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Effat Khodaeiani
Department of Dermatology,
Sina Hospital,
Tabriz University of Medical Sciences, Tabriz, Iran

Tel: +989141140440

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Changes of Hair Diameter after Treatment of Androgenic Alopecia; the First Case-control Study

[1]Effat Khodaeiani, [1]Shahla Babaeinejad, [1]Mahsa Jamshidi Asl, [1]Elham Razzagh Karimi, [2]Daniel F. Fouladi and [3]Morteza Ghojazadeh

Diminished hair diameter has been suggested as an early indicator of androgenic alopecia. The objective of the present work is to examine hair diameter changes after appropriate treatments in patients with androgenic alopecia, considering other possible interfering factors such as sex, natural hair color and location of hair sampling on the scalp. In a cross-sectional, case-control setting, 41 patients with androgenic alopecia (the case group) and 41 age and sex-matched healthy individuals (the control groups) were recruited from a referral dermatological center in Tabriz from September 2008 to December 2011. Patients received standard treatments for six months. Hair diameter was measured using a standard digital micrometer (Mitutoyo 0.001 mm, Japan) at baseline and six months later in both groups. In the case group, the mean hair diameter increased significantly from 0.052±0.008 to 0.055±0.008 m, 6 months later ($p = 0.03$). In the control group, the change of the mean hair diameter was not statistically significant in the controls. Frontal hairs were the While the mean hair diameter in female patients was higher, the mean change of hair diameter after treatment was significantly more in male patients. The mean hair diameter was significantly higher in light-brown than in dark-brown hairs of the patient's thinnest samples, in this study. In conclusion, although hair diameter increased significantly after treatment, other factors such as gender, hair color and location on the scalp may also play significant roles in this regard.

Key words: Hair loss, hair diameter, androgenic alopecia

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[1]Department of Dermatology, Sina Hospital,
[2]Drug Applied Research Center,
[3]School of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran

INTRODUCTION

Hair has been always important for human in terms of beauty, attractiveness and even social prestige. Thus, hair loss and disorders may significantly affect mental and physical well-being of patients. In females, hair loss has been interpreted as marred feminine characteristics (Helms *et al*., 2008; Erol *et al*., 2012). Hair problems are very common all over the world. Many etiologies underlie hair disorders, among them androgenic alopecia is a widespread subtype in both males and females (Gordon and Tosti, 2011; Firooz and Fouladi, 2012). In normal individuals, hair diameter varies between 40 and 120 micrometer. Accordingly, hairs can be categorized as "fine" (thickness >60 μm), "medium" (thickness: 60-80 μm) and "thick" (thickness >80 μm) (Kang *et al*., 2009). Along with hair loss, diminished hair thickness has been also suggested as a major sign of androgenic alopecia, even in early stages when the problem is not apparent yet. This is because hair diameter is an accurate index of hair mass (Paus and Cotsarelis, 1999). As a result, hair diameter changes can be used as an indicator of treatment efficacy in such patients. Despite the importance of hair diameter in this regard, there is lack of related studies in the literature (Ishino *et al*., 1997; Sagsoz *et al*., 2004). The present study, for the first time, aimed to examine hair diameter changes after appropriate treatments in androgenic alopecia in a well-designed, case-control study. In addition, possible effect of other factors such as gender, hair color and hair location on the scalp was also investigated in this regard.

MATERIALS AND METHODS

In this case-control study, 41 patients with androgenic alopecia were recruited from a referral clinic of dermatology in Tabriz from September 2008 to December 2011. Androgenic alopecia was present in at least one first-degree relative of the enrolled patients. Forty-one age and sex-matched healthy individuals served as the controls. First-degree relatives of the controls were negative for androgenic alopecia. The ethics committee of Tabriz University of Medical Sciences approved this study. Written informed contests were obtained from the participants. All the patients in the case group received similar appropriate treatments for androgenic alopecia by an experience dermatologist for 6 months. A standard hair pull test (Gordon and Tosti, 2011) was performed on the scalps of both cases and controls at the baseline. This test included gentle traction on a group of hairs (approximately 40-60) on three separate areas of the scalp. The test was repeated 6 months later in the case group and at the same time in the control group. A digital micrometer (Mitutoyo 0.001 mm, Japan) was used to measure diameter of the pulled hairs near their base (Dhurat and Saraogi, 2009). The operator was blind to the group of the studied hairs. In addition to hair diameter, age, sex and natural hair color were also documented.

Statistical analysis: The SPSS Software for Windows (ver.16.0, SPSS Inc., IL, USA) was used for analysis. One-way Analysis of Variance (ANOVA) along with Tukey *post hoc* test and the Chi-square (χ^2) or Fisher's exact tests were used. A p-value ≤0.05 was considered statistically significant.

RESULTS

Demographics and general data of the cases and controls are summarized in Table 1. The two groups were comparable in terms of sex, age, hair color and hair diameter at baseline. In the case group, the mean hair diameter increased significantly from 0.052±0.008 to 0.055±0.008 m, 6 months later (p = 0.03). The change of the mean hair diameter was not statistically significant in the controls (0.050±0.009 m at baseline, 0.049±0.008 m 6 months later, p = 0.46). The mean change of hair diameter was significantly higher in the cases than in the controls (p<0.001). After the treatments, the mean hair diameter in the case group was significantly higher in females than in males (0.056±0.010 m vs. 0.053±0.009 m; p = 0.01). The mean change of hair diameter after treatment, however, was significantly higher in male than in female patients (p<0.01). Considering the hair color in the patients after the treatments, the mean hair diameter was significantly higher in light-brown than in dark-brown

Table 1: Demographic and general data of the patients with androgenic alopecia and normal controls

Variable	Patients (n = 41)	Controls (n = 41)	p-value
Sex			
Male	14 (34.1)	27 (65.9)	0.23
Female	10 (24.4)	31 (75.6)	
Age (year)	36.861±15.870	34.532±14.561	0.79
Hair color			
Blond	10 (24.4)	9 (22)	0.50
Light-brown	18 (43.9)	23 (56.1)	
Dark-brown	13 (31.7)	9 (22)	
Hair diameter (m)			
Baseline	0.052±0.008	0.050±0.009	0.28
Month six	0.055±0.008	0.049±0.008	-

Data are shown as Mean±Standard deviation or frequency (%) p-value <0.05 is significant

hairs (0.056±0.008 m vs. 0.050±0.010 m; p = 0.04). There was no significant difference between the other hair-color groups (p<0.05). Considering the area of hair sampling on the scalps of the patients 6 months after the treatments, the mean hair diameter was significantly lower when the pull test was performed in frontal area (0.50±0.008 m; p = 0.03). The mean hair diameter was 0.053±0.009 m in temporal region; 0.053±0.010 m in parietal region and 0.055±0.010 m in occipital region.

DISCUSSION

Androgenic alopecia is a very common finding not only in males, but also in females. The underlying etiology of this type of alopecia is increased action of 5-alpha reductase and diminished receptors of dihydrotestosterone (active metabolite of testosterone) (Odom *et al*., 2000; Firooz and Fouladi, 2012). In females, hormonal abnormalities may also play role in pathogenesis of hair disorders (Navali *et al*., 2011), including androgenic alopecia. Hair loss happens when anagen phase is gradually reduced, growth cycle of the hair becomes shorter and hair follicles create vellus hair (Burn *et al*., 2004). Along with hair loss, decreased hair diameter is a prominent finding in androgenic alopecia. A variety in hair diameter >20% has been suggested as an early sign of alopecia areata (Tosti *et al*., 2005; Inui *et al*., 2009). Ishino *et al*. (1997) followed hair diameter changes for three years in 56 Japanese with male pattern alopecia and concluded that the average hair diameter reduced significantly almost 1.1 micron per year. Sagsoz *et al*. (2004) also reported a significant positive correlation between hair diameter and serum androgen levels. In the present work, the effect of appropriate treatments on hair diameter was investigated in patients with androgenic alopecia in a well-designed, case-control setting. Accordingly, the hairs became thicker significantly after treatments in the patients. To the best of our knowledge, there is no similar study in the literature. To clarify the effect of gender in this regard, hair diameter of males and females were compared in the patient groups after the treatments. Interestingly, while the mean hair diameter in females was significantly higher after treatment, the mean amount of hair diameter change before and after treatment was significantly more in the male patients. It has been previously shown that hair follicle miniaturization plays pivotal role in the pathogenesis of androgenic alopecia (De Lacharriere *et al*., 2001). One of possible mechanisms of this difference observed between male and female patients in the present work is the difference in rate and extent of follicle miniaturization between the two genders. This needs to be examined in future studies. Another interesting finding in the present work was the effect of hair color on its diameter after treatment. Accordingly, the mean hair diameter in patients with light-brown hairs was significantly higher than that in the cases with dark-brown. This is in contrast to a general belief that darker hairs are thicker, because there was not a significant difference between blond and brown hairs in terms of their diameter in the current study. The underlying physiopathology of this finding needs to be investigated in future studies.

Last but not least, the present study showed that hair diameter was the thinnest in specimens obtained from frontal region comparing with those from other regions on the scalp. It is known than the frontal area is the first involved region in androgenic alopecia. This may justify this finding regarding hair diameter observed in the present work. In addition to previously emphasized areas for further studies in this regard, larger sample size and considering the role of age (Sagsoz *et al*., 2004; Babaeinejad *et al*., 2011) are also important in this regard.

CONCLUSION

This study, for the first time, reported hair diameter changes before and after treatment in androgenic alopecia. Although hair diameter increased significantly after treatment, other factors such as gender, hair color and location on the scalp may also play significant roles in this regard.

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