Medico-Legal Age Estimation in a Sub-adult Portuguese Population: Validation of Atlas Schour and Massler and London

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Abstract

Introduction: Age estimation in children and adolescents often depends on morphological methods, such as examination of dental development.

Objectives: The aim of this project was to validate, in a Portuguese population, two forensic methods of dental age estimation – Schour and Massler charts and the London atlas.

Materials and Methods: The test sample was composed by 108 dental radiographs of living and known-age individuals. Dental age was estimated according to each method. Chronological age was then compared to the estimated dental age using individual t-test and paired t-test.

Results: Results showed that the Schour and Massler charts underestimated age and the London atlas overestimated age. Nevertheless, the London atlas performed better in all measures. Mean differences for both the London atlas and Schour and Massler were 0,1389 and -5,4167 months respectively. Schour and Massler charts showed significant statistical difference between dental age and chronological age (p <0.05).

Discussion and Conclusions: We conclude that, in the evaluated sample, age estimation using the London atlas represents an improvement in forensic age estimation from developing teeth. Further studies should be done with a larger Portuguese population sample.

Keywords: Age estimation; Forensic dentistry; Dental age; Schour and Massler charts; London atlas; Portuguese sub-adult population

Introduction

Forensic age estimation in sub-adults, which can be defined as children, adolescents and young adults who have not reached complete development, has been requested transversally by the authorities using dental age [1]. Dental age can be estimated by observing the morphological stages of tooth mineralization [2,3]. There are numerous methods that use dental development to estimate age. Some compare the mineralization stage confirmed in radiographs with standardized schemas or diagrams – atlases based methods [4]. The first atlas based method in forensic age estimation was developed by Schour and Massler in 1941 (and modified by the authors in 1944) [5,6]. The most recent one is the London atlas developed in 2010 [7].

Objectives

The main objective was to estimate the chronological age of a sub-adult Portuguese population by applying two dental methods used in forensic age estimation: Schour and Massler atlas and the London atlas. Additionally, we proposed to compare the two dental methods and determine which one is the most accurate when applied to a Portuguese sub-adult population.

Material and Methods

The study was conducted in two phases: a selection phase and a laboratorial phase. In the first one, 108 panoramic dental radiographs, taken at the Radiological Clinic (University of Lisbon – College of Dentistry) from patients aging between 7 and 21 years, were selected to participate in this research according to the inclusions criteria. The number of males and females selected for each age category was the same. In the second phase the data was analysed and each radiograph classified according to dental development and position. Age was then estimated using Schour and Massler atlas and the London atlas. After one month, 29% of the observations were repeated to assess intra-evaluator variability. Data was submitted to statistical analysis with SPSS for Windows (22.0), with an inclusion level $p < 0.05$. The tests applied were normality tests and T Student for paired samples.

Results

Kappa agreement

Kappa values were calculated for each side of the jaw and show almost perfect agreement for the two methods. These results reveal excellent reproducibility for both methods (Figure 1).

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Difference between methods

Results show significant difference between estimated age provided by Schour and Massler's atlas and the London atlas (Table 1).

Estimated age and chronological age

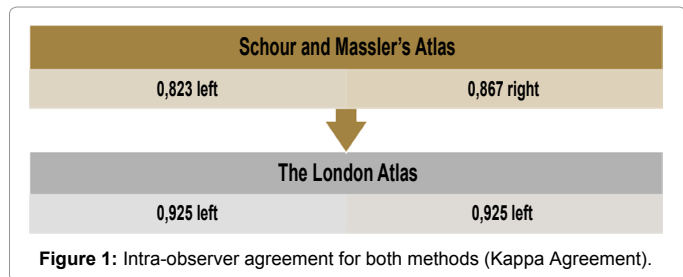Results show statistically significant difference between chronological age and estimated age obtained with Schour and Massler's atlas (p<0.05) (Table 2).

Results show no statistically significant difference between chronological age and estimated age obtained with the London atlas (p>0.05) (Table 3).

Estimated age and chronological age difference

Results show that Schour and Massler's atlas under-estimated age by approximately 5.4 months (p>0.05) (Table 4). The London atlas over-estimated age by around 0.1 months (p>0.05) (Table 5).

Estimated age by gender

Results show that Schour and Massler's atlas under-estimated age independent of gender. The London atlas under-estimated age in females; and for males over-estimated the age. However, the results of

Figure 1: Intra-observer agreement for both methods (Kappa Agreement).

	Paired Differences							
	Mean	**SD**	**Standard Error Mean**	**95% Confidence Interval of the Difference**		**t**	**df**	**_P_ value**
				Lower	**Upper**			
Estimated age Schour (left)-Estimated age London(left)	-5,556	16,152	1,554	-8,637	-2,474	-3,574	107	0,001
Estimated age Schour (right side)-Estimated age London(left)	-5,551	16,723	1,617	-8,757	-2,346	-3,434	106	0,001

Table 1: T test results for paired differences between estimated age obtained with each method.

	Paired Differences							
	Mean	**SD**	**Standard Error Mean**	**95% Confidence Interval of the Difference**		**t**	**df**	**_P_ value**
				Lower	**Upper**			
Chronological age in months-Estimated age Schour (left)	5,417	24,001	2,309	0,838	9,995	2,345	107	0,021
Chronological age in months -Estimated age Schour (right)	5,417	24,001	2,309	0,838	9,995	2,345	107	0,021

Table 2: T test results for the paired differences between chronological and estimated age by Schour and Massler's atlas, in months.

	Paired Differences							
	Mean	**SD**	**Standard Error Mean**	**95% Confidence Interval of the Difference**		**t**	**df**	**_P_ value**
				Lower	**Upper**			
Chronological age in months-Estimated age London (left)	-0,139	15,683	1,509	-3,131	2,853	-0,092	107	0,927
Chronological age in months -Estimated age London(right)	-0,131	15,569	1,505	-3,115	2,853	-0,087	106	0,931

Table 3: T test results for the paired differences between chronological and estimated age by the London atlas, in months.

	N	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**
Schour and Massler error	108	-73,00	46,00	-5,4167	24,00083

Table 4: Mean error between estimated age and chronological age for Schour and Massler atlas.

	N	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**
London error	108	-51,00	43,00	0,1389	15,68347

Table 5: Mean error between estimated age and chronological age for the London atlas.

	Sex	**N**	**Mean**	**Standard Deviation**	**Standard error mean**
Schour and Massler error	Males	54	-4,2593	22,59503	3,07479
	Females	54	-6,5741	25,48888	3,46860
London error	Males	54	2,4074	15,25942	2,07654
	Females	54	-2,1296	15,91374	2,16559

Table 6: Mean error between estimated age and chronological age discriminated for males and females in both methods.

estimated age by London atlas were closer from chronological age in both males and females (Table 6) more accurate.

Discussion and Conclusions

The London atlas revealed a better performance and more accurate than Schour and Massler's atlas: with minor mean error and showed no statistically significant difference between estimated age and chronological age. The London atlas presents more advantages to be applied as an indicator of chronological age with application at clinical dentistry and forensic dentistry. Regarding the sample size of this research, nevertheless, is not minor than the original one applied to design the London Atlas [7], further studies shall be done in order to create new diagrams only for the Portuguese population. However, the diagrams present by London Atlas must be preferred for the Portuguese Population rather than the older Schour and Massler's Atlas.

Acknowlegment

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