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Age Assessment Using Nolla's Method in a Group of Mangalore Population: A Study on 25 Children

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ABSTRACT:

Aim: The age estimation method introduced by Nolla in 1960 comes under age determination during the first two decades of life. Present study is conducted to assess age of children by using Nolla's method and also to estimate the efficacy of Nolla's method of age assessment in Mangalorean Population.

Materials and method: The present study was conducted on 25 selected subjects (15 males and 10 females) ranging from 3-16 years from Mangalore. Dental age assessment was done using panoramic radiographs taken for the same. The obtained data were analysed by using paired t test, intra class correlation coefficient and regression analysis using SPSS 13 software for statistical analysis.

Results: Average chronological age was 10.213 ± 2.3385. Average age estimated by Nolla's method was 10.040 ± 2.2485. The intraclass correlation coefficient between the two methods showed excellent agreement between the two. Statistical analysis showed that there is no significant difference between chronological age and age obtained by Nolla's method.

Conclusion: Nolla's method of age estimation was accurate in both males and females. Age of subjects can be estimated with greater degree of accuracy using regression equation which was obtained after statistical analysis.

KEY WORDS: Panoramic radiograph, Regression equation, Nolla's method, age estimation.

INTRODUCTION:

Radiograph plays an important role in human age determination. There are various methods of age estimation using radiographs.one among that is Nolla's method introduced by Nolla in 1960 which comes under age estimation during first two decades of life. [1] Saunders a dentist, was the first to publish information regarding dental implications in age assessment by presenting a pamphlet entitled ''Teeth A Test of Age'' to the English parliament in 1837. [2] Application of radiology in forensic science was first introduced in 1896 by Professor Arthur Schuster. [3]

Tooth development shows less variability than other developmental features and also low variability in relation to chronological age. [4] Dental tissues are resistant to mechanical, chemical and thermal changes. Dental tissues can be used as a better aid for estimating age. 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 Lucknow population and noticed that there was insignificant difference between dental age and chronological age. [5]

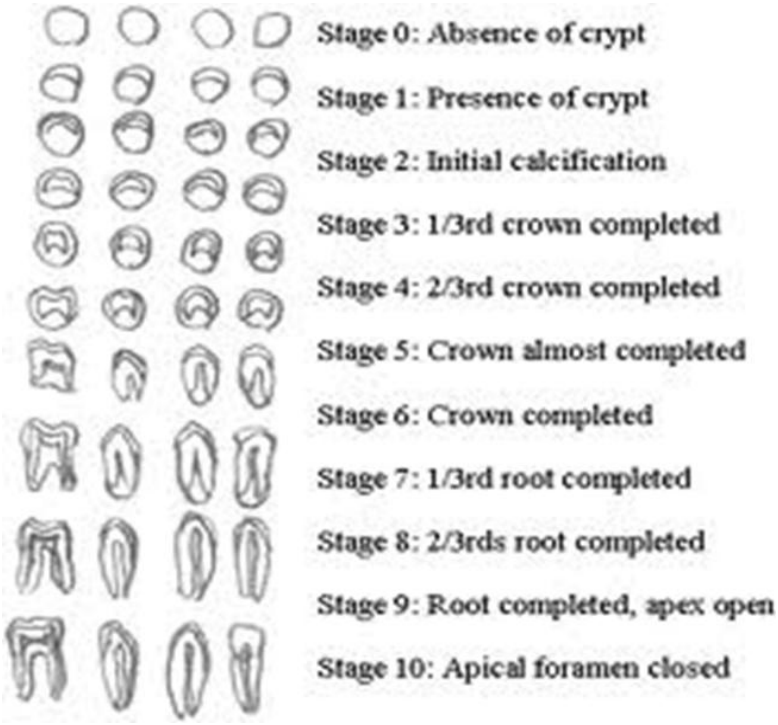
With this background the present study was done with an objective to assess age of children by using Nolla's method and to estimate the efficacy of Nolla's method in Mangalorean Population.

MATERIALS AND METHOD:

The present study was conducted in the Department of Oral medicine & Radiology, Mangalore on 25 co-operative patients (10 females, 15 males) with age group of 3-16 years who were advised for panoramic radiograph. Patients with developmental anomalies and missing tooth on both the sides were excluded.

Nature of the study was explained to the patient. Brief clinical findings along with personal details of the patient were recorded using a standard format. Chronological age was calculated from date of birth to date of radiograph being taken. Chronological age= Date of radiograph taken-Date of birth. Patients were subjected to panoramic radiograph (Planmeca Promax, Finland) using phosphor plates which was later digitized on a laser scanner (Agfa-nx) and images were recorded by a computer-aided Agfa-nx drafting program.

The radiograph is then compared with Nolla's chart (figure.1) to assign scores for individual tooth for both maxillary (right or left quadrant) and mandibular (right or left quadrant) teeth. If the tooth shows a stage between any two stages a score of 0.5 is added. After every tooth is assigned a reading a total is made of maxillary and mandibular teeth either including third molar or not including third molar and the total is compared to the Nolla's age norms given separately for boys and girls(table:1-4).[1] According to the total the dental age is assigned for the particular subject. The chronological age and dental age obtained using Nolla's method was later subjected to paired t test, intra class correlation coefficient and regression analysis using SPSS 13 software.



Graph 1: Comparison of chronological age and age assessed using Nolla's method.

Table 1: Age norms for maxillary and mandibular teeth of girls excluding third molars.

Age in years	Sum of stages for 7 mandibular teeth	Sum of stages for 7 maxillary teeth	Sum of stages for 14 maxillary and mandibular teeth
3	24.6	22.2	46.8
4	32.7	29.6	62.3
5	40.1	37.9	78.0
6	46.6	43.4	90.0
7	52.4	49.5	101.9
8	57.4	54.9	112.3
9	58.4	59.6	118.0
10	64.3	63.4	127.7
11	66.3	64.0	130.3
12	67.9	67.8	135.7
13	68.9	69.2	138.1
14	69.4	69.7	139.1
15	69.8	69.8	139.6
16	70.0	70.0	140.0
17	70.0	70.0	140.0

Table 2: Age norms for maxillary and mandibular teeth of girls including third molars.

Age in years	Sum of stages for 8 mandibular teeth	Sum of stages for 8 maxillary teeth	Sum of stages for 16 maxillary and mandibular teeth
7	54.2	49.5	103.7
8	59.5	57.0	116.5
9	66.7	62.0	122.7
10	67.5	66.6	134.1
11	70.0	68.3	138.3
12	72.6	73.2	145.7
13	74.7	75.4	150.1
14	75.9	76.5	152.4
15	76.7	77.1	153.8
16	77.5	78.0	155.5
17	78.0	78.7	156.7

Table 3: Age norms for maxillary and mandibular teeth of boys excluding third molars.

Age in years	Sum of stages for 7 mandibular teeth	Sum of stages for 7 maxillary teeth	Sum of stages for 14 maxillary and mandibular teeth
3	22.3	18.9	41.2
4	30.3	26.1	56.4
5	37.1	33.1	70.2
6	43.0	39.6	82.6
7	48.7	45.5	94.2
8	53.7	50.8	104.5
9	57.9	55.5	113.3
10	61.5	59.5	121.0
11	64.0	62.6	126.6
12	66.3	65.3	131.6
13	67.8	67.3	135.1
14	69.0	68.5	137.5
15	69.7	69.3	139.0
16	70.0	70.0	140.0
17	70.0	70.0	140.0

Table 4: Age norms for maxillary and mandibular teeth of boys including third molars.

Age in years	Sum of stages for 8 mandibular teeth	Sum of stages for 8 maxillary teeth	Sum of stages for 16 maxillary and mandibular teeth
7	49.5	45.5	95.0
8	55.1	51.8	106.9
9	59.7	57.3	117.0
10	63.5	61.8	125.3
11	66.7	65.6	132.3
12	69.8	69.3	139.1
13	72.3	72.2	144.5
14	74.3	74.4	148.7
15	75.9	75.9	151.8
16	77.3	77.7	155.0
17	77.6	78.0	155.6

RESULTS:

This study comprised of 25 patients between the age group of 3-16 years and the method used to determine the age was Nolla's method. In our study out of 15males, four males showed dental age underestimation by 1.4years ,1.2years , 1.3years and 10 months , three males showed underestimation of dental age by few months which is less than 6 months, six males showed overestimation by few months out of which the highest is by 7months and two males showed exact correlation with estimated age. Out of 10 females one female showed dental age underestimation by 11months,four females showed underestimation by less than 6 months, three females showed overestimation by few months less than 6months and two females showed exact correlation with estimated age. Difference of less than 6 months was considered as normal.

Distribution of patients with their gender, chronological age with minimum age of 5.1 and maximum of 13.4 and the estimated age using Nolla's method with minimum age of 5.1 to maximum of 13.6 is shown in table 5 and graph 1.

Table 5: Distribution of patients with their gender, chronological age and the estimated age using

Sl no	Gender[M/F]	Chronological age (years)	Age by Nolla's method(years)
1	M	8.1	8.6
2	M	13.4	13.6
3	M	5.1	5.1
4	M	11.8	11.4
5	M	11.6	11.10
6	M	11.10	10.8
7	M	10.3	10.10
8	M	10.1	10
9	M	13.1	12.3
10	M	10.1	8.10
11	M	7.5	7.5
12	M	11.3	11.6
13	M	10.11	9.7
14	M	8.5	8.2
15	M	12.1	12.3
16	F	8.5	8.1
17	F	10.11	10.5
18	F	12.1	12.2
19	F	11.1	11.1
20	F	16	15.1
21	F	8.4	8.1
22	F	8.2	8.6
23	F	8.3	8.1
24	F	11.2	11.2
25	F	7.2	7.6

Graph 1 also shows no significant difference between chronological age and age calculated with Nolla's method. Intraclass correlation coefficient is shown in table 6 which shows intra-class correlation of 0.994 for males and 0.980 for males and the p value is 0.000 for both females and males which is highly significant.

Table 7 shows that there is no significant difference between chronological age and age with Nolla's method both in males and females.

Table 6: Intraclass correlation coefficient.

Intraclass Correlation Coefficient

Gender	Intraclass Correlation	95% Confidence Interval		p value	
		Lower Bound	Upper Bound		
Female	.994	.975	.998	.000	HS
Male	.980	.938	.993	.000	HS

Table 7: Mean and standard deviation of chronological age and age assessed using Nolla's method for both males and females.

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	N	Minimum	Maximum	Mean	Std. Deviation	Diff	t value	p value
Chronological age (years)	25	5.1	16.0	10.213	2.3385	.1728	1.635	.115
Age by Nolla's method(years)	25	5.1	15.1	10.040	2.2485			NS

It also shows mean and standard deviation in two methods. Mean chronological age was 10.213 and standard deviation of 2.3385 was seen. Average chronological age was 10.125 ±2.3492 .The mean age by Nolla's method was 10.040 and standard deviation of 2.2485 was seen. Average chronological age was 10.213±2.3385 and average age by Nolla's method was 10.040±2.2485 shows statistically non-significant difference. Following statistical analysis a regression formula was obtained which can be used to do age assessment by Nolla's method in Mangalorean children which is shown in table 8.

Table 8: Regression analysis results

Regressopn analysis results[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	p
		B	Std. Error	Beta		
1	(Constant)	-.085	.523		-.163	.872
	Age by Nolla's method(years)	1.014	.049	.975	20.643	.000
	Gender	.203	.221	.044	.921	.367

a. Dependent Variable: Chronological age (years)

Regression formula:
Chronological age = -0.085 + 1.014* Age by Nolla's method + 0.203

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DISCUSSION:

The study of morphological parameters of teeth on dental x-ray of children is more reliable than most other methods for age estimation and is most commonly used to determine age in living humans.[3]In the present study we tried age assessment using Nolla's method in 25 children from Mangalore and a good correlation was found. Nolla's method also showed to be easy to apply and less time consuming. Nolla's method was introduced by Nolla in 1960.In this method the staging is done based on calcification of individual tooth which is from stage 0 to 10(figure.1). Nolla has given age norms separately for boys and girls and also including and excluding third molars which is one unique feature of this method. [1]

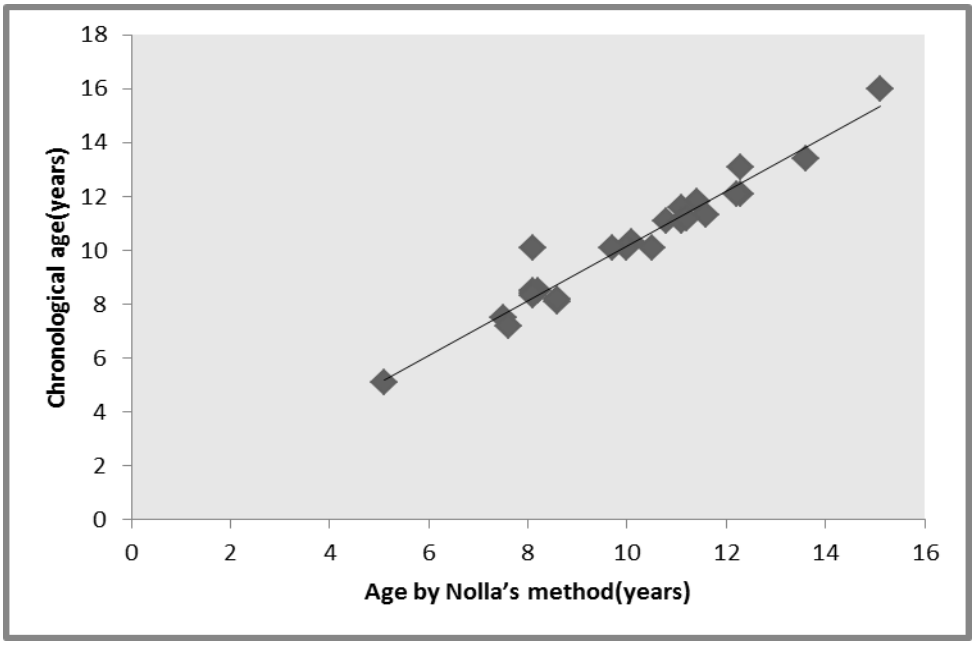

Figure 1: Nolla's standards for determination of age of teeth

Nolla's method was used on Maltese school children in 2005 and no significant difference was found between dental age and chronological age of male children but a significant difference existed for females. The study also stated that Maltese school girls exhibit slower dental development when compared to the figures given in the literature.[6] Another study was conducted on Brazilian population in 2007 to evaluate the applicability of the methods proposed by Nolla and Nicodemo and colleagues for assessing dental age and its correlation to chronological age and concluded that the mean difference between true and estimated age for males and females was underestimated and the use of correction factors were recommended.[7]

Nolla's method can also be used for dental maturation assessment. This method was used in 2008 to assess the maturation of permanent dentition on a group of Egyptian children .After the completion of the study the authors gave a separate dental maturation curves for maxillary and mandibular teeth of Egyptian population.[8]

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. [9] 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. [10]

Few studies were done on Indian population using Nolla's method of age assessment. In 2013 Nolla's method was used to assess skeletal age using hand wrist radiographs and to find correlation amongst skeletal, dental and chronological ages of Indian population. The study stated that in Indian population females were more advanced in skeletal maturation than males and chronological age showed inconsistent correlation with dental and skeletal age. This study also suggested that canine calcification stages can also be used to assess skeletal maturation.[11]In another study conducted to find out the reliability of Nolla's age assessment method in Lucknow population concluded that females were more advanced in dental maturation than males and chronological age showed inconsistent correlation with dental age.[4]

In our study we used Nolla's method on 25 patients in Mangalorean children and found good correlation between chronological age and the estimated age. Statistically no significant difference was found in males and females. The inter class correlation for males and females also showed excellent agreement. We concluded our study by giving a regression formula which can be used to estimate more accurate age of Mangalorean population using Nolla's method.

CONCLUSION:

Nolla's method can be considered as a good method of dental age assessment. No statistical significance was found between chronological age and age estimated using Nolla's method for males and females. The regression formula given for Mangalorean population can be used for dental age assessment to get better results. The sample size used in our study is less, so studies with more sample size are needed to consider the specificity of this method.

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