



RESEARCH ARTICLE

COMPARATIVE EVALUATION OF AGE ESTIMATION BY NOLLA'S METHOD AND CHRONOLOGICAL AGE OF 6-13 YEARS OLD CHILDREN – A CROSS SECTIONAL ANALYTICAL STUDY

*Shreyal Deshmukh, Dr. Darshana Shah, Dr. Rasika Pawar, Dr. Archana Gupta,
Dr. Sangeeta Palaskar and Dr. Rupal Punse

Sinhgad Denatal College and Hospital, India

ARTICLE INFO

Article History:

Received 14th June, 2017
Received in revised form
17th July, 2017
Accepted 28th August, 2017
Published online 29th September, 2017

Key words:

Dental age,
Mandibular Canine,
Calcification Stages,
Forensic Odontology.

ABSTRACT

Background: In recent years forensic odontology has gained a lot of importance in age estimation of an individual. Developing teeth are used to estimate age in number of disciplines using various techniques of age estimation.

Aim: To compare chronological age with age estimated by Nolla's method in children of 6-13 years.

Materials and Methods: Digital orthopantomogram of 100 children (50 males and 50 females) visiting Sinhgad Dental College and Hospital, Pune in the age group of 6-13 years were selected. Calcification stages of mandibular left and right canine were assessed and graded according to Nolla's calcification stages for determination of dental age and compared with the chronological age. Paired 't' test and Pearson's correlation test was used for statistical analysis.

Result: There was a strong positive correlation found between age estimation by Nolla's method and chronological age on left as well as right mandibular canine.

Conclusion: Nolla's method is simple and reliable method in estimating dental age. Such studies should be carried out on larger sample size and variable age groups to generalize the result.

Copyright©2017, Shreyal Deshmukh et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Shreyal Deshmukh, Dr. Darshana Shah, Dr. Rasika Pawar et al. 2017. "Comparative evaluation of age estimation by nolla's method and chronological age of 6-13 years old children – A cross sectional analytical study", *International Journal of Current Research*, 9, (09), 57159-57163.

INTRODUCTION

Age is one of the essential factors, which plays an important role in every aspect of life. Age estimation is carried out for various reasons in forensic odontology such as criminal cases, mass disasters, rape, kidnapping, illegal immigration, employment, marriage, premature births, adoption etc (Panchbhai, 2011; Cameriere, 2007). Dental radiograph plays an important role in human age estimation. One among the various radiographic methods is Nolla's method introduced by Nolla in 1960 for age estimation in children (Freny, 2009). Body development is not completely associated with biological and chronological age. In many cases, chronological age may not be same as biological age, due to the developmental variations. Dental development is more reliable as an indicator of biological maturity in children. Dental maturity is more relevant as it is less affected by nutritional and endocrine status. Also dental tissues are resistant to mechanical, chemical and thermal changes (McKenna, 2002). As radiographs provide a two dimensional view of the dental tissues it is very much helpful in forensic dentistry. Nolla's method was applied on various populations and noticed that there was correlation between dental age and chronological age (Sachan, 2013).

With this background the present study was aimed to compare chronological age with age estimated by Nolla's method in children residing in Pune, Maharashtra.

MATERIALS AND METHODOLOGY

The present study was conducted on randomly selected 100 healthy children (50 males and 50 females) visiting Sinhgad Dental College and Hospital, Pune in the age group of 6-13 yrs. The reporting of this study follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guide.

Criteria for case selection

- Subjects who are undergoing or completed orthodontic treatment were excluded from the study.
- All the subjects without any history of deformities, major illness in the past or history of trauma or surgery in the dentofacial region, congenital abnormalities, muscular dystrophy etc.
- The subjects with muscular dystrophy, congenital abnormalities affecting growth or development of jaws and teeth were excluded.

*Corresponding author: Shreyal Deshmukh,
Sinhgad Denatal College and Hospital, India.

METHODS

This is a cross sectional study in which digital orthopantomogram of 100 children (50 Males and 50 Females) were taken from the dental records. Calcification stages of mandibular left and right canine were assessed and graded according to Nolla's calcification stages for determination of dental age.

Nollas's Developmental Stages : (Figure 1)

Stage 10: apical end of root completed
 Stage 9: root almost complete, apex open
 Stage 8: two-third of the root completed
 Stage 7: one-third of the root completed
 Stage 6: crown completed
 Stage 5: crown almost completed
 Stage 4: two-third of crown completed
 Stage 3: one-third of crown completed
 Stage 2: Initial calcification
 Stage 1: presence of crypt
 Stage 0: absence of crown

RESULTS

The mean chronological age and age estimated by Nolla's method in overall population for left canine was found to be 10.06 ± 1.91 and 9.31 ± 1.94 respectively. The mean chronological age and age estimation by Nolla's method in overall population for right canine was found to be 10.06 ± 1.91 and 9.49 ± 1.99 . The mean chronological age of left and right mandibular canine in males is 10.12 ± 1.78 and in females is 10.00 ± 2.04 . The mean age estimated by Nolla's method in Mandibular left canine in males was found to be 9.12 ± 1.86 and in females was found to be 9.5 ± 2.01 . Similarly, the mean age estimated by Nolla's method in Mandibular right canine in males was found to be 9.22 ± 1.91 and in females was found to be 9.76 ± 2.05 (Figure 2, 3 & 4). When the age estimation by Nolla's method was compared with chronological age in total study population, the mean difference was found to be 0.75 for the left side canine and 0.57 for the right side canine. These difference was statistically not significant ($p=0.365$ for left side and $p=0.516$ for right side). Among males, this difference was 1.0 for left side and 0.9 on right side which is statistically significant ($p<0.05$) on the left as well as right side. Among the

Table 1. Mean Difference between chronological age and age estimation of left and right canine in overall population and in males and females and their corresponding p value

		Paired Differences			
		Mean	Std. Deviation	t value	p value
Pair 1	Estimation of Age by Nollas Method (in yrs) (Left Canine) - Chronological Age (in yrs) (Left Canine)	-.75000	1.15798	-6.477	.365
Pair 2	Estimation of Age by Nollas Method (in yrs) (Right Canine) - Chronological Age (in yrs) (Right Canine)	-.57000	1.09411	-5.210	.516
Pair 3	Estimation of Age by Nollas Method (in yrs) (Left Canine) MALE - Chronological Age (in yrs) (Left Canine) MALE	-1.00000	1.08797	-6.499	.000
Pair 4	Estimation of Age by Nollas Method (in yrs) (Left Canine) FEMALE - Chronological Age (in yrs) (Left Canine) FEMALE	-.50000	1.18235	-2.990	.234
Pair 5	Estimation of Age by Nollas Method (in yrs) (Right Canine) MALE - Chronological Age (in yrs) (Right Canine) MALE	-.90000	1.05463	-6.034	.000
Pair 6	Estimation of Age by Nollas Method (in yrs) (Right Canine) FEMALE - Chronological Age (in yrs) (Right Canine) FEMALE	-.24000	1.04119	-1.630	.110

Table 2. Correlation between Chronological age and age estimation by Nolla's Method

		Correlation	Sig.
Pair 1	Estimation of Age by Nollas Method (in yrs) (Left Canine) & Chronological Age (in yrs) (Left Canine)	.819	.000
Pair 2	Estimation of Age by Nollas Method (in yrs) (Right Canine) & Chronological Age (in yrs) (Right Canine)	.843	.000
Pair 3	Estimation of Age by Nollas Method (in yrs) (Left Canine) MALE & Chronological Age (in yrs) (Left Canine) MALE	.822	.000
Pair 4	Estimation of Age by Nollas Method (in yrs) (Left Canine) FEMALE & Chronological Age (in yrs) (Left Canine) FEMALE	.830	.000
Pair 5	Estimation of Age by Nollas Method (in yrs) (Right Canine) MALE & Chronological Age (in yrs) (Right Canine) MALE	.839	.000
Pair 6	Estimation of Age by Nollas Method (in yrs) (Right Canine) FEMALE & Chronological Age (in yrs) (Right Canine) FEMALE	.871	.000

According to above mentioned stages, Mandibular left and right canine were graded. When the radiographic reading lay between two grades this appraisal was indicated as the value of 0.5. When the radiograph showed a reading that was slightly greater than illustrated grade, but not as much as half way between that stage and the next, the value of 0.2 was added. If development of the tooth were slightly less than the grade indicated the value 0.7 was added.

Analysis

Statistical analysis was done using SPSS 21.0v. Descriptive analysis was done to estimate the mean age. Paired t- test was done to compare between age estimation by Nolla's method and chronological age. Pearson's correlation test was used to assess the relation between the two methods. The level of statistical significance was kept at $p<0.05$.

females, the mean difference in age estimated by Nolla's method when compared with chronological age was found to be 0.5 for left canine and 0.24 on right side. This difference is statistically not significant ($p=0.23$ for left side and $p=0.11$ on right side). Thus Nolla's method can be used to estimate age in females accurately, whereas in males Nolla's method shows an underestimation of age as compared to chronological age. (Table 1) In total study population of 100, there was a strong positive correlation between age estimation by nolla's method and chronological age on left as well as right side ($r=0.819$ on left side, $r=0.843$ on right side). This correlation was statistically significant ($p<0.05$). Similarly among males there was a strong positive correlation between age estimation by nolla's method and chronological age on left as well as right side ($r=0.822$ on left side, $r=0.830$ on right side). This correlation was statistically significant ($p<0.05$).

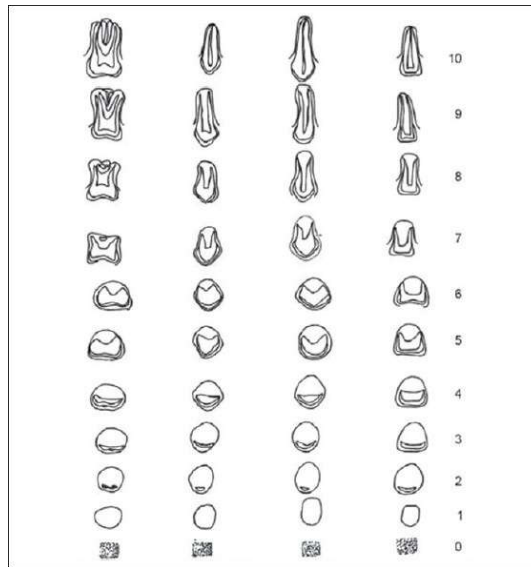


Figure 1. Nollas developmental stages

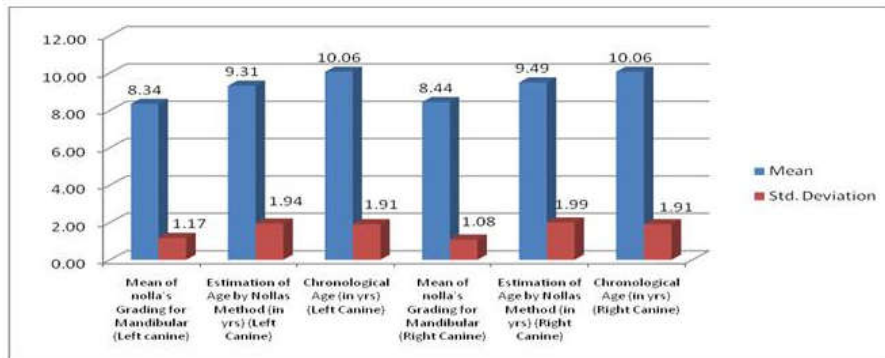


Figure 2. Mean and SD of chronological age and age estimated by Nolla's method in overall population (left and right canine)

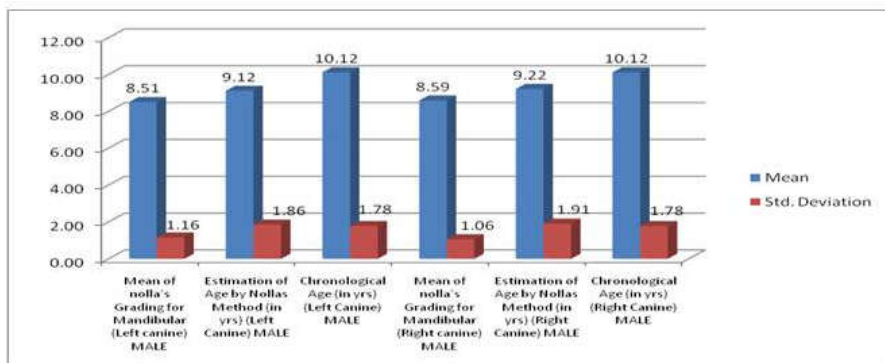


Figure 3. Mean and SD of chronological age and age estimated by Nolla's method in Males

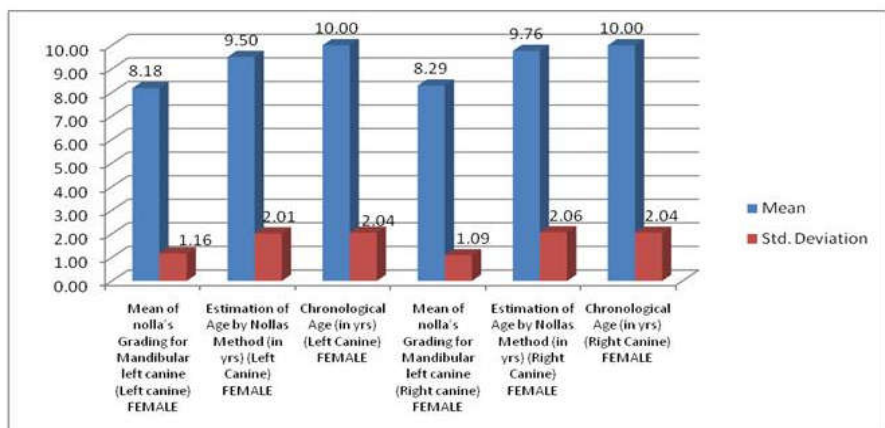


Figure 4. Mean and SD of chronological age and age estimated by Nolla's method in females

Among females there was a strong positive correlation between age estimation by nolla's method and chronological age on left as well as right side ($r=0.839$ on left side, $r=0.871$ on right side). This correlation was statistically significant ($p<0.05$). (Table 2)

DISCUSSION

One of the important aspects in forensic science is age estimation which is helpful in human identification and determining legal age in criminal cases (Gray, 1958). It can also be carried out for various reasons such as identification of mutilated victims of mass disasters, rape, kidnapping, employment, marriage, premature births, adoption, illegal immigration, pediatric endocrinopathy, and orthodontic malocclusion (Altunsoy *et al.*, 2013). Age is estimated on the basis of chronological age, bone age, dental age, mental age, and various other factors such as height, weight etc. Dental age is the most reliable indicators of chronological age and is widely applicable in forensic and legal dentistry. Tooth being the integral part of body shows less variability and other developmental features and are indestructible. They can even survive after death and also remains relatively unchanged for thousands of years (Priyadarshini, 2015; Altunsoy *et al.*, 2013). Amongst the various methods available for age determination in individuals, the radiological method has more benefits over histological and biochemical methods. The study of morphological parameters on dental x-ray of teeth is more valid as it is simple, noninvasive, easily reproducible on living and dead person and not likely to get altered by local factors (Panchbhai, 2011; Thomas *et al.*, 2014). Age estimation methods applied in children and adolescent are Schour and Masseler method, Moorees, Fanning and Hunt method, Demirjian, Goldstein and Tanner method, Nolla's method and age estimation using open apices. Among these Nolla's method is known as the most accurate method and is based on the time of emergence of tooth in oral cavity and tooth calcification and is less influenced by environmental factors (Sachan, 2013; Mohammed *et al.*, 2015). One of the advantages of Nolla's method is that it can be applied to an individual with or without the third molar (Priyadarshini *et al.*, 2015). In the present study, dental age from 6-13 years in children was calculated using Nolla's method based on developmental stages (0-10) of right and left mandibular canine. Dental age was given according to development of right and left mandibular canine in females and males independently. The mean difference between actual (chronological) age and estimated (dental) age was stastically not significant in total population which means that both age advances at the same time. Nolla has given age norms for females and males separately and also excluding and including 3rd molars (Thomas *et al.*, 2014). Comparing the chronological and dental age calculated by Nolla method for age assessment in left and right mandibular canine; the p value was found to be statistically insignificant ($p>0.05$) in females whereas it was statistically significant ($p<0.05$) in males. Among the females, the mean difference was 0.5 on the left side and 0.24 on the right side.

This difference is statistically not significant. It indicates that both the age assessed by mandibular right and left canine by Nolla's method and the chronological age, advanced in the same direction and is more or less similar to chronological age. Among the males, mean difference was 1.0 on the left side and 0.9 on the right side which is stastically significant on the right

as well on the left side. The difference between chronologic age and dental age shows variability which is called as individuality of growth in tooth development. For this reason lower than average difference in the canine development among male was found in our study (Nolla, 1960). Our study was supported by Anderson and his associates who found that Dental development is more strongly related to morphological development than to skeletal development in both genders (Anderson, 1975). Another study by Green found that dental age shows the highest degree of correlation with chronological age ($r = 0.6774$) and the lowest correlation with skeletal age ($r = 0.4616$). (Green, 1961) In another study on Mangalorean children Nolla's method showed good correlation between chronological age and the estimated age and statistically no significant difference was found in males and females (Thomas *et al.*, 2014). In our study no statistically difference was found in chronological age and estimated age among females whereas male group showed statistically significant difference. The mean dental ages were underestimated on both right and left side could be due to individuality in the development of teeth and growth in males and the sample size. The overall difference was insignificant between chronological and dental age which indicates that dental maturation in terms of development of canine also increased with the chronological age. (Anderson *et al.*, 1975; Gray, 1958) Also according to our study females were ahead in dental maturation than males in all the ages (Castellanos *et al.*, 1996; Koshy *et al.*, 1998; Prabhakar *et al.*, 2002; Hunter *et al.*, 1966; Muller-Bolla *et al.*, 2003). Thus it is possible to calculate dental age using Nolla's method. Further study has to be conducted in larger population of different age group and geographical location to generalize the outcome. In this study we used Nolla's method for age estimation, which would be the strength of the study. Smaller sample size can be the limitation of the study. Further studies on larger sample size are recommended for extrapolation of the result.

Conclusion

Nolla's method is a simple and reliable method to determine dental age. It matches with chronological age in overall studied population. To validate the result such studies should be carried out on larger sample size and variable age groups.

Acknowledgements

I thank Dr. Vineet Vinay for his help in statistical analysis and other detailing.

Conflicts of Interest

There are no conflicts of interest.

REFERENCES

- Altunsoy M, Nur BG, Akkemik O, Ok E, Evcil MS. 2013. Dental Age Assessment: Validity of the Nolla Method in a Group of Western Turkish Children. *Marmara Dental Journal*, 2:49-52.
- Anderson DL, Thompson GW, Popovitch F. 1975. Interrelationships of dental maturity, skeletal maturity, height and weight from age 4 to 14 years, Growth. 39:453-62.
- Cameriere R, Flores-Mir C, Mauricio F, Ferrante L. 2007. Effects of nutrition on timing of mineralization in teeth in a

- Peruvian sample by the Cameriere and Demirjian methods. *Ann Hum Biol*, 34:547-556.
- Castellanos J, Carmona A, Catalina-Herrera CJ, Vipuales M. 1996. Skeletal maturation of wrist and hand ossification centers in normal spanish boys and girls: A study using the Greulich Pyle method. *ActaAnat (Basel)*;155:206-11.
- Freny R Karjodkar. 2009. Textbook of dental and maxillofacial radiology. Jaypee brothers medical publishers, New Delhi, India. 2:940-944
- Gray. L. 1958. A study of the relationship between tooth eruption age, skeletal development age and chronological age in sixty-one Atlanta children. *Am J Orthod.*, 44:687-91.
- Green LJ. 1961. Interrelationship among height, weight and chronological, dental and skeletal ages. *Angle Orthod*, 31:189-93.
- Hunter CJ. 1966. The correlation of facial growth with body height and skeletal maturation at adolescence. *Angle Orthod*, 36:44-54.
- Koshy S, Tandon S. 1998. Dental age assessment: The applicability of Demirjian's method in South Indian children. *Forensic SciInt*, 94:73-85.
- McKenna CJ, James H, Taylor JA, Townsend GC. 2002. Tooth development standards for South Australia. *Aust Dent J.*, 47:223-7.
- Mohammed RB, Sanghvi P, Perumalla KK, Srinivasaraju D, Srinivas J, Kalyan US, et al. 2015. Accuracy of four dental age estimation methods in southern Indian children. *J ClinDiagn Res.*, 9(1):1-8.
- Muller-Bolla M, Lupi-Pegurier L, Quatrechomme G, Velly AM, Bolla M. 2003. Age estimation from teeth in children and adolescents. *J Forensic Sci.*, 48:140-148.
- Nolla CM. 1960. The development of the permanent teeth. *J Dent Child*, 27:254-66.
- Panchbhai AS. 2011. Dental radiographic indicators, a key to age estimation. *DentomaxillofacRadiol*;40:199-212.
- Prabhakar AR, Panda AK, Raju OS. 2002. Applicability of Demirjian's method of age assessment in children of Davangere. *J Indian SocPedodPrev Den.*, 20:54-62.
- Priyadarshini C, Puranik MP, Uma SR. 2015. Dental Age Estimation Methods: A Review. *Int J Adv Health Sci.*, 1(12):19-25.
- Sachan K, Sharma VP, Tandon P. 2013. Reliability of Nolla's dental age assessment method for Lucknow population. *J Pediatr Dent.*, 1(1):8-13.
- Thomas D, Shenai P, Chatra L, Veena K M, Rao PK, Prabhu R, et al. 2014. Age Assessment Using Nolla's Method in a Group of Mangalore Population: A Study on 25 Children. *J Contemp Med.* 4(3):121-127.
