

G26 Dental Age Estimation Using the Demirjian Method: A Flawed and Obsolescent System

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After attending this presentation, attendees will be aware of the serious shortcomings of the Demirjian system of Dental Age Estimation (DAE). Attendees will be able to consider the reasons for the difficulty in comprehending and applying this system and will be in a position to use a simpler system of DAE based on the Dental Age Quicksheets (DAQS) approach.

This presentation will impact the forensic science community by providing information that will lead to the adoption of the DAQS system for the accurate estimation of dental age as a surrogate for chronological age.

Introduction: Dental age assessment using the method of Demirjian and colleagues published in 1973 has been widely used over the past 40 years.¹ Despite its widespread use, even a cursory reading of the paper leads to the conclusion that the details of the methodology are elusive. A recent systematic review revealed there were wide discrepancies between the Chronological Age (CA) and the Dental Age (DA) estimated using the Demirjian method.² This has led to other criticisms of the reliability of the Demirjian method.³

Problems with the Demirjian System: It is convenient to break down the method into two major components: (1) The Demirjian Tooth Development Stages (TDS) — the first of these, the TDS, has made a major contribution to DA studies. The observer agreement when assessing the TDSs has proven to be of the highest level.⁴ (2) The System of Mathematical Integration of Ages of Attainment (AoA) — the second issue is the major weakness of the Demirjian system. This is the failure to censor Stage H, which leads to grossly inflated AoA for all the H Stages from LL1 through LL7 (see table below). This results in elevated values for Stage H.

	LL1	LL2	LL3	LL4	LL5	LL6	LL7
Development Stage	H	H	H	H	H	H	H
	Years	Years	Years	Years	Years	Years	Years
AoA UNCENSORED	15.43	15.73	16.69	16.98	14.54	16.29	17.82
AoA CENSORED	12.73	13.05	13.22	13.38	17.59	13.16	15.03
Difference	2.70	2.68	3.47	3.60	3.05	3.13	2.79

The data in this table reveals that the effect of non-censoring is to elevate the AoA by between two and three-fourths and three and one-half years. Although the detailed mathematics are complex, this may explain the underlying cause of the systematic overestimation of DA using the system of constraints.

The original mathematical approach was to use the system of “constraints” to assign to each of the Demirjian TDS a “value” that, when summed, came to 100.⁵ This was deemed to be the equivalent of “Full Maturity.”

Can It Be Rectified?: The straightforward answer to this is no. Over the past few years, persistent attempts have been made to unravel the mathematical approach to this method, including repeated contacts with the original authors.

Conclusions: The method of constraints used in the original 1973 paper has shortcomings and should no longer be used. The ease of use of modern spread sheets makes elaborate computations straightforward for forensic odontologists. The Demirjian system of TDS remains the choice for DAE. It is the most fully described and most reliable in terms of reproducibility.

Reference(s):

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3. Carneiro J.L., Caldas I.M., Afonso A., Cardoso H.F.V. Is Demirjian's method really useful for age estimation in a forensic context? *Forensic Sci Med Pathol.* 2015; 11: 216-221.
4. Dhanjal K.S., Bhardwaj M.K., Liversidge H.M. Reproducibility of radiographic stage assessment of third molars. *Forensic Sci Int.* 2006; 159(Suppl 1): S74-S77.
5. Goldstein H. The choice of constraints in correspondence analysis. *Psychometrika.* 1987; 52(2): 207-215.

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