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The distribution of hair in Han Chinese

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Dr. Zhi-Qi Hu, MD, chariman of plastic surgery of Nanfang Hospital. He have engaged in plastic and cosmetic surgery for more than 20 years. His research interest is advanced basic and clinical facial paralysis, basic and clinical study of hair transplantation. He is experienced in clinical curing for AGA, scar after trauma, and congenital facial deformity. Now he is devoting himself to curing alopecia, including the medicine cure, and the surgical operation - follicle unit extraction (FUE). At present, his research of hair transplantation gets ahead in China and the research of hair follicle regeneration is in the domestic first-class and international advanced level.

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ABSTRACT

Aim: To explore the characteristics of normal hair distribution in Han Chinese. **Methods:** A total of 146 healthy Han Chinese and 41 patients with androgenetic alopecia (AGA) were selected as research subjects. Digital photographs of the vertex, temporal, and occipital regions were taken after their hair was trimmed. An image analysis software was used to compute the number of follicular units (FUs) and hairs. **Results:** The mean FU density of the 146 healthy Han Chinese was 74.36 ± 13.33 units/cm^2 and their mean hair density was 143.33 ± 28.08 hairs/cm^2. There was no significant difference between males and females ($P > 0.05$). The mean FU density in the occipital region of AGA patients was 77.78 ± 2.99 units/cm^2 and their mean hair count was 148.12 ± 6.98 hairs/cm^2. Both were lower than those of healthy Han Chinese, and the differences were statistically significant ($P < 0.001$). Two-hair FUs (52.62%) were the predominant type found in Han Chinese. **Conclusion:** The FU and hair densities of healthy Han Chinese are lower than those of whites and Africans. The study provides hair transplantation surgeons with information on hair distribution in Han Chinese. It also provides a quantitative basis for the area of donor site and transplantation density necessary for hair transplantation surgeries. The research findings provide some theoretical data for the hair distribution characteristics of Han Chinese. These data can contribute to the preoperative assessment, surgery planning, and postoperative outcome evaluation by hair transplantation surgeons.

Quick Response Code:

INTRODUCTION

Follicular unit transplantation (FUT) and follicular unit extraction (FUE) have become two preferred methods in hair transplantation surgery due to their aesthetic and natural postoperative appearance, and high survival rate. FUT and FUE achieve their cosmetic and modification effects by the redistribution of existing hair rather than by increasing the absolute number of hairs. Thus, no matter which surgery method to choose, patients will require detailed evaluation in multiple aspects, including the area of donor site to excise or extract[1,2]. Western scholars have conducted detailed research on the hair distribution of whites and Africans[3-5]. These studies have shown that the hair density of Asians is lower than that of whites and Africans. However, due to geographical and ethnic differences leading to disparities in hair distribution among Asians, it is necessary to investigate the hair distribution in Han Chinese. This paper aims to explore the normal hair distribution characteristics of Han Chinese, in order to facilitate clinical practice.

METHODS

Research subjects

A total of 146 healthy volunteers were Han Chinese residents aged 20-70 years. None had ever received hair coloring, perming, or other treatments. The volunteers and their relatives had no hair diseases, such as androgenetic alopecia, alopecia areata, or hirsutism. Another 41 patients with androgenetic alopecia (AGA) were selected for comparative analysis. All volunteers were informed of the objectives and specific methods of the study, and all gave informed consent.

Experimental method

The vertex region (the intersection between the preauricular line connecting the left and right ears, and the line connecting the glabella and external occipital protuberance), temporal region (2 cm above the preauricular line for both ears), and occipital region (centered on the external occipital protuberance) in the volunteers were selected as the observation sites. Close-up photographs were taken of 2.5 cm × 1.5 cm areas within the observation regions after the hair within the area was trimmed. Photoshop CS5 was used to read the images and count the number of follicular unit (FU) types (n_1, n_2, n_3, n_4, and n_5) comprising of 1, 2, 3, 4 and 5 hairs, respectively, within 1 cm^2 of the photographed region [Figure 1]. The following two formulas were use to calculate FU density and hair density: FU density (hairs/cm^2) = $n_1 + n_2 + n_3 + n_4 + n_5$; Hair density (hairs/$cm^2$) = $n_1 + 2 \times n_2 + 3 \times n_3 + 4 \times n_4 + 5 \times n_5$.

As the vertex and temporal regions of most AGA patients had no hair, these regions had no statistical meaning. Thus, the photography and statistical methods were only applied to the occipital region in this group [Figure 2]. The statistical data were processed in the same way as in the healthy group.

Statistical analysis

SPSS 13.0 software was used for statistical analysis of the data. The measurement data were expressed as mean ± standard deviation. Comparisons between two groups were performed using independent-samples *t*-tests. Comparisons among multiple groups, such as homogeneity of variance, were performed using one-way analysis of variance (ANOVA) and Bonferroni pairwise comparison. Welch's approximate

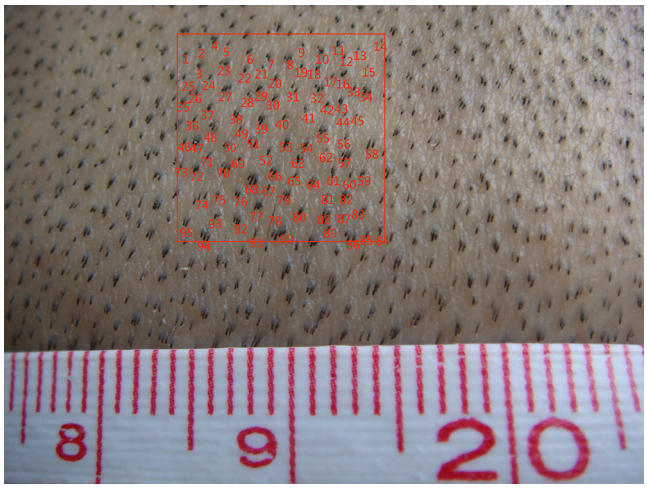

Figure 1: Area measured at 1 cm^2. The FU density in the occipital region of healthy patient was 95 units/cm^2. FU: follicular unit

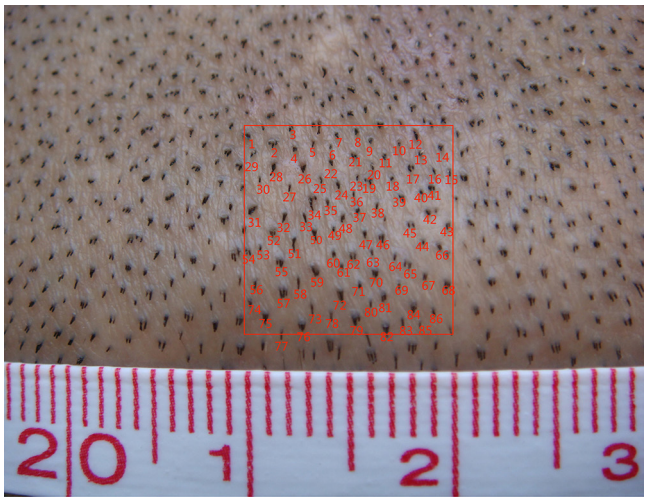

Figure 2: Area measured at 1 cm^2. The FU density in the occipital region of AGA patient was 86 units/cm^2. AGA: androgenetic alopecia; FU: follicular unit

ANOVA and Dunnett's T3 pairwise comparison were used for data with heterogeneity of variance. Correlation analysis was performed using Spearman correlation analysis. $P < 0.05$ indicated that a difference was statistically significant.

RESULTS

Demographic characteristics

The selected 146 healthy Han Chinese included 80 males and 66 females and had a mean age of 44.47 ± 14.53 years. The 41 alopecia patients included 36 males and 5 females, and had a mean age of 41.24 ± 10.71 years.

Comparisons of FU density and hair density in healthy Han Chinese

Results are shown in Table 1. The overall FU density of the population was 74.36 ± 13.33 units/cm^2 and hair density was 143.33 ± 28.08 hairs/cm^2. The differences between males and females ($P > 0.05$) were not statistically significant. FU density and hair density were high in the vertex and occipital regions but low in the temporal region. The difference was statistically significant ($P < 0.001$).

Comparisons of FU density and hair density in the occipital region of AGA patients

Results are shown in Table 2. The FU density was 77.78 ± 2.99 units/cm^2 and hair density was 148.12 ± 6.98 hairs/cm^2, which were lower than the values in the occipital region of healthy Han Chinese. The differences were statistically significant ($P < 0.001$).

Types of follicular units

Results are shown in Table 3. One-hair FUs accounted for 28.38%, 2-hair FUs accounted for 52.62%, 3-hair FUs accounted for 17.48%, 4-hair FUs accounted for 1.30%, and 5-hair FUs accounted for 0.21%. No FUs comprising 6 hairs and above were found in our sample.

Correlation analysis between FU density and age

To analyze the relationship between FU density at various sites and age, we conducted correlation analyses on the FU density at three sites according to age. The results are shown in Table 4. The FU density at the three sites exhibited negative correlations with age.

DISCUSSION

Headington found that hairs are not uniformly distributed singly, but instead grow as a unit of 1-5 hairs. Each unit has a relatively independent sebaceous gland, erector pili muscles, and perifollicular vascular plexus and nerve fibers, which form a FU[6]. FUT and FUE has been two primary surgical methods for hair transplantation due to their high postoperative hair survival rate and natural postoperative appearance[7]. However, patients detailed evaluation before hair transplantation surgery, including determination of the amount of donor site to excise or extract. Thus, the theoretical support of data on hair distribution density is needed. There are differences in hair among various races. Previous research has indicated that there are substantial differences in hair density among whites, blacks, and Asians[5]. Thus, the populations of various races usually require different areas of donor sites.

Table 1: Distribution of follicular unit and hair counts in Han Chinese (mean ± SD)

	Density of follicular units (units/cm^2)			Hair density (hairs/cm^2)		
	Total	Males (n = 80)	Females (n = 66)	Total	Males (n = 80)	Females (n = 66)
Vertex	83.32 ± 7.75	83.56 ± 7.88	83.02 ± 7.64*	160.95 ± 20.66	161.33 ± 21.00	160.50 ± 20.40#
Occipital	82.66 ± 4.12	83.05 ± 4.16	82.20 ± 4.05*	158.90 ± 13.41	160.15 ± 13.26	157.39 ± 13.54#
Temporal	57.10 ± 2.97	57.50 ± 2.88	56.62 ± 3.02*	110.14 ± 10.17	111.20 ± 9.57	108.85 ± 10.79#
Overall	74.36 ± 13.33	74.70 ± 13.33	73.94 ± 13.36*	143.33 ± 28.08	144.23 ± 27.96	142.25 ± 28.26#
P_1	0.751	0.940	0.828	0.680	0.965	0.828
P_2	0.000	0.000	0.000	0.000	0.000	0.000
P_3	0.000	0.000	0.000	0.000	0.000	0.000

P_1: vertex *vs.* occipital; P_2: vertex *vs.* temporal; P_3: occipital *vs.* temporal. Based on a comparison with males, *$P > 0.05$, #$P > 0.05$

Table 2: Distribution of occipital follicular unit and hair counts of AGA patients and healthy Han Chinese (mean ± SD)

	Density of follicular units (units/cm^2)			Hair density (hairs/cm^2)		
	Total	Males	Females	Total	Males	Females
AGA group	77.78 ± 2.99	77.42 ± 2.89	80.40 ± 2.51	148.12 ± 6.98	147.11 ± 6.59	155.40 ± 5.68
Healthy group	82.66 ± 4.12	83.05 ± 4.16	82.20 ± 4.05	158.90 ± 13.41	160.15 ± 13.26	157.39 ± 13.54
P	0.000	0.000	0.008	0.000	0.000	0.007

AGA: androgenetic alopecia

Table 3: Percentages of different types of FU (%)

	1-hair FUs	2-hair FUs	3-hair FUs	4-hair FUs	5-hair FUs
Vertex	27.65	53.72	17.23	1.23	0.17
Occipital	29.24	51.31	17.96	1.25	0.24
Temporal	28.26	52.84	17.25	1.43	0.22
Overall	28.38	52.62	17.48	1.30	0.21

FU: follicular unit

Table 4: Correlation analysis between density of follicular units and age

	r	*P*
Vertex	-0.897	0.000
Occipital	-0.876	0.000
Temporal	-0.788	0.000

r: Spearman correlation coefficient

As the Chinese population is predominantly Han, it is necessary to investigate and study FU and hair density in Han Chinese.

Our study found that the mean FU density in 146 healthy Han Chinese was 74.36 ± 13.33 units/cm^2. This is lower than the results obtained by Bernstein and Rassman[3] and similar to the result by Tsai *et al.*[8] (71.78 units/cm^2). There were no statistical differences between males and females (P = 0.553). The mean hair density in healthy Han Chinese was 143.33 ± 28.08 hairs/cm^2, which is lower than that in whites and Africans[7]. There were no statistical differences between males and females (P = 0.464). The mean FU densities of the vertex, occipital, and temporal regions were 83.32 ± 7.75 units/cm^2, 82.66 ± 4.12 units/cm^2, and 57.10 ± 2.97 units/cm^2, respectively. The mean hair densities were 160.95 ± 20.66 units/cm^2, 158.90 ± 13.41 units/cm^2, and 110.14 ± 10.17 units/cm^2, respectively. These results indicate that there are differences in the FU density and hair density among the different scalp sites of Han Chinese. There was no statistical difference between the vertex and occipital regions, but both had significantly higher values than in the temporal region[7-9]. This provides us with strong data for the theoretical support of temporal hair transplantation.

The results on the 41 AGA patients indicate that the mean FU density of the occipital region was 77.78 ± 2.99 units/cm^2 and the mean hair count was 148.12 ± 6.98 hairs/cm^2. Both results were lower than those in the occipital regions of healthy Han Chinese, and the differences were statistically significant (P < 0.001). Orentreich[10] successfully transplanted non-hormone sensitive hair follicles from the occipital region into the bald area and proposed the donor dominance theory, which has become the theoretical basis of hair transplantation surgery for patients with alopecia. Our research data provide a reference to evaluate the area of donor site that should be transplanted in Han Chinese AGA patients.

Our research on the distribution of FU types in healthy Han Chinese found that 1-hair FUs accounted for 28.38%, 2-hair FUs accounted for 52.62%, 3-hair FUs accounted for 17.48%, 4-hair FUs accounted for 1.30%, and 5-hair FUs accounted for 0.21%. No FUs comprising more than 5 hairs were observed in our study. The proportions of FU types are different for different races[3]. Our research indicates that the FU types found in healthy Han Chinese are dominated by 2-hair FUs. The result is consistent with the FU types of whites, whereas the FU types of Africans are dominated by 3-hair FUs.

The result of correlation analysis indicated that FU density decreased with an increase in age; therefore, the FU density at the vertex can be used as an indicator to evaluate the degree of aging in healthy Han Chinese.

Our research findings have provided some theoretical data on the hair distribution characteristics of Han Chinese. These data can contribute to preoperative evaluation, surgery planning, and postoperative outcome evaluation performed by hair transplantation surgeons. The required amount of hair transplantation, area of donor site excision or extraction, postoperative density, and cost may be estimated, depending on the area of recipient site during the preoperative consultation[11,12]. For example in a male patient with vertex hair loss with a recipient site measuring 2 cm × 2 cm, assuming that all the transplanted FUs survive, the transplantation of 200 FUs can achieve 60% of the normal density of vertex hair. By mean of FUT, this requires a scalp area of about 2.4 cm^2 to be excised from the occipital region. By mean of FUE, according the theory that it will be not significantly affect the occipital region appearance after the extraction of 40% the occipital hair follicles[3], this requires a scalp area of about 6 cm^2 to be extracted from the occipital region. The transplantation of 300 FUs can achieve 90% of the normal density of vertex hair. This requires a scalp area of about 3.6 or 9 cm^2 to be excised or extracted from the occipital region.

We hope that our results can serve as a reference for clinical practice. In addition, we will continue to collect clinical cases to establish a database for hair distribution of Han Chinese for further research.

DECLARATIONS

Authors' contributions

Images' analysis and wrote the article: Z.H. Guo
Collected hair photoes of clinical patients: G. Wang

Analyzed data and made statistical charts: Y. Miao, Z.X. Fan
Communicated with patients and selected the right patients: X.M. Liu, Q. Qu
Searched some related literature: K. Ye, D.C. Zhu
Offered advice and corrected the article: Z.Q. Hu

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Conflicts of interest
There are no conflicts of interest.

Patient consent
All volunteers were informed of the objectives and specific methods of the study, and all gave informed consent.

Ethics approval
The experiment was performed under the approval of the Southern Medical University Ethics Committee.

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