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Occipital Squama Convexity and Neurocranial Covariation in Extant Homo sapiens

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Abstract : A distinctive pattern of occipital squama convexity, known as the occipital bun or chignon, has traditionally been considered a derived Neandertal trait. However, some early modern and extant Homo sapiens share similar occipital bone morphology, showing pronounced internal and external occipital squama curvature and paralambdoidal flattening. It has been posited that these morphological patterns are homologous in the two groups, but this claim remains disputed. Many developmental hypotheses have been proposed, including assertions that the chignon represents a developmental response to a long and narrow cranial vault, a narrow or flexed basicranium, or a prognathic face. These claims, however, remain to be metrically quantified in a large subadult sample, and little is known about the feature's developmental, functional, or evolutionary significance. This study assesses patterns of chignon development and covariation in a comparative sample of extant human growth study cephalograms. Cephalograms from a total of 549 European-derived North American subjects (286 male, 263 female) were scored on a 5-stage ranking system of chignon prominence. Occipital squama shape was found to exist along a continuum, with 34 subjects (6.19%) possessing defined chignons, and 54 subjects (9.84%) possessing very little occipital squama convexity. From this larger sample, those subjects represented by a complete radiographic series were selected for metric analysis. Measurements were collected from lateral and posteroanterior (PA) cephalograms of 26 subjects (16 male, 10 female), each represented at 3 longitudinal age groups. Age group 1 (range: 3.0-6.0 years) includes subjects during a period of rapid brain growth. Age group 2 (range: 8.0-9.5 years) includes subjects during a stage in which brain growth has largely ceased, but cranial and facial development continues. Age group 3 (range: 15.9-20.4 years) includes subjects at their adult stage. A total of 16 landmarks and 153 sliding semi-landmarks were digitized at each age point, and geometric morphometric analyses, including relative warps analysis and two-block partial least squares analysis, were conducted to study covariation patterns between midsagittal occipital bone shape and other aspects of craniofacial morphology. A convex occipital squama was found to covary significantly with a low, elongated neurocranial vault, and this pattern was found to exist from the youngest age group. Other tested patterns of covariation, including cranial and basicranial breadth, basicranial angle, midcoronal cranial vault shape, and facial prognathism, were not found to be significant at any age group. These results suggest that the chignon, at least in this sample, should not be considered an independent feature, but rather the result of developmental interactions relating to neurocranial elongation. While more work must be done to quantify chignon morphology in fossil subadults, this study finds no evidence to disprove the developmental homology of the feature in modern humans and Neandertals.

Keywords : chignon, craniofacial covariation, human cranial development, longitudinal growth study, occipital bun
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