Clinical Application of Toothbrush Technique for Specimen Collection of Tinea Capitis

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ABSTRACT

Objective: To demonstrate the efficacy of toothbrush culture test. Moreover, influential factors which affected the success of these methods were analyzed.

Methods: To retrospectively analyze clinical presentation and investigation data of 59 Buddhist novices who diagnosed TC. The laboratory data of the toothbrush technique was reviewed and the efficacy of this technique was investigated.

Results: The efficacy of toothbrush technique was demonstrated as 49.2% by comparing to the standard method. The analysis proved that more than 15% area TC involvement of scalp group achieved higher positive fungal culture outcome to be 65.5 % (p-value = 0.013). In the aspect of the clinical presentation, the effectiveness of the hairbrush technique significantly increased in the gray patch TC group (p-value 0.024). For the reason that the toothbrush technique demonstrated statistically higher efficacy in a group of patients with > 15 % gray patch area involvement (p-value = 0.007).

Conclusion: The toothbrush technique was a good cooperation method that was recommended to apply in TC patients who presented as gray-patch type and more than 15% scalp area involvement.

Keywords: Tinea capitis; ectothrix dermatophyte infection; gray-patch type; toothbrush technique; hair-plucking technique (Siriraj Med J 2019;71: 165-167)

INTRODUCTION

Tinea capitis (TC) is a contagious condition that commonly diagnosed in children due to immature sebum production.[1] Outbreaks of TC usually especially occurred in poor personal hygiene and low socioeconomic area. TC is reported in several areas in the world. Interestingly, the difference of causative organisms is demonstrated in the geographic region.[2] For example, *Trichophyton tonsurans* is the most reported species in the United States.[3] The variety of etiologic organisms in different countries in Asia is demonstrated. *Trichophyton violaceum* is commonly found in India,[4] whereas, *Microsporum canis* is the main causative organism in Thailand.[5] Moreover, the crossover organism is detected in each outbreak. Asymptomatic carriers are assumed as a major role in the spread of infection.[6] The carrier is defined as an individual who has dermatophyte-positive scalp culture without any appearance of TC.[7] Clinical presentations of TC depend on the degree of hair invasion and inflammation that varies from a scaly noninflamed lesion to erythematous lesions with permanent alopecia. Ectothrix remains a dermatophyte infection that confined to hair surface. In contrast, endothrix refers to the invasion of dermatophyte into the hair shaft and internalize into the hair cell. Practically, clinical presentations are categorized into 4 types as follows: (1) gray-patch type: single or multiple scaly patches with lack of inflammation, (2) black dot type: broken hair at the level of the scalp on nonscarring

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alopecia (3) kerion: intense inflamed plaques on scarring alopecia and (4) favus: chronic inflammation with thick yellow crusts on scarring alopecia.[4] In the mycological laboratory, standard investigation of TC is a microbial culture from a specimen obtained by hair-plucking technique. This technique was collecting infected hairs and scraping scale by a sharp blade.[8] However, pain usually was the major complaint of patients of the standard technique, furthermore, the panic of the blade was observed in children. Owing to disadvantages, non-invasive techniques such as cotton swab and toothbrush were developed to collect infected scalp scales.[9,10]

Toothbrush technique was gently performed on the suspected area by sterile toothbrush for scale scratching and then pressed onto the surface of sabouraud dextrose agar (SDA) culture medium, consequently. However, studies about the toothbrush technique were limited in number. Accordingly, the main purpose of the study is to determine the efficacy of the toothbrush technique, comparing with standard technique focusing on specimen collection in TC patients. Duration and satisfaction on specimen collection were also analyzed.

MATERIALS AND METHODS

Clinical and laboratory data of 59 Buddhist novices who confirmed TC diagnosis by the standard technique were reviewed in this retrospective study. This study was approved by Siriraj Institutional Review Board, Faculty of Medicine Siriraj Hospital (Si 624/2014) and consent from the Royal Thai Monastery in India. Demographic and clinical data of novices whom toothbrush technique was used to collect specimens concurrently with standard method were included in the analysis. Efficacy of toothbrush techniques was reviewed and applicable situations were explored.

In this study, statistical analysis was achieved by Statistical Package for the Social Sciences (SPSS, Inc., Chicago, IL, USA) version 22. To compare the efficacy of the toothbrush technique with the standard technique was analyzed by Mann-Whitney U test. Additionally, Fisher's exact test was applied to identify significant factors that influence the efficacy of the toothbrush technique. The reliability of all statistical significance was demonstrated with a p-value that was less than 0.05.

Specimen collection

All participants have performed scalp examination to detect broken hairs and scaling. All the lesions were cleansed with 70% alcohol. Then, both of standard technique and toothbrush technique was applied to collect a specimen from all area of the scalp with the addition of a suspected area such as an area having the scale or broken hair until obtaining an adequate amount of specimen.[10] After that, the specimen was placed onto the medium and continue the incubation process. The evidence of growth was recorded in the patient's medical history. The laboratory data were enrolled in this study to further analysis.

RESULTS

All of Fifty-nine of Buddhist novices with TC, the mean age (SD) of patients was 11.6 (1.9) years. All cases had positive fungal culture from standard technique including hair-plucking technique and scraping scale by the sharp blade to confirmed diagnosis TC. In the aspect of epidemiology, *Trichophyton violaceum* was the major isolated TC pathogen (33 cases, 55.9%). Additionally, *T. mentagrophytes* (27 cases, 45.8%), *Microsporum canis* (21 cases, 35.6%), and *T. tonsurans* (8 cases, 13.6%) were reported respectively. Mixed dermatophyte infection was noticeable in 34 cases (57.6%).

To compare outcomes between toothbrush technique and standard technique, the efficacy of the toothbrush technique to collect a specimen for culture was 49.2% (29 cases). Adjacent areas of scalp including face, neck, ear, and shoulder areas were defined as extended scalp areas. Extended area involvement was associated with more efficacy of toothbrush technique. (p-value = 0.036). In this study, median scalp area involvement in patients with successful toothbrush techniques was 20%, compared with patients whose toothbrush failed to collect a specimen (11.5%). More than 15% area involvement was significantly higher efficacy of this technique that demonstrated by the increased efficacy to be 65.5 % (19 cases, p-value = 0.013).

Clinical presentations were considered and described as follows: (1) gray-patch type (51 cases, 86.4%) (2) black dot type (2 cases, 3.4%) (3) kerion (37 cases, 62.7%). No favus type was reported in this study. Focus on the gray-patch type, scalp area involvement was related with positive toothbrush technique. To demonstrate in the gray-patch group, the median scalp area involvement of positive toothbrush technique patients was 25% while other types of TC were 11.5% (p-value 0.024).

Patients with >15 % gray patch area involvement had a statistically higher probability to obtain a positive fungal culture from the toothbrush technique (p-value = 0.007). Efficacy of toothbrush technique through the patient selection with gray-patch type and more than 15% of scalp area involvement was increasing from 49.2% to 66.7%.

DISCUSSION

Outbreaks of TC were still reported as global health care problems and economic burden. TC remained a common disease in childhood. To confirm the diagnosis of TC, positive fungal infection in hair or scalp was performed by hair-plucking technique and scraping scale by a sharp blade which was the standard technique. However, most children are not well-cooperated due to pain and panic. Previous studies reported noninvasive techniques including hairbrush, cytobrush and toothbrush techniques. Toothbrush technique was performed by sterile toothbrush and rub it in gently on the affected area. This technique was preferred to apply in asymptomatic carrier patients.[11] According to this study, the toothbrush technique was also practical in patients with symptomatic TC, however, the patient selection by clinical presentation is considered as the important points. This study showed that patients with gray patch and extended scalp area involvement were most suitable for the toothbrush technique.

The clinical presentations were categorized into 2 groups by the severity of inflammation. The gray-patch and black dot type were classified to be a non-inflammatory group of infection. Owing to the severe inflammation, the kerion and favus were labeled as an inflammatory group. Gray-patch type predominantly demonstrated scaling with lack of inflammation that was consistent with ectothrix TC. For this reason, it was appropriate to apply with the toothbrush technique for collecting scale. More than that this type is the most common presentation of TC, therefore it is practicable to use in screening and in outbreaks period. Moreover, this technique was simple and painless therefore it may easy to apply in children. To compare with other endothrix types including black dot and kerion types, the toothbrush technique results in unfavorable outcomes due to the inability to detect the fungal penetration in the hair shaft. Owing to the fact that the hair-plucking and scraping scale by sharp blade technique was more recommended to be performed for endothrix TC investigation.

Other important factor in the toothbrush technique was scalp area involvement. The previous study mentioned that the greater surface area involves, the higher efficacy of hairbrush technique significantly increases.[10] However, the experiment to set suitable conditions for the toothbrush technique has been never established. As stated in the results of the toothbrush technique in this study, more than 15% scalp area involvement of TC was suitable for practice. Accordingly, the efficacy of the toothbrush technique depended on patient selection in the aspect of clinical presentation and scalp area involvement. Thus the patients with gray-patch presentation and more than 15% scalp area involvement were suggested to confirm TC diagnosis by toothbrush technique, especially in outbreaks. Furthermore, laboratory technicians mostly agreed with the toothbrush technique was more appreciative and comfortable in practice than the standard technique. Time-saving on specimen collection and good patient's cooperation were reasonable to be the advantages of this technique. Furthermore, time for fungal culture process was not different between the toothbrush technique and standard technique.

In conclusion, the toothbrush technique was recommended to practice with "gray-patch" TC patients who presented more than 15% scalp area involvement due to the time-saving and well-cooperated method.

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