



Original communication

Dental age assessment of Maltese children and adolescents. Development of a reference dataset and comparison with a United Kingdom Caucasian reference dataset



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ABSTRACT

The purpose of this study was to develop and validate a Reference Data Set for Dental Age Assessment of the Maltese population and compare the mean Age of Attainment to a UK Caucasian Reference Data Set.

The Maltese Reference Data Set was developed from 1593 Dental Panoramic Tomograms of patients aged between 4 and 26 years, taken from the radiographic archives of the Dental Department, Mater Dei Hospital, Malta. Tooth Development Stages were recorded for all 16 maxillary and mandibular permanent teeth on the left side and both permanent third molars on the right, according to Demirjian's staging method. Summary and percentile data were calculated for each Tooth Development Stage, including the mean Age of Attainment. These means were used to estimate the Dental Age of each subject in the study sample using the simple unweighted average method. The estimated Dental Age was compared to the gold standard of the Chronological Age. Comparison of the Maltese and UK Caucasian Reference Data Set was by a series of t-tests, carried out for each paired Tooth Development Stage by gender.

The mean Age of Attainment was slightly higher for the Maltese than the UK Caucasians in both males and females. However there was no statistically significant difference between the Chronological Age and Dental Age for either sex.

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1. Introduction

Age estimation may be useful for civil, criminal, forensic and anthropologic purposes. Many techniques have been devised to estimate chronological age. These include somatic growth measurements and others that rely on dental development. Tooth development for age estimation has been used for a long time.¹ The somatic development of each individual is affected by genetic, nutritional, climatic, hormonal, and environmental factors,^{2,3} but even under the effects of extreme systemic disease, dental development appears to be affected only to a minor extent.⁴ Tooth development shows less variability than other developmental features and exhibits low variability in relation to chronological age.⁵ Age can be estimated in children and adolescents by

development of deciduous and permanent teeth, including the 3rd molar, up to 26 years.⁶ After this, age can only be estimated by structural changes in teeth. A number of schemes have been developed that use Tooth Development Stages (TDS) for age estimation. One popular method is that of Demirjian, which describes eight discrete anatomical stages of tooth development.⁷ This system has been applied to a number of different populations, as the stages are clearly described and supported by pictorial TDS, making it clear and highly reproducible.⁸

The Dental Age Assessment system⁶ uses Demirjian's staging method to estimate Dental Age (DA), extended to include third molars, combined with the statistical technique of meta-analysis. This new system was shown to provide a rapid and accurate estimation of Chronological Age (CA) using DA, when tested in British children at the 10 year old threshold,⁹ 13 year old threshold¹⁰ and 16 year old threshold.¹¹ However, in a recent study comparing different statistical techniques to determine their accuracies against the gold standard of CA, it was concluded that the simple

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unweighted average method was accurate and reliable, comparing favourably to other weighted average methods including ones that used meta-analysis.¹²

The two sexes differ significantly in that the age at which the stages of tooth mineralisation appears and in the length of the inter-stage intervals. The maturation of teeth is later in males, except for the third molars.¹³ Different ethnic groups develop at different rates.^{14,15} Therefore, for valid comparison of different ethnic groups, sex and ethnic-specific databases based on large numbers of individuals are required.

The aims of the study were to develop a Reference Data Set (RDS) specific to the Maltese population, partitioned by gender and to compare this database to the UK RDS. This would enable accurate age estimation in this racial group using dental development and detect any racial differences between a Northern and a Southern European population.

2. Materials and methods

Ethical approval was granted from University of Malta Research Ethics Committee (Ref No: 64/2011). The radiographic archives held in the digital computer system at the Dental Department, Mater Dei Hospital, Malta were used for this study.

2.1. Inclusion criteria

Dental Panoramic Tomograms (DPT) were used exclusively and included in study if they were:

1. Taken and stored in the radiographic archives of Mater Dei Hospital.
2. Of registered Maltese citizens, defined as being in possession of a full Maltese Identity Card.
3. Of patients age range 4 years–26 years.
4. Of patients with full dentition, however, patients were also included if they had developmentally absent third molars and missing teeth due to previous extractions.
5. Of good diagnostic quality.

2.2. Exclusion criteria

Radiographs were excluded from study if they were:

1. Of patients with developmentally missing teeth, apart from developmentally absent third molars and missing teeth due to previous extractions.
2. Of poor diagnostic quality.
3. Cleft lip and/or cleft palate patients or other radiographically apparent craniofacial deformities.

2.3. Data collection procedure

Two assessors, W.E. and H.A. hand searched the radiographic archives at the Dental Department, Mater Dei Hospital, Malta. The workload was divided equally. Patients with DPTs that satisfied the inclusion criteria were recorded and the following data was collected from the department's Patient Appointment System.

- Maltese National ID Number
- Date of Birth
- Date of Radiograph
- Gender
- Ethnicity
- Identifiable Human Group

All DPTs were taken at Mater Dei Hospital, Dental Department using a Gendex Orthoralix 9200 DDE, (Gendex Dental Systems, Italy), and digital radiograph software application, (VixWin Pro, Version 1.5f, Gendex Dental Systems, USA). These were collected and imported in.jpeg format, indexed by Maltese National ID Number to prevent duplication and saved to a password protected computer for future assessment and analysis. All DPTs were assessed using the contrast, brightness and zoom facilities to enhance images and facilitate assessment. Further image enhancement was achieved by the use of grayscale enhancer and magnifier options present on VixWin Pro program. After masking the date of birth of each subject from the assessor, each DPT was assessed by identifying each of the 18 Tooth Morphologic Types (TMTs) – one for each of the 16 permanent teeth on the left side and both third molars on the right (Table 1). The use of all four third molars in the DAA was justified due to the asymmetric development and higher variability of third molars^{7,16,17} The TDS of each of the TMTs were recorded on a hard copy Data Card by using Demirjian's staging system. This included the use of eight well-defined TDSs, as described by Demirjian, with the aid of the schematic diagrams (Fig. 1) and written (Fig. 2) descriptions.

As minimal difference in tooth development between one tooth and its contralateral fellow exists¹⁸ only the left side of the dentition was used. However if a tooth on the left side was not present or unreadable, attempts were made to use the contralateral tooth. If a tooth was unreadable on both sides, the letter (K) was placed in the box. If a tooth is not present on both sides, the letter (J) was placed in the box, and the reason for the absence was recorded. Fig. 3 and Table 2 give an example of a subject whose age is estimated from the tooth development stages on a DPT.

This information was then transferred to a Microsoft Access Database (Microsoft Corporation, USA). This database is made up one record for each subject comprising of data entry forms for personal details, Demirjian's TDS for all TMTs, as well as one form specific to record missing teeth and indicate the reason for absence. Once all of the data was entered into the (DAA-GR Malta) database, it was then merged with the DARLInG Database (DAA-GR), which holds data from over 14,000 subjects of different ethnic and racial groups.

2.4. Inter-rater agreement

Ten DPTs for subjects of known age were randomly selected and assessed by both investigators W.E. and H.A. on two occasions, 2

Table 1
The tooth morphology types (TMTs) used in the assessment of dental age (DA).

Tooth nomenclature		Anatomical description of TMTs
Br dent J system	FDI system	
UL 1	21	Upper Left Central Incisor
UL 2	22	Upper Left Lateral Incisor
UL 3	23	Upper Left Canine
UL 4	24	Upper Left First Premolar
UL 5	25	Upper Left Second Premolar
UL 6	26	Upper Left First Molar
UL 7	27	Upper Left Second Molar
UL 8	28	Upper Left Third Molar
LL 1	31	Lower Left Central Incisor
LL 2	32	Lower Left Lateral Incisor
LL 3	33	Lower Left Canine
LL 4	34	Lower Left First Premolar
LL 5	35	Lower Left Second Premolar
LL 6	36	Lower Left First Molar
LL 7	37	Lower Left Second Molar
LL 8	38	Lower Left Third Molar
UR 8	18	Upper Right Third Molar
LR 8	48	Lower Right Third Molar

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