

Natural progression of male pattern baldness in young men

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Summary

Twenty-six men who presented with male pattern baldness (androgen-dependent alopecia), were quantitatively evaluated for scalp hair variables and compared with 13 age-matched controls. Compared to controls, significant mean differences for hair variables were found in the frontal-vertex area, while in the occipital area, a reduction in total hair density (hairs/cm²) was the only significant ($P < 0.05$) finding. A large proportion (48.5%) of meaningful hair (non-vellus hair) was ≤ 40 mm in length, yet had diameters similar to hairs growing much longer. In controls, these hairs accounted for only 12.2% of the total population. Compared to baseline, mean values from the frontal-vertex area of subjects with androgen-dependent alopecia were significantly lower for total hair density, meaningful hair density (non-vellus hairs/cm²) and percentage of hair in the anagen growth phase, 12 and 24 months later. During this time, total hair density decreased by 6.5% after 12 months and by 11.9% after 24 months. Similarly, meaningful hair density declined at 12 months by 10.8% and by 22.7% after 24 months. No change in any hair variable was detected in controls after 12 or 24 months.

Our findings suggest that medications capable of maintaining the existing hair population should be regarded as effective treatments for this condition. Left untreated androgen-dependent alopecia progressively deteriorates. The induction of non-vellus hairs ≤ 40 mm in length to grow longer, would substantially improve the aesthetic profile without the need to generate new hair.

Androgen-dependent alopecia (known as male pattern baldness, androgenic alopecia, androgenetic alopecia, common baldness or genetic hair loss) is a genetic condition which requires androgen mediation for its phenotypic expression.¹ The distribution and incidence was first documented by Hamilton,² and its prevalence is considered to be almost 100%, although precise epidemi-

ological data are not available.³ For most men, the hair loss involves a recession of hair from the crown or temporal regions, while reduced hair 'volume' over the frontal-vertex area is a notable feature. A female pattern of hair loss in men (diffuse thinning while retaining the frontal hair line) is much less frequent.

Most scalp hair disorders can be characterized quantitatively by analysing three fundamental hair variables: hair density, hair diameter and hair length. The unit area trichogram⁴ is a technique capable of providing such information.⁵ The technique involves the epilation of all the hair contained within a defined area. The hairs obtained were then analysed microscopically for diameter, phase of growth and length.^{6,7} The method has been employed to detail scalp hair changes during systemic anti-androgen therapy in women^{8,9} and topical 2% minoxidil treatment in men with pattern baldness.¹⁰ In view of the lack of quantitative trichological data in young men with androgen-dependent alopecia, we used the unit area trichogram to investigate the natural progression of this condition in their most affected site.

Methods

Selection of subjects with androgen-dependent alopecia

Twenty-six Caucasian males aged between 20 and 30 years (25.7 ± 2.9 , mean \pm s.d.) with androgen-dependent alopecia, who attended for hair-care and hair loss advice, were studied over a 24-month period. The duration of alopecia varied from 3 to 8 years. From the initial group of 26, 22 were available for re-sampling after 12 months, 10 were re-evaluated after 24 months and in six, data was obtained both at 12 and 24 months. Hair samples were obtained from the most affected site within the frontal-vertex area; however, frontal hair lines and areas of scalp with obvious differences in hair density, were not sampled. In 15 subjects, samples from the occipital area were also obtained. All gave their informed consent. No subject had taken iron, vitamin B₁₂, folic acid, multi-vitamin supplements, prescribed medications or had suffered any illness lasting longer than seven days, 6 months prior to entering the study. No subject had

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applied products known to influence scalp hair growth either before or during the study. Biochemical, haematological and thyroid-function evaluations were all normal. Subjects with alopecia areata, cicatricial alopecia or a history of thyroid dysfunction were excluded.

Selection of control subjects

Thirteen controls were all Caucasian males aged between 20 and 30 years (24.2 ± 3.3) who were unaware of changes in hair quality or quantity, nor were they aware of any increase in hair shedding. None had suffered illnesses lasting longer than 7 days or taken medications during the previous 6 months, and none had ever sought medical advice for hair loss. Hair samples were obtained from the frontal and occipital areas, the locations of which have been described previously.⁴ Hair variables in the frontal area and vertex area of men without androgen-dependent alopecia (controls) are not significantly different,⁶ comparisons between frontal values from controls, and vertex values from subjects with androgen-dependent alopecia were therefore possible.

The unit-area trichogram

All subjects and controls followed the same standardized procedure over the 2 days prior to sampling as detailed previously,⁴ with the recent modifications of Rushton *et al.*⁷ Two unit-area trichograms, separated by less than 30 mm, were undertaken initially in each subject and repeated after 12 or 24 months, within ± 5 mm of the original sites. Values obtained from both sites at each time interval were pooled for data analysis. Re-location of the sample sites was achieved relatively easily by employing midline and facial co-ordinates. In controls, the mean number of hairs examined per site was 126 from the frontal area and 108 from the occipital area, while in subjects with androgen-dependent alopecia a mean of 88 hairs was obtained from the frontal and 87 from the occipital area.

Hair variables employed in this study

The hair variables employed are listed in Table 1. The reproducibility of the unit area trichogram has been established previously^{5-7,9,10} and, as in this study, the generated mean values were accurate to $\pm 5\%$. The term meaningful hair (hairs $> 40 \mu\text{m}$ in diameter) introduced by Rushton *et al.*⁴ was redefined by also including hairs $\leq 40 \mu\text{m}$ in diameter having a length > 30 mm.^{5-7,9} This provided a working definition for vellus hair and, consequently, hair $\leq 40 \mu\text{m}$ in diameter having a length ≤ 30 mm was classified as a vellus hair. The proportion of hair ≤ 40 mm in length provided an estimate of hair cycle disturbance during the previous 3 months. The percent-

age of telogen hair ≤ 30 mm in length was employed to assess complete growth cycles of less than 6 months. Where reference is made to hair length, this term relates to uncut hairs only or cut hair above the pre-assigned limit. Subjects whose hair had been cut below these limits were excluded.

Statistical analysis

Group mean differences were compared statistically employing Wilcoxon signed rank test or Student's *t*-test for paired or unpaired (independent) samples, as appropriate. All analyses were undertaken on an Apple MacintoshTM computer using the statistical program STATWORKSTM.

Results

Distribution of hair variables in men with androgen-dependent alopecia compared with age-matched controls (Table 1)

Values for hair variables from the frontal and occipital areas were obtained in 13 controls and compared to values from age-matched subjects with androgen-dependent alopecia (frontal-vertex area, $n=26$; occipital area, $n=15$). In the frontal-vertex area, significant mean differences were observed in total hair density (hairs/cm², $P<0.0001$) and meaningful hair density (non-vellus hairs/cm², $P<0.0001$). The frequency (%) of values above or below the control range was also determined (Table 1). In subjects in whom frontal-vertex hair densities were within the control ranges, all had an increase in the percentage of vellus hair (hairs $\leq 40 \mu\text{m}$ in diameter, ≤ 30 mm in length) and percentage of telogen hair ≤ 30 mm in length, above the highest value obtained in controls.

In the occipital area, basal mean values from subjects with androgen-dependent alopecia were not significantly different compared with controls, except for total hair density, where a significant ($P<0.05$) decrease was observed. However, for total hair density, meaningful hair density and percentage of hair in the anagen growth phase, 40.0%, 33.3% and 60.0%, respectively, were below their lowest control value (data not shown).

Changes in hair variables in men with androgen-dependent alopecia after 12 months (Figs 1-3)

After 12 months mean values ($n=22$) from the frontal-vertex area of men with androgen-dependent alopecia were significantly reduced for total hair density ($P<0.01$), meaningful hair density ($P<0.01$), percentage of hair in the anagen growth phase ($P<0.01$) and percentage of meaningful anagenhair ($P<0.05$) com-

Table 1. Comparisons between hair values from age-matched controls and subjects with androgen-dependent alopecia from the frontal-vertex area and frequency (%) above or below the control range

Variable	Controls (n=13)	Subjects (n=26)	(%) Above	(%) Below
Total hair density per cm²				
Mean \pm s.d.	301 \pm 30	†† 232 \pm 51	None	65.4
Median	300	218		
Range	256–358	144–346		
Meaningful hair density per cm²				
Mean \pm s.d.	282 \pm 26	†† 192 \pm 52	None	76.9
Median	282	181		
Range	232–325	69–302		
(%) Anagen hair				
Mean \pm s.d.	89.2 \pm 4.1	60.9 \pm 14.9	None	92.3
Median	89.2	60.3		
Range	83.3–94.9	26.6–90.0		
(%) Meaningful anagen hair				
Mean \pm s.d.	90.7 \pm 3.5	63.6 \pm 15.1	None	92.3
Median	90.9	64.9		
Range	84.9–96.8	31.3–91.7		
(%) Hair \leq 40 mm length				
Mean \pm s.d.	17.9 \pm 5.7	65.9 \pm 20.9	96.2	None
Median	17.1	68.0		
Range	11.3–29.5	29.4–100.0		
(%) Vellus hair				
Mean \pm s.d.	6.0 \pm 3.2	17.8 \pm 10.8	73.1	None
Median	5.6	15.9		
Range	0.6–10.9	1.5–51.9		
(%) Telogen hair \leq 30 mm length				
Mean \pm s.d.	2.8 \pm 2.9	27.3 \pm 17.3	92.3	None
Median	2.9	23.4		
Range	0.8–6.1	3.2–70.6		

†† $P < 0.0001$; Student's *t*-test (independent samples)

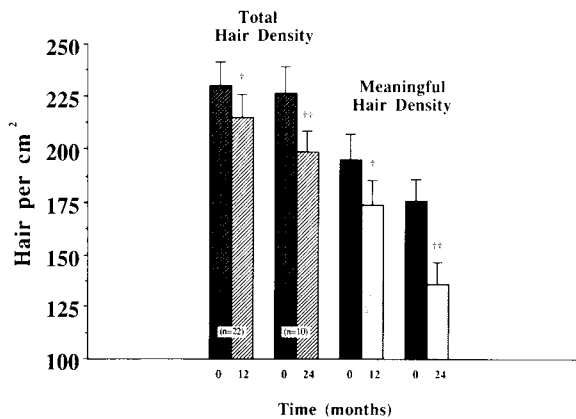


Figure 1. Changes in total hair density (hairs/cm²) and meaningful hair density (non-vellus hairs/cm²) in 22 subjects with androgen-dependent alopecia after 12 months, and in 10 after 24 months (means \pm s.e.m.). Statistical significance: † $P < 0.01$, †† $P < 0.0001$ (Student's *t*-test).

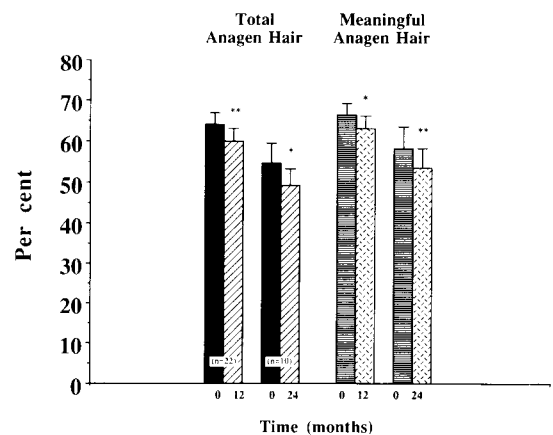


Figure 2. Changes in the percentage of hair in the anagen growth phase and percentage of meaningful hair in the anagen growth phase in 22 subjects and percentage of meaningful hair in the anagen growth phase, and in 10 after 24 months (means \pm s.e.m.). Statistical significance: * $P < 0.05$, ** $P < 0.01$ (Wilcoxon signed rank test).

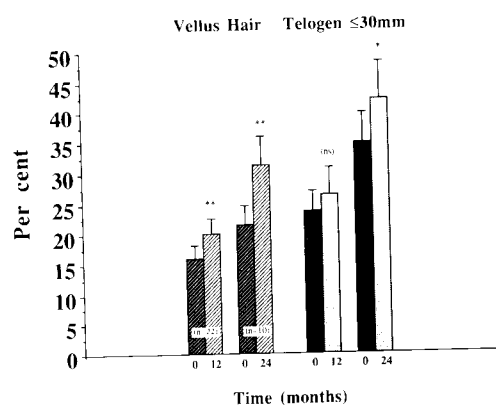


Figure 3. Changes in the percentage of vellus hair and percentage of telogen hair ≤ 30 mm in length in 22 subjects with androgen-dependent alopecia after 12 months, and in 10 after 24 months (means \pm s.e.m.). Statistical significance; ns = not significant, * $P < 0.05$, ** $P < 0.01$ (Wilcoxon signed rank test).

pared to baseline (Figs 1 and 2). During this time, a significant increase in the percentage of hair ≤ 40 mm in length ($P < 0.05$, data not shown) and percentage of vellus hair ($P < 0.01$) was observed. No significant change in the percentage of telogen hair ≤ 30 mm in length could be found at this time (Fig. 3). In contrast to these findings from the frontal-vertex area, mean values from the occipital area ($n = 15$) were not significantly different for any hair variable 12 months later (data not shown).

Changes in hair variables in men with androgen-dependent alopecia after 24 months (Figs 1-4)

Mean values ($n = 10$) obtained 24 months later from the frontal-vertex area, were also significantly lower compared to baseline. These changes were greater than those observed after 12 months (Figs 1-3). Mean total hair density decreased by 6.5% after 12 months and by 11.9% after 24 months, while mean values for meaningful hair density were reduced by 10.8% after 12 months and by 22.7% after 24 months. Analysing the individual data and minimizing the differences between baseline values and those obtained after 12 or 24 months, by correction for twice ($\pm 10\%$) the variability of the unit area trichogram, a decrease in meaningful hair density was observed in 20% of subjects after 12 months, and in 80% after 24 months. Baseline comparisons for total hair density and meaningful hair density were available in six subjects after 12 and 24 months, the changes observed are presented in Fig. 4.

Changes in hair variables in five controls after 12 months

In controls, mean values ($n = 5$) for hair variables obtained from the frontal and occipital areas were not significantly different 12 months later, nor in two, after 24 months. All values were within $\pm 5\%$ of their baseline levels (data not shown).

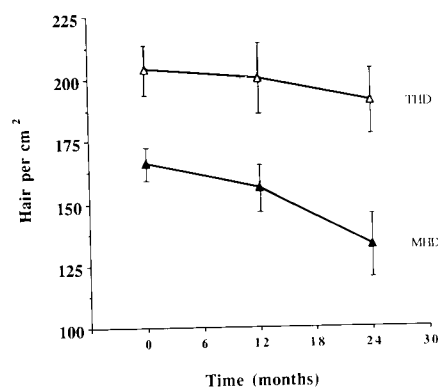


Figure 4. Changes over time in total hair density (THD) and meaningful hair density (MHD) in six men with androgen-dependent alopecia (means \pm s.e.m.).

Discussion

For most men, the onset of androgen-dependent alopecia occurs before the age of 30. The role of male hormones,¹ the pattern and the distribution have been well documented,² however, changes within an affected area have not been followed quantitatively. In an attempt to study this aspect, hair values from age-matched controls were compared with values from subjects with androgen-dependent alopecia. We then followed these subjects for up to 24 months.

Comparisons between age-matched controls suggests that the following sequence of events occurs in androgen-dependent alopecia. Initially, there is a reduction in the percentage of hair follicles in the anagen growth phase (92.3% had reduced anagen values) as a result, the length of hair grown declines (96.2% and 92.3%, respectively, had increases in the percentage of hair ≤ 40 mm in length and percentage of telogen hair ≤ 30 mm in length). As these events proceed, genetically orchestrated (androgen-mediated) changes begin to appear and the proportion of vellus hair increases. Meaningful hair density (non-vellus hairs/cm²) decreases in responses to modification of terminal hair and, finally, as the vellus hairs fail to emerge, total hair density declines.

Changes in hair variables from subjects with androgen-dependent alopecia over a 24-month period, confirmed the above events: the percentage of hair in the anagen phase decreased further, as did total hair density and meaningful hair density. The latter showing the largest response. Compared to baseline, meaningful hair density was reduced by 10.8% after 12 months and by 22.7% after 24 months, with corresponding increases in other hair measurements also occurring. Subjective impressions were confirmed by quantitative findings, particularly where the subject felt a deterioration had occurred. However, these opinions were less reliable in subjects in whom changes in meaningful hair density were less than