Original Article

Chronologic and Dental Ages of Maltese Schoolchildren - A Pilot Study

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Abstract

Objectives: Dental ageing systems are useful for forensic, research and clinical purposes. As no data exists relating to the dental development of the Maltese population, we set up a pilot study to initiate formation of a set of tables pertaining to the dental development of Maltese schoolchildren.

Methods: Panoramic radiographic records of 120 patients aged 11 to 14 years were sequentially collected from the records kept at the School Dental Clinic, Floriana and St Luke's Hospital. These records were matched for age and sex. The calcification of the teeth was graded according to Nolla (1960) and the results obtained compared to Nolla's tables to determine how closely the Maltese population conforms to these tables.

Results: We found no significant difference between the estimated (dental) age and the chronological age of male schoolchildren. A significant difference existed for female schoolchildren. The dental age of the female schoolchildren was delayed when compared to that of male schoolchildren.

Conclusion: Nolla's tables require to be adjusted to take into account the variation in dental development of the Maltese population. Maltese schoolgirls exhibit slower dental development when compared to the figures given in the literature.

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Introduction

The concept of physiological age is based on the degree of maturation of the different tissue systems. Skeletal age, morphological age, secondary sex character age and dental age are examples of how the age of an individual may be assessed. These criteria may be applied singly or in conjunction to assess the degree of physical maturity of a child.

Dental age may be assessed either by tooth eruption dates or by the progress of tooth calcification. The limitations to the use of tooth eruption dates are:

a) they are susceptible to environmental influences[1-3] and
b) they cannot be applied between the ages of three to six years, or past the age of thirteen.

In comparison, the teeth progressively calcify in several easily definable stages so that age can be reliably defined by the stage of calcification. It is the least susceptible of these systems to change, both over the centuries[4] and to environmental influences[5-9] and is independent of somatic growth.[10] Tooth calcification has a major genetic component[11] and is the most accurate way of estimating dental age.

There are a number of forensic advantages to using tooth calcification to determine age. Calcified teeth are extremely durable, often surviving conditions which consume all other human tissues and may be used to age cadavers. This has a similar application in archaeology where the degree of age-related change in a tooth may be used to estimate the age of human remains. Tooth calcification may also be used to rapidly and accurately determine an individual's age for legal purposes. Situations may arise where a child's age is unknown or deliberately withheld. This has particular relevance given the arrival of large numbers of illegal immigrants on our shores.

Dental age is one of the factors taken into account when formulating treatment plans, having particular relevance to the timing of treatment.

Certain genetic conditions are characterised by a delay in dental development. Often, this may be a diagnostic factor, e.g in cases of cleidocranial dysplasia. The requirements of a dental ageing system are that it should be:

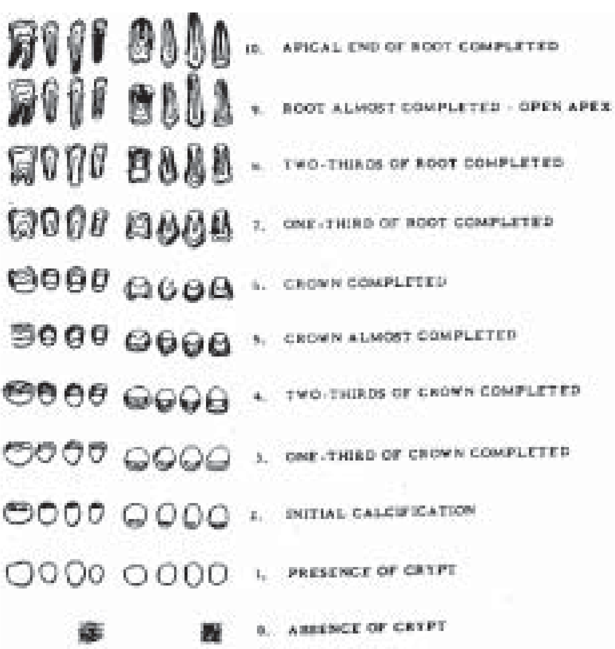
- *Applicable to all situations.* While both crowns and roots of cadaver teeth are easily examined, this is not the situation in living children. Therefore the system should be applicable to radiographic images of the jaws and teeth. Furthermore the whole dentition should be graded, in order to be able to estimate the age of a single tooth or group of teeth.

- *Reliable.* The system of measurement should use reproducible points for measurements
- *Valid.* Anatomically valid points should be used. In particular absolute measurements must not be used, as these are subject to individual variation and radiographic distortion.
- *Precise.* The age should be determinable within reasonable limits.
- *Accurate.* It should be applicable to the population in question.

Table 1: *Inclusion criteria for the study*

- Age range 11-14 years
- Healthy non-syndromic children
- All teeth present except third molars
- All teeth erupting within normal limits
- Radiographs of diagnostic quality

Figure 1: *Gradation method as used by Nolla (1960). The development of each tooth is divided into ten recognizable stages and categorically numbered 1 through 10. The sum of the scores of all the teeth is used to define the dental age*



The main system presently in use is Demirjian's method, based on eight defined stages in tooth development,[12-13] developed from a large random sample of French-Canadian children. This method satisfies most of the above requirements. It is based on the development of seven or four teeth in the mandible, making it quick, easy to use and accurate but rendering it useless for assessing partial dentitions which do not include these teeth or for analyzing patterns of maturation in individuals. The scale requires adjustment when applied to other populations.[14-17]

Nolla[18] developed a similar scale, based on ten stages in tooth development. Sample numbers were much smaller; however the whole dentition was analysed. Bolanos[19] developed scales based on Nolla's tables applicable to three and four teeth, making Nolla's tables more practical for epidemiological studies.

Given that either scale would most likely require adjustment to be applicable to Maltese children, the method of Nolla was preferred for this study as it would give more information on the development of the dentition.

There exists no data pertaining to dental maturity of Maltese children. We therefore set up a pilot study to formulate a scale of dental maturity applicable to Maltese schoolchildren for forensic, research and clinical purposes.

Figure 3: *Box and whisker plots of Chronologic Ages minus Dental Ages of both groups*

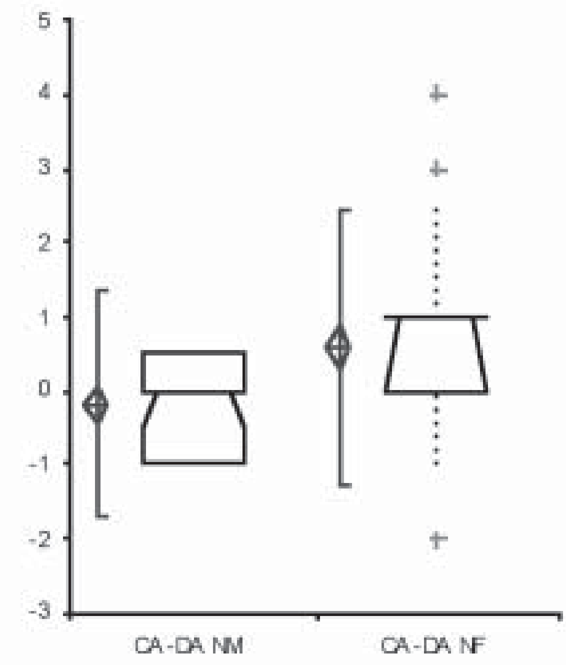


Table 3: Median, Interquartile Range and Confidence Index for both groups

Chronologic Age-Dental Age	*n*	*Median*	*IQR*	95% CI of Median	
Normal Males	60	0.000	1.500	-0.500	to 0
Normal Females	60	1.000	1.000	0.000	to 1.000

Material and methods

Panoramic radiographic records of 60 male and 60 female patients were sequentially collected from the records kept at the School Dental Clinic, Floriana and St Luke's Hospital. These records were matched for age. The inclusion criteria are listed in Table 1.

The radiographs were examined and the development of both maxillary and mandibular teeth of the left side of the mandible graded according to Nolla (1960) as shown in Figure 1.

Statistical analysis

Twenty cases were selected at random and scored by each examiner. Inter-examiner reliability tests were carried out. The same 20 cases were re-scored after 2 weeks to determine intra-examiner reliability. All statistical tests were carried out using the *Analyse-it* plug in program for Microsoft Excel.

One-way ANOVA and Student *t* tests showed no significant differences between the examiners or between the same examiners over a period of 2 weeks.

The Shapiro-Wilk w test was applied to the data. The result showed non-normal data, requiring nonparametric statistical tests.

The median and interquartile values for Male and Female Chronologic Age are similar, showing the groups to be well matched.

Results

The median value for Dental Age was lower than that for Chronologic Age. For males this difference was not statistically significant. However, for females there was a statistically significant difference using the Mann-Whitney U test, $p<0.05$ (Figure 2, Table 2).

The median value for male Dental Age is slightly lower than that for Chronologic Age. However the Mann-Whitney U test shows no significant difference, ($p>0.05$).

The median value for female Dental Age is lower than that for Chronologic Age. The Mann-Whitney U test shows a significant difference, ($p<0.05$). (Figure 2, Table 2).

The difference in Chronologic age and Dental Age was calculated for both male and female Groups (Figure 3, Table 3). The Mann-Whitney U test shows a highly significant difference between the two groups, ($p<0.0001$).

The dental age of Maltese boys approximates to Nolla's tables for the age ranges studied but girls show a marked deviation. The conclusion is that Nolla's table cannot be use on Maltese school children for the age groups in question without adjustment.

Figure 2: *Box and whisker plots of Chronologic Ages and Dental Ages of both groups.*

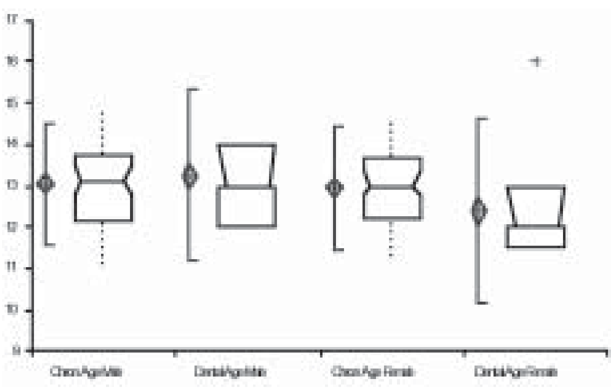


Table 2: *Median and Interquartile Range of both groups*

Normal Male/Female	*n*	*Median*	*IQR*
Chronologic Age Male	60	13.080	1.580
Dental Age Male	60	13.000	2.000
Chronologic Age Female	60	13.000*	1.483
Dental Age Female	60	12.000*	1.500

* p < 0.05

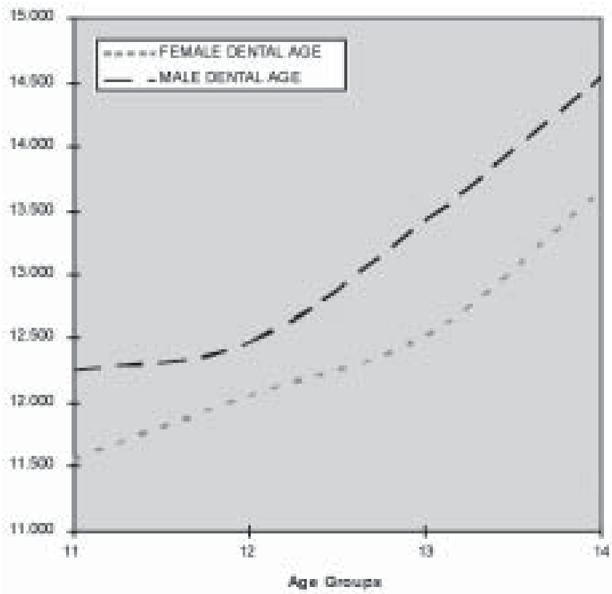
Discussion

Our study showed that Nolla's tables are not directly applicable to Maltese children. The dental age of female school children is delayed as compared to published reports in the literature.

The figures for male dental development corresponded well with Nolla's tables. The median Dental Age was higher than the median Chronologic Age but there was no significant difference between the Chronological Age and the Dental Age for this sample.

The situation was different for females. The median Dental Age was lower than the median Chronologic Age and the

Figure 4: *The Dental Age of male schoolchildren is consistently ahead of female schoolchildren in the age groups studied*



difference here was significant.

A plot of the mean dental ages of the groups (Figure 4) showed that dental age in the male group was consistently advanced relative to the female group. This contradicts reports in the international literature, which put the dental development of males behind that of females.[19-24] There is no obvious cause for this anomaly. Three factors may affect the precision of a method to assess dental age:

i) quality of the reference material;
ii) reliability of the measurement method;
iii) biological variability in dental development.

The first two factors would be similar for both male and female groups and so would not account for our results. Therefore the observed difference is possibly due to the third factor - the wide biological variability among individuals.

The dental development of schoolchildren with ectopic maxillary canines is retarded when compared to unaffected schoolchildren, with females being affected more than males (Camilleri et al, unpublished data). The prevalence of ectopic canines on the Maltese Islands is high.[25, 26] Furthermore, the condition of ectopic canines has been shown to be genetic[27] and to exhibit a sex bias towards females.[28] It is possible that the wide variation in dental ages seen in the female sample here is due to inadvertent inclusion of affected subjects. Penetrance of the gene may be incomplete, with calcification being affected but the canines erupting normally.

A further analysis of the difference between Chronologic Age and Dental Age shows that for the male group the 95% Confidence Index of the median was -0.5 to 0 years whereas for the female group the 95% Confidence Index was 0 to 1 year. This suggests that Nolla's tables will overestimate the chronologic age by up to 6 months in boys and underestimate the chronologic age by up to one year in girls. The confidence limits in both groups were within the ranges quoted in the literature.[19]

These figures, while being quite precise, are not accurate when applied to the Maltese population. Tables constructed from local data are required to accurately assess the relationship between dental maturity and chronological age in Maltese schoolchildren.

Orthodontic treatment is usually carried out on the age groups studied, where panoramic radiographs are routinely taken. We therefore expected to find sufficient material to complete the study in a relatively short period. Problems were however encountered with missing and poor quality radiographs so that future studies should be prospective with careful storage of radiographs and careful attention to quality.

Inclusion of other age groups will enable us to assess whether our observations apply to other age groups and whether the delay in calcification seen in females is limited and exhibits 'catch up' or is prevalent over the whole period of dental development.

Analysis of individual teeth will help to establish whether any effect is due to delay in development of one particular tooth or group of teeth.

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