

## G30 Dental Age and Odds Probability at the 18-Year Threshold

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**Learning Overview:** After attending this presentation, attendees will understand different strategies for presenting data in forensic age estimation reports based on expert witness reports in the United Kingdom Immigration Court in relation to the 18-year threshold.

**Impact on the Forensic Science Community:** This presentation will impact the forensic science community by showing how the former legal threshold of Preponderance of the Evidence (which in Europe is referred to as "Balance of Probability" (> or < 50%)) has transmogrified into 100% Certainty as the level of proof. The Minimum Value Threshold (beyond reasonable doubt) is the level of proof recommended in Europe as promoted by the European Commission.<sup>1</sup>

**Issues for Consideration:** Use of teeth as an indicator of age is the most reliable method for estimating chronological age using human biological growth markers based on Normal distribution summary statistics.<sup>2</sup> Arising from this is Simple Probability (SP), which provides a neat technique to estimating the probability that a subject is more than 18 years of age.<sup>3</sup>

There are four possible approaches to expressing uncertainty in relation to the 18-year threshold and the lower left third molar.

Simple probability—this requires the full raw dataset.<sup>4</sup> Results for over 18 years old are: United Kingdom-Whites,  $p=0.7920$ ; Iran,  $p=0.9483$ ; and for Southern Chinese,  $p=0.9991$ .

Odds—this also requires the full raw dataset.<sup>5</sup> *Specificity* and *Sensitivity* are calculated. This enables estimation of the Odds. In this context, the Odds of a subject with a mature 3<sup>rd</sup> molar for United Kingdom subjects is (approximately) 1:4; for Iranian subjects, 9,483:1; and for Southern Chinese subjects, the Odds are 9,991:1.

Likelihood Ratio (LR)—this also requires the full raw dataset.<sup>6</sup> For United Kingdom subjects, this is given by  $0.792/0.208=3.82$ . This is weak support for the view that the subject is more than 18 years old. For Iranian subjects, the LR is given by  $0.9483/0.0517$ , which gives the LR as 18.34. This is moderate evidence to support the contention that an Iranian subject is more than 18 years old. For Southern Chinese subjects, the LR is given by  $0.9991/0.0009$ , which is 1110.1. This is compelling evidence that a Southern Chinese subject with a mature 3<sup>rd</sup> molar is more than 18 years of age.

Minimum Threshold Value (MTV)—this comes from European Commission Guidelines.<sup>1,7</sup> It is a robust marker for age and provides a 100% probability that a subject is below the minimum age of the Tooth Development Stage used for assessment. The MTV has the advantage that values from summary statistics in published papers can be used to make the assessments. It is not necessary to have access to the raw data.

**Concluding Remarks:** The MTV is an unambiguous technique for indicating whether or not a subject is under (or over) the 18-year threshold.

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### Dental Age Estimation, Minimum Threshold Value, Odds Values and Likelihood Ratio