Multifactorial Classification of Male and Female Androgenetic Alopecia

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BACKGROUND. Various classifications of male androgenetic alopecia have been described. In fact, all the classification schemes proposed so far are only topographic. A more objective, accurate, and detailed approach to classifying baldness is needed.

OBJECTIVE. To propose a dynamic multifactorial classification of certain parameters that can be quantitated and computerized.

METHODS. A multifactorial classification has been developed to study parameters such as fixed distances of the face, scalp mobility and thickness, and covering power of hair. This includes density, caliber, shape, length, growth rate, and hair color.

RESULTS. Classification proved to be efficient during the fluctuations of different parameters in hormonal and minoxidil treatments. It also helps to determine surgical indications of hair transplant and the stage of maximal baldness.

CONCLUSION. This approach will lead to a better evaluation of the evolution of androgenetic alopecia in both sexes, either spontaneously or under treatment.

MALE OR FEMALE androgenetic alopecia induces a relatively early hair loss phenomenon of varying incidence and extent. Several intermediate evolutive stages exist between minimal thinning due to a decrease in hair density (frontotemporal recessions, crown, or vertex) and the stage where only a narrow horseshoe-shaped band remains. Classifications of baldness require a more objective, precise, and detailed approach for the different modifications determined by the evolutive process. This is equally true for all the experimental, medical, and surgical approaches of alopecia. Therefore we propose the combined use of two classifications, one of the various simplified or detailed classifications, and a dynamic, detailed, multifactorial classification in which we have accurately integrated several parameters: extension of the bald and hair-bearing areas, the elasticity and density of the scalp, and hair characteris- tics such as diameter, length, shape, color, and growth rate that confer the covering power of hair.

History of Classifications

Various classifications have been proposed since the study of Beek in 1950 done on 1000 male Caucasians with two evolutive aspects (frontal and frontovertical baldness). In 1951, Hamilton established a classification based on the description of eight evolutive aspects and three subgroups. He also made a comparison between the incidence of baldness in Caucasians and that in Chinese (Figure 1).

In 1953, 15 types of balding were distinguished by Ogata from 20 different aspects. He classified them in six evolutive groups (Figure 2).

In 1969 Feit proposed a more detailed classification than that of Hamilton. He characterized 12 different varieties of 16 categorized aspects.

In 1970, Setty simplified Hamilton’s classification in three groups: totopilosis (corresponds to Hamilton type I), indentato-pilosis (Hamilton type II-V), and indentatio-circulo-pilosis (more or less Hamilton type VI-VII). The latter is subdivided into confluent and nonconfluent.

In 1975, Rook and Dawber described a classification in five evolutive stages. The same year, Norwood made a more detailed classification than that of Hamilton. Six years later, Takashima studied the incidence of age for the different classifications on androgenetic alopecia development in Caucasians and Mongoloids (Figure 3).

In 1976, Bouhanna proposed a simplified classification of alopecia in five evolutive stages with two subgroups. This allowed a more precise evaluation of the surgical indications of hair transplantation (Figure 4). In 1984, Blanchard and Blanchard determined the measurement of six distances between fixed landmarks of the face and the fluctuating borders of alopecia (Figure 5). Savin (Savin RC, personal communication, 1982) proposed a classification based on the evaluation of baldness areas through computer-based global photographs. Bouhanna and Dardour’s classification of baldness, although more detailed than that of Blan-
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Figure 1. Hamilton-Norwood classification of the various types of male androgenetic alopecia.

chard and Blanchard, proved to be very complicated and difficult to apply.

In 1977, Ludwig classified female androgenetic alopecia in three stages. In women there is a diffuse alopecia of the top of the scalp with a preserved frontal fringe (Figure 6).

The diversity of techniques for the surgical treatment of alopecia caused us to develop a multifactorial classification of male and female androgenetic alopecia.15

Materials and Methods

Parameters measured with the highest possible accuracy help to determine the surgical indications through the evaluation of the extent of the bald and hairy areas, the degree of elasticity and thickness of the scalp, and the covering power of hair according to density, caliber, shape, length, growth rate, and hair color.

Extent of Bald and Hairy Areas

In men, it is useful to know the normal values of the fixed measurements corresponding to the prebalding stage. The extent of bald and hairy areas (Figure 7) can be determined with precision according to the following parameters:

- Median sagittal distance (MS): 34–37 cm (mean 35 cm). The distance between the edge of the frontal hairline and the lower occipital ridge.
- Left and right sagittal paramedian distances (LSPM and RSPM): 33–36 cm (mean 34 cm). The distances between the bottom of the left or right frontal recession and the lower occipital line.
- Transverse supra-auricular distance (TSA): 30–34 cm (mean 32 cm). The distance between the two left and right supra-auricular hairlines.
- Temporal anterior spacing distance (TAS): 34–40 cm (mean 37 cm). The distance between the two most proximal anterior temporal lines.
- Stage of maximal balding (SMB): 5 cm.

In women, the values of the fixed measurements corresponding to the stage of a normal head of hair are MS = 30–34 cm (mean = 32 cm), LSPM and RSPM = 30–33 cm (mean = 32 cm), TSA = 28–32 cm (mean = 30 cm), TAS = 30–36 cm (mean = 34 cm). The stage of maximal baldness cannot be measured since female androgenetic alopecia is diffuse.

Variable measurements of the hair-bearing areas include right and left vertical temporal diameter (RVT and LVT),

Figure 2. Ogata's classification with 15 evolutive varieties. (Courtesy of Hair Research: Orfanos, Montagna, Stüttgen. Berlin: Springer-Verlag, 1981.)

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Figure 3. Age-specific incidence of advanced baldness in Caucasians and Mongoloids.

Figure 4. Bouhanna's simplified classification of male androgenetic alopecia: three evolutive stages with two subgroups including a vertex alopecia.

vertex sagittal diameter (VSD), and the vertex transverse diameter (VTD). These will not be developed in this article.

Mobility of the Scalp

Mobility of the scalp is measured on a scale, according to Norwood, and graded from 0 to 3; 0 = 0 folds, 1 = 1-2 folds, 2 = 3-4 folds, and 3 = ≥5 folds. It depends on the folds resulting from the bimanual compression of the scalp to determine the class of mobility.

Thickness of the Scalp

In order to measure scalp thickness we set up a very simple method. A single use subcutaneous needle is inserted vertically until it reaches the galea. The emerging portion of the needle is extracted with Kocher forceps. The sunken portion is then measured with a micrometric measuring device (Figure 8). Scalp thickness is graded on a scale of 0-3: 0 = very thin (<2 mm), 1 = thin (2-3 mm), 2 = medium (3-8 mm), 3 = thick (>8 mm).

Covering Power of Hair

This essential variable for the surgical indications of hair transplantation depend upon various parameters:

Hair density. Hair density is either graded from 0 to 3 [0 = poor (<50 hairs/cm²), 1 = medium (50-100 hairs/cm²), 2 = good (100-200 hairs/cm²), 3 = very good (>200 hairs/cm²)], or measured macrophotographically with great precision (<50 hairs/cm², 50-200, >200 hairs/cm²).

Hair diameter (caliber). We proposed a correlation between the subjective evaluation of hair caliber (small, medium, and big) and that of hair shaft rated on a scale from 0 to 3: 0 = vellus hair (<40 μm), 1 = small caliber (40-60 μm), 2 = medium caliber (60-80 μm), 3 = big caliber (>80 μm). The
only objective method available is the accurate microscopic measurement of hair shaft diameter (Figure 9).

Shape of hair shaft. This variable classifies the shape of the hair shaft as straight, wavy, curly, or frizzy (Figure 10).

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Measurement</th>
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<tbody>
<tr>
<td>1</td>
<td>Straight</td>
<td>a = 5.5 - 6.0 cm</td>
</tr>
<tr>
<td>2</td>
<td>Wavy</td>
<td>a = 5.5 - 6.0 cm</td>
</tr>
<tr>
<td>3</td>
<td>Curly</td>
<td>a &gt; 6.5 cm</td>
</tr>
<tr>
<td>4</td>
<td>Frizzy</td>
<td>d &lt; 19 cm</td>
</tr>
<tr>
<td>5</td>
<td>Straight</td>
<td>c &gt; 11 cm</td>
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Hair length. Hair length (L) is graded on a scale of 0-3: 0, L < 1 cm; 1, L = 1-2 cm; 2, L = 3-5 cm; 3, L > 5 cm.

Growth rate of hair. The growth rate of hair can be evaluated either through a phototrichogram, which measures the growth rate of hair on two successive macrophotographs at a 3-day interval (Figure 11), or through a personal method: hairs which have been located by tattooing are cut just above their point of emergence. They are then marked with a light tincture for dark hair and a dark tincture for blondes. Each hair shaft that has been located and dyed is cut at its point of emergence 3–7 days later. The length value determines the growth rate (Gr), which is graded on a scale of 0–3: 0, Gr < 0.2 mm/day; 1, Gr = 0.2–0.3 mm/day; 2, Gr = 0.3–0.4 mm/day; 3, Gr > 0.4 mm/day.

Hair color. For practical classification purposes, we propose four basic tones: black (Bk), blond (B), red (R), and white.

Hair shaft color. For practical classification purposes, we propose four basic tones: black (Bk), blond (B), red (R), and white.

![Ludwig's classification of female androgenetic alopecia of the diffuse type.](image1)

![Blanchard's classification in five evolutive stages with the related measurements.](image2)

![Diagram showing the four fixed measurements of the scalp, according to Bouhanna: +++ median sagittal diameter, + + + paramedian sagittal diameter, 000 transverse supra-auricular diameter, xxx anterior intertemporal diameter.](image3)
Figure 8. A) Thickness of the scalp measurement by inserting a single-use subcutaneous needle to the galea. The emerging portion is then withdrawn using Kocher forceps. B) Measurement of the sunken portion of the needle.

(W). These are mixed together according to the natural appearance of the hair (e.g., gray hair = Bk + W).

Discussion
The diversity of surgical treatments for baldness prompted us to study the morphologic as well as the dynamic parameters of hair. Constants measured with the highest level of accuracy allow us to determine the surgical indications in order to evaluate the extent of the bald and hair-bearing areas, the degree of elasticity and thickness of the scalp, and the covering power of hair according to density, caliber, shape, length, growth rate, and hair color. This classification has proved to be equally useful in both medical and hair cosmetology evaluations.

We should point out the benefit of this classification during the fluctuations of these parameters in certain hormonal treatments or after minoxidil application. The basic principle of hair transplant surgery consists of sharing hair harmoniously among the bald and hairy areas. Therefore we have set up a prospective method of evaluation that allows determination of the stage of maximal baldness in men. This is done by drawing two axes from two fixed landmarks.

The angle between these two prolonged axes allows the prospective evaluation of the residual medio-occipital hairy area in the stage of maximal baldness. The superior axis is drawn according to the external angle of the eye and the apex of the ear lobe. The inferior axis is drawn between the external angle of the eye and the external auditory canal (Figure 12). In women, this stage cannot be quantitated because female androgenic alopecia is diffuse.

We have no precise evaluation method for the mobility of the scalp. Norwood® proposed an easy method consisting of a bimanual compression of the bald and the hair-bearing areas. According to the number of folds obtained, a scale of 0–3 is established (Figure 13). This test is particularly useful for determining the mobility of the vertex before scalp reduction and the lax-

Figure 9. Micrometric measurement of hair shafts under an optical microscope.

Figure 10. Shape of the hair shaft in four types.
ity of the crown before flap transposition. We strongly emphasize that there might be a dissociation between the degree of mobility given by this test and the relative stiffness of the galea. In fact, the flexibility of the galea is merely what conditions the complete approximation of the borders of an incision. The use of expanders or extenders will improve the laxity of the aponeurosis.

The thickness of the scalp is an important parameter to be taken into consideration before any grafting or flap transposition. We have noticed a better take of transposition flaps in thick scalps. The evaluation of the thickness might be equally modified during the insertion of expanders.

In a normal individual, hair density varies between 200 and 400 hairs/cm². The balding process leads to a more or less severe decrease in hair density. An alopecia becomes apparent for densities between 50 and 150 terminal hairs/cm². The thinning is even more important in cases of intermediate and nonvellus hairs or straight and thin hairs. Recent works on the progressive distention created by expanders subcutaneously enabled us to verify with successive phototrichograms the progressive evolution of alopecia compared to the parallel decrease in hair density. This latter has reached values as low as 20–30 hairs/cm².

The diameter of the hair shaft can vary from one to three folds for the same head of hair over different areas or between two individuals. The caliber of the terminal hair is directly related to genetic predisposition and ethnic origin. Mongoloid hair, for example, has a greater diameter than Caucasoid hair. Several articles on the subject showed an increase in hair caliber in the vicinity of inflammatory phenomena of the scalp (tinea capitis, pseudopelade, grafted hairs, etc.).

The shape of the hair shaft is of utmost importance in the choice of a surgical technique. Hair appearance might be straight, wavy, curly, or frizzy due to the different configurations of the keratin chains which are determined by heredity and ethnic origin. Chemical agents in perms can transitorily modify the hair shape. Wavy or curly hairs have a maximal covering effect both in situ and at a distance. However, frizzy hair has only an important covering power in situ. Therefore hair shape can influence the choice of the grafting technique. Sometimes transplanted hair that was initially straight on the donor site will become wavy or curled with an increase in the caliber of the hair shaft over the recipient area.

The covering power of hair at a distance is directly related to the length of hair. Certain techniques, for
Ethnic origin and genetic background can give the hair a black, blond, or red pigmentation. Aging will provoke a more or less rapid loss of hair pigmentation to give a gray to white color. Transplantation of very dark mini-grafts can give an artificial and unsightly aspect to the frontal hairline. This is especially true for fair skinned individuals, where the contrast is even greater.

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References