



## Physical Anthropology Section – 2010

### H55 And Dens There Were Two: The Utility of the Second Cervical Vertebra as an Indicator of Sex and Age-at-Death

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After attending this presentation, attendees will learn that the second cervical vertebra is a reliable estimator of sex and age-at-death.

This presentation will impact the forensic science community by illustrating the importance of continuing research and data collection from previously under-utilized elements in forensic anthropology because they may also yield reliable results.

Medicolegal death investigation involving cases in which human remains have become skeletonized rely heavily on the preparation of a biological profile. This profile, consisting of age-at-death, sex, ancestry, and stature, serves to assist the investigator in the confirmation of a decedent's identity. Several reliable methods for establishing a biological profile exist, however many of these methods rely on either the recovery of several specific bones or on fragile skeletal elements that are frequently lost or destroyed in archaeological context. It is for this reason new methods utilizing other previously under-documented bones should be established.

In instances of skeletal remains recovery where the most reliable indicators of sex and age-at-death have been destroyed or lost, an investigator must rely on other, less commonly used elements.<sup>1,2</sup> Previous research conducted by Wescott<sup>3</sup> suggests that the second cervical vertebra is a reliable predictor of sex (ranging from 81.7 to 83.4%) while the work of Algee-Hewitt and coworkers<sup>4</sup> suggests that the element may also inform age-at-death estimates. Moreover, the second cervical vertebra has been shown to be more frequently recovered in its entirety than pelvic bones<sup>5</sup>; therefore, warranting further investigation by the forensic anthropological community.

In order to test the utility of the second cervical vertebra in forensic contexts, skeletons were drawn from the donated skeletal collection curated at the Hamilton County Forensic Center (HCFC) in Chattanooga, Tennessee ( $n=57$ ). Data were collected from 19 adult females and 38 adult males with an age-at-death for the pooled sample ranging from 21 to 89 years with a mean age of 54.19 years. Following Wescott<sup>3</sup>, five dimensions of the second cervical vertebra were taken with digital sliding calipers and recorded to the nearest 0.1mm: (1) Maximum Sagittal Length (XSL); (2) Superior Facet Sagittal Diameter (SFS); (3) Superior Facet Transverse Diameter (SFT); (4) Length of Vertebral Foramen (LVF); and, (5) Maximum Height of the Dens (XDH). Measurements of bilateral landmarks were always taken from the left for consistency. In addition, lipping projecting from the superioanterior aspect of the dens was recorded as present or absent. Lipping projecting  $\geq 1$ mm was scored as present.

Metric data collected from second cervical vertebrae were used to calculate five discriminant functions reported by Wescott.<sup>3</sup> These equations use as few as one and as many as five measurements to predict sex. Results mirror those of Wescott<sup>3</sup> and suggest that the second cervical vertebra is a dimorphic bone that can be used to predict sex in forensic anthropological contexts. The correct number of classified cases ranged from 80.7% (two variable model) to 87.5% (four variable model). Moreover, results demonstrated that a single measurement (XSL) correctly predicts sex in 84.2% of cases.

The lipping data collected were used to calculate the age-at-transition for which an individual passed from the absent to the present category. *Nphases*, a Fortran-based computer program written by Konigsberg<sup>6</sup>, was used to calculate the age-at-transition for this particular trait. Results indicate an age-at-transition of 35.3 years ( $sd=11.2$ ).

While additional analyses are required on a larger sample of documented individuals, these results indicate that in the absence of the os coxa, the second cervical vertebra is a good indicator of sex. Also, lipping, present on the dens, may have some utility as an age indicator in forensic contexts. This reality underscores the importance for researchers to continue developing novel approaches for documenting sexual dimorphism in skeletal remains as well as age-related skeletal change.

#### References:

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- <sup>3</sup> Wescott DJ. Sex variation in the second cervical vertebra. *J Forensic Sci* 2000;45(2):462-466.
- <sup>4</sup> Algee-Hewitt BFB, Weisensee KE, Milner GR. Age is Subjective: A Non-traditional Method of Age Estimation for the Adult Skeleton; 2008 Apr 7-13; Columbus, OH. Proceedings of the Annual Meeting of the American Association of Physical Anthropologists.
- <sup>5</sup> Pickering TR, Carlson KJ. Baboon taphonomy and its relevance to the investigation of large felid



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<sup>6</sup> Nphases [computer program]. Fortran version. 2003.

**Forensic Anthropology, Skeletal Biology, Second Cervical Vertebra**