Ancestry estimation: Analysis of os coxae form using virtual models

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ABSTRACT

Introduction: Ancestry estimation is a key component in biological profiling of unknown skeletal remains within forensic anthropology and bioarcheology. The os coxae, a component of the pelvic complex, has long been recognised for its diagnostic value due to its complex morphology and sexually dimorphic features. Ancestry estimation using the os coxae is well-justified, as its shape is influenced by population-specific evolutionary pressures that vary across ancestral groups. **Materials and Methods:** A total of 402 virtual os coxae models were reconstructed from multislice computed tomography (CT) scans. The form of the os coxae was captured using twenty-five anatomical landmarks, which was then analysed using a size-preserving geometric morphometric approach and principal component analysis (PCA). Multivariate analysis of variance (MANOVA) was employed to assess statistically significant differences in form between the ancestral groups (Malay, Chinese and Indian). Discriminant function analysis (DFA) was used to classify the os coxae models by ancestry and to determine cross-validated classification accuracy. **Results:** The PCA generated 69 principal components (PCs), each representing distinct aspects of morphological variation within the study sample. The first four principal components accounted for over 53% of the total form variance, with the first PC alone explaining approximately 25%. MANOVA revealed a statistically significant difference in os coxae form among the ancestral groups ($F = 10.161$, $p < 0.001$; Wilks' Lambda = 0.103; partial $\eta^2 = 0.68$). Ancestry was correctly classified in 83.6% of os coxae models within the study sample based on form DFA. The classification accuracy varies across the ancestral groups: Malay – 81.3%, Chinese – 91.8% and Indian – 77.6%. **Conclusion:** The findings demonstrate that geometric morphometric analysis offers a statistically robust approach for capturing and comparing morphological variation in the os coxae relevant to ancestry estimation in forensic and anthropological contexts. Although the skull is conventionally used for ancestry estimation, it is not always available or intact. In such cases, the os coxae serves as a reliable alternative or complementary element, particularly when dealing with fragmented or incomplete skeletal remains.

Keywords: Ancestry estimation, Geometric morphometrics, Os coxae, Pelvis, Forensic Anthropology