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Exogen Hairs in Women with and without Hair Loss

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Abstract
Contrary to the classical view of the hair cycle, in which telogen is the resting phase that precedes the release of the hair shaft, another phase has been introduced, exogen. Exogen is the phase wherein the processes for the release of the hair shaft are initiated and successfully executed. Exogen ends when the shaft is liberated. Accordingly, human hairs would be preferably released not with telogen but with exogen roots. To better understand this somehow revolutionary point and what occurs in telogen effluvium (TE) and in androgenetic alopecia (AGA), we undertook a morphological study. We examined 25 women of comparable age by collecting shedding hairs by the Modified Wash Test under stringent diagnostic criteria. Eight patients were "normal", 5 had AGA, 9 TE, and 3 had a TE+AGA overlap. Hair roots were divided into early telogen, full telogen, and exogen. Exogens accounted, in normal women, for 2.6% of all hairs, for 5.2% in AGA, for 6.6% in TE, and for 2.3% in TE+AGA, without any significant difference. Our exogen prevalence (2.6%) did not vary in patients with AGA and TE. Therefore, the pathogenetic role of exogen in AGA and TE seems negligible.

Classically, the hair cycle includes 3 phases, anagen, catagen, and telogen, the last 1 being considered the resting phase that precedes the disconnection of the hair shaft and its release. In the last years, however, another phase has been introduced that changed this traditional point of view: the exogen phase. Exogen is, according to Stenn [1] who first set forth the concept [2], "… the phase of the cycle wherein the signals for shaft release are given and the processes for that release are initiated and successfully executed. Exogen ends when the shaft is liberated". Accordingly, Stenn's innovative, and somehow revolutionary, conclusion is that "the resting state of telogen does not, and is often mistakenly imputed to, imply shedding" [1].

The exogen phase has been described in some animals. In humans, a similar root morphology had been documented long ago by Savill [3], who, curiously enough, labeled them "bed hairs". More recently, Van Neste et al. [4] designed a specific device exerting the minimal strength needed to pluck exogen hairs from the scalp while sparing telogen hairs, and stated that, the exogen hair density does not exceed 7/cm^2, being usually in the region of 5–6/cm^2.

There is authoritative evidence, therefore, suggesting that "normally" human hairs are preferably released displaying not telogen roots as currently believed, but rather exogen roots.

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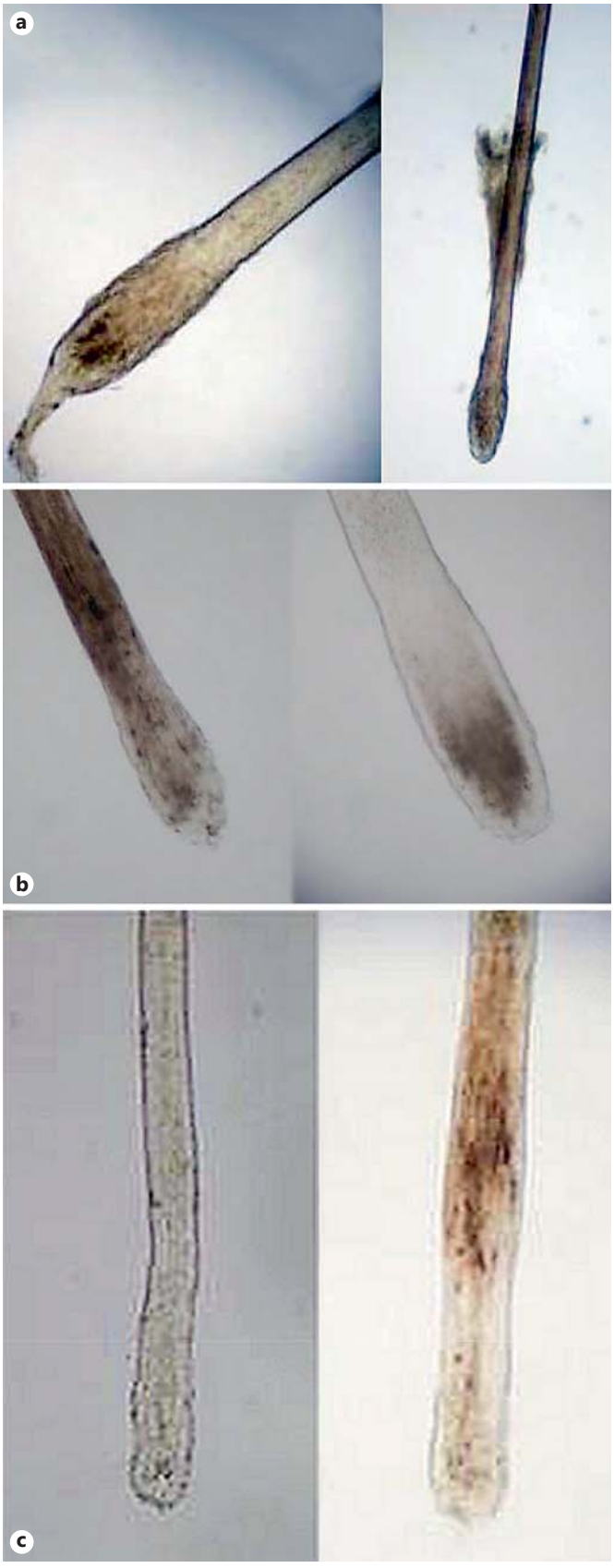

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To shed further light on this innovative point and to understand what occurs whenever hairs are lost profusely as in telogen effluvium (TE), or when the hair cycle is modified by a pathological agency as in androgenetic alopecia (AGA), we undertook a specific morphological study.

Material and Methods

We examined 25 women with different trichological conditions. They were studied and diagnosed by means of clinical observation and trichoscopy. To confirm the diagnosis, they were submitted to the Modified Wash Test, whose details have been published elsewhere [5]. In brief, after 5 days of refraining from shampooing, the subjects were invited to wash their hair in a basin, to collect all shed hairs with the aid of a pad or gauze, and to count them. Hairs shorter than 3 cm (vellus hairs [6]) were counted separately.

We recruited as "normal" women who shed less than 50 hairs with less than 6% vellus hairs. TE was diagnosed when the shed hairs exceeded 91 [7]. AGA was diagnosed when the number of shed hairs was comprised in between 10 and 91 and when the vellus hairs exceeded 6% [7]. Individuals who shed more than 91 hairs and more than 6% of vellus hairs were classified as having a TE+AGA overlap. By excluding all other TE varieties, our TE subjects belonged to the third category of the TE classification [8], i.e., to the premature entering into telogen, without any food inadequacy or cytostatic drug intake being reported.

Eight women fulfilled the normality criteria. Their age ranged in between 24 and 57 years, averaging 34.8 ± 10.26. Five women were diagnosed as having AGA. Their age ranged in between 29 and 44 years, averaging 37.8 ± 5.72. Nine women had TE. Their age ranged in between 19 and 57 years, averaging 34.9 ± 11.74. Three women had both TE and AGA. Their age ranged in between 22 and 67 years, averaging 41.7 ± 23.03. The ages of the 4 groups did not differ significantly ($F = 0.31$, $p = 0.818$).

Out of the global number of collected hairs, 30 hair shafts (or all of them when the total number was lower than 30) were mounted on slides by means of the Eukitt mounting medium and observed under the microscope. Their roots were classified according to their microscopical features into the following types: late catagen/early telogen, full telogen, and exogen. In particular, early telogen roots kept traces of epithelial sheath surrounding a well-marginated club, full telogen had no remnants of sheath but still exhibited a well-marginated club, while exogen had no sheaths and a scalloped or nibbled terminal tip (Fig. 1).

All data were submitted to the analysis of variance. A p value ≤ 0.05 was considered significant.

Fig. 1. a Late catagen/early telogen: the club-like root keeps some pigment and has well-marginated borders. Note the fragments of sheaths. **b** Full telogen: the club keeps remnants of pigment and the borders are becoming scalloped. The remnants of sheath have disappeared. **c** Exogen: the club has disappeared and the margins are scalloped.

Table 1. Prevalence of early telogen, full telogen, and exogen roots in normal women and in those with AGA, TE, and TE+AGA

Condition	*N*	% early telogen (mean ± SD)	% full telogen (mean ± SD)	% exogen (mean ± SD)
Normality	8	27.0±16.26	70.4±15.51	2.6±4.87
AGA	5	17.4±11.33	77.4±13.56	5.2±5.02
TE	9	16.2±12.48	77.2±13.23	6.6±7.55
TE+AGA	3	16.3±11.59	81.3±7.57	2.3±4.04

Results

The main results are shown in Table 1. At the Modified Wash Test, normal women shed 24.5 ± 14.42 hairs, those with AGA shed 36.2 ± 23.10 hairs, those with TE shed 342.7 ± 152.50 hairs, and those with TE+AGA 210.3 ± 101.00 hairs. Vellus hairs averaged 2.1 ± 3.40% in normal subjects, 24.6 ± 8.56% in women with AGA, 4.2 ± 2.82% in women with TE, and 27.7 ± 18.04% in those with TE+AGA.

Exogens accounted, in normal women, for 2.6% of all collected hairs, for 5.2% in women with AGA, for 6.6% in women with TE, and for 2.3% in women with TE+AGA. No statistically significant difference was found among the 3 diagnostic groups. In particular, the prevalence of exogen hairs in normal subjects did not differ significantly from that of the 3 classes of women with hair disorders ($F = 0.79$, $p = 0.512$).

Discussion

Morphologically, as shown in Figure 1, the sheath and pigment remnants and the club-like terminal tip are progressively disappearing from the bulbs whose margins are gradually becoming scalloped. What we labeled exogen, therefore, seems to be, from the mere morphological point of view, just the completion of an imperceptible progression towards the release of the hair shaft.

Besides, only a minority of hairs shedding after shampooing in normal individuals can be ascribed to the exogen category. Exogens, in other words, are an occasional finding in humans, accounting for less than 3% of hairs that are shed at any moment by normal women. In addition, when we compared the morphology of shed hairs in ordinary hair disorders like AGA and TE with that of normal women, we found no difference in the exogen prevalence. More than 75% of all shed hairs, in all types of hair loss, belonged to the full telogen category. Accordingly, therefore, it seems unlikely that exogen is involved in the pathogenesis of AGA or TE.

Ostensibly, the exogen prevalence we obtained in normal women (2.6%) is almost identical to the density found by Van Neste et al. [9]. They stated that exogens are 5–6/cm^2, in any case not exceeding 7/cm^2. In fact, given a hair density of 200 hairs/cm^2, Van Neste et al.'s [9] average density of 6 exogens/cm^2 would in fact correspond to 3% of all hairs. Actually, the 2 figures, ours and Van Neste et al.'s, are not comparable. In fact, Van Neste et al.'s figure refers to the actual density in the scalp of exogen hairs ready to fall, i.e., the exogen percentage of all hairs including anagens, whilst our figure corresponds to the exogen percentage of the hairs that already shed, among which anagens were obviously absent.

One might also argue that the plucking strength applied by the hands during shampooing may be greater than that exerted by Van Neste et al.'s device. Were that the case, however, no exogens could have escaped our sampling and our prevalence should have been even higher.

Either way, one gets the impression that 3% exogen hairs is too high a density. Assuming 120,000 hairs as the normal scalp hair population [10], 3% would correspond to the incongruous figure of 3,600 exogen hairs present at any time on the normal scalp and ready to fall. A less unreasonable figure can be attained adopting the mesh constructed by Tellez-Segura [11]. He found the surface of the galea to measure 268 cm^2. Six exogens/cm^2 would, therefore, account for a total of about 1,600 exogens, which is half the previous figure, but still a huge number for hairs ready to fall at any moment.

A possible explanation is given by the fact that exogen comprises, in animals and perhaps in humans as well, an early exogen subphase as distinct from a late exogen one [12]. Exogen, in other words, could last a time long enough to "dilute" over time the incongruous number of 3,600 hairs ready to fall, getting a more reasonable figure of daily shedding. Regrettably, to get the daily shedding of <50 hairs, which is the one we assumed for our normal subjects, the exogen phase must last as many as 72 days, almost the whole duration of the telogen phase. Another, and possibly most likely, explanation is given by the presence of hairs in their true resting phase, i.e., in kenogen [13]. The kenogen presence, or better the temporary absence of a hair shaft in the follicle, would alter the calculation on the global hair population changing the whole scenario.

We are fully aware that our study is based on a small number of subjects and that all of them were women. It is still possible, though unlikely, that in men, the situation would be different, but the difficulty of finding subjects willing to participate to the study has been greater than we thought at the time of designing it. We do hope that other researchers will be luckier than us in the next future because the issue is essential to understand these new facets of hair physiopathology.

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Statement of Ethics

All patients gave their consent to the study.

Disclosure Statement

The authors have no conflicts of interest to disclose.

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