

### A26 A Study on the Asymmetry Between the Left and Right Human Pubic Symphysis for Age-at-Death Estimation Based on 3D Laser Scans and Computational Methods

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The goal of this presentation is to investigate how asymmetry observed between the left and right pubic symphyseal surfaces of one individual affect the accuracy of age-at-death estimates produced by the use of novel techniques involving 3D laser scans and computational algorithms.

This presentation will impact the forensic science community by demonstrating that an accurate and reliable age-at-death estimation can be achieved with either the left or right human pubic symphysis, independent of individual factors that are potentially unknown to the forensic investigator, such as the weight or stature of the person in question. Attendees will be presented with a number of the many advantages that modern laser scanning technology has to offer to the field of forensic anthropology. Particularly, attendees will be familiarized with new computational techniques used for age-at-death estimation from the adult skeleton and show how, with these methods, they can produce accurate and reliable age estimates even in cases when one pubic symphyseal surface is missing or damaged.

There is a well-established tradition of using the human pubic symphysis for age-at-death estimation.<sup>1</sup> Therefore, anthropologists have devoted considerable effort to refining and improving the methodology.<sup>2-4</sup> In recent years, there has been a growing interest to better understand, capture, and quantify the link between the morphology of the symphyseal surface and age.<sup>5,6</sup> The currently accepted practice for age-at-death estimation using the pubic symphysis is based on the visual inspection of the skeletal element and its comparison to images, casts, and/or written descriptions that are associated with pre-defined age intervals. Such methodologies are relatively easy to apply but are prone to high interobserver and intraobserver error as they are highly dependent on the scientists' experience and expectations.<sup>7</sup> With the advancement of current data acquisition and analytic technologies, researchers have begun to look for new ways to study age indicator morphology and infer chronological age. Most recently, new methods for age-at-death estimation of the pubic symphysis have been developed that use 3D laser scan data and computational methods that seek to eliminate the element of subjectivity in estimation.<sup>8-10</sup> The methods include two surface analysis algorithms, one ventral outline measure, and two multivariate-regression models that combine each surface measure with the outline score. These models were calibrated on 3D scans of left or right pubic symphysis selected at random. These new computational methods have been shown to be at least as accurate and reliable as the traditional techniques and have the potential to allow for better understanding of the morphology of the symphyseal surface.

This study further investigates the utility of these methods by focusing on the issue of asymmetry. Data was generated from 88 White males with known ages at death, for whom both the left and right pubic symphysis were scanned; the three measures and five age estimates were produced using the aforementioned computational algorithms and the accuracy of the age estimate produced by each side was analyzed. The effect of the individuals' height, weight, and calculated body mass index must be taken into consideration. The results demonstrated that both sides are equally reliable in estimating the age at death of the individual. Neither side proved to be consistently less accurate. Further, regression models were built using only left or only right scans to demonstrate that neither side models the age-progressive changes better than the other. Overall, the difference in age estimates between the left and right estimates are less than five years for more than half of the data and nearly all estimates are less than 15 years apart. For individuals with notably asymmetric sides, the difference in estimates was not associated with advanced age, weight, height, or body mass index. The findings indicate that in situations in which one side of the pubic symphysis is damaged or missing, the side that is available can be used with the same level of confidence. Further, the fact that the computational algorithms produce consistent results regardless of the weight and stature of the individual means that scientists can apply these techniques to casework situations when no soft-tissue or personal life history information is available.

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#### Pubic Symphysis Asymmetry, Age-At-Death Estimation, Computational Methods