especially between the Uzzo and Oriente B sites, giving their vicinity and accessibility during the Early Holocene. We applied 3D geometric morphometric methods to assess size and shape variation as well as geographic and diachronic patterns. All analysed specimens, plus a comparative sample from the Old World dated to the Upper Palaeolithic to Early Mesolithic, were digitized and standard craniofacial landmarks plus semilandmarks were extracted from the 3D models.

Our results underline a high variability among the Mesolithic specimens, as well as a drastic distance from the presumed founder Palaeolithic settlers representatives (San Teodoro specimens) that have closer morphological affinities with European Palaeolithic specimens.

Processes that Generate Modularity in the Mammalian Skull: Implications for Primate Skull Evolution

NANDINI SINGH[1], ROGER H. REEVES[2] and JOAN T. RICHTSMEIER[1]

[1]Anthropology, Pennsylvania State University, [2]Institute of Genetic Medicine and Department of Physiology, Johns Hopkins

Morphological integration and modularity are concepts widely used to understand human and non-human primate skull evolution. However, most studies focus on patterns of covariation and correlation rather than the processes that generate those patterns. The discovery that key developmental pathways are conserved across mammalian phylogenies has allowed the use of murine models to identify processes that generate patterns and magnitudes of variation in skeletal structures. Here we use a murine model to demonstrate how an up-regulation of Sonic hedgehog (Shh), an evolutionarily conserved gene critical for dorso-ventral and medio-lateral patterning of the mammalian face, affects the cranium and mandible. Using 3D geometric morphometrics, principle components and 2B-partial least squares analyses, we quantified and analyzed the effects of a synthetic Shh-based agonist, SAG, on craniofacial and mandibular morphology of adult mice. Our results show that such an acute up-regulation of the SHH pathway has markedly different effects on the cranium, particularly on the mid-face, relative to the mandible. As SAG was administered at birth, these varied effects indicate that Shh affects cranial postnatal growth differently from the mandible. Shh signaling in the face is regulated by a Shh-responsive center in the forebrain. The variation generated by this direct connection between Shh signaling and the developing cranium indicates that for some processes the cranium and mandible are distinct modules, and demonstrates how developmental-genetic pathways differentially affect aspects of the skull. These results have important implications for how variation in key developmental pathways can cause distinct morphological changes realized as modular patterns.

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A novel cranial base drilling method with direct access to petrous bones for analyzing ancient DNA and preserving ancient human remains

KENDRA A. SIRAK[1,2], DANIEL M. FERNANDES[2,3], OLIVIA CHERONET[2], MARIO NOVAK[4], BEATRIZ GAMARRA RUBIO[2], TÍMEA BALASSA[5], ZSOLT BERNERT[6], ANDREA CSÉKI[7], JÁNOS DANI[8], JÓZSEF ZSOLT GALLINA[9], IVETT KŐVÁRI[10], ORSOLYA LÁSZLÓ[11], ILDIKÓ PAP[6], RÓBERT PATAY[12], ZSOLT PETKES[13], GERGELY SZENTHE[14], TAMÁS SZENICZEY[15], TAMÁS HAJDU[15] and RON PINHASI[2]

[1]Department of Anthropology, Emory University, [2]School of Archaeology and Earth Institute, University College Dublin, [3]Department of Life Sciences, University of Coimbra, [4]Institute for Anthropological Research, Zagreb, Croatia, [5]Biomedical Centrum Ltd., Pomáz, Hungary, [6]Department of Anthropology, Hungarian Natural History Museum, [7]Archeodata 1998 Ltd., Polgár, Hungary, [8]Déri Museum, Debrecen, [9]Ásatárs Ltd, Kecskemét, Hungary, [10]Joint Prisoner of War/Missing in Action Accounting Command, Hawaii, USA, [11]Analytical Laboratory, Hungarian National Museum, [12]Department of Archaeology, Ferenczy Museum, [13]Research Centre for the Humanities, Hungarian Academy of Sciences, Institute of History, [14]Department of Archaeology, Hungarian National Museum, [15]Department of Biological Anthropology, Eötvös Loránd University

Ancient DNA (aDNA) research depends on available skeletal material to study ancient peoples. However, there is often discord between maintaining the anatomical integrity of the remains and obtaining samples for aDNA research. Our previous findings suggest that the inner ear part of the petrous is the most DNA-dense region of the skeleton; we now explore a novel "cranial base drilling method" (CBDM) for accessing this region on a complete skull without causing substantial visible damage or altering anthropologically-important features.

Beginning with equal initial DNA concentration (20ng), we compared endogenous DNA yields, damage patterns, mitochondrial contamination, sex and mitochondrial haplogroup, and projected PCA position using both petrous bones (one petrous processed inside an aDNA cleanroom, the other processed in the field using the CBDM) and one postcranial element (processed inside a cleanroom) for seven Hungarian archaeological specimens spanning from the Neolithic (4500 BP) to the Avar period (8th century CE). Cleanroom-processed petrous bones yielded 18.26-73.07% endogenous DNA while petrous bones processed with the CBDM yielded 8.73-56.76% endogenous DNA, representing a reduction of 4.5-67.6% with the CBDM. Postcranial elements yielded 0.04-5.24% endogenous DNA, representing a reduction of 92.2-95.5% when a non-petrous element is used. Though we observe a reduction in DNA quantity with the CBDM, we obtain results consistent with those produced from cleanroom processing of the petrous; in contrast, non-petrous elements often do not yield enough data for useable results. We demonstrate that the CBDM should be utilized instead of a non-petrous element in cases of a complete skull.

Distributions of secondary osteon collagen/lamellar morphotypes are important in avoiding stress fractures: A new hypothesis for the etiology of stress fractures

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JOHN G. SKEDROS

Bone and Joint Laboratory, VA Medical Center, University of Utah

Bones resist failure during natural cyclic loading by optimizing material toughness. This can be achieved by varying predominant collagen fiber orientation (CFO) between regions of a bone in accordance with the distribution of the prevalent/predominant strain mode (tension, compression, and shear). Although this can occur independent of osteon remodeling, it is achieved in many bones through the formation of secondary osteon morphotypes (SOMs) that have distinctively different collagen/lamellar patterns that are adapted for a prevalent/predominant strain mode. Evidence from the horse racing industry suggests that microstructural adaptation via regional variations in SOM distributions helps avoid stress fractures. In the fracture-prone third metacarpal, the region most susceptible to fracture receives a strain mode (compression) during training that changes to another strain mode (shear) during racing. Consequently, typical training does not allow for SOM-mediated microstructural adaptation for the strain mode experienced during racing. This leads to microdamage accumulation and eventual fracture. Realizing that regional shifts in prevalent/predominant strain mode can precipitate stress fractures, horse racing trainers reduced the incidence of fractures by modifying training methods. I reviewed theories of the pathogenesis of stress fractures to see if any consider microstructural adaptation as important for resisting microdamage formation due to changing strain-mode distributions. Results showed that little attention is given to how bones avoid stress fractures by modifying specific microstructural characteristics. When CFO-based microstructural adaptation is considered, it is easier to explain the pathogenesis of tension vs. compression stress fractures and the etiology of atypical femur fractures in patients taking bisphosphonates for osteoporosis.