

Scanning electron microscopic examination of hair in tinea capitis caused by *Trichophyton tonsurans*

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Abstract

Objectives: Ultrastructural examination of hair gives many clues about diagnosis. We aimed to investigate the ultrastructural surface on hair infected by *Trichophyton tonsurans* var. *sulfureum*.

Methods: The hair shaft specimens were obtained from subjects with tinea capitis. Specimens were examined by scanning electron microscopy (SEM).

Results: In routine SEM procedure, spor-like structures were observed on hair surfaces with cuticular cells peeling off like minor dissolving.

Conclusion: The ultrastructural surface alterations on infected hair with endothrix dermatophytes such as *Trichophyton tonsurans* might be an unexpected finding during SEM examination of hair. These results may help for differential diagnosis.

Key words: tinea capitis; *Trichophyton tonsurans*; hair; scanning electron microscope

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Introduction

The dermatophytes show different manifestations including alteration or perforation on surface structures of hair by scanning electron microscopy (SEM).¹⁻³ Ultrastructural examination of hair may give many clues about disease. SEM is a three dimensional examination technique revealing easily comparable images and it is indispensable for examination in various tissues, which permit considerable magnification.⁴ There were studies by SEM of scalp hair from subjects infected with *Trichophyton violaceum* and of guinea pig skin infected experimentally with *Trichophyton mentagrophytes*.^{2,3} The aim of the study is to show ultrastructure of endothrix

invasion of *Trichophyton tonsurans* on human hair shaft as help for diagnosis by using SEM in diseases with hair involvement.

Materials and Methods

Recently, an outbreak of tinea capitis gladiatorum has been described in wrestling school Denizli, Turkey.⁵ In early 2005, five new patients admitted to dermatology clinic of Pamukkale University Hospital were included in the study. The hair samples of the patients (5 males between the ages 11 and 15) were obtained from the scalp lesions before therapy. The region was cleaned with 70% alcohol. Samples were taken with tweezers.

Endothrix spores were determined in 15% KOH preparation by light microscope in all the specimens. In Sabouraud dextrose agar slant, *Trichophyton tonsurans* var. *sulfureum* was isolated after four weeks incubation at room temperature.

In SEM procedure; the hair samples were fixed in 2.5% glutaraldehyde for 24 hours, washed in phosphate buffer (pH: 7.4), post-fixed in 1% osmium tetroxide for one hour, washed in phosphate buffer (pH: 7.4), dehydrated in increasing concentrations of acetone, critical point dried and mounted on metal stubs with a double sided adhesive band.⁴ Then, the samples were sputtered with a 100 Angstrom thick layer of gold in a BIO-RAD sputter apparatus. Their photographs were taken with a Jeol SEM-ASID 10 scanning electron microscope. The details of surface structure including hair surface, cuticle

pattern, hair's filamentous-keratinized structures and hair degeneration were evaluated.

Results

In SEM examination, samples of 4 patients have yielded us to consider a possible mycotic process by fungal spores (Figures 1 and 2). Spores were separated on the cuticular layer (Figure 3). We observed obviously an abnormal pattern of the cuticular cells of the hair shaft when compared with normal hair (Figure 4). Cuticle cell of the hair was raised with minor dissolve and they were peeled off (Figure 5). As a result, regularity of the cuticle was altered in these areas. Hair surface structure was normal except cuticle pattern. There was no hair degeneration and change in color. Hair's filamentous-keratinized structures were normal.

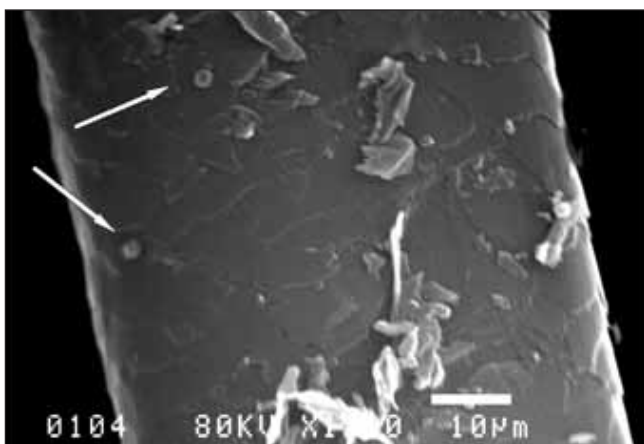


Figure 1. Some examples of fungal spores (white arrows) on hair surface.

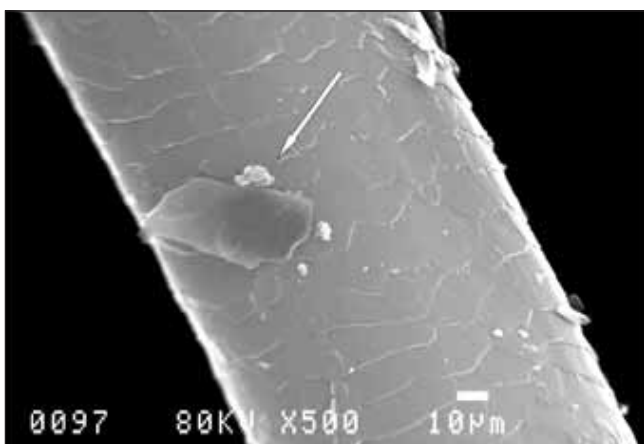


Figure 2. Another example of fungal spores (white arrow) on hair surface.

Figure 3. Spores were separated on the cuticular layer.

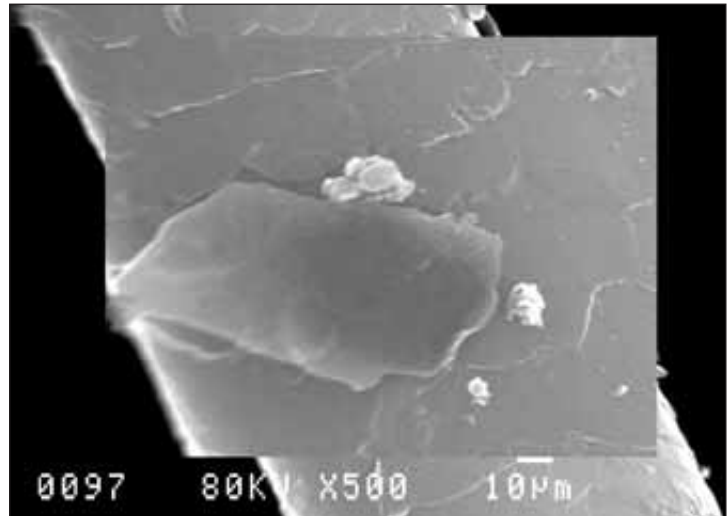


Figure 4. Abnormal pattern of the cuticular cells of the hair (arrowheads).

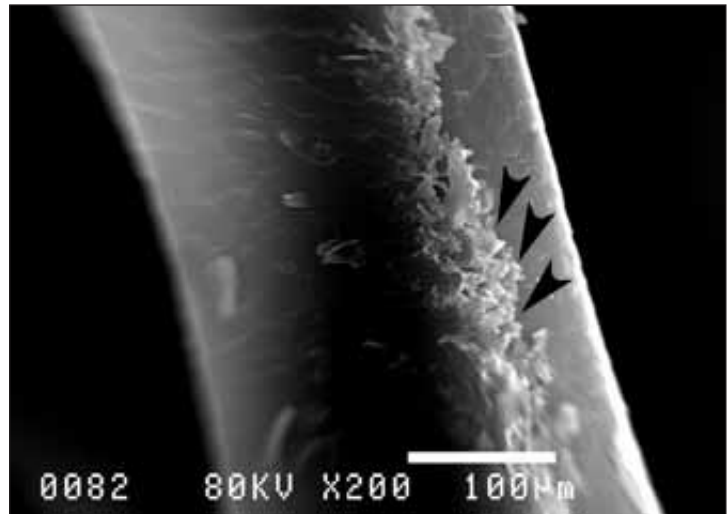
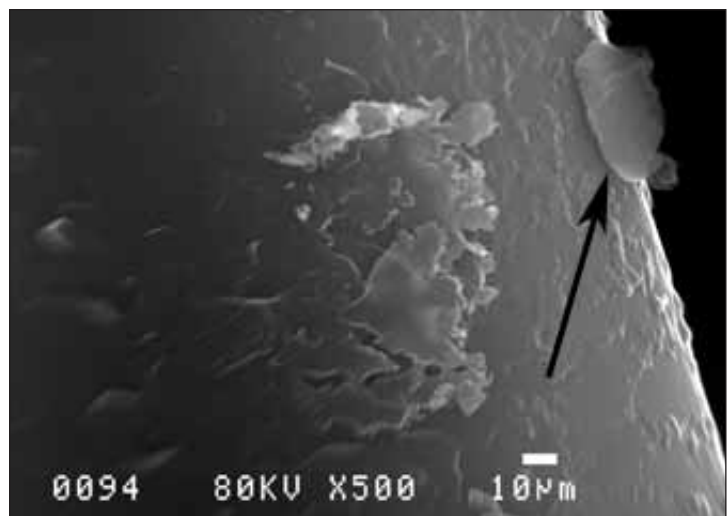


Figure 5. Cuticle cell of the hair was raised with minor dissolve and they were peeled off (arrow).



Discussion

Tinea capitis due *Trichophyton tonsurans* frequently presents as the “seborrheic” type characterized by diffuse scaling with or without patches of hair loss. Unless “black dots” within a patch of alopecia or inflammatory lesions with adenopathy are observed, *Trichophyton tonsurans* infections are difficult to diagnose clinically. It is well-known that *Trichophyton tonsurans* causes endothrix infection.⁶ Alterations in hair shaft may not be evaluated with light microscope. SEM examination of hair represents the outer surface of the hair shaft and variations due to endothrix pressure of the ringworms have been demonstrated. Naturally, shaft continuity may be disrupted by various dermatophytes especially *Trichophyton species*.

Surface of hair is studied for different purposes.⁷ English described the stages by which detached hairs are attacked by keratinophilic fungi as follows; cuticle lifting, cortical erosion, production of penetrating organs, and colonization of the medulla.¹ Pavlov studied cuticle patterns of scalp hair of 5 subjects from different countries and found that cuticle could show variation according to racial factors.⁸ Selvaag et al. studied hair of patients that showed different structural abnormalities like twisted hair, longitudinal grooves, trichorrhexis nodosa as well as variations in the hair caliber.⁹ There were studies by SEM of scalp hair from subjects infected with *Microsporum gypseum* and of guinea pig skin infected experimentally with *Trichophyton mentagrophytes*.^{2,3} The histological features of *Trichophyton tonsurans* in hair has been shown by light microscope, but, the ultrastructural surface alterations on hair have not been shown yet in literature. In this report, these morphologic changes are described.

The hair diseases presenting with hair shaft abnormalities in children may coexist with tinea infections of the scalp. Clinical and ultrastructural features may over-

lap. Light microscope may be used for routine diagnosis of *Trichophyton tonsurans* infections where as SEM may be used to differentiate the disease from the other diseases effecting hair surface morphology. Its routine usage in many dermatologic and hair diseases with surface alterations will result in valuable contribution to scientific literature. This report demonstrates that the structural changes of the hair with *Trichophyton tonsurans* in detail. So, our results can be presented as an ultrastructural demonstration of tinea capitis infection with *Trichophyton tonsurans*. Our findings must be useful in clinical applications of dermatologic hair diseases.

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