Flame Hair

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Key Words

Hair loss · Dermatoscopy · Trichoscopy · Pathology · Broken hairs · Alopecia

Abstract

Background: ‘Flame hairs’ is a trichoscopic feature described as hair residue from pulling anagen hairs in trichotillomania. **Objective:** To detect whether flame hairs are present in other hair loss disorders. **Methods:** We retrospectively, independently and blindly reviewed the trichoscopic images of 454 consecutive patients with alopecia areata (99 cases), trichotillomania (n = 20), acute chemotherapy-induced alopecia (n = 6), acute radiotherapy-induced alopecia (n = 2), tinea capitis (n = 13), lichen planopilaris (n = 33), frontal fibrosing alopecia (n = 60), discoid lupus erythematosus (n = 30), dissecting cellulitis (n = 11), central centrifugal cicatricial alopecia (n = 94) and traction alopecia (n = 86) for the presence of flame hairs. We prospectively obtained trichoscopy-guided scalp biopsies from flame hairs in trichotillomania, alopecia areata, traction alopecia and central centrifugal cicatricial alopecia (1 case each). **Results:** Flame hairs were detected in 100% of the acute chemotherapy- and radiotherapy-induced alopecias, where they were the predominant hair abnormality. They were also found in trichotillomania (55%), alopecia areata (21%), traction alopecia (4%) and central centrifugal cicatricial alopecia (3%). On pathology, they corresponded to distorted hair shafts. **Conclusion:** The flame hair is a type of broken hair which can be seen in various hair loss disorders. It results from traumatic pulling of anagen hairs or from anagen arrest due to inflammation or drugs.

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Introduction

‘Flame hairs’ were first described by Rakowska et al. [1] as a trichoscopic sign of trichotillomania. They defined flame hairs as a type of hair residue that results from severe external injury to the hair shaft after pulling anagen hairs. In the last year, we detected this trichoscopic sign in other forms of alopecia. The aim of this paper is to report the conditions where the flame hair and its pathological correlation can be observed.

Materials and Methods

After an Institutional Review Board approval, the trichoscopic images of 454 consecutive patients seen at our Department from January 2013 to December 2014 for different types of scarring and nonscarring alopecias known to present with broken hairs on trichoscopy were retrospectively reviewed by two independent, blinded evaluators for the presence of flame hairs. These included alopecia areata (99 cases), trichotillomania (n = 20), acute chemotherapy-induced alopecia (n = 6), acute radiotherapy-induced alopecia (n = 2), tinea capitis (n = 13), lichen planopilaris (n = 33), frontal fibrosing alopecia (n = 60), discoid lupus erythematosus (n = 30), dissecting cellulitis (n = 11), central centrifugal cicatricial alopecia (n = 94) and traction alopecia (n = 86). The diagnosis was confirmed by pathology in all cases except for chemotherapy/radiotherapy-induced alopecias and 8 cases of tinea capitis, which were diagnosed by fungal cultures.

Flame hairs were defined as very short (<1 mm) pigmented hairs with a thin, wavy, distal tip, resembling the flame on a match point (fig. 1).

Trichoscopic images were obtained with the FotoFinder dermatoscope (n = 184) or with the Handyscope attached to the iPhone (n = 270; FotoFinder Systems, Bad Birnbach, Germany). Three images at ×20 magnification were reviewed for each case.

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Fig. 1. Trichotillomania. The flame hair appears as a short broken hair with a distal wavy tip (FotoFinder Systems). $\times 70$.

Fig. 2. Acute radiotherapy-induced alopecia. The predominant trichoscopic finding is numerous flame hairs which present as short wavy, broken hairs (FotoFinder Systems). $\times 20$.

Fig. 3. Alopecia areata. There are numerous flame hairs among black dots, broken hairs and hair powder (Handyscope, FotoFinder Systems) $\times 20$.

Fig. 4. Traction alopecia. There is a single flame hair. Note also the pinpoint white dots (Handyscope, FotoFinder Systems). $\times 20$.

When available, high-magnification images of cases with flame hairs were also evaluated to better identify the morphology.

From June 2014, we also prospectively obtained dermoscopy-guided 4-mm punch biopsies from 4 patients with various hair disorders showing flame hairs on trichoscopy. In all these cases, the flame hairs were non-distinguishable with the naked eye from other forms of short broken hairs. These include alopecia areata, trichotillomania, central centrifugal cicatricial alopecia and traction alopecia (1 case each). The biopsies were evaluated on horizontal sections bisected according to the Headington technique [2] and stained with H&E.

Results

Trichoscopy

Our results are summarized in table 1. Flame hairs were detected in 46 cases including nonscarring and scarring alopecias. Flame hairs were present in all cases of acute chemotherapy- or radiotherapy-induced alopecia, where they were numerous and represented the predominant type of broken hairs (fig. 2).

Fig. 5. Central centrifugal cicatricial alopecia. There is a single flame hair within a white scar. Note the absence of follicular ostia with the presence of a peripilar white halo around remaining hairs (Handyscope, FotoFinder Systems). $\times 20$.

The other two most common conditions showing flame hairs on trichoscopy were trichotillomania (55%) and alopecia areata (21%; fig. 3). In both conditions, flame hairs were numerous and often associated with other types of broken hairs, such as black dots and hair powder in both, and exclamation mark hairs in alopecia areata. Flame hairs were only rarely found in traction alopecia (4%; fig. 4) and central centrifugal cicatricial alopecia (3%; fig. 5), and, in these conditions, they were very sparse or individual.

Pathology

Results of the dermoscopy-guided biopsies of the flame hairs are reported in table 2.

In alopecia areata, trichotillomania and traction alopecia, the pathology showed individual hair follicles with features of distorted pigmented hair shafts (fig. 6, 7a) on

Table 1. Flame hairs identified on trichoscopy in nonscarring and scarring alopecia

Diagnosis	Total cases	Cases with flame hairs
Alopecia areata	99	21 (21)
Trichotillomania	20	11 (55)
Chemotherapy-induced alopecia	6	6 (100)
Radiotherapy-induced alopecia	2	2 (100)
Tinea capitis	13	0
Lichen planopilaris	33	0
Frontal fibrosing alopecia	60	0
Discoid lupus erythematosus	30	0
Dissecting cellulitis	11	0
Central centrifugal cicatricial alopecia	94	3 (3)
Traction alopecia	86	3 (4)

Figures in parentheses are percentages.

the background of other diagnostic findings for these conditions (fig. 7b), as summarized in table 2.

In trichotillomania, there were also single follicles revealing features of black, round, compact clumps of melanin known as pigmented casts, centrally located inside the hair canal with absent inner root sheath (button sign). The pigmented casts were not associated with hair shafts (fig. 6).

In central centrifugal cicatricial alopecia, the biopsy of the flame hair also revealed very dense lymphocytic and focally granulomatous inflammation (fig. 8).

Discussion

Our study shows that flame hairs are not exclusive to trichotillomania, but they can be observed in other non-scarring and scarring hair disorders. These results are divergent from the results published by Rakowska et al. [1] who found flame hairs to be specific to trichotillomania. Our explanation is that regardless of the cause, flame hairs is a form of broken hairs which occurs either because of severe mechanical pulling of anagen hairs (trichotillomania), continuous mechanical trauma to anagen hairs (traction alopecia) or acute damage to anagen follicles from drugs (radiotherapy, chemotherapy) and inflammation (alopecia areata and central centrifugal cicatricial alopecia). The flame hairs were very numerous in alopecias due to anagen effluvium, including chemotherapy- and radiotherapy-induced alopecia (100%) and

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Fig. 6. A biopsy obtained around a flame hair in trichotillomania reveals on horizontal sections a hair follicle with a distorted hair shaft (red arrow). There is a follicle with a black round clump of melanin in the hair canal resembling a 'black button'; note the absence of a hair shaft (yellow arrow). Increased catagen follicles are present, too. H&E. $\times 10$. Colors refer to the online version only.

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Fig. 7. a A biopsy obtained around a flame hair in alopecia areata reveals on horizontal sections two hair follicles with a distorted hair shaft at the level of the infundibulum. H&E. $\times 10$. **b** The same follicles at the low follicular level show features of telogen with perifollicular lymphocytic infiltrate. H&E. $\times 10$.

Table 2. The pathologic findings in a 4-mm punch biopsy showing flame hairs on trichoscopy

Diagnosis	Pathology
Trichotillomania	Individual hair follicle showing a distorted hair shaft (trichomalacia) Hair follicle showing pigmented casts Increased number of catagen follicles
Alopecia areata	Individual hair follicles with distorted hair shafts (at the level of the infundibulum) Increased number of telogen follicles with perifollicular lymphocytic infiltrates (at the level of low follicles) Hair follicles showing pigmented casts
Central centrifugal cicatricial alopecia	A single hair follicle showing a disrupted morphology: broken cuticle and irregularly distributed melanin in the cortex; it is surrounded by dense lichenoid inflammation Follicular dropout Naked hair shafts
Traction alopecia	Individual hair follicle showing a distorted hair shaft Follicular dropout with intact sebaceous glands Increased number of vellus follicles No inflammation and no fibrosis

acute alopecia areata (21%). These conditions are characterized clinically by the abrupt onset of focal or extensive non-scarring alopecia, including alopecia totalis, and with various types of broken hairs on trichoscopy [3–7]. The hair breakage results from acute damage to the matrix and keratogenous zone of terminal anagen follicles causing hair anagen arrest. In acute chemotherapy/radiotherapy-induced alopecia, this is due to the direct cytotoxic effect of the treatment on the matrix cells, and, in

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Fig. 8. A biopsy obtained around a flame hair in central centrifugal cicatricial alopecia reveals on horizontal sections a naked hair shaft with destroyed follicular epithelium by very dense lymphocytic and focally granulomatous inflammation. Note the disrupted irregular cuticle and the abnormal melanization of the cortex. H&E. $\times 40$.

alopecia areata, it is due to immune injury of the affected matrix by invasion of CD4+ and CD8+ T cells in follicular bulbs [8]. Recently, CD8+ NKG2D+ T cells were found to be the predominant violating T-cell type [9].

In trichotillomania, the flame hairs occur due to mechanical injury to anagen hairs, which results in the thin and irregular proximal remnant of the traumatized hair shaft. On pathology, this feature corresponded to a distorted hair shaft. The flame hairs differ from hair powder, also described in trichotillomania, by the presence of a

hair shaft. Hair powder corresponds to follicles devoid of hair shafts which show only pigmented casts close to the surface.

Flame hairs were individual or sparse in traction alopecia (4%), where the mechanical damage to the follicle is usually less severe than in trichotillomania.

In central centrifugal cicatricial alopecia, flame hairs were also rarely found (3%). On pathology, the flame hair corresponded to an affected terminal anagen hair by inflammation destroying the follicular epithelium and resulting in a naked hair shaft. The shaft itself showed an irregularly disrupted cuticle and abnormal melanization of the cortex, which may explain the trichoscopic finding of a thin and wavy short, broken hair. The presence of flame hairs in central centrifugal cicatricial alopecia can also be explained by trauma to anagen follicles. In fact, hair breakage has been reported as a feature of early central centrifugal cicatricial alopecia [10], and broken hairs are a recommended site to obtain the scalp biopsy [11].

In conclusion, the flame hair is a trichoscopic term for a broken hair which, apart from trichotillomania, can also be seen in radiotherapy- and chemotherapy-induced alopecia, alopecia areata and, occasionally, in traction alopecia and central centrifugal cicatricial alopecia.

Statement of Ethics

The authors have no ethical conflicts to disclose.

Disclosure Statement

The authors declared no conflicts of interest.

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