicles are arranged in FUs, with groupings typically ranging from one to four hairs, with groupings of four or more hairs comprising $< 5\%$ of all FUs in the healthy scalp.[5,6] The number of hairs differ depending on the location on the scalp. For example, the frontal, occipital and temporal areas should contain less than 35%, 30% and 40% FUs containing only one hair, respectively.[6] In some hair loss disorders, the number of hairs per FU is decreased.[6] In addition, there is uniformity in thickness and color of hair shafts, with thin hairs accounting for up to 20% of the total number of hairs.[6] Other trichoscopic findings in the healthy scalp include empty follicular openings, yellow dots (follicular infundibula with sebum or keratotic material), and white dots (follicular and eccrine sweat gland openings) whose distribution, morphology, size and number vary with different hair pathologies.[7,8]

AGA is the most common cause of hair loss for which transplant surgery is sought. It is characterized by patterned hair loss in males and females due to increased androgens. Often, it is diagnosed clinically, given the time course and location of hair loss in androgen-dependent areas. On trichoscopy, characteristic findings include anisotrichosis ($> 20\%$ variability in hair shaft thickness) corresponding to vellus hair formation, reduced hair density, and single-hair FUs.[3] Some studies have also noted the presence of yellow dots and peripilar white dots to correlate with increasing severity in both males and females.[3,9–11] Specifically, yellow dots are found predominantly in the frontal scalp compared with the occipital scalp. White dots are seen in the normal scalp of darkly pigmented skin types or sun-exposed scalps and correspond to follicular openings and sweat gland openings.[12] Nonetheless, hair shaft variability is the canonical trichoscopic sign of patterned hair loss.

Patterned Hair Loss Mimicker #1: Alopecia Areata Incognita

AAI occurs more commonly in females and presents as acute diffuse telogen hair shedding. Reduced hair density is at times more pronounced on androgen-dependent areas.[13,14] In addition to patterned hair loss, telogen effluvium (TE) is also considered on the differential diagnosis, given the clinical pattern.

In typical alopecia areata, trichoschopy reveals signs of hair breakage such as exclamation point hairs, cadaverized hairs, or black dots. Trichoscopy of AAI, however, differs as it does not show these signs but shows only polycyclic yellow dots that vary in size, located diffusely throughout the scalp (►**Fig. 1 A**). These yellow dots correspond to the dilated ostia of nanogen and miniaturized hair follicles that contain keratin debris and sebum. Other common features include large numbers of regrowing, tapered terminal hairs, and circle hairs (►**Fig. 1 B**). Hair shaft variability is also commonly present in AAI.

A biopsy, taken from scalp skin with yellow dots as determined by trichoscopy, is therefore warranted to render a definitive diagnosis. Characteristic histologic features include dilated infundibular openings, reduced anagen-to-telogen ratio (greater telogen follicles), and miniaturization.[14–16] The percent of telogen structures is highest in AAI compared with patterned hair loss and TE.[14] Inflammatory bulbar infiltrate, which is typical of classic alopecia areata, may also be occasionally found.

AAI is responsive to steroid treatment, with many patients exhibiting full regrowth.[15] Therefore, the hair transplant surgeon must carefully establish the diagnosis of AAI, as these patients may not be transplantation candidates. It is important to note that patterned hair loss and AAI may coexist, and full hair regrowth may not be accomplished. In such a setting, hair transplantation may then be considered.

Patterned Hair Loss Mimicker #2: Fibrosing Alopecia in a Patterned Distribution

The nonclassical presentation of lichen planopilaris (LPP) with an patterned hair loss-like distribution is becoming increasingly appreciated. This has been termed as FAPD, where affected scalp areas demonstrate features of both patterned hair loss and LPP.[17–19] It is debated as to whether patterned hair loss leads to a lichenoid lymphocytic reaction or if these cases are a patterned variant of LPP.[20] An

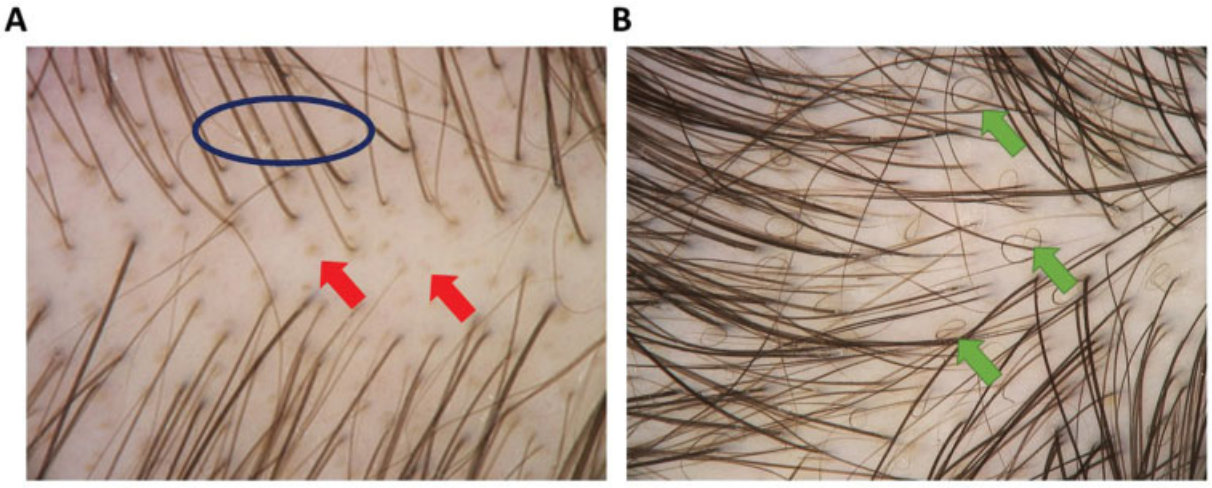

Fig. 1 Trichoscopic features of alopecia areata incognita (AAI). (**A**) Red arrows denote yellow dots and the blue circle highlights hair shaft variability (difference in shaft diameters). (**B**) Green arrows denote circle hairs.

association with frontal fibrosing alopecia (FFA) has also been noted. FAPD affects both Caucasians and those with skin of color.[21] Both sexes are affected but there appears to be a female predilection.[18] Notably, unlike FFA, FAPD does not affect eyelashes or body hair, but it rarely involves the eyebrows.[22]

On gross clinical examination, patients exhibit characteristics of patterned hair loss with hair loss in a patterned distribution along with scalp erythema and scaling. Oftentimes, FAPD is overlooked as patients are presumed to have seborrheic dermatitis or a concomitant irritant or allergic contact dermatitis.[23] It is therefore critical to ascertain what treatments patients have been using as treatment-resistant suspected seborrheic dermatitis or contact dermatitis due to topical(s) (e.g., minoxidil) may point the hair surgeon toward the diagnosis of FAPD. Allergen patch testing is useful in the latter case. In addition, scalp pruritus may be present in the above cases as well as FAPD. One study of 26 patients presenting with patterned LPP with subtle erythema and scaling revealed 46% (12/23) experienced pruritus.[24]

Trichoscopy reveals characteristic features of both patterned hair loss and LPP. Characteristic features of the peripilar casts that are diagnostic for LPP are only observed with dry trichoscopy without use of an interface solution such as alcohol solution or ultrasound gel. Wet trichoscopy with application of interface solution, which is typically used to reduce reflection of light (surface glare) from the stratum corneum, results in the removal of these casts, rendering them undetectable by this trichoscopic modality. It is therefore very important for hair transplant surgeons always to first examine their patients without using an interface solution. Peripilar casts are associated with hair shaft variability and miniaturization.[24] Casts often surround groups of two or three hairs emerging from the same ostium (►**Fig. 2 A**). Advanced disease may have absent follicular openings (►**Fig. 2 B**). In a study of 16 female Brazilian patients of Hispanic or African descent, dermoscopic findings were significant for loss of follicular ostia and increased hair fiber diameter diversity in all patients as well as perifollicular erythema and scaling in $>85\%$.[21] As much as 75% of patients also exhibited white patches, peripilar white halos, and honeycombed pigment networks which are similarly described in patients with central centrifugal cicatricial alopecia.[15] A comparison of trichoscopic findings in patterned hair loss, AAI, and FAPD are listed in ►**Table 1**.

A punch biopsy is required to make the final diagnosis of FAPD. The biopsy site must be carefully selected, so as not to miss the inflammatory component of the disease process. Dermoscopy aids in identifying the appropriate site that shows a tuft of hair surrounded by peripilar casts. Histology of active FAPD shows follicular miniaturization, LPP-characteristic partial loss or absence of sebaceous glands, and compound follicular structures with perifollicular lymphocytic lichenoid infiltrate and fibrosis.[24] Miniaturized hair follicles tend to demonstrate lichenoid reaction pattern.[18] Late-stage FAPD may show concentric lamellar fibrosis but lack acute interface dermatitis.

Diagnosing FAPD is of great importance for the surgeon, as hair transplantation is contraindicated during active inflammation, especially given the risk of koebnerization[25]. The surgeon must be keenly aware of this condition and assess for it during preoperative evaluation. This is especially important during the early stage of FAPD, which may present subtly. Dermoscopy, therefore, becomes an essential tool in the preoperative diagnosis of FAPD.

Donor Site Trichoscopic Assessment

Trichoscopy could serve as an invaluable tool for preoperative assessment of potential donor hair sites. Donor site quality is typically assessed by hair density (#hairs/cm^2), FU density (FU/cm^2), and hair shaft diameter. This is critical for estimating the size of the donor strip for follicular unit transplantation (FUT) as well as calculating the upper limit of units that may be extracted during follicular unit extraction (FUE).

Generally, the greater the number of FUs and total number of hair available for transplant, the more likely success of the

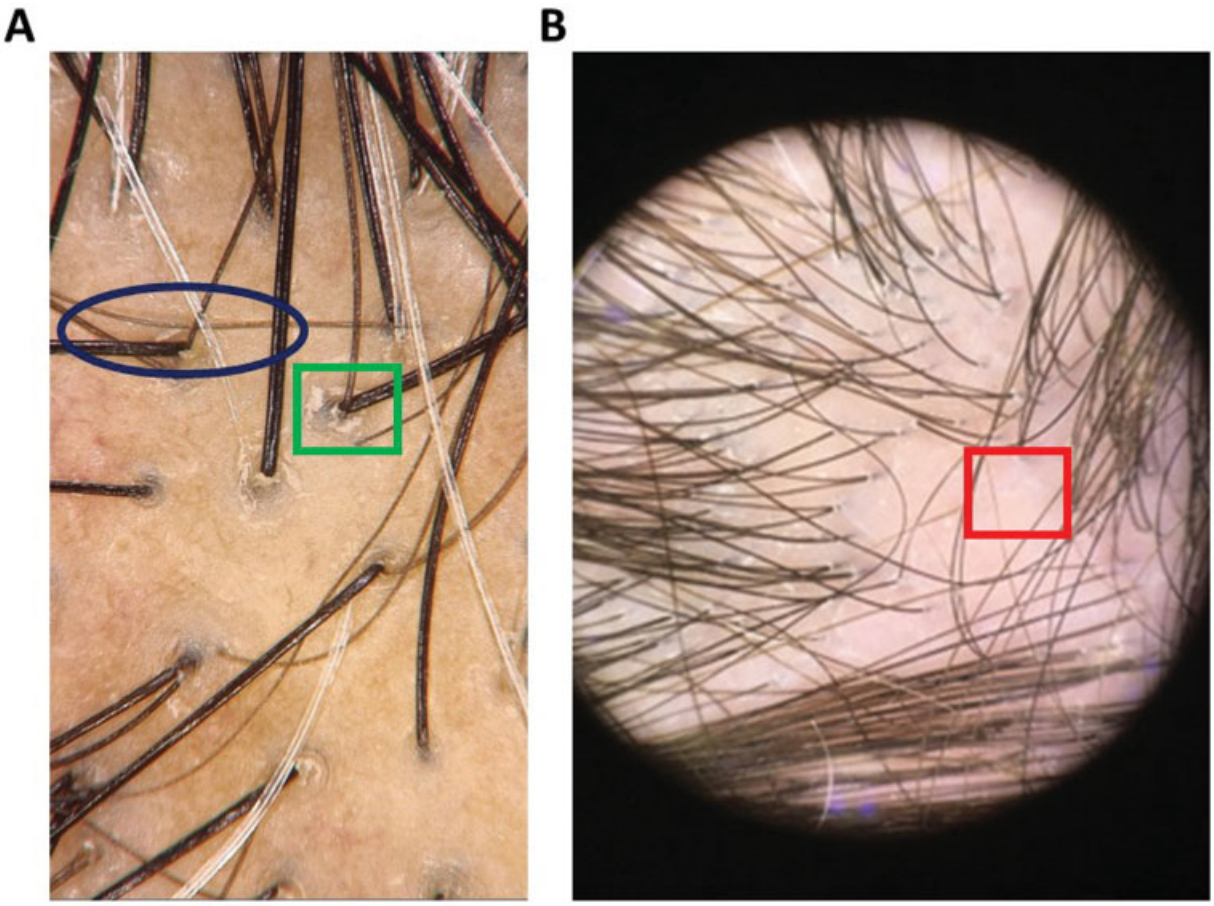

Fig. 2 Trichoscopic features of fibrosing alopecia in patterned distribution (FAPD). (**A**) The blue circle shows hair shaft variability and the green square illustrates tufts of hair surrounded by peripilar casts. (**B**) The red square exemplifies loss of follicular openings (scarring of hair follicles).

Table 1 Trichoscopic features of patterned hair loss (AGA) and its clinical mimickers AAI and FAPD. Canonical features of each entity are in bold

Patterned hair loss (AGA)	AAI	FAPD
Hair shaft variability Vellus hairs Thin short regrowing hairs Single-hair FUS Yellow Dots White Dots	**Yellow dots** Short regrowing hairs Pigtail hairs	**Peripilar casts** Hair tufting Hair shaft variability

Abbreviations: AAI, alopecia areata incognita; AGA, androgenetic alopecia; FAPD, fibrosing alopecia in patterned distribution; FU, follicular unit.

procedure. The average scalp has 1 FU/mm^2, with each FU on average containing two hairs for a hair density of 2 hairs/mm^2.[26] The permanent zone, or SDA, comprises 25% of the total scalp area, with half (12.5%) available for extraction/transplantation without causing the donor area to visually appear thin or less dense postoperatively. For the average scalp (surface area 50,000 mm^2 (500 cm^2) and 100,000 total hairs), the usable donor area (62.5 cm^2) therefore contains approximately 12,500 total hairs (or ~6,250 FUs with two hairs each).

According to a study by Jimenez and Ruifernandez on 50 patients, the hair density of the occipital donor scalp ranged from 124 to 200 hairs/cm2 with 65 to 85 FUs/cm^2 (approximately half the hair density).[27] Racial variations in hair density are also present. Bernstein and Rassman found the average hair densities of Africans, Asians and Caucasians to be 160, 170 and 200 hairs/cm2, respectively, and the average FU density to be 60, 100 and 100 FU/cm^2, respectively, in a collection of over 5,000 patients.[26] Another study in 119 male Chinese patients with patterned hair loss found an average hair density of 137 hairs/cm^2, FU density of 77 FU/cm^2, and mean hair diameter of 0.97 mm. Multiplying these densities (particularly those on the higher end) by the average usable donor area of 62.5 cm^2 results in the total number of available hair follicles and FUs available close to that previously noted by Bernstein et al for transplantation. Using this methodology, trichoscopy allows the hair transplant surgeon to assess donor site density and approximate total hairs/follicles available for transplantation. This further allows for appropriate preoperative planning for staged procedures and the donor strip area needed for achieving a desired recipient site density in a single session.

While the 50% SDA rule touted by Bernstein and Rassman is taken as a rule of thumb, there are many considerations

that affect the number of FUs extracted as well as the distribution of extraction, leading to an acceptable postdonor appearance.[28] One is the hair shaft structural morphology where curly or wavy hair appear to have greater density than straight hair with smaller diameter. Another is the hair shaft exit angle, where acute angles provide a "shingle" effect, allowing for hair shaft layering and blockage of sunlight to minimize contrast between scalp and hair. This is exemplified in Asian hair, where more obtuse hair shaft exit angles reduce this effect and lead to visible donor thinning after extraction. Postoperative hair length is also an important consideration, as short hair will reduce the layering effect and accentuate "empty spaces" created by extraction. Taken together, these factors affect the residual donor density (minimum density necessary for satisfactory donor coverage). The hair transplant surgeon must take these considerations in preoperatively assessing how many FUs can aesthetically be extracted without overharvesting.

In addition to hair density, assessment of hair shaft diameter is also important. The choice of hair shaft diameter chosen for transplantation is dependent on the specific needs of the patient. For example, women with different hairline patterns than men often require finer (thinner) single hair transplants for a more natural appearance. Finding the donor site area with the appropriate hair caliber for transplantation, which varies vertically along the occipital scalp, can therefore be done with the aid of trichoscopy.[29]

Furthermore, a patient's impetus to seek a hair transplant surgeon may be due to a sudden recent hair loss such as TE, which may coexist with long-standing patterned hair loss.[1,3] It is critical for the surgeon to identify such a process as the donor scalp area may be affected. Trichoscopy, along with a history of acute shedding, a recent stressor and a positive pull test, helps in establishing the diagnosis of TE. The key trichoscopic findings are the lack of features typical of other hair loss disorders along with short regrowing hairs of normal thickness, empty hair follicles and FUs with one hair.[1,3,30] Once the diagnosis is confirmed, patients may be candidates for hair transplantation after regrowth (usually 6 months after the resolution of the inciting event), as the donor site follicles will have escaped dormancy by then.[31]

Trichoscopy of the donor site allows the hair transplant surgeon to calculate the hair and FU densities. Using technologies such as Fotofinder TrichoVision, the surgeon may perform these calculations effortlessly. Trichoscopy also aids in the identification of anisotrichosis, prompting the surgeon to avoid donor regions with significant hair shaft variability, as they may not regrow optimally after extraction.

Conclusion

Trichoscopy is an excellent method by which hair transplant surgeons can more definitively diagnose the hair loss condition at hand. This is especially useful when patients present with mimickers of male or female pattern hair loss such as AAI and FAPD. Preoperative donor hair site assessment is also aided through trichoscopy to assess donor hair density and hair caliber. Surgeons stand to benefit from the incorporation of routine trichoscopic evaluation in their hair transplant practices.

Financial Disclosures
None.

Conflicts of Interest
None.

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