A31 Sex Assessment — The Utility of Endocranial Landmark Data

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After attending this presentation, attendees will understand the potential applications of 3D digitized landmark data to sex assessment of endocranial skeletal remains, specifically, the creation, definition, and utilization of standardized endocranial landmarks and Interlandmark Distances (ILDs) that can be used to assess sex in cases of fragmentary cranial remains.

This presentation will impact the forensic science community by explaining how this analysis will increase the potential number of cranial measurements that can be taken from a set of remains, and allow for more confident assessments of sex in cases of incomplete or fragmentary materials.

Biological profile is a crucial part of any forensic anthropological investigation, of which sex is one influencing factor. Fragmentation and erosion of skeletal remains acts to complicate both metric and non-metric assessment of skeletal remains and lessen the number of potential measurements that can be taken; however, the cranium offers a unique skeletal structure in that fragmentation allows for direct access to complex surfaces and structures that increases the possible number of direct measurements.

Use and definition of ectocranial landmarks have a long history dating back more than a century. In general, these landmarks are now well defined, and their use in everyday craniometrics is standard practice. On the other hand, endocranial structures are rarely defined in terms of landmarks. When endocranial landmarks are identified, their definitions typically lack specificity and leave their exact location open to interpretation. This lack of specificity increases the potential of measurement error and incorrect assessment when data from different samples or studies are collated.

Over the past decade, researchers, including Isaza et al. and Kalmey and Rathbun, have begun to investigate metric sex differences of endocranial structures.[1,2] These studies have shown promise for the use of these structures for sex assessment, both using traditional caliper measurements and computer assisted ILDs; however, previous research has focused on isolated areas within the cranium, leaving out overall morphology or uses landmarks that are methodically difficult to locate and identify.

The present study examined 330 crania from the Rainer Osteological Collection in Bucharest, Romania. Nine midline and 11 bilateral landmarks were defined and collected from the crania using a MicroScribe® G2X digitizer. Landmarks were excluded on an individual basis in cases of fragmentation, erosion, or expression of diffuse or localized pathological conditions. ILDs were extracted for all possible landmark combinations, and subsets of regionally clustered landmarks were created to simulate potential areas of cranial fragmentation. Each set of ILDs was analyzed using discriminant function analysis.

Of the 465 possible interlandmark distances across the entirety of the endocranial surface, a subset of 11, selected in a stepwise analysis, rendered cross-validated classification accuracies up to 85% with an almost negligible observed sex-bias below 5%. Simulated fragmentary analysis of four regionally clustered sets of landmarks results in cross-validated classification accuracies of up to 75% with a sex-bias below 5%. While the classification accuracies reported here are lower than those reported for traditional ectocranial landmarks, they are still appropriate for reliable and statistically sound assessments, particularly of fragmentary materials. Unlike ectocranial landmarks, endocranial structures that are well suited for landmarks are unaffected by muscular attachments that can greatly increase sexual dimorphism of a region or of measurements. While the endocranium has been mostly ignored in terms of sex assessment, with the exception of the petrous portion, it is a complex 3D surface that has great potential in expanding the number and types of analyses that can be used for assessment of the biological profile.

Reference(s):

1. Isaza J., Diaz C., Bedoya J., Monsalve T., Botella M. Assessment of sex from endocranial cavity using volume-rendered CT scans in a sample from Medellin, Colombia. *Forensic Sci Int* 2014;234:186.e1-186.e10.
2. Kalmey J., Rathbun T. Sex determination by discriminant function analysis of the petrous portion of the temporal bone. *J Forensic Sci* 1996;41(5):865-867.

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