Evaluation of Hair Follicle Counts of Occipital Scalp Biopsies from Male Hair Transplant Patients in Thailand

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ABSTRACT

Objective: To evaluate the average hair follicle count from the occipital scalp of Thai males with AGA who were candidates for hair transplantation.

Materials and Methods: A cross-sectional study of 47 male with AGA undergoing hair transplantation surgery was conducted. The 4-mm punch biopsies from the occipital scalp were evaluated for hair count parameters. The results were compared to prior studies.

Results: The average counts of total hair follicles and the density of hair follicle per square millimeter were 18.6±1.2, and 1.5±0.1, respectively. The terminal-to-vellus ratio was 11.1, and the percent ratio of anagen-to-telogen ratio was 91.9:8.1. The hair count number is significantly lower than other ethnicities including Thais in general population ($P < 0.001$), but greater than the Thai males with AGA in the previous study. ($P < 0.001$).

Conclusion: Our study showed a lower average hair density as compared to the other normal Asian population. The total hair count in the occipital area from this study is less when compared to the previous studies conducted in Thai normal controls but higher than those with more advanced AGA. This result supported the evidence of hormonal effect involving the occipital scalp of male AGA.

Keywords: Hair counts; hair density; occipital area; androgenetic alopecia (Siriraj Med J 2023; 75: 132-137)

INTRODUCTION

The occipital scalp has been the common donor site for hair transplantation as treatment for androgenetic alopecia (AGA). It is considered androgen insensitive because the growth cycle and the density of the hair follicle originating from this area is not affected by androgen even after transferring to the baldness zone.[1-2] Therefore, the hair counts from the occipital area should represent a normal reference for hair density in the general population. However, recent published data regarding the androgenetic effect on this nonbalding scalp area in AGA cases have been reported in both males and females.[3-5] Evaluation of hair density from the occipital scalp in individuals with AGA could reassure the appropriate quality and quantity of hair from the donor site suitable for hair transplantation surgery.

AGA is the universal cause of non-scarring alopecia among general population. It is characterized by the

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gradual and progressive reduction in the hair density and hair diameter in both genders. Male AGA shows the characteristic features of patterned alopecia in both temporal and anterior hairline as well as hair thinning at the vertex region of the scalp. Assessment of the hair counts from the donor-site, or occipital area has been previously reported in a few studies.[4-6] Therefore, we aim to evaluate the average number of hair follicles and follicular density at the occipital scalp in Thai males with AGA for the reference record and to compare with the previous studies in Thailand.[4] Furthermore, we aim to compare the hair count parameters with the previous published data of hair counts in general Thai population and among other ethnics worldwide.[1,7-13]

MATERIALS AND METHODS

This descriptive, cross-sectional study enrolled 47 male participants who were candidates for hair transplantation for the treatment of AGA at Siriraj Hair Transplantation Clinic, Department of Dermatology, Faculty of Medicine Siriraj Hospital. This study was approved by Siriraj Institutional Review Board with written informed consents signed by all the participants prior to the study enrollment. (COA no. Si 581/2010) Demographic data including age, age at onset of hair loss, duration of the disease, family history of AGA, grading of the disease severity by Hamilton and Norwood classification, treatment, and underlying medical conditions was recorded. The scalp involvement of other skin diseases such as psoriasis, seborrheic dermatitis, atopic dermatitis, and superficial fungal infection were excluded by history taking and clinical evaluation.

Biopsy methods and tissue sample processing

Two pieces of 4-millimeter (mm) punch biopsy specimens were performed at the external occipital protuberance of clinically normal-looking occipital scalp before the beginning of hair transplantation surgery. One specimen was bisected vertically and the other specimen was transversely bisected at 1 mm below the dermo-epidermal junction with the cut surface embedded side-by-side in the paraffin cassette. All paraffin-embedded-tissue blocks were routinely processed and serially sectioned by an experienced technician. Ten consecutive sections with a 5-micrometer thickness were stained with hematoxylin and eosin (H&E) and prepared for microscopic evaluation by two independent dermatopathologists (PP and PS) in the blinded fashion. Histological records included the total number of the following hair parameters; follicular units, hair follicles, follicular stelae, type of hair (terminal or vellus/miniaturized hair), phase of hair cycle (anagen and telogen/catagen), terminal-to-vellus ratio, and anagen-to-catagen ratio percentage. We did not differentiate between intermediate and vellus hair but we grouped them together with miniaturized hair. We also combined the number of catagen and telogen hair in the same parameter. The maximum number of each hair count parameter was noted by each dermatopathologist and the average counts between both evaluators were recorded for statistical analysis.

Statistical analysis

All statistical analyses were analyzed and reported as descriptive statistics values by SPSS v.18 (SPSS Inc., Chicago, IL, USA). Categorical data was reported as numbers and percentages, and continuous data was reported as mean (range) or mean ± SD. The mean hair count was compared with the previous published data using the one-sample t-test for continuous variables and Chi-square for categorical data. P-value of < 0.001 was considered statistically significant.

RESULTS

A total of 47 male participants, who were candidates for hair transplantation for the treatment of AGA, were enrolled in this study. The demographic data (gender, age, age at disease onset, disease duration before transplantation, disease classification, previous treatment for AGA, and underlying medical conditions) of the study participants was demonstrated in Table 1. The mean age was 35.2±8.3 years, ranging from 21-53 years. The average age at the disease onset was 26.2±6.7 years, ranging from 18-40 years. The average disease duration before the transplantation was 9.0±4.9 years, ranging from 2-22 years. Thirty-seven participants (78.7%) reported the family history of AGA. The number of participants categorized by Hamilton-Norwood classification were 8 cases in type II (17%), 26 cases in type III (55.3%), 9 cases in type IV (19.1%), and 4 cases in type V (8.5%), respectively. Previous treatments recorded for AGA were monotherapy of oral finasteride in 8 cases (17%), topical minoxidil in 2 cases (4.3%), and a combination of oral finasteride and topical minoxidil in 37 cases (78.7%). There were 6 participants (12.8%) with known underlying medical diseases. The participants under 40 years old tend to present with less disease severity when compared with the age group above 40 years old ($P = 0.04$). Moreover, the presence of family history of AGA, the previous or current treatment of AGA, and underlying medical conditions were not associated with the grading of AGA severity ($P = 0.242$, 0.106, 0.602, respectively).

The hair count parameters from the transverse section

TABLE 1. Demographic data.

Demographic characteristics (N = 47)	
Gender: Male, n (%)	47 (100)
Age; years, mean (range)	35.2 (58 - 21)
Age at onset of AGA; years, mean (range)	26.2 (18 - 40)
Disease duration; years, mean (range)	9.0 (2 - 22)
Family history of AGA, n (%)	37 (78.7)
Hamilton-Norwood classification, n (%)	
Type II	8 (17.0)
Type III	26 (55.3)
Type IV	9 (19.1)
Type V	4 (8.5)
Treatment history for AGA, n (%)	
Oral finasteride	8 (17.0)
Topical minoxidil	2 (4.3)
Oral finasteride and topical minoxidil	37 (78.7)
Presence of underlying systemic diseases, n (%) *	
Dyslipidemia	4 (8.5)
Diabetes mellitus type 2	1 (2.1)
Hypertension	2 (4.3)
Chronic hepatitis B infection	1 (2.1)

Abbreviations: AGA: Androgenetic alopecia, SD: Standard deviation
*Three participants with more than one underlying diseases

of 4-mm punch biopsy were presented in Table 2. The mean number of the following hair count parameters was calculated: follicular units was 8.2±1.3 and total hair follicles were 18.6±1.2. The ratio between terminal and vellus hair (T:V ratio) was 11.1:1. The average percentage of anagen to telogen (A:T) ratio was 91.1:8.1. The mean count of follicular stelae was 0.4±0.7 and follicular density was 1.5±0.1 follicle per mm^2.

Comparison of hair count parameters from the transverse section of 4-mm punch biopsy between the present study and the previous published data among Asians including Thais, Caucasians, African-Americans, and Hispanics was also shown in Table 2. The number of hair follicles and follicular density was significantly less than the previous studies from normal Thai subjects, other Asians (Taiwan and Iran), Caucasians, African Americans, and Hispanics ($P < 0.001$). In contrast, this study showed a significantly higher number of hair count and follicular density as compared to the Korean subjects with hair diseases in the previous study. ($P < 0.001$).

The comparison of the data with the previous study in Thai male AGA and the control group was shown in Table 3. The average age of the participants in this study was not significantly different from the control group but was significantly less than the AGA group from that study ($P = 0.007$ and < 0.001, respectively). When compared to normal controls of the previous study, the mean number of total hair follicles, terminal hair count and follicular unit of our study were significantly less ($P < 0.001$). On the other hand, there were no statistical differences between vellus hair count, T:V ratio and A:T ratio ($P = 0.001$, $P = 0.001$ and $P = 0.249$, respectively) between the two studies. When compared to the male AGA group of the previous study, there were significantly higher number of total hair follicles and terminal hairs, as well as T:V ratio, and A:T ratio in the present study. ($P < 0.001$). In contrast, the median number of vellus hair was significantly lower in the present study as compared to the previous study ($P < 0.001$).

TABLE 2. Hair counts in transverse biopsy sections and comparison with previous reports among different ethnic populations.

Ethnic				Asians			Caucasians		African American	Hispanic
Country and study	**Present study**	**Thailand 1** (Ref 9)	**Thailand 2** (Ref 10)	**Taiwan** (Ref 11)	**Korea** (Ref 12)	**Iran** (Ref 13)	**USA** (Ref 1)	**USA** (Ref 14)	**USA** (Ref 1)	**Mexico** (Ref 15)
Number of cases	47	90	20	31	35	30	12	22	22	50
Hair conditions	AGA	Normal	Normal	Normal	AGA>AA>Normal	Normal	Normal	AGA	Normal	Normal
Biopsy site	Occipital	Occipital	Vertex	Vary	Occipital	Vary	Vary	Vertex	Vary	Occipital
Gender (M:F)	47:0	51:39	16:4	17:14	19:16	21:9	4:8	13:9	12:10	25:25
Age (years)	35.2 (8.3)	36.5 (15.1)	55.1 (15.8) *	37 (15.3)	33.1 (10)	35.5 (14.7)	34.7 (12.2)	43 (3.5) *	31.7 (8.5) *	34.14 (10.57)
Total hair follicles	18.6 (1.2)	20.5 (5.2) *	28.3 (9.2) *	21.3 (4.8) *	16.1 (3.6) *	36.4 (7.2) *	35.5 (5.5) *	40 (2.2) *	21.5 (5) *	23.2 (4.29) *
Follicular density (per mm^2)	1.5 (0.1)	NA	2.2 (0.7) *	1.7 (0.4) *	1.2 (0.3) *	NA	2.7 (0.4) *	3.1 (0.8) *	1.7 (0.4) *	1.75 (0.6) *
Terminal hairs	16.9 (1.4)	18.2 (4.1) *	16.5 (8.4)	20.5 (4.6) *	14.9 (3.2) *	34 (6.4) *	30.4 (6.4) *	35 (2.1) *	18.4 (5) *	21.08 (4.1) *
Vellus hairs	1.7 (0.6)	2 (0-7) **	6.9 (7) *	0.8 (1) *	1.1 (1.3) *	2.4 (1.2) *	5.1 (3.5) *	5 (0.6) *	3 (2.1) *	2.12 (1.04) *
T:V ratio	11.1:1	8.9:1*	2:1*	25.3:1*	13.5:1*	17.4:1*	6:1*	7:1*	6.1:1*	11.37:1
A:T ratio percent	91.9:8.1	91.9:7.9	NA	91.6:8.4*	93.6:6.4*	93.7:6.3*	94.5:5.5*	93.5:6.5*	93.9:6.1*	90.7:7.84
Follicular units	8.2 (1.3)	9.1 (1.6) *	10.7 (2.6) *	9.4 (1.9) *	7.8 (1.7)	NA	NA	14 (0.5) *	NA	7.56 (1.63) *

Numbers indicate mean (standard deviation), AGA; Androgenetic alopecia, M:F; male to female, T:V; terminal to vellus, A:T; anagen to telogen,
NA; not available, Ref; reference number
* Statistical significance ($p < 0.001$)
** Median (max-min), no comparison with the present study

TABLE 3. Comparison with occipital hair count in normal Thai male and Thai male with AGA.[6]

Hair counts from occipital scalp	Present study	Control	P-value	AGA	P-value
Number of cases	47	82		82	
Age, years, mean (SD)	35.2 (8.3)	38.6 (10.5)	0.007	40.1 (8.9)	< 0.001
Total hair follicles, mean (SD)	18.6 (1.2)	19.9 (6.1)	< 0.001	17.6 (4.2)	<0.001
Terminal hairs, mean (SD)	16.9 (14.)	17.9 (4.2)	< 0.001	15.9 (3.8)	<0.001
Vellus hairs, median (range)	2 (1-3)	2 (0-7)	0.001	3 (0-14)	<0.001
T:V ratio	11.1:1	8.9:1	0.001	7.4:1	<0.001
A:T ratio	91.9:8.1	92.2:7.8	0.249	87.6:12.4	<0.001
Follicular units, mean (SD)	8.2 (1.3)	9.3 (1.9)	<0.001	8.4 (1.8)	0.264

Abbreviations: AGA; androgenetic alopecia, SD; standard deviation, T:V; terminal-to-vellus, A:T; anagen-to-telogen
Statistical significance ($p < 0.001$)

DISCUSSION

The occipital scalp is considered the common and appropriate donor site for hair transplantation surgery for the treatment of AGA due to the follicular unresponsiveness to the androgenetic effects.[1-2] The scalp biopsy is a useful tool for the diagnosis of various hair and scalp diseases.[14] Different reference values of hair count parameters have been reported among various ethnic groups worldwide. The differences of hair density in each ethnic population have been established and a few similar studies reported that Asian individuals have less amount of hair follicles than that of whites, African-Americans, and Hispanics.[1, 7-13] We reported the average hair count parameters from the occipital scalp biopsy of male AGA in transverse sections using a 4-millimeter punch biopsy. Our study result shows significantly lower hair density than normal populations of previously mentioned ethnic groups including Thais, with an exceptionally greater amount of hair counts than the Korean cohort. This present study has a limitation of obtaining skin punch biopsies at the occipital area of Thai male subjects with AGA, because it was assumed that the samples acquiring from the patients mentioned above were comparable to the average hair parameters of the normal Thai male populations. However, the hormonal effects of androgen in AGA patients could influence the decreased amount of occipital hair as observed in the results of both present and previous studies.[10] In the aspect of T:V ratio, the ratio in the present study is higher than the previous reported data in Thai AGA males. The results in this study might be contrast with the results and analysis of the previous studies regarding the androgenetic effect upon the occipital area, due to the lack of evidence of miniaturization.[4,7,8] But it is important to take note that, the majority of the population in this study belonged to the less disease-severity groups (Hamilton-Norwood classification type II and III) and was relatively younger than the Thai male with AGA subjects in the previous study.[4] These observations could explain the less androgenetic effect in the population included in the present study.

The total hair counts from this study is less when compared to previous studies conducted in Thai normal controls.[4,7,8] This could be due to the fact that the biopsy specimen of the present studies was taken from live patients with AGA while those of the previous studies were taken from cadavers who did not have scalp or hair diseases especially AGA.

We do not report nor discuss the histological findings of vertical scalp biopsy section due to previously documented data that vertical section would be inappropriate and is not contributable for the diagnosis of non-scarring alopecia. In contrast, transverse section provides more information of the hair cycle phase, hair density and diameter than vertical section which would be very useful in the diagnosis of non-scarring alopecia especially AGA.[14-15]

CONCLUSION

This study reported the average hair follicular parameters from the donor site of the occipital scalp in Thai male patients with AGA who were undergoing hair

transplantation surgery. These results aimed to be utilized as a reference of the average hair density of the donor site in Thais. Hair density was shown to be distinctive among different races and fluctuates among Asians, of which, our study supported lower average hair density among Asians. In addition, the total hair counts in the occipital area from this study is less when compared to the previous studies conducted in Thai normal controls but higher than those with more advanced AGA. This result supports the evidence that hormonal effects may play a major role in the determination of the hair density even in normal looking, uninvolved occipital region. Further studies are recommended to emphasize the androgenetic effect in the different regions of the scalp, especially those which are known to be non-hormonal affected areas.

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