Hair Whorls and Monozygosity

To the Editor:

Hair (scalp) whorls are a feature of human developmental biology, where there is a real void of literature (Ziering and Krenitsky, 2003). It has been noted previously that of all mammals, only humans have hair whorls, and that each individual must have a hair whorl (Wunderlich and Heerema, 1975). These observations were made without any supporting evidence. Even so, it does seem odd that a developmental feature so common, yet perhaps unique to humans, has had so little investigation.

We are aware of one case of dichorionic monozygotic twin boys (we thank the anonymous parents for allowing us to report on their children), in which twin A has a single hair whorl opening in a clockwise direction and twin B has two hair whorls, each opening in opposite directions (see Fig 1). Monozygosity was determined by DNA analysis of nine short tandem repeat loci using the AmpFLSTR Profiler Plus ID PCR amplification kit (Applied Biosystems, Foster City, California). According to a recently suggested classification of hair whorl patterning, twin A has an "S" pattern and twin B has a "DSZ" pattern (Ziering and Krenitsky, 2003).

These particular twins were conceived naturally in 1999. Because these twins were dichorionic, their separation had occurred within days after conception (Moore, 1982; Machin, 1996). The pregnancy went full-term, and delivery was uneventful. After delivery, the pediatrician noted that twin B had a visible sinus at the anterior aspect of the helix of his right outer ear, whereas twin A had no distinguishing features. We assume that the hair whorl patterning was evident at birth because hair patterning is established *in utero* (Wunderlich and Heerema, 1975). At about 10 wk of age, twin A developed a noticeable pigmented nevus anterior to his right ear and twin B developed a similar nevus of similar dimensions above his right eye. To date, these boys have had unremarkable growth. Twin A has always been marginally taller and heavier. At this stage of development, both boys appear to be right handed, a developmental characteristic that may relate to their early separation, prior to the establishment of symmetry (Sommer *et al*, 2002).

Our belief is that hair whorl patterning would be primarily determined by genetics (Smith and Gong, 1973; Wunderlich and Heerema, 1975; Samlaska *et al*, 1989) and gene expression, and such a significant difference between individuals of an identical genetic background is confusing. There is a belief among some physicians that hair whorls are determined prior to, or during the events of neuralation (circa days 17–24 *in utero*) (Moore, 1982). The literature does offer a few alternate hypotheses for the development of hair whorls such as (1) the possibility of a physiological mechanism such as a gradient of growth factors (Colin, 1943); (2) the manner of amnionic fluid flow, and other prenatal environmental influences (Wunderlich and Heerema, 1975); and (3) the mechanical tension placed on the epidermis during the rapid expansion of the cranium at approximately weeks 10–12 *in utero* (Samlaska *et al*, 1989), but these hypotheses are not supported by any experimental or statistical evidence. With the current understanding of developmental biology, it seems appropriate to assume that these and other influences may all contribute to hair whorl patterning. Examples of other likely influences include epithelial cell migration (Ribeiro *et al*, 2003) prior to and during the events of neuralation, and the gene expression and cell signaling (Curtiss *et al*, 2002) that is occurring at the site of the developing scalp.

Additional hair whorl studies on monozygotic twins may show that what has been described here is not uncommon. In the future, scientists may be able to explain the timing and development of hair whorls with greater accuracy. Meanwhile, there is no doubt that as time passes differences between these particular monozygotic twins will become more obvious, or evolve, and nurture may explain many of these changes.

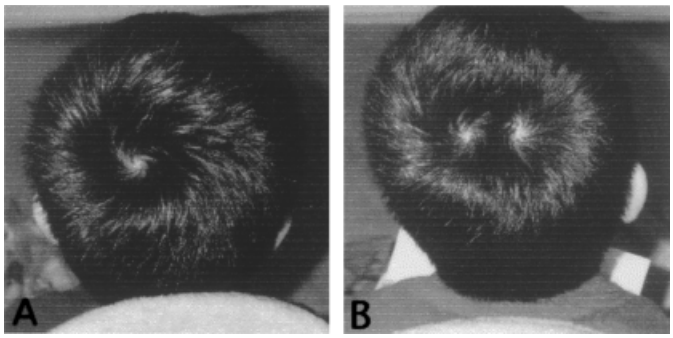

Figure 1
Hair whorl pattern for twin A (panel *A*) and twin B (panel *B*).

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DOI: 10.1111/j.0022-202X.2004.22420.x

Manuscript received September 3, 2003; revised October 16, 2003; accepted for publication November 10, 2003

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References

Colin EC: Hair direction in mammals: Embryogenesis of hair follicles in the guinea-pig. J Morphol 72:191–223, 1943

Curtiss J, Halder G, Mlodzik M: Selector and signalling molecules cooperate in organ patterning. Nat Cell Biol 4:E48–E51, 2002

Machin GA: Some causes of genotypic and phenotypic discordance in monozygotic twin pairs. Am J Med Genet 61:216–228, 1996

Moore KL: The Developing Human. Clinically Oriented Embryology, 3rd edn. Philadelphia, PA: W. B. Saunders Company, 1982; p 56–63

Ribeiro C, Petit V, Affolter M: Signaling systems, guided cell migration, and organogenesis: Insights from genetic studies in Drosophila. Dev Biol 260:1–8, 2003

Samlaska CP, James WD, Sperling LC: Scalp whorls. J Am Acad Dermatol 21:553–556, 1989

Smith DW, Gong BT: Scalp hair patterning as a clue to early fetal brain development. J Pediatr 83:374–380, 1973

Sommer IEC, Ramsey NF, Mandl RCW, Kahn RS: Language lateralization in monozygotic twin pairs concordant and discordant for handedness. Brain 125:2710–2718, 2002

Wunderlich RC, Heerema NA: Hair crown patterns of human newborns. Studies on parietal hair whorl locations and their directions. Clin Pediatr 14:1045–1049, 1975

Ziering C, Krenitsky G: The ziering whorl classification of scalp hair. Dermatol Surg 29:817–821, 2003