

Hair Crown Patterns of Human Newborns

Studies on Parietal Hair Whorl Locations and Their Directions

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HAIR is embryologically an epidermal derivative, as is the skin. Study of its directional patterning, known as *trichoglyphics*, can be compared to the *dermatoglyphic* study of skin directional patternings.

The dermatoglyphic pattern on the hands develops in fetuses from 70 to 140 mm at approximately 13 to 19 weeks of age. Once established, this does not change.^{2,3} Family data show clear evidence of hereditary influences on finger-ridge patterns,^{2,4,5} but the number and nature of genes involved have not been ascertained. The embryologic development of the nerve fibers which go from the spinal cord to the finger rudiments seems to influence the dermatoglyphics.⁶ Additionally, the pattern may be affected in mongolism, the 17-18 trisomy syndrome,² other chromosomal anomalies, and in prenatal maternal rubella infection.⁷ Thus, an individual's dermatoglyphic pattern appears to be a result of the interaction of both genetic and prenatal influences.

Hair color, hair texture, and male baldness,

as well as body distribution of hair, have been shown to be genetic traits.^{8,9} A genetic basis for the hair whorl pattern has not been investigated. Identical twins do not always have identical hair whorls (personal observation), but it is not uncommon for families to be aware that a particular frontal hair pattern (upsweep, whorl, local albinism, etc.) "runs in the family."

If they have enough hair on the head to examine, all white persons display at least one hair whorl on the back of the head which typically is situated in the parietal area.**

Being a cutaneous appendage, hair, like skin, may be abnormal in a variety of disorders. A white forelock is seen in Waardenburg's syndrome; ectodermal dysplasia manifests various hair disturbances; in "pili torti," the individual hair shafts may be twisted; and kinky hair is characteristic of Menke's syndrome. Furthermore, aberrant scalp and upper facial hair patternings have been reported to be often associated with abnormal brain development during early fetal life.¹

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** As an exception to this generalization, David W. Smith and Bradley T. Gong have indicated that 25 per cent of patients with severe microcephaly lack a parietal whorl and that an additional 45 per cent have a poorly developed posterior whorl.¹

According to the studies of Smith and Gong,¹ hair directional patterning seems to be determined by the stretch exerted on surface skin by the developing brain between 10 and 16 weeks of gestation, at which time the hair follicles are growing. From their studies of the trichoglyphic findings for normal children and those with abnormal brain development, Smith and Gong indicate that trichoglyphics can provide direct evidence of the week in early gestation when deviations in brain development began.

Some therapists who work with children with learning problems believe that the parietal hair crown is situated on the same side as the hemisphere of the brain which is dominant. Thus, most right-handed persons should have their parietal whorl on the left side. The origin of this belief is not known.

Figure 1 shows the location and directionality of representative hair whorls. Since whorls are more clearly identified in older individuals, these pictures were obtained from subjects beyond the neonatal period.

Personal Observations

In the nursery of St. Anthony's Hospital, St. Petersburg, Florida, we studied heads of 404 newborn white infants (217 boys and 187 girls) for their hair whorl patterns. The male:female ratio among the 404 infants was 0.5371. Compared with the established ratio of 0.5146, this is well within the limits of experimental variation ($\chi^2 = 0.841$; $0.30 < P < 0.50$).

The nurse in charge of the nursery made all the observations, in daylight, and these were frequently checked for accuracy by the senior author, a pediatrician. Only crown hair whorl patterns were noted; frontal patterns were ignored. The heads were viewed from behind along the long axis of the newborn lying on the back so that the examiner was looking directly at the central occipital area. Whorls were classified as being 1)

clockwise or 2) counterclockwise according to the swirling direction of the hair. Whorls directly or nearly on the sagittal suture were classified as central, whereas those clearly to the infant's right or left were classified as right or left, respectively.

When there were two crown hair whorls (bilateral) these were classified as doubles. The directions of the double whorls were not noted.

Findings

The results of this study are tabulated in Table 1. Of these 404 newborn infants, 98.5 per cent had single parietal whorls and 1.5 per cent had double. In 93.8 per cent of the infants, the whorls were clockwise; in 4.7 per cent, the whorls were counterclockwise. In order of decreasing frequency, the types and positions were as follows (both sexes): clockwise center, clockwise right, clockwise left, counterclockwise center, double, counterclockwise left, and counterclockwise right.

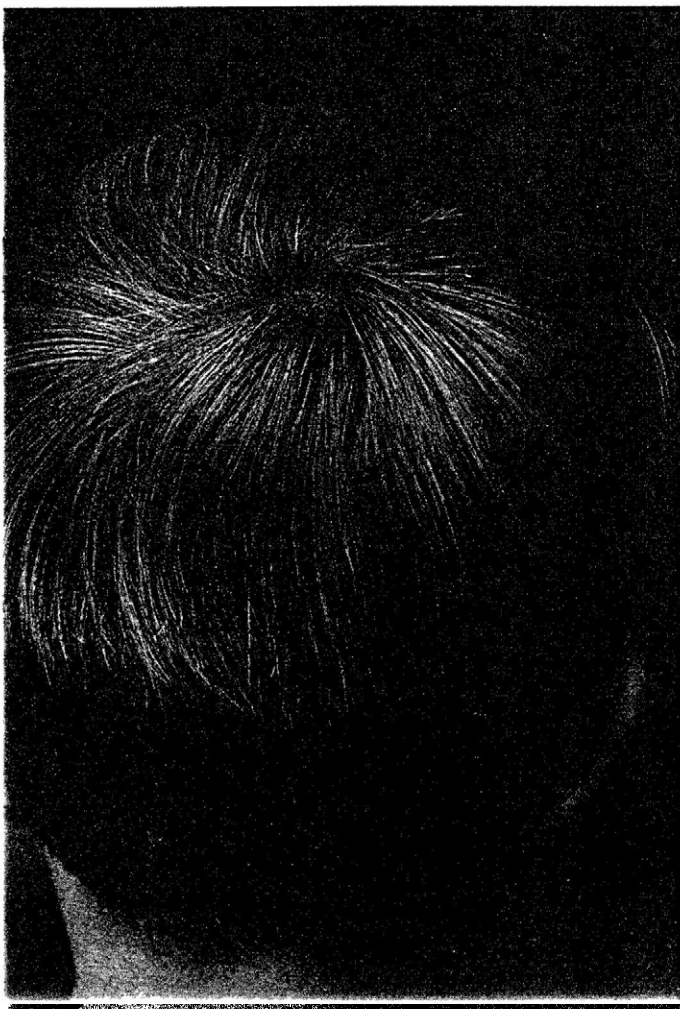
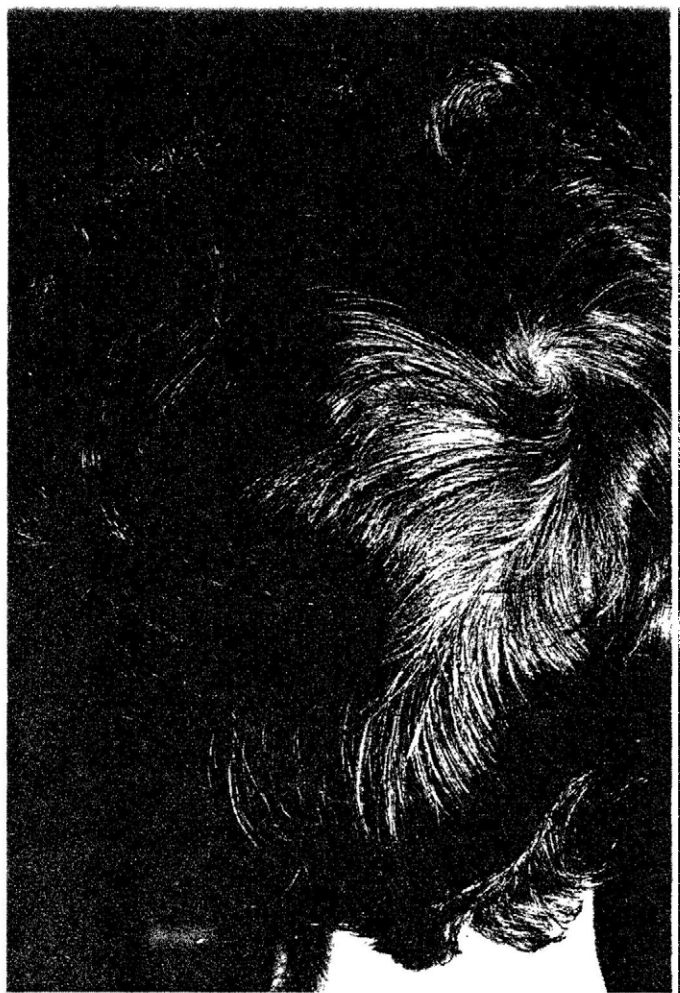
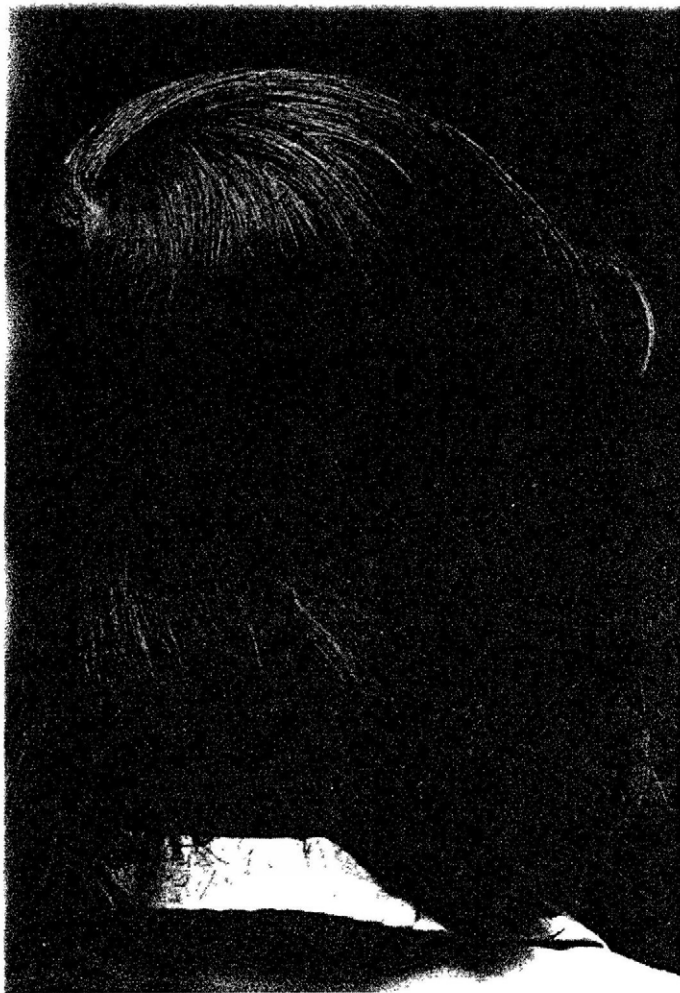
Clockwise hair whorls seem to be shifted more toward the right side of the head, and vice versa, though larger samples are needed to establish these suggestive relationships.

Of the whorls, 131 (32.4%) were on the right side; only 33 (8.2%) on the left; and 234 (57.9%) were central.

All parietal hair whorls were anterior to the posterior fontanel. The centers of all were between 10 and 50 per cent of the distance between the posterior fontanel and the midpoint of the anterior fontanel. Most were at 20 to 30 per cent of this distance.

The chi-square and P values for the male:female distribution within each hair whorl classification were computed, using the total male:female ratio 0.5371. Only one class, counterclockwise center, deviated significantly from the typical sex distribution (1 per cent level of significance), with fewer males in this class than would be expected

FIG. 1. (Top left and right). The single parietal hair whorls on the left and right sides of the head swirl in a clockwise direction. (Bottom left) Although this single parietal hair whorl appears to be situated slightly to the right of the midline, it was actually located over the sagittal suture. The direction of the swirl is clockwise. (Bottom right). This individual has double (bilateral) parietal hair whorls. The whorl on the left swirls clockwise, and the whorl on the right swirls counterclockwise.



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TABLE 1. *Tabulated Data on 404 White Newborns, Showing The Locations and Directions of Swirling of the Parietal Hair Whorl According to Sex*

Type and Position of Whorl	Number Identified According to Sex			Percentages According to Sex			Per Cent
	Male	Female	Total	Male	Female	Total	
Clockwise left	17	13	30	4.2	3.2	7.4	93.8
Clockwise center	114	105	219	28.2	25.3	54.2	
Clockwise right	76	54	130	18.8	13.4	32.2	
Counterclockwise left	2	1	3	.5	.25	.75	4.7
Counterclockwise center	3	12	15	.75	3.0	3.7	
Counterclockwise right	1	—	1	.25	—	.25	
Double	4	2	6	1.0	.5	1.5	1.5
Totals	217	187	404				

if sex and hair whorl pattern were independent.

Chi-square tests were performed to find whether the direction of the whorl, clockwise or counterclockwise, was related to the position of the whorl on the head, whether left, central, or right. (These calculations were based on the 398 infants with single hair whorls.) There was a deviation at the 2 per cent level of significance in hair whorls on the right side of the head. More of these hair whorls swirl in a clockwise direction and fewer in a counterclockwise direction than would be expected if hair whorl direction and position were independent.

Neither hair whorl position nor hair whorl direction follow the Hardy-Weinburg distribution for a single gene factor in a panmictic population.[†] One must keep in mind, however, that all observations were made at a single hospital, and that a sample size of 404 may not be adequately large.

Smith and Gong¹ in their report on the hair whorl patterns of 200 white children (ages and sex not given), noted a single parietal whorl in 95 per cent and bilateral parietal whorls in 5 per cent. In our series, 98.5 per cent were single and 1.5 per cent were double (bilateral). As did Smith and Gong, we found all whorls in normal children anterior to the posterior fontanelle.

Smith and Gong reported single whorls to the right of the midline in 56 per cent, to

the left in 30 per cent, and midline in 14 per cent. We found right in 32.4 per cent, left in 8.2 per cent, and midline (center) in 57.9 per cent. Both series had more right-than left-sided whorls. The discrepancy in the midline figures could result from subjective differences in assessment of what constituted a midline (center) placement.

Clockwise swirling was reported in 79 per cent by Smith and Gong. We found 93.8 per cent of the single whorls to swirl clockwise.

Discussion

To the authors' knowledge, not many studies have been carried out on human hair whorls. Ignorance attends the relative frequencies of type and location; the relevance, if any, of frontal patterns to the crown pattern; or to other factors such as gender, handedness, or hair color. Smith and Gong indicate that various frontal patterns reflect the convergence of the downgrowing parietal and upgrowing frontal hair streams.¹

Prenatal influences such as the direction and manner of flow of the amniotic fluid may conceivably influence the development of an individual's hair whorl pattern. Achs, *et al.*⁷ noted that the location of the hair whorl in subjects studied over the period from birth to five years of age did not change. This observation suggests that once established, the location remains fixed throughout life.

Factors which seem related to the characteristics of the hair whorl are the angle at which the hair follicles lie in the scalp, the

[†] A panmictic population is a population which breeds randomly.

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nature of the associated pilo-sebaceous system,³ and the status of the erector pili muscles. The slope of the hair follicles appears to be related to the relative plane of tension exerted on the skin by the underlying tissues during the period of hair follicle downgrowth. Altered hair whorl patterns may be seen in patients with abnormal head shape.¹

The human head must have a hair whorl. Roughly speaking, the human body is topologically a sphere. It can be shown mathematically that it is impossible to entirely cover a sphere with hair without at least one spot from which the hair would radiate. The hair whorl perhaps lies at the focal point of the scalp where, in early fetal life, the relative tension from the underlying rapidly expanding brain is at its lowest.

The hair whorl is already discernible in the 16- to 18-week human fetus (personal observation). A hair whorl is not found on the head of other mammals, including the other primates, but may be seen in other locations on other mammals. The bodily distribution of hair, the constitution of the terminal hairs on the head, and the shape of the skull may be factors contributing to the human uniqueness of this trait.

It is also possible that the locations of Langer's lines are related to the position of a hair whorl. Langer's lines are lines of skin cleavage; such skin tension lines are determined by the position of collagen bundles and elastic fibers.¹⁰ These lines of formative direction converge to a central point on the posterior scalp¹⁰ and could determine the locus of the hair whorl.

Hair whorls have been readily recognized on nearly all Caucasians examined. They are, however, much less often identifiable in blacks. On only about 10 per cent of blacks examined could we find hair whorls. The reason for this is unknown. Subsequent to the gathering of the data on newborn whites here reported, we carried out some observations on hair whorls in black newborn infants. When the hair is kinky or curly, a whorl is not often discernible. When the

hair is smooth and noncurly, a whorl is much more likely to be identified.

Our findings give no support to the notion that the hair whorl is situated over the dominant hemisphere of the brain. Since 85 to 90 per cent of the general population is right-handed, the vast majority of these individuals have left brain dominance. But the 4 to 1 ratio of right to left hair whorls as found in this study would lend some support to the notion that the hair whorl tends to lie over the nondominant hemisphere. Furthermore, one wonders whether those individuals with centrally located whorls are more likely to be ambilateral. For such questions, investigations of older children and adults are needed.

Acknowledgment

The authors wish to thank Mrs. Florence Thompson, R.N., who made the observations of the infants.

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