MODERN VARIATION AND EVOLUTIONARY CHANGE IN THE HOMININ EYE ORBIT

DISSERTATION

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By

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ABSTRACT

The principal aim of this research is to investigate variation and change in orbital morphology among past and modern human groups. This involves a comparison of individuals from Western Europe (68), China (57), and South Africa (54); an investigation of how the orbit varies amid the neurocranium and lower face in *Pan*, *Australopithecus africanus*, *Homo erectus*, Archaic *Homo sapiens*, and anatomically modern *Homo sapiens* representing different grades of cranial expansion and reduced facial prognathism; an analysis of more recent change in orbital morphology among Western European groups dating to the Upper Paleolithic; as well as an examination of how temporal and spatial variation in orbital and overall craniofacial form may relate to a recent global trend of reduced visual acuity in humans.

Univariate and multivariate statistical tools are used to test hypotheses relating to these aspects of variation and evolutionary change. Analysis of Variance (ANOVA) reveals many differences in orbital form among modern human groups, with the greatest degree of inter-group variation observed for orbital volume, orbital depth, and shape of the orbital margins, while no difference was found for interorbital breadth, and biorbital breadth. Mahalanobis distance and canonical discriminant function analyses indicate that despite these differences, the orbits are less variable compared to broader traits of the skull, and that groups with a similar overall craniofacial form can differ markedly in orbital morphology.

The orbits are found to vary in association with a grade shift in cranial size and facial prognathism, becoming more retracted relative to basion, more rectangular, and more frontated in association with increased cranial size and decreased lower facial projection. During the last 30,000 years in Western Europe, the orbits have shifted posteriorly relative to basion, while internal orbital depth has also been reduced. Shape of the orbital margins have changed most throughout this period, becoming taller and narrower, while orbital volume, orbital frontation, and interorbital breadth show no relationship to time.

An examination of eyeball size, orbit size, and spherical equivalent refractive error (SER) reveals a strong relationship between relative size of the eye within the orbit and the incidence/severity of myopia. This widespread neutral human trait is examined in the context of variation in orbital and overall craniofacial form between the sexes, among modern human populations, and throughout hominin evolution. These results indicate that future research into the etiology of juvenile-onset myopia should consider how the eyeball interacts with the matrix of structural and functional components of the skull during ontogenetic and evolutionary morphogenesis.