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REVIEW

Trichoscopy of Tinea Capitis: A Systematic Review

Anna Waśkiel-Burnat · Adriana Rakowska · Mariusz Sikora · Piotr Ciechanowicz · Małgorzata Olszewska · Lidia Rudnicka

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ABSTRACT

Introduction: An increased incidence of tinea capitis has been observed over the last few decades. Trichoscopy is a non-invasive, in-office method helpful in establishing the correct diagnosis in patients with hair loss and inflammatory hair disorders. The objective was to review and analyze current data on the trichoscopy of tinea capitis.

Methods: A systematic review of the literature was conducted using the PubMed, EBSCO and Scopus databases. The search terms included 'tinea capitis' combined with 'trichoscopy', 'dermatoscopy', 'dermoscopy', 'videodermatoscopy' or 'videodermoscopy'.

Results: Of 326 articles, 37 were considered eligible for the quantitative analysis. The most characteristic (with a high predictive value) trichoscopic findings of tinea capitis included comma hairs (51%), corkscrew hairs (32%), Morse code-like hairs (22%), zigzag hairs (21%), bent hairs (27%), block hairs (10%) and i-hairs (10%). Other common, but not characteristic, trichoscopic features were broken hairs (57%), black dots (34%), perifollicular scaling (59%) and diffuse scaling (89%). Morse code-like hairs, zigzag hairs, bent hairs and diffuse scaling were only observed in *Microsporum* tinea capitis (8/29, 28%; 6/29, 21%; 4/29, 14% and 4/29, 14%, respectively). In *Trichophyton* tinea capitis, corkscrew hairs were more commonly detected compared to *Microsporum* tinea capitis (21/38, 55% vs 3/29, 10%).

Conclusion: The presence of characteristic trichoscopic features of tinea capitis is sufficient to establish the initial diagnosis and introduce treatment before culture results are available. Trichoscopy may be useful in distinguishing between *Microsporum* and *Trichophyton* tinea capitis.

Keywords: Alopecia; Dermatoscopy; Dermoscopy; Hair disorders; Hair loss; Tinea; Tinea capitis; Trichoscopy; Scalp; Fungal infection

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A. Waśkiel-Burnat · A. Rakowska (✉) · M. Sikora · P. Ciechanowicz · M. Olszewska · L. Rudnicka
Department of Dermatology, Medical University of Warsaw, Warsaw, Poland
e-mail: adriana.rakowska@gmail.com

Key Summary Points

During the last few decades, an increased prevalence of tinea capitis with a remarkable change in the pattern of the causative dermatophytes among different countries has been observed.

Although mycological examination is considered to be the gold standard diagnostic method in tinea capitis, it is highly valuable to find a method useful in making a correct diagnosis before culture results are available.

The aim of the study was to establish the role of trichoscopy in diagnosing tinea capitis.

Trichoscopy is helpful in diagnosis of tinea capitis, differentiation between *Microsporum* and *Trichophyton* infection, and monitoring of treatment efficacy.

The presence of characteristic trichoscopic features of tinea capitis is sufficient to establish the initial diagnosis and introduce treatment before culture results are available.

INTRODUCTION

Tinea capitis is a cutaneous fungal infection or dermatophytosis of the scalp [1]. During the last few decades, an increased prevalence of the disease with a remarkable change in the pattern of the causative dermatophytes among different countries has been observed, probably due to immigration, emigration, traveling and changes in the level of surveillance [2]. Nevertheless, tinea capitis is mainly caused by *Microsporum* and *Trichophyton* species [3], its etiological agents differ according to the geographical distribution [2, 4]. The disease is most commonly observed in children between 3 and 7 years of age [5]. Adults (especially elderly individuals) may be occasionally affected [4]. Clinically, tinea capitis is characterized by the presence of hair loss areas with coexistent scaling, inflammation or pustules [4]. Mycological examination is considered to be the gold standard diagnostic method in tinea capitis [6]. However, trichoscopy may be useful in making a correct diagnosis before culture results are available [6]. It has been reported, that trichoscopy, an easy to perform, non-invasive method [7, 8], is characterized by a higher sensitivity compared with direct examination (94% vs 49.1%) in diagnosis of tinea capitis [9]. Moreover, a high specificity of trichoscopy in tinea capitis has been described (83%) [9]. Slowinska et al. [10] first described the trichoscopic features of tinea capitis in 2008. Since then, numerous studies have been published that addressed the role of trichoscopy in the diagnosis and therapeutic monitoring of tinea capitis.

METHODS

A review of the literature regarding trichoscopic findings of tinea capitis was performed by searching the PubMed, Scopus and EBSCO databases. The terms used for the search were: 'tinea capitis' combined with 'trichoscopy', 'dermatoscopy', 'dermoscopy', 'videodermatoscopy' or 'videodermoscopy'. The references of all relevant articles were also searched for further publications. Original studies, case series and case reports considering the frequency of various trichoscopic findings in tinea capitis and published in English were eligible for the analysis. Studies with no primary epidemiologic data reporting the numbers of patients with tinea capitis or the frequency of various trichoscopic findings, animal studies and reviews were excluded from this analysis. If data were duplicated in more than one study, the most complete study was included in the analysis.

Based on the results of original studies, an analysis of the frequency of the most common trichoscopic findings of tinea capitis was performed. The sensitivity, specificity, and positive and negative predictive values of the most characteristic trichoscopic findings for tinea

capitis were calculated and presented as percentages.

Based on the results of original studies, case series and case reports, trichoscopic differences between *Microsporum* and *Trichophyton* tinea capitis were assessed.

The role of trichoscopy in the monitoring of treatment efficacy in tinea capitis was described.

Statistical analysis of the data was conducted using Statistica software, version 12.0. The differences in the incidence rate of various trichoscopic features between *Microsporum* and *Trichophyton* tinea capitis were examined with a chi-squared test. The results were considered statistically significant if they had p values lower than 0.05.

This article is based on previously conducted studies and does not contain any studies with human participants or animals performed by any of the authors.

RESULTS

Of 326 articles retrieved, 37 studies (consisting of 536 patients with tinea capitis) were found eligible for quantitative analysis: 16 original studies, 7 case series and 14 case reports. A PRISMA flow diagram is presented in Fig. 1.

The frequency, sensitivity, specificity, and positive and negative predictive values of the most characteristic trichoscopic findings for tinea capitis are presented in Table 1.

The Most Characteristic Trichoscopic Findings of Tinea Capitis

Comma Hairs

Comma hairs (Fig. 2) are short, C-shaped hairs, that are homogeneous in pigmentation and thickness [11]. They were first described by Slowinska et al. in 2008 [10]. Comma hairs are formed due to subsequent cracking and bending of a hair shaft filled with hyphae [10]. The frequency of comma hairs varied between 13% and 100% (mean value: 51%) of patients with tinea capitis [6, 9, 12–24]. They were also occasionally detected in patients with alopecia areata and trichotillomania [16].

Corkscrew Hairs

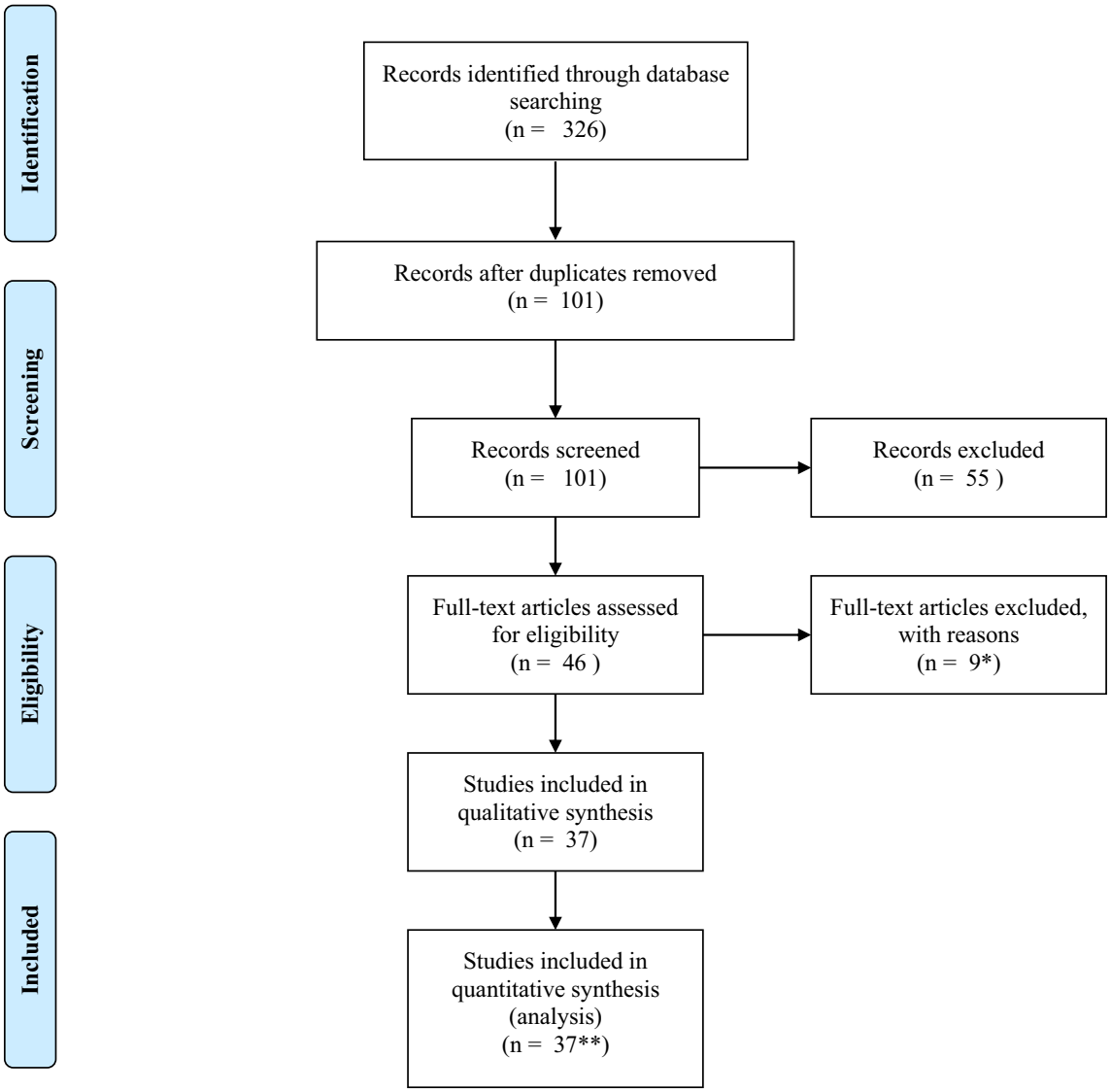
Corkscrew hairs (Fig. 3) are multiple twisted and coiled hairs with corkscrew-like structure [11]. They were first described by Hughes et al. [23] in 2011 as a specific form of comma hairs in black-skinned patients (with African hair types) or a specific trichoscopic finding of tinea capitis caused by *Trichophyton soudanense*. However, corkscrew hairs were also described in white-skinned patients [25–27] with straight hair [28]. They were observed in endothrix tinea capitis caused by *Trichophyton tonsurans* [22, 26–31] and *Trichophyton violaceum* [25, 32, 33]. Moreover, corkscrew hairs were detected in ectothrix-type fungal infection caused by *Trichophyton verrucosum* [12], *Microsporum canis* and *Microsporum audouinii* [22]. The incidence of corkscrew hairs varied between 14% and 100% (mean value: 32%) of patients with tinea capitis [6, 9, 12–24]. Corkscrew hairs were described as a specific trichoscopic feature of tinea capitis. However, they may also be observed in ectodermal dysplasias [34, 35].

Morse Code-like Hairs

Morse code-like hairs (Fig. 3), also known as bar code-like hairs, represent hairs with multiple thin white bands across the hair shaft [11]. The term was introduced in 2011 by Rudnicka et al. [34]. Morse code-like hairs are formed due to the accumulation of spores around the hair shaft that cause a transverse perforation of the hair shaft. They were only described in patients with ectothrix-type fungal infection with an incidence rate between 12% and 56% (mean value: 22%) [9, 22, 36–40].

Zigzag Hairs

Zigzag hairs, first described by Rudnicka et al. [34], are bent hairs with multiple sharp angles. Their formation results from incomplete, transverse fractures along the hair shaft [31]. Zigzag hairs were only described in patients with ectothrix-type fungal infection with an incidence rate between 5% and 49% (mean value: 21%) [6, 9, 13, 15, 18–21, 24]. They were also reported in patients with alopecia areata [41].



* Excluded articles: 3 articles did not consider the frequency of various trichoscopic findings, 2 articles were reviews, 2 articles were duplications, 1 study did not contain the frequency of various trichoscopic findings, 1 case series with patients with coexisted different hair diseases

** 16 original studies, 14 case reports and 7 case series

Fig. 1 PRISMA flow diagram

Bent Hairs

Bent hairs are characterized by bending of the hair shaft with homogeneous thickness and pigmentation [42]. In contrast to comma hairs, no hair shaft shortening is observed [42]. Very few studies reported bent hairs in tinea capitis, with an incidence rate between 4% and 71% (mean value: 27%) [6, 19, 20, 42]. They were only observed in patients with ectothrix-type fungal infection [37, 43].

Block Hairs and i-Hairs

Block hairs are very short hairs with a transverse horizontal distal end [11]. i-Hairs are block hairs

Table 1 Trichoscopic features of tinea capitis

Trichoscopic feature	Reported prevalence in %[a] (mean value[b])	Sensitivity[c] (%)	Specificity[d] (%)	Positive predictive value (%)	Negative predictive value (%)
Comma hairs	13–100 (51)	50	99	94	82
Corkscrew hairs	14–100 (32)	32	100	98	77
Morse code-like hairs	12–56 (22)	13	100	100	73
Zigzag hairs	5–49 (21)	17	99	83	73
Bent hairs	4–71 (27)	7	100	100	72
Block hairs	4–50 (10)	2	100	83	70
i-Hairs	4–33 (10)	6	100	97	71

[a] The ranges from original studies [6, 12–24, 42] are given for trichoscopic features for which the frequency was evaluated
[b] Mean value was calculated by dividing the total number of patients with a particular feature by the total number of patients in studies reporting the frequency of this feature
[c] The sensitivity was calculated based on the results from original studies [6, 12–24, 42]
[d] The specificity was calculated based on the results from original studies [12–18, 20, 21, 42]

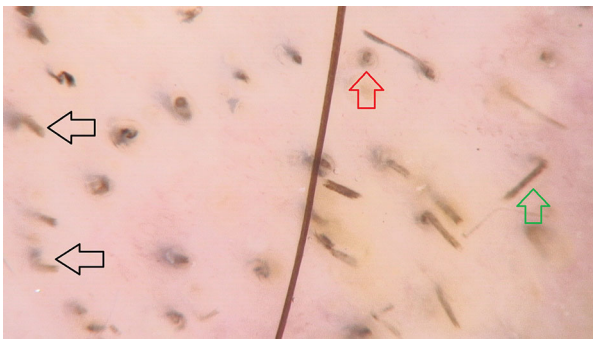


Fig. 2 Trichoscopy of tinea capitis with comma hairs (black arrows), black dots (red arrow) and broken hairs (green arrow) (×70)

with an accented dark distal end [11]. The terms were introduced by Rudnicka et al. [44]. There were very few studies reporting block hairs and i-hairs in tinea capitis, with an incidence rate of 4–50% (mean value: 10%) and 4–33% (mean value: 10%) [13, 18–21, 24], respectively. They were also detected in patients with alopecia areata and trichotillomania [45].

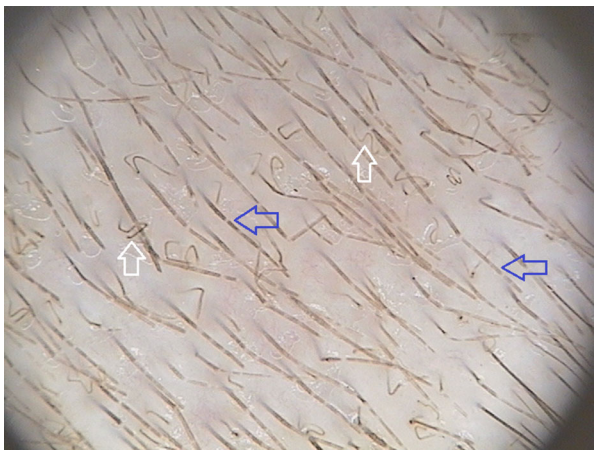


Fig. 3 Trichoscopy of tinea capitis with the presence of Morse code-like hairs (blue arrows) and corkscrew hairs (white arrows) (×20)

Other Trichoscopic Findings of Tinea Capitis

Other commonly observed, but not characteristic, trichoscopic findings of tinea capitis include broken hairs, black dots (Fig. 2), and perifollicular and interfollicular scaling.

Table 2 Trichoscopic differences between *Microsporum* and *Trichophyton* tinea capitis

Trichoscopic feature	*Microsporum* tinea capitis Number of patients[a] (%)	*Trichophyton* tinea capitis Number of patients[b] (%)	Statistical significance (p value)
Comma hairs	21/29 (72)	24/38 (63)	0.42
Corkscrew hairs	3/29 (10)	21/38 (55)	< 0.001
Morse code-like hairs	8/29 (28)	0/38 (0)	< 0.001
Zigzag hairs	6/29 (21)	0/38 (0)	< 0.01
Bent hairs	4/29 (14)	0/38 (0)	< 0.05
Block hairs	0/29 (0)	0/38 (0)	–
i-Hairs	0/29 (0)	0/38 (0)	–
Broken hairs	13/29 (45)	17/38 (45)	0.99
Black dots	3/29 (10)	3/38 (8)	0.73
Perifollicular scaling	3/29 (10)	2/38 (5)	0.43
Diffuse scaling	4/29 (14)	0/38 (0)	< 0.05

[a] 22 cases of *Microsporum canis* [10, 12, 22, 27, 36, 37, 39, 40, 43, 46–48], 5 cases of *Microsporum audouinii* [22, 38, 40], 1 case of *Microsporum langeronii* [23] and 1 case of *Microsporum ferrugineum* [40]

[b] 9 cases of *Trichophyton violaceum* [23, 25, 32, 33, 40, 49], 17 cases of *Trichophyton tonsurans* [22, 26–30, 43], 4 cases of *Trichophyton soudanense* [23] and 8 cases of *Trichophyton verrucosum* [12, 50]

Broken hairs and black dots were observed in both endothrix and ectothrix tinea capitis with an incidence rate of 8–100% (mean value: 57%) [6, 9, 12–23, 42] and 17–80% (mean value: 34%) [6, 12–20, 42], respectively. In 6–95% (mean value: 59%) [6, 16, 19–22] and 53–100% (mean value: 89%) [6, 14, 16, 19, 20, 24, 42] of patients with tinea capitis perifollicular and diffuse scaling were detected.

Trichoscopic Differences between *Microsporum* and *Trichophyton* Tinea Capitis

In the present analysis Morse code-like hairs, zigzag hairs, bent hairs and diffuse scaling were only present in *Microsporum* tinea capitis (8/29, 28%; 6/29, 21%; 4/29, 14% and 4/29, 14%, respectively) ($p < 0.001$, $p < 0.01$, $p < 0.05$ and $p < 0.05$, respectively). Conversely, corkscrew hairs were more commonly observed in *Trichophyton* compared to *Microsporum* tinea capitis (21/38, 55% vs 3/29, 10%) ($p < 0.001$). No significant difference was found in the frequency of comma hairs, black dots, broken hairs, perifollicular scaling, block hairs and i-hairs between *Microsporum* and *Trichophyton* tinea capitis.

Detailed data are presented in Table 2.

Trichoscopy in the Monitoring of Treatment Efficacy

In a study conducted by Campos et al. [19] the disappearance of short broken hairs, corkscrew hairs and zigzag hairs was reported on the 4th week follow-up visit after starting the treatment. At week 8, the decrease of comma hairs, black dots, perifollicular scaling and diffuse scaling was additionally observed. On the 12th week follow-up visit after starting the treatment, dystrophic hairs were not present. However, perifollicular scaling and diffuse scaling were detected. Souissi et al. [36] also reported the disappearance of Morse code-like hairs with the presence of perifollicular scaling and diffuse desquamation on the 4th week follow-up visit. At this time, the fungal culture was negative.

Moreover, Richarz et al. [33] presented a case of a patient with disappearance of corkscrew hairs on a follow-up visit after 4 weeks of therapy, with positive direct potassium hydroxide examination and negative fungal culture.

DISCUSSION

This systematic review aimed to summarize and analyze the usefulness of trichoscopy in tinea capitis. The analysis demonstrated that the presence of characteristic trichoscopic features (comma hairs, corkscrew hairs, Morse code-like hairs, zigzag hairs, bent hairs, block hairs, and i-hairs) is predictive of tinea capitis. According to these observations, trichoscopy may be useful to establish the primary diagnosis of tinea capitis and start the therapy before culture results are available. Moreover, it may be helpful to perform screening in high-risk populations. Broken hairs, black dots, perifollicular and diffuse scaling are commonly observed in tinea capitis. However, they may also be detected in other hair and scalp diseases such as alopecia areata, trichotillomania, lichen planopilaris, discoid lupus erythematosus, seborrheic dermatitis or psoriasis, so they cannot be considered as disease-specific [44].

The present analysis confirmed that trichoscopy is a useful method in differentiating between *Microsporum* and *Trichophyton* tinea capitis (Fig. 4), which is important from the perspective of a different therapeutic approach. Terbinafine is considered to be the first-line therapy for *Trichophyton* tinea capitis, while in *Microsporum* tinea capitis griseofulvin is recommended by many experts [1]. It has been hypothesized that endothrix-type fungal infection (particularly *Trichophyton*) induces the deformation of the hair shaft without an impairment of the color [31]. Moreover, according to Schechtman et al. [43], in endothrix tinea capitis the hair shaft filled with hyphae tends to break easily near the follicular ostia, so a large number of short comma hairs and black dots may be present in trichoscopic examination. In ectothrix infection (particularly *Microsporum*) the accumulation of spores around the hair shaft with transverse perforation of the hair shaft is present. This results in the presence of white, thin bands across the hair shaft that form a Morse code-like appearance [31]. Furthermore, transverse fractures of the hair shaft are observed farther from the follicular ostia. Thus, longer corkscrew or zigzag hairs may be observed. In case of a complete fracture, broken hairs may be detected [31]. In the present analysis, corkscrew hairs were more commonly observed in *Trichophyton* compared with *Microsporum* tinea capitis. Morse code-like hairs, zigzag hairs, bent hairs and diffuse scaling were only observed in patients with *Microsporum* tinea capitis. There was no significant difference in the frequency of broken hairs, black dots and comma hairs between *Trichophyton* and *Microsporum* tinea capitis.

The role of trichoscopy in monitoring tinea capitis therapy has also been described in the literature [19, 33, 36]. The trichoscopic marker of treatment efficacy is the disappearance of

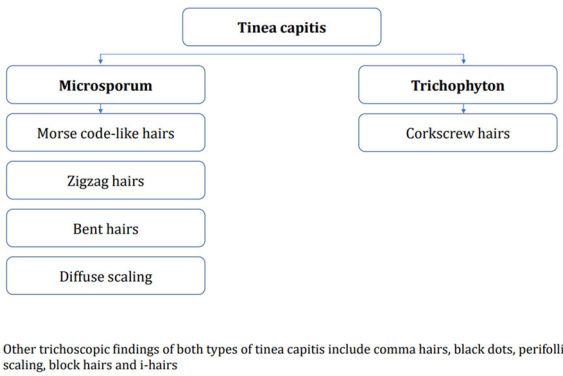


Fig. 4 Characteristic trichoscopic findings of *Microsporum* and *Trichophyton* tinea capitis

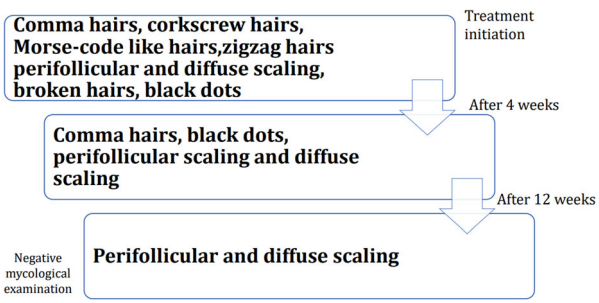


Fig. 5 Trichoscopy of tinea capitis during treatment. Based on Campos et al. [19], Richarz et al. [33] and Souissi et al. [36]

dystrophic hairs (comma hairs, corkscrew hairs, zigzag hairs, Morse code-like hairs, broken hairs and black dots), 4–12 weeks after therapy initiation [19, 33, 36]. Perifollicular and diffuse scaling tends to resolve more slowly compared to hair shaft abnormalities (Fig. 5). Therefore, it cannot be considered to be a marker of therapy failure. Moreover, previous data suggested that trichoscopy may be more reliable than repeated potassium hydroxide examinations in the monitoring of treatment efficacy in tinea capitis [33].

A limitation of our review was due to the small size of the group of patients in the analysis of trichoscopic differences between *Microsporum* and *Trichophyton* tinea capitis.

CONCLUSIONS

Trichoscopy is a useful method in the diagnosis of tinea capitis. Comma hairs, corkscrew hairs, Morse code-like hairs, zigzag hairs, bent hairs, block hairs and i-hairs are diagnostic trichoscopic markers of tinea capitis. Trichoscopy may be a helpful method in the differentiation between *Microsporum* and *Trichophyton* tinea capitis, and consequently, the selection of the appropriate therapy. Finally, it can be applied to the monitoring of treatment efficacy.

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Compliance with Ethics Guidelines. This article is based on previously conducted studies and does not contain any studies with human participants or animals performed by any of the authors.

Data Availability. The datasets during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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