Trichoscopic Evaluation of Hair

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Abstract:

Collecting data on hair counts helps dermatologists diagnose hair diseases more accurately. Quantitative trichoscopy analysis is a common way to evaluate hair parameters.

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Introduction:

Dermoscopy is a non-invasive diagnostic technique used to see a variety of patterns and structures in skin lesions that are not discernible to the naked eye and that can be very useful in the characterization of skin lesions. It has several other names such as epiluminescence microscopy, dermatoscopy or skin surface microscopy **(1)**.

The technique consists of placing mineral oil, alcohol or even water on the skin lesion that is subsequently inspected using a hand-held lens, a hand-held dermatoscope a stereomicroscope, a camera, or a digital imaging system. The magnifications of these various instruments range from 6x even up to 100x. The fluid placed on the lesion eliminates surface reflection and renders the cornified layer translucent, thus allowing a better visualization of pigmented structures within the epidermis, the dermoepidermal junction and the superficial dermis **(1)**.

Trichoscopy is a dermoscopic examination of the hair and scalp and is a simple, reproducible, easy to perform, non-invasive, harmless and validated instrumental analysis method, which allows, through the use of a manual or digital dermatoscope, the diagnosis and follow-up of various scalp diseases **(2)**.

Both handheld dermatoscope and videodermatoscope is suitable to perform trichoscopy. Handheld dermatoscopes allow for tenfold magnification, while the magnification of digital dermatoscopes is ranging from tenfold to 50-fold and higher. Handheld dermatoscopes have the advantage of being both time and cost-effective. On the other hand, digital dermatoscopes have the superiority of taking easier photography and having higher magnifications **(3)**.

Principle

The basic principle of dermoscopy is transillumination of a lesion and studying it with a high magnification to visualize subtle features. Light incident on skin can

undergo reflection, refraction, diffraction and absorption. These phenomena are determined by the physical properties of the skin. A smooth, oily skin allows most of the light to pass through it, reaching the deeper dermis. This principle has been coupled to improve the visibility of subsurface skin structures by retaining application of linkage fluids oils (immersion oil, mineral oil and olive oil), water, an antiseptic solution and glycerin **(4).**

Technique

Non-contact or contact technique can be used for dermoscopy. The glass plate of the instrument comes in contact with the surface of the lesion where the linkage fluid was applied in the contact technique. In the non-contact technique, there is no contact of the lens with the skin; the cross-polarized lens absorbs all the scattered light and hence, allows only light in a single plane to pass through it. Disadvantages of this technique are decreased illumination and poor resolution, but the non-contact technique ensures that there are no nosocomial infections.

Trichoscopic observations can be broadly grouped as

- ❖ Hair signs
- ❖ Vascular patterns
- ❖ Pigment patterns
- ❖ Interfollicular patterns **(5).**

Normal Scalp

There are evenly spaced groups of few hair shafts coming out of the same follicular ostium in a healthy scalp. Single-and double-hair units are found in temporal scalp and occipital scalp has triple-hair units. After chronic sun exposure and in subjects with dark skin, a honeycomb pigmented network comprising a homogenous mosaic of contiguous brown rings is seen **(6).**

Trichoscopic Pattern

Trichoscopic evaluation of normal and diseased scalp is based on study of follicular patterns, interfollicular patterns and hair signs.

Follicular patterns.

White dots

Yellow dots

Black dots

Interfollicular Patterns

Vascular patterns

Pigment pattern

Trichoscopy structures and patterns

Anagen hairs usually are long, with uniform diameter and rectangular shape, slight distal end angel<20°, intense pigmentation of bulb and covered by sheaths and membranes. Telogen hairs are shorter and have higher roots compared to anagen roots; their root is club shape without any distal angel, absent or weak pigmentation of bulb and sheath is absent.

Dystrophic hairs have tapering diameter like exclamation mark, irregular contour, distal angel >20° and without any sheath. Catagen hairs in trichogram are usually rare. Anagen/telogen ratio during age (95%/5% in children, 83%/15% in adult maleand 83%/11% in adult female). Therefore, trichogram depends on gender to a degree. Anogen/Telogen ratio >7/1 indicates normal, more than >20% telegen hairs indicates telogen effluvium and and>3/1 is considered in favor of androgenic alopecia like FPHL **(7).**

Normal scalp is characterized by the presence of follicular units containing about 2–4 terminal hairs and 1 or 2 vellus hairs of uniform thickness and color. The mean thickness of normal hair was about 0.06 mm ; however, up to 10% of hairs are represented by vellus hairs which lack the medulla (**6**).

Normal terminal hair is uniform in thickness and color throughout its length, however, vellus hairs are lightly pigmented Simple, fine red loops, which represent capillaries within the dermal papillae, are generally visible hairs, and the subpapillary plexus is visible as linear arborizing vessels. In dark-skinned individuals, a perifollicular pigmented network (honeycomb pattern) is usually appreciated over the scalp which is accentuated over sun-exposed areas, and follicular openings and ecrine sweat gland duct openings appear as white dots (WD) **(4).**

In male or female androgenic alopecia different diameters of hair shafts, progressive shortening of hairs, dystrophic hairs and increased telogen hair proportion, are diagnostic features The most important finding of AGA is the hair diameter variability, which reflects hair miniaturization **(8)** .

Trichoscopy allows for magnified observation of the following: hair shafts, hair follicle openings, the perifollicular epidermis, and blood vessels. In particular, trichoscopy may be useful for the diagnosis, prognosis and follow-up of androgenetic alopecia (AGA), alopecia areata (AA), telogen effluvium (TE), trichotillomania, congenital triangular alopecia, tinea capitis, cicatritial alopecias, and hair shaft disorders **(9).**

Rakowska et al. proposed major and minor dermoscopic criteria for the diagnosis of FAGA.

Major criteria include

(1) more than four yellow dots in four images at 70-fold magnification in the frontal area;

(2) lower average hair thickness in the frontal area compared with the occipital area

(3) >10% of thin hairs (< 0.03 mm) in the frontal area.

Minor criteria include

(1) increased frontal to occipital ratio of single-hair pilosebaceous units >2:1

(2) Ratio of number of vellus hairs, frontal area to occiput >1.5: 1

(3) Ratio of hair follicles with perifollicular discoloration, frontal area to occiput >3:1.

The diagnosis of FAGA is made with the presence of two major criteria or one major plus two minor criteria **(10).**

The main trichoscopical sign in FAGA is the presence of hair diameter variability >20%. Moreover, it may show yellow dots that are indicative of empty follicles, small areas of focal atrichia and peripilar hyperpigmentation **(11)**

Dermoscopy is very useful for distinguishing FPHL from acute and chronic telogen effluvium. In women with severe FPHL, most follicular units consist of a single hair shaft.

Short vellus hairs (<0.03 mm): These are a sign of severe miniaturization. Their presence in the frontal scalp is a very useful clue for diagnosis. FPHL can be diagnosed when 10% or more than seven vellus hairs are detected in the frontal scalp.

Peripilar sign: This sign is commonly found in patients with early FPHL. **Yellow dots**: These are a sign of severe miniaturization and are more numerous in patients with severe FPHL. More than four yellow dots in four images from thefrontal scalp at high magnification (70×) are considered a major criterion for diagnosis.

Pinpoint white dots: The sun-exposed scalp can reveal this feature in very severe cases.

Scalp pigmentation: A honeycomb-like pattern is seen in sun-exposed areas. **Focal atrichia**: Postmenopausal women often present with small bald areas, which at dermoscopy show follicular openings and very thin and short vellus hairs **(12).**

Three main patterns of FAGA presentation have been described. Most frequently it shows a frontal hair thinning accentuation resulting in the 'Christmas tree' pattern (Olsen pattern) **(13).** The second most common pattern is characterized by central scalp involvement with the sparing of the frontal hairline (Ludwig pattern) **(14)** (**Fig. 1**) and **(table 1).** Finally, in patients with signifcant androgenization, bitemporal recession can be observed; rarely it could be associated with vertex thinning (Hamilton pattern). However, severe FAGA often involves parietal and occipital regions with difuse hair thinning **(15).**

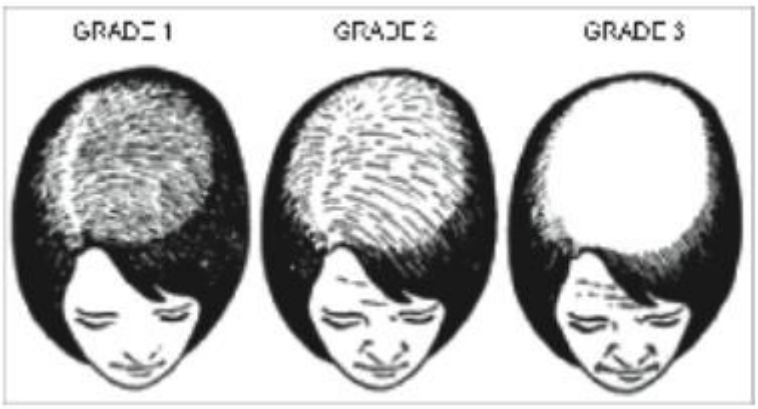

Figure 1: Ludwig classification of FPHL (14).

Table 1: Ludwig classification of FPHL(14).

Stage	Features
Ludwig Stage I	Perceptible thinning of hair from the anterior part of the crown with minimal widening of the midline part width. At this stage hair loss can be camouflaged.
Ludwig Stage II	The rarefaction on the crown becomes more pronounced, and the number of thinner and shorter hairs increase. Camouflage of the denuded areas by special hairstyles is no longer possible
Ludwig Stage III	The crown may become literally bald. A fringe of hair along the frontal hair line persists.

Rossi et al. (16) considered the following trichoscopic parameters:

1. the percentage of anisotrichosis (determined as the number of not terminal hair divided by total hairs number);

2. the percentage of vellus hairs (defined as hairs with a diameter lower than 0.03 mm and shorter than 30 mm);

3.the number of empty follicles

4. the percentage of single-hair follicular units (SHFUs)

5. the percentage of follicles with peripilar sign

6. the presence of honeycomb pigment pattern (HCPP)

7. the presence of fibrosis.

The first 5 parameters were selected as activity indexes, while HCPP and fibrosis were considered as marker of long-lasting disease.

Hair shaft thickness heterogeneity (anisotrichosis) is an expression of the terminal hair transformation into vellus hair, suggesting that it might represent an accurate clinical sign reflecting the miniaturization process evolution, which is the basis of AGA pathogenesis Anisotrichosis higher than 20% is an essential criterion for the diagnosis of AGA **(17).**

Empty follicles have been described in AGA, especially in advanced stages of the disease. Trichoscopically they appear as yellow dots (YD), which correspond to empty follicles filled with keratotic material and/or sebum, or follicles containing a completely miniaturized hair or a kenogen hair. If the scalp is exposed to the sun, these follicles can appear as pinpoint white dots **(18).**

Rakowska et al. (10) observed that the mean percentage of hair follicles with surrounding discoloration was around 32% in the frontal area and around 7% in the occipital area in patients

with FAGA. Nevertheless, they documented that healthy subjects presented perifollicular discoloration in less than 25% of the follicles in the frontal area, less than 15% in the occiput and less than 20% in the temporal areas.

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