H98 A Review of Age Estimation Using Rib Histology: Its Impact on Evidentiary Examination

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The goal of this research is to show that the forensic specialist must perform more rigorous scientific trials on new and existing methods, especially if the method is being used: 1) well outside of the reference sample, 2) on an element other than the one for which the method was developed, or 3) if the method has been altered on the premise of specialized knowledge that has not been adequately tested.

The main impact of this research is to bring attention to assessing the precision and accuracy of methods that are being utilized by forensic specialists, particularly if those methods have been altered without further testing. Often, in the literature, the terms “precision” and “accuracy” are confused or entirely ignored. More rigorous testing must be performed before publishing new methods or they could run the risk of failing the *Daubert* or *Mohan* criterion when utilized in forensic casework.

Research has shown that the use of rib histomorphometrics for the estimation of adult age at death can provide precise and accurate age estimates. Current methods require histological thin sections from the middle third of the sixth rib. Human ribs have thin cortices and are less resilient to destructive taphonomic processes than other skeletal elements. Therefore when human remains are recovered, the ribs are often severely damaged or absent. In these circumstances it may be difficult or impossible to identify a specific mid-thoracic rib. If the sixth rib is unavailable or cannot be positively identified, closely associated midthoracic ribs (namely the 5th and 7th) or a suspected sixth rib are often deemed adequate for use due to similarities reported in bone remodeling kinetics. The affect that slight remodeling deviations have on histologically derived age estimates has not been reported. The goal of this research is to record the amount of variation in osteon population densities of the middle third of the mid-thoracic ribs and determine if age prediction equations developed for the sixth rib can be applied to nonsixth ribs with similar reliability. The potential rate of error must be explored in order to meet the *Daubert* and *Mohan* criterion, which established general guidelines for admissibility of scientific evidence in U.S. and Canadian courts.

The sample consists of ribs taken from twenty cadavers (eleven males and nine females) from two university teaching facilities in Ontario. Ages range from 59 to 89 years. Thin sections were removed from the middle third of ribs three through eight. A total of 120 thin sections were analyzed and osteon population densities (OPD) calculated. Results show that osteon population density values for ribs three, four, seven, and eight were consistently below the OPD values of the sixth ribs indicating that the sixth rib may possess a different remodeling environment. Intra and interperson results indicate that the eighth rib is the most variable of the non-sixth ribs. The large variance demonstrated in some of the intraperson OPDs indicates that remodeling may be occurring at different rates between ribs of the same person. The difference between values may not appear to be significant until they are figured into the age prediction equations.

Overall, all the non-sixth ribs produced significant correlations with the sixth rib OPD values. This was expected considering that previous research has demonstrated that rib tissue is less biomechanically active, and has minimal variability in bone remodeling. However, regardless of which non-sixth rib is used intraperson OPD values may vary sufficient that age estimates would be significantly different than those from the sixth ribs. Factor analysis and regression analysis indicate that ribs five and seven are better predictors of the sixth rib OPD values than ribs three, four, and eight and therefore should be used if the sixth rib is unavailable. Due to differential OPD values within the ribcage, error ranges developed from this research for non-sixth rib OPD values should be used when the sixth rib is unavailable or unidentifiable.

Because of the guidelines established from the *United States Supreme Court in Daubert v. Merill-Dow Pharmaceuticals, 113 S.Ct. 2786 (1993)*, and from the Canadian courts in *R. v. Mohan, 89 C.C.C. (3d) 402 (1994)*, and in the wake of the *United States v. Plaza, Criminal NO. 98-362 (2002),* methods utilized or altered by forensic anthropologists may soon be challenged. The forensic specialist must perform more rigorous scientific trials on new and existing methods in order to meet the *Daubert* and *Mohan* standards.

Histomorphometry, Osteon, *Daubert*

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