

Age Estimation by the Application of Nolla's Method

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Abstract:

Teeth and dental restorations are resistant to destruction by fire and the elements are therefore useful in identification. This permits identification of a missing child or remains. Age estimation is useful in general dentistry and in forensic dentistry. It is also used in the area of anthropology to estimate the age of past populations from immature skeletal remains. Dental age estimation in living individuals is done by mainly non-invasive methods such as general physical examination, intraoral examination and a panoramic radiograph. The aim of the study is to estimate the age by Nolla's method using the mandibular left third molar (38). Fifty Orthopantomographs [25 male and 25 female] were used to study for the estimation of age determination of children using Nolla's method. The OPGs belonged to children of the age group 10-15 years old. The results of the study has shown that there was a strong correlation between gender and 38 staging. Gender with 38 staging was found to be statistically significant [p value<0.05]. There was no correlation or association between gender and actual age of the children in the present study. Actual age is not statistically significant for gender [p value>0.05]. The standard deviation values for age of males and females involved in this study are 1.48313 and 1.33601. The standard deviation values for 38 staging of males and females involved in this study are 2.432 and 2.318. The present study concludes by saying that studies involving larger sample size and population specific data needs to be developed.

Keywords: Age Estimation by Teeth, Forensic Dentistry, Nolla's Method, Orthopantomographs, Dental Age, Chronological Age.

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Introduction

Development of dentition can be used in the determination of age in situations such as attainment of maturity, criminal responsibility, consent, marriage, employment etc. in living individuals. Teeth are non-destructible and have the least turnover of their structure, hence provide a vital clue for identification of individuals in Forensic Odontology. A system of dental age assessment using radiological appearances of maxillary and mandibular teeth was devised by Nolla.

The method is a classification of dental development of children. It has stages from 0 to 10 that represents the events in dental development of children. Nolla divided the calcification of permanent dentition into stages such as 0-absence of crypt, 1-presence of crypt, 2-initial calcification, 3-one third of the crown formed, 4-two thirds of the crown formed, 5-crown almost complete, 6-crown completed, 7-one third of the root formed, 8-two thirds of the root formed, 9-root almost complete apex open, 10-root complete apex closed. It is essential that every dentist treating children has a good knowledge of the development of the dentition. In order to widen one's thinking about the impingement of development on dental problems and perhaps improve one's clinical judgment, a comprehensive study of the development of the teeth should be most helpful.

In the study of child growth and development, it has been pointed out by various investigators that the development of the dentition has a close correlation to some other measures of growth the eruption of the teeth may differ greatly in the time of appearance in the mouth of different children, the majority of the children exhibit some pattern in the sequence of eruption. However, a consideration of eruption alone makes one cognizant of only one phase of the development of the dentition. A measure of calcification at different age-levels will provide a more precise index and will contribute to the concept of the organism as a whole.

Forensic Odontology utilizes the knowledge of a dentist to serve the judicial system. Estimation of age is an important aspect of forensic research. In planning treatment of orthodontic and pedodontic patients the assessment of age is an important factor. Its use is increasing in both civil and criminal matters and is also helping in the identification of age at death of a dead individual in mass disasters and natural calamities.

Age estimation also provides valuable information when the birth date is not available, as in case of illegal immigrants. Also the chronological age of living

people is important in cases of employment and marriage. An approximate assessment of age can be done by skeletal, dental and psychological methods to assess the degree of physical maturity of individuals.

Age estimation is used in the area of anthropology to estimate the age of past populations from immature skeletal remains. It helps in determining whether an individual has to be prosecuted as a juvenile or as an adult. Gender of a person can also be found out. It helps in estimating the chronological age of people without documents for judicial purposes.

Nolla's method showed no significant difference in relation to chronological age (**Lopes et al., 2018**). Nolla's method help to determine dental maturity in Spanish children but Nolla's method tends to underestimate age in general combination of Nolla and Demirjian methods for estimating chronological age from dental age affords a predictive capacity of over 99% and is fast, easy and inexpensive. (**Paz Cortés et al., 2019**).

Demirjian's method was applicable to all age groups and for both genders with better accuracy than Nolla's method, which has a limited utility in younger age group. The Demirjian's method is better suited when compared to Nolla's method in North Indian Population (**Sinha et al., 2014**). Correlation of dental age using modified Demirjian method and Nolla method using orthopantomograph with skeletal maturation by cervical vertebral maturation index using lateral cephalogram showed that the methods of age estimation were not reliable in predicting the accurate age in Indian population (**Jampani Nancy et al., 2020**).

Various studies for assessing the dental age with chronological age have been conducted on the Western population. Whereas only a few studies have been reported in the Indian population. Thus, the aim of the present study is estimation of age by Nolla's method in the South Indian Population using mandibular left third molar.

Methodology

The present study was conducted at Saveetha Dental College, Chennai, India. 50 Orthopantomographs from the Department of Oral and Maxillofacial Radiology, Saveetha Dental College, consisted of 25 male and 25 female. The age group taken into consideration for this study was 10-15 years. Therefore all the OPGs belonged to the 10 to 15 year old children. The development of the mandibular left third molar was chosen for dental assessment in this study. This is because many teeth are undergoing development and

calcification simultaneously. However, after the early teens most teeth have calcified and erupted except for the third molars. This makes the third molar development the most important choice for age assessment from the late teens to the early twenties. Also the difference in the developmental stages of the third molar in various populations calls for more ethnic-specific reports to be performed in different parts of the world. This would provide an accurate view of the association between chronological age of the individuals and the developmental stages of the third molar and also mandibular erupt before maxillary teeth, and teeth erupt sooner in females than males.

The mandibular left third molar in each orthopantomograph was assessed carefully and compared with the developmental stages of Nolla table and with the comparative images given by Nolla. 38 staging for all 50 OPGs was recorded. The data was enrolled into excel and then imported to SPSS (statistical package for the social sciences) where descriptive statistics and inferential statistics (chi square test) were performed. The average and standard deviation values for actual age and 38 staging for males and females involved in this study were also calculated. The data was internally validated and verified by the principal investigator/guide. There was no conflict of interest. Error identification and censored data is NIL.

Sample Distribution

Table No. 1: Distribution of male and female sample according to age

GROUPS	AGE (YEARS)	MALE	FEMALE
1	10 to 10.9	5	4
2	11 to 11.9	5	6
3	12 to 12.9	5	6
4	13 to 13.9	5	4
5	14 to 14.9	5	5

Results and Discussion

The results of the present study have shown that:

The average age of males and females involved in this study respectively are 12.352 and 12.30.

The average values of 38 staging for males and females involved in this study respectively are 3.8 and 3.96.

The standard deviation values for age of males and females involved in this study are 1.48313 and

1.33601. The standard deviation values for 38 staging of males and females involved in this study are 2.432 and 2.318.

Statistical significance was considered for p value < 0.05 in all cases. From statistical analysis (chi square test) it was observed that there is no correlation or association of gender with actual age (p value = 0.153). Therefore there was no significant difference between the actual ages of males and females involved in this study.

The results of the study implied that there was a strong correlation or association between gender and 38 staging (p value = 0.02).

Henceforth there was a significant difference between the 38 staging of males and females. Based on the findings of the study, the majority of males (18%) belonged to the age group 12.1 to 13 and majority of the females (14%) belonged to the age group 10 to 11.

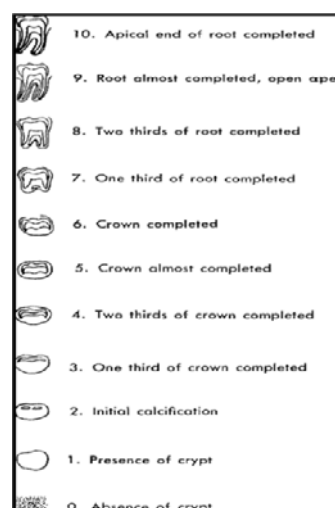


Figure No. 1: Nolla's Teeth Developmental Chart.
It shows the Stages for Mandibular Teeth Development.



Figure No. 2: A Radiograph showing the Mandibular Left Third Molar at Stage 6 or Crown complete.



Figure No. 3: A Radiograph showing the Mandibular Left Third Molar at Stage 3 or one third of Crown Completed.

Table No. 2: The Mean and Standard Deviation values for Actual Age and 38 Staging of Males and Females involved in this study.

GENDER		MEAN	STANDARD DEVIATION
MALE	Actual age	12.3528	1.48313
	Staging	3.8	2.432
FEMALE	Actual age	12.308	1.33601
	Staging	3.96	2.318

Table No. 3: P Value obtained after doing the Chi Square Test for Actual Age.

	ACTUAL AGE P VALUE	STAGING P VALUE
GENDER	0.153	0.02

Table No. 3 represents the p values obtained after doing the chi square test for actual age and 38 staging of males and females involved in this study. Based on the findings of the study it can be observed that 38 staging is reported to be statistically significant for gender (p value < 0.05). There was no statistical significance between genders with actual age (p value > 0.05).

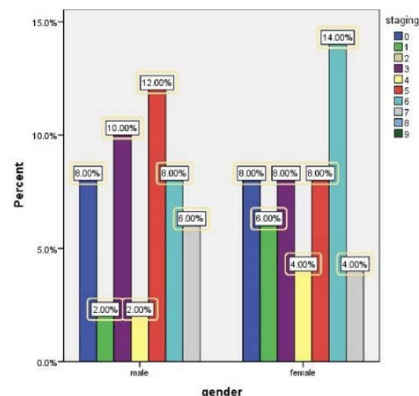


Figure No. 4: Bar Chart depicting the Percentage of Males and Females involved in this study with their 38 Staging.

Figure No. 4 represents a bar chart depicting the percentage of males and females involved in this study with their 38 staging. X axis represents gender while Y axis represents the stages allotted to the mandibular left third molar of males and females. Based on the findings of the current study, majority of the percentage of males (12%) were allotted stage 5 and the majority of the percentage of females (14%) were allotted stage 6. The stages 2, 8, 9 and 10 were not reported for any individual of this study.

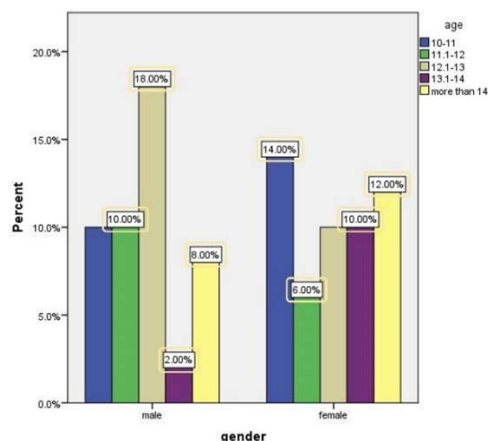


Figure No. 5: A Bar Chart comparing Gender with Age Groups from 10 to 15.

Figure No. 5 represents a bar chart comparing gender with age groups from 10 to 15. It shows the percentage of males and females belonging to a particular age group. X axis represents the gender while Y axis represents the age group. Based on the findings of the study, the majority of males (18%) belonged to the age group 12.1 to 13 and majority of the females (14%) belonged to the age group 10 to 11.

Discussion

The present study showed that the stages 2, 8, 9 and 10 were not applicable for the present study population. The 38 staging is completed for 50 children out of which 25 are male and 25 are female. The data from this study may offer worthy information to researchers studying Nolla's age determination method using the mandibular left third molar. Dental system and dentition development are integral parts of the human body. The growth and development of the human body can be studied in parallel with other physiological maturity indicators such as bone age, menarche, and height (**Willems et al., 2001**).

Nolla's method was introduced by Nolla in 1960. Nolla has provided stages for calcification of individual tooth 9 (stage 0 to 10). It has additional staging of mineralization which proves it to be more accurate and reliable and thus making it the most commonly used method around the world (**Bolaños et al., 2000**). In 2011 Nolla's method was applied to investigate whether or not this method is appropriate for Turkish children for the determination of the dental age. The study suggested that the method is suitable for Turkish boys, but it is less suitable for Turkish girls (**Miloglu et al., 2011**). In another study conducted in 2012 Validity of Demirjian and Nolla methods for dental age estimation for North Eastern Turkish children were compared and Nolla's method was found to be a more accurate method for estimating dental age in North Eastern Turkish population (**Nur et al., 2012**).

The present study agrees with the previously mentioned analysis by various researchers and proves that Nolla's method of estimating dental age by analysing 10 stages of teeth development is better as compared to other methods and easy to perform. Tooth development shows less variability than other developmental features and also low variability in relation to chronological age (**Metsäniitty et al., 2018**). Previous literature studies have revealed that many studies have been conducted previously to assess the dental age using Nolla's method of age estimation in their specific population or region in Bangladesh, England (**Maber et al., 2006**), Brazil (**Kurita et al., 2007**), Turkey (**Kirzioğlu and Ceyhan, 2012**), Malaysia (**Kumaresan et al., 2014**), and East Turkey (**Miloglu et al., 2011**). In most of the studies, it was found that Nolla's method of age estimation had better accuracy (**Lopes et al., 2018**) while contrary

results were seen in few studies (**Maber et al., 2006**) as well. In a study conducted in the North Indian population, high correlation was found between skeletal age and dental age (assessed from Nolla's method) in both sexes in the 12–14 years age group (**Bala et al., 2012**). In contrast another study observed that Demirjian's method was better when compared to Nolla's method in North the Indian population because it was applicable to all the age groups unlike Nolla's method that was applicable only in the younger age group only (**Sinha et al., 2014**). Dental Age estimation using the age group 10 to 15 years is useful in situations involving child abuse, child marriage, child labor etc. Similar to our study, another study regarding age estimation by using a third molar was performed by (**Arthanari et al., 2020**).

The limitation of this study is that it had a small sample size. It also only checks for age estimation by Nolla's method in a south Indian population. For future scope, studies involving larger sample size and population and race/ethnic specific data needs to be developed.

Conclusion

Estimation of age is an important aspect of forensic research. The assessment of age is useful in planning treatment of orthodontic and pedodontic patients. Its use is increasing in both civil and criminal affairs. Helps in the identification of age at death of a dead individual in mass disasters and natural calamities. Its use is increasing in both civil and criminal affairs. Age estimation provides valuable information when the birth date is not available, as in case of illegal immigrants. Also the chronological age of living people is important in cases of employment and marriage. It helps in determining whether an individual needs to be prosecuted as a juvenile or adult. For future research, studies involving larger sample size and population specific data needs to be developed.

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Conflict Of Interest

The authors hereby declare that there is no conflict of interest in this study



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