



F2 Age Estimation: Aspartic Acid Racemization Utilizing Whole Teeth

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After attending this presentation, attendees will be knowledgeable of a method to estimate the age of unknown decedents based on the ratio of optical isomers of aspartic acid in whole teeth or portions of whole teeth that have undergone racemization. The goal of this study is to develop a method of preparing and utilizing whole teeth for aspartic acid racemization analysis so that medical examiners and coroners can apply the method for more reliable and accurate age estimation. The age estimations using this technique may provide the forensic community with more accurate estimations and smaller age ranges to help narrow search parameters for matches between missing person and unidentified body cases.

This presentation will impact the forensic science community by providing medical examiners and coroners a method of preparing and utilizing whole teeth for aspartic acid racemization analysis for more reliable and accurate age estimation.

Age estimation using the dentition has long been useful to the forensic community. Several methods, including primary and permanent tooth formation, tooth eruption, third molar formation, and the analysis of tooth morphology including the ratio of dentin to pulp, have been utilized for age estimation. Tooth formation and development is useful and accurate for age estimation for children from before birth up to about the middle teen years. Third molar formation is only useful for estimating ages up to the late teen years; after that, the third molar is fully developed and no longer useful for age estimation. The ratio of dentin to pulp is useful but like third molar development, is subject to much variability and to fairly large age ranges. Alternatively, aspartic acid racemization offers the possibility of age estimations with smaller age ranges of +/- 3-4 years, according to some researchers.

Aspartic acid racemization is based on the natural conversion of an amino acid that is present in many metabolically inactive tissues including tooth enamel, dentin, and cementum, the lens of the eye, vertebral discs and the white matter of the brain. Aspartic acid is present at birth primarily in the levorotary or L-form. Some of the L-Aspartic Acid will spontaneously convert, or racemize, to the mirror image dextrorotary or D-form over time. Racemization is a chemical reaction influenced by various factors including pH and temperature. Of the amino acids, aspartic acid seems to racemize at a faster rate and is more useful for age estimation. Using the ratios of L- and D-forms, it may be possible to estimate the age of both living and deceased individuals within a range of +/- 3-4 years.

Previous published studies detected aspartic acid using only dentin, only enamel, or only cementum. The current project uses whole teeth or portions of whole teeth. It is considered that this will simplify the sample submission process and the pre-analysis protocol. Most earlier studies used Gas Chromatography and employed a different method of derivatization of the samples. The current project is focused upon developing and testing the most useful protocols for detecting aspartic acid from whole teeth using High Performance Liquid Chromatography and Mass Spectrometry (HPLC/MS), then quantifying and determining the ratios of the optical isomers. A database of L/D aspartic acid ratios from persons of known age is concurrently created. This database is an initial step toward the ultimate goal of gathering multiple profiles and generating data utilizing teeth from many persons of known age. A whole tooth from a person of unknown age may then be submitted, tested, and compared with the database to establish a more specific age estimation. The current status and implications of the ongoing data collection and analysis will be reported.

Forensic Odontology, Age Estimation, Aspartic Acid Racemization