INTRODUCTION

Tinea capitis is the most frequent manifestation of dermatophyte infection in children, especially in the lower socioeconomic strata. The three clinical types of tinea capitis have been described: non-inflammatory variants (gray patch, black dot, seborrheic, and alopecia areata-like), inflammatory variants (kerion, favus, and pustular-like), and mixed pattern (new variant) associated with slow onset and extensive involvement.[1,2]

Epidemiology of tinea capitis varies greatly with respect to its geographic location and specific population groups. Among children, the worldwide prevalence of tinea capitis varies from 7.1% to 47.5%, and the incidence in India is 0.5% to 10%.[3,4] Currently, Trichophyton tonsurans and Microsporum canis are the leading causes of tinea capitis in children in the United States and Europe, respectively.[5] In the Indian population, Trichophyton violaceum was the most common etiological agent during the period of 2006–2010.
with isolation rates of 30%–88%.\textsuperscript{1,2,4} Geographical distribution within India varies with \textit{T. violaceum} (88.6%) being the most common etiological agent in North India, \textit{Trichophyton mentagrophytes complex} (43%) in hilly areas of India, \textit{Trichophyton rubrum} (21.8%) in South India, and \textit{Trichophyton tonsurans} (61.1%) in Kashmir.\textsuperscript{1,2,4,6}

Tinea capitis is screened by microscopy (10% potassium hydroxide [KOH] hair mount) and confirmed by growth in Sabouraud dextrose agar (SDA) culture media that takes 3–4 weeks, with resultant delayed treatment and increase in the risk of horizontal transmission.\textsuperscript{7} Therefore, trichoscopy can aid in the early diagnosis (without need for expert opinion for the interpretation of trichoscopic features) and prompt treatment to avoid contamination and complications such as cicatricial alopecia (as occurs in inflammatory variant).\textsuperscript{8} However, studies regarding the trichoscopic findings of patients with tinea capitis are relatively uncommon.\textsuperscript{8–13} Therefore, the present study has been designed to establish the utility of trichoscopy as a diagnostic tool in tinea capitis and to determine the correlation of the etiological agent, pattern of invasion, and clinical types with trichoscopic changes, if any.

MATERIALS AND METHODS

We carried out an observational, descriptive study over 18 months, after obtaining approval from the Institutional Ethics Committee. We recruited 98 (<18 years) with suspected tinea capitis (patchy alopecia, scaling, broken hair, pustules, boggy swelling, and cervical lymphadenopathy) that were positive for hyphae (endothrix or ectothrix) on 10% KOH mount microscopy. After a written informed consent, history and detailed clinical examination were carried out including scalp site examination and evaluation for lymphadenopathy, coexistent fungal infection (including nail), and associated diseases (nonfungal). A clinical photograph was taken, and trichoscopic examination of the most affected scalp lesion was performed. This was done by USB dermatoscope: AM7013MZTS Dino-Lite Premier (AnMo Electronics Corporation, Taiwan, China), and the trichoscopic findings were noted at ×70 and ×170 in polarized and nonpolarized mode. These features were evaluated by the single observer. Subsequently, extracted hair root and scalp scraping of the recruited participants were sent for Sabouraud’s dextrose agar culture.

The statistical analysis was performed using the IBM SPSS software version 20.0 (IBM Corp., Armonk, Chicago, IL, NY; USA) with a threshold of significance of \( P \) (two-tailed) <0.05 (confidence interval = 95%) significant. The comparison of trichoscopic features of tinea capitis with clinical type, pattern of invasion, and mycological culture was done using the Chi-square test.

RESULTS

The details of the 98 recruited patient’s sociodemographic profile are depicted in Table 1. Most of the patients (92.85%) were below 12 years, with a peak age range of 4–6 years, and a marginal female preponderance with a male-to-female ratio of 1:1.18.

The duration of tinea capitis varied from 1 to 48 months, with a 50\textsuperscript{th} percentile of 2 ± 3 months (median ± interquartile range [IQR]) and a mean ± standard deviation of 3.79 ± 6.63 months. The most common symptom in tinea capitis was hair loss (94.89%) followed by scaling (86.73%) and pruritus (82.65%) with predominant multifocal scalp involvement. The associated findings included regional lymphadenopathy (65%), tinea faciei (7.14%), tinea manuum (1%), and onychomycosis (1%). The other concurrent diseases were molluscum contagiosum (3.06%), pediculosis capitis, and verruca vulgaris (2.04% each).

The most common clinical type of tinea capitis was black dot (46.93%) followed by gray patch (28.57%), kerion (11.22%), seborrheic variant (7.14%), alopecia areata (3.06%), and the least common was the pustular variant (3.06%). No case of favus was seen in the present study. KOH mount microscopy examination revealed endothrix variant was more common in tinea capitis as compared to ectothrix (74% versus 26%). Endothrix invasion was significantly more in black dot and

| Table 1: Sociodemographic profile and various history of 98 study participants |
|-----------------|-----------------|-----------------|
| **Demographic profile** | **Total (n=98), n (%)** |
| **Sex** | | |
| Male | 45 (45.91) |
| Female | 53 (54.08) |
| **Mean age, (years with SD)** | 7.26±3.34 |
| **Median duration, (monthssIQR)** | 2±3 |
| **SES Class IV** | 86 (87.75) |
| **Family history** | 92 (93.87) |
| **Pets** | 6 (6.12) |
| **Comb sharing** | 96 (97.96) |
| **Oil application** | 98 |
| **Topical treatment** | 6 (6.12) |
| **Past history** | 9 (9.18) |

\( \text{SES} - \text{Socioeconomic status} ; \text{IQR} - \text{Interquartile range} ; \text{SD} - \text{Standard deviation} \)
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P. described for the first time kerion (P = 0.038) clinical variants. Mycological culture was positive in 51 out of the 98 cases. The most common causative agent in the present study was T. violaceum (86.27%) followed by Trichophyton verrucosum, Trichophyton mentagrophytes complex, Trichophyton tonsurans (each 3.92%), and Trichophyton rubrum (1.96%). No Microsporum species were isolated in our patients.

Hair morphologies observed in tinea capitis on trichoscopy were short-broken hair, comma hair, cork-screw hair, black dot, zigzag hair, i-hair, Morse code hair, horse-shoe hair (novel finding), exclamation hair, flame hair, regrowing hair, and perifollicular scaling.

The frequency of different trichoscopic features of tinea capitis is depicted in Figure 1. Black dot (82.65%) was the most common finding followed by comma hair, short-broken hair, perifollicular scaling, cork-screw hair, horse-shoe hair, and zigzag hair. Whereas, other findings such as regrowing hair, i-hair, flame hair, morse code hair, thick scale, erythema, telangiectasia, and hemorrhages (ETH) were observed in one-fifth or fewer cases.

Black dot (P = 0.015) and ETH (P = 0.00) were significantly present in noninflammatory and inflammatory variant of tinea capitis, respectively, on trichoscopy. The clinical types of tinea capitis showed a significant presence of trichoscopic features, like comma hair (P = 0.019), black dot (P = 0.008), horse-shoe hair (P = 0.056, marginal significant), and perifollicular scaling (P = 0.023) in black-dot variant [Figure 2a and b] and perifollicular scaling (P = 0.03) in gray patch tinea capitis [Figure 3a and b]. Similarly, black dot (P = 0.021) and ETH (P = 0.001) were significantly present in kerion variety. Endothrix variant showed comma hair, cork-screw hair (P = 0.007 each), zigzag hair (P = 0.011), and horse-shoe hair (P = 0.062, marginal significant) as significant trichoscopic findings. Similarly, a significant presence of perifollicular scaling (P = 0.028) in ectothrix form was noted. Correlating with the etiological agent, comma hair (P = 0.005) was significantly found in tinea capitis caused by T. violaceum [Table 2].

The sensitivity (95% confidence interval of mean) of individual trichoscopic features for diagnosing tinea capitis was short-broken hair 53.1% (43.1–63.0), comma hair 57.1% (47.2–66.9), cork-screw hair 32.7% (23.3–42.0), black dot 82.7% (75.1–90.2), and perifollicular scaling 46.9 (36.9–56.8). By combining perifollicular scaling, comma hair, short-broken hair, and black dot, a sensitivity of 98.97% was achieved.

**DISCUSSION**

Tinea capitis is a common fungal infection among children (median age ± IQR: 2 ± 3 years) mostly belonging to lower socioeconomic scale, with a slight female predominance. In the present study, 50% cases presented within 3 months of the onset of disease, with an early presentation being observed in the inflammatory variants. Coexisting fungal infection was seen in 13.26% cases that could be attributable to autoinoculation of fungus from the untreated tinea capitis lesions. Culture on SDA media-yielded growth in 52% cases, and only Trichophyton isolates were found. Further, with an 86.7% isolation rate in our study, T. violaceum continues to be the predominant species in north India.

In 2008, Slowinska et al. described for the first time the dermoscopic image finding of comma hair in two children with tinea capitis, due to M. canis.[14] Subsequent studies revealed perifollicular scaling (95%), short-broken hair (74%–100%), comma hair (26%–66%), cork-screw hair (13%–80%), zigzag hair (25%–50%), black dot (13%–65%), i-hair, and Morse code hair (16%–26.5%) as trichoscopic features suggestive of tinea capitis.[8–17]

There is a paucity of data evaluating trichoscopic features in patients with tinea capitis and the diagnosis of tinea capitis based on trichoscopic diagnostic criteria has not been well established due to low power of the previous studies.[8–16] The various trichoscopic features of tinea capitis in our cohort are depicted in Table 3 and compared with other studies. Similar to our findings, comparable percentage of black dot, comma hair, cork-screw hair and zigzag hair were reported by El-Taweel et al. and Aqil et al.[8,13] This could be attributed to a similar profile of etiological agents (most importantly T. violaceum) isolated in these two

![Figure 1: Frequency of trichoscopic features in 98 children with tinea capitis](image-url)
The most common etiological agent in our study *T. violaceum* (86.27%) causes hair-shaft deformation without color impairment by endothrix invasion, resulting in comma and corkscrew hair. However, bent hair, forked hair, and V-shaped hair reported by Aqil et al. were not present in our study. Zigzag hair [Figure 4], horse-shoe hair, and regrowing hair were seen in 10%–17% patients, and Morse code hair [Figure 5], flame hair, and i-hair were seen in 2%–7% patients in the present study. Transverse perforation of hair shaft by ectothrix invasion followed by few and several fracture results in Morse code hair and zigzag hair, respectively, and complete transverse fracture produce broken and black-dot hair. Morse code hair and zigzag hair in Caucasians and comma hair in Africans were significantly noted by Dhaille et al. We were unable to correlate trichoscopic hair findings with racial hair types due to similar ethnic profile of our patients. Further, trichoscopic features were independent of gender in

**Figure 2:** (a) Clinical image showing black-dot tinea capitis. (b) Trichoscopy (×70 magnification, polarized mode) shows comma hair (red arrow), cork-screw hair (blue arrow) and horse-shoe hair (green arrow) in patient in (a)

**Figure 3:** (a) Clinical image showing gray patch tinea capitis. (b) Trichoscopy (×70 magnification, polarized mode) shows perifollicular scaling (yellow arrow) in the patient in (a)

**Figure 4:** Zigzag hair (red arrow) in tinea capitis: (×70, polarized mode)

**Figure 5:** Morse code hair (violet arrow) as trichoscopic finding in tinea capitis (70x magnification, polarised mode)
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our study group, in contrast to the study by Aqil et al., wherein cork-screw hair was significantly present in female children.\(^{[13]}\)

Trichoscopy of noninflammatory variant (particularly black-dot tinea capitis) and inflammatory variant (particularly kerion) characteristically showed black dot (in both variants) and ETH, respectively. The ectothrix invasion presenting as gray patch tinea capitis is characterized by perifollicular scaling on trichoscopy. Endothrix invasion causing black-dot tinea capitis is characterized by comma hair (particularly *T. violaceum* affected cases) and horse-shoe hair. Apart from this, cork-screw hair and zigzag hair were also produced by endothrix invasion. This is in agreement with our study and the findings of Dhaille *et al.*, where corkscrew and comma hair were present in endothrix cases.\(^{[8]}\) Zigzag hair has also been described in ectothrix variant by Bourezane and Bourezane.\(^{[11]}\)

Horse-shoe hair was a novel finding in the present study, observed in 16% children with tinea capitis (predominantly

### Table 2: Comparison of frequency of trichoscopic features with clinical types, microscopic form, and etiological agents

| Trichoscopic features | Noninflammatory (n=84), n (%) | Inflammatory (n=14), n (%) | Gray patch (n=28), n (%) | Black dot (n=6), n (%) | Kerion (n=11), n (%) | Endothrix (n=72), n (%) | Ectothrix (n=26), n (%) | 
|-----------------------|-------------------------------|---------------------------|--------------------------|------------------------|----------------------|------------------------|-------------------------|  
| Short-broken hair     | 51.2                          | 64.3                      | 60.7                     | 43.5                   | 72.7                 | 54.2                   | 50                      |                 
| Comma hair            | 58.3                          | 50                        | 53.6                     | 69.6                   | 48.5                 | 65.3                   | 34.6                    | 72.7                
| Cork-screw hair       | 33.3                          | 28.6                      | 32.1                     | 37                     | 18.2                 | 40.3                   | 11.5                    | 38.6                
| Black dot             | 86.9                          | 57.1                      | 82.1                     | 93.5                   | 54.5                 | 86.1                   | 73.1                    | 88.6                
| Zigzag hair           | 14.3                          | 21.4                      | 21.4                     | 10.9                   | 27.3                 | 20.8                   | 0                       | 18.2                
| i-hair                | 6.1                           | 14.3                      | 7.1                      | 4.3                    | 9.1                  | 6.9                    | 7.7                     | 4.5                 
| Morse code hair       | 2.4                           | 0                         | 7.1                      | 0                      | 2.8                  | 0                      | 0                       |                    
| Horse-shoe hair       | 16.7                          | 14.3                      | 7.1                      | 23.9                   | 9.1                  | 20.8                   | 3.8                     | 23.9                
| Flame hair            | 3.6                           | 0                         | 3.6                      | 2.2                    | 0                    | 1.4                    | 7.7                     | 0                   
| Thick scale           | 3.6                           | 7.1                       | 7.1                      | 2.2                    | 9.1                  | 4.2                    | 3.8                     | 2.3                 
| ETH                   | 7.1                           | 50                        | 0                        | 10.9                   | 54.5                 | 13.9                   | 11.5                    | 11.4                
| Perifollicular scaling| 48.8                          | 35.7                      | 64.3                     | 34.8                   | 45.5                 | 40.3                   | 65.4                    | 40.9                
| Regrowing hair        | 11.9                          | 0                         | 7.1                      | 13                     | 0                    | 8.3                    | 15.4                    | 4.5                 
| \(P\)                | 0.015                         | 0.000                     | 0.03                     | 0.019, 0.008, 0.021, 0.007, 0.007, 0.028, 0.005, 0.011, 0.062 |  

The entries in boldface corresponds to the trichoscopic features whose \(P\) is significant and in the sequential order. ETH – Erythema, telangiectasia, and hemorrhage

### Table 3: Comparative trichoscopic features between our study and other studies

| Reference                  | \(n\) | Study type       | Black dot (%) | Comma hair (%) | Short-broken hair (%) | Perifollicular scaling (%) | Cork-screw hair (%) | Horse-shoe hair (%) | Zigzag hair (%) | Remarks (%)         |  
|----------------------------|-------|------------------|---------------|-------------------|--------------------------|----------------------|-------------------|------------------|-----------------|-------------------|  
| Present study India (2016-2018) | 98    | Observational descriptive study | 82.65  | 57.14  | 53.06  | 46.93  | 32.65  | 16.32  | 15.30  | Morse code hair (2.04) |  
| Dhaille *et al.* [8] France (2015-2017) | 100   | Prospective multicenter study | -     | 34     | -     | 50     | 14     | -     | 50     | Morse code hair (16) |  
| Brasileiro *et al.* [11] Portugal (2016) | 50    | Prospective study | 34     | 20     | 74     | 94     | 30     | -     | 12     | Diffuse scaling (90) |  
| Aqil *et al.* [13] Morocco (2017) | 34    | Prospective analytic study | 73.5   | 55.9   | 91.2   | 82.4   | 35.3   | -     | 17.6   | Bent hair (70.6), forked hair (32.4), morse code hair (26.5), translucent and V shaped hair (11.8, both) |  
| Bourezane and Bourezane [11] France (2008-2016) | 24    | Retrospective study | 100    | +      | 100    | -      | +      | -      | +      | Morse code hair* |  
| El-Taeeel *et al.* [9] Egypt (2012-2013) | 20    | Observational analytic study | 90     | 55     | 90     | -      | 45     | -      | 25     |                                  |  
| Ekiz *et al.* [14] Turkey (2012-2013) | 15    | Observational analytic study | 13.3   | 66.7   | 100    | -      | 18     | -      | -      |                                  |  

\(n\)=Total number of subjects enrolled and analyzed, Trichoscopic features: +: Present, -: Absent
in the black-dot variety). It is defined as U-shaped hair (resembling horse-shoe) with arms of equal length and could be considered as exacerbation of the comma hair (and hence similar pathogenesis). On SDA culture media, these cases showed T. violaceum (56.25%) as the predominant isolate and a single isolate of Trichophyton mentagrophytes complex was also recovered. This hair pattern was observed in both non-inflammatory and inflammatory variants of tinea capitis in the present study.

Tinea capitis cannot be diagnosed by a single trichoscopic feature but requires combination of features such as perifollicular scaling, along with any type of dystrophic hair or broken hairs that have been found to be specific for tinea capitis. Brasileiro et al. concluded that a combination of six trichoscopic features (short broken, black dot, comma, corkscrew, zigzag hair, and perifollicular scaling) were essential to make the diagnosis of tinea capitis. In contrast, a recent study by Dhaille et al. suggested that a single trichoscopic feature is predictive of tinea capitis. They reported the sensitivity of a single trichoscopic feature for the prediction of tinea capitis varied from 22.6% to 83% in their study, as compared to our study wherein individual predictive sensitivity varied from 32.7% to 82.7%. It is pertinent to note that our study analyzed 98 confirmed tinea capitis as compared to the study by Dhaille et al., wherein 58 out of the 100 recruited participants were considered as case of tinea capitis and alternate diagnosis of alopecia areata, trichotillomania, and lichen planopilaris were considered for the other patients. The researchers had included these 58 cases on the basis of presence of at least 2 hair showing tinea capitis specific trichoscopic features and had also excluded kerion case. We found that at least 4 among the above 6 features were consistently present in 97 out of 98 patients in the present study; therefore, we recommend that 4 features (short-broken hair, black dot, comma hair, and perifollicular scaling) are sufficient for diagnosing tinea capitis with a 98.97% sensitivity. Further, we infer that a single trichoscopic feature may lead to a low sensitivity in the diagnosis of tinea capitis.

Limitation of our study was the isolation of only Trichophyton species as etiological agents and absence of any Microsporum species. Therefore, we cannot comment on trichoscopic findings and correlation pertaining to the latter species. Furthermore, Trichophyton species (other than T. violaceum) also had low isolation rates (2%–4%), and their correlation with altered hair morphology on trichoscopy cannot be commented upon. We recommend that in order to establish the correlation between trichoscopic features with etiological agents of tinea capitis, inclusion criteria should include fungal culture-positive cases wherein a minimum number of cases caused by each common causative agent is included.

CONCLUSIONS

Trichoscopy had a sensitivity of 98.97% in diagnosing tinea capitis by considering the combination of perifollicular scaling and 3 dystrophic hair (short-broken hair, comma hair, and black dot). Therefore, we validate that trichoscopy may be rapid diagnostic tool for tinea capitis obviating the need for traditional fungal culture method that takes several weeks. Horse-shoe hair is a novel finding in the present study and needs to be validated in future trichoscopy studies of tinea capitis.

Limitations of the study

The study is limited by the inability to measure and document hair shaft diameter and variability owing to the lack of sophisticated dermoscope-like FotoFinder.

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Conflicts of interest

There are no conflicts of interest.

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