Journal of Research in Medical and Dental Science
2022, Volume 10, Issue 9, Page No: 48-54

Available Online at: www.jrmds.in
eISSN No. 2347-2367: pISSN No. 2347-2545

Modified Anderson's Method Age Estimation Using Mandibular Left and Right Third Molar in South Indian Population

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ABSTRACT

Introduction: Age estimation plays an important role in the field of forensics not only in postmortem age determination for individual identification but also for identification of live individuals in case if immigration issues, criminal identification, etc. Teeth are vital pieces of evidence in several such investigations as they are preserved in the closed oral cavity and are hence highly resistant to any subjected changes, thus making them very useful in analysis.

Aim: The aim of our study is to determine the accuracy of age estimation using modified Anderson's method for the teeth 38 and 48 in both males and females and compare them.

Materials and Methods: 100 OPGs were collected - 50 male and 50 female from the age group 10-20 years and the teeth 38 and 48 were compared with the images in Anderson's chart and numbered according to the stage they were found to be in. The chronological age was also noted. The estimated age of male and female of 38 is compared and similarly the estimated age of male and female of 48 is compared. The mean, standard deviation and standard deviation error of the data were obtained.

Results: The mean of 38 staging for males is 7.34 and that for females is 6.64 while the mean of staging of 48 for males is 7.40 while for females it is 6.72. P value was found to be less than 0.05 and hence significance was found to be present between 38 for males and females.

Conclusion: Hence the modified Anderson's method of age estimation was used for age determination of OPGs. It was found that males had higher dental maturity from the age group 18-18.9. Not much difference was seen between the ages males and females in the age group 12-12.9 and 14-14.9..

Key words: Lung cancer, A549, Andrographis paniculata, Cytotoxic, Antiproliferative

HOW TO CITE THIS ARTICLE: Yoshita Guntupalli, Abirami Arthanari, Modified Anderson's Method Age Estimation Using Mandibular Left and Right Third Molar in South Indian Population, J Res Med Dent Sci, 2022, 10 (9):48-54.

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Received: 23-August-2022, Manuscript No. jrmds-22-70106;

Editor assigned: 25-August-2022, PreQC No. jrmds-22-70106(PQ);

Reviewed: 08-September-2022, QC No. jrmds-22-70106(Q);

Revised: 13-September-2022, Manuscript No. jrmds-22-70106(R);

Published: 20-September-2022

INTRODUCTION

With the ever-increasing crime rate in our society, the field of forensic sciences has become highly evolved. Forensic dentists play a pivotal role in various areas of crime scene investigations and thereby help solve innumerable mysteries. Teeth appear to be vital pieces of evidence in several such investigations. Teeth are preserved in the closed cavities of the mouth and are generally resistant to the threatening environmental conditions that may be associated with the death of an individual, making them very useful in postmortem analysis. Teeth thus obtained may be useful in age estimation of the deceased victim or in determining his blood group [1].

The need to rely on proper, simple, and accurate methods for age estimation in adults is still a world-wide issue. It has been well documented that teeth are more resistant than bones to the taphonomic processes, and that the use of methods for age estimation based on dental imaging assessment are not only less invasive than those based on osseous analysis, but also have shown similar or superior accuracy in adults [1,2].

While age estimation of unidentified corpses and skeletons for identification purposes has a long tradition in forensic sciences, age estimation of living persons has formed a relatively recent area of forensic research which is becoming increasingly important. The international interdisciplinary Study Group on Forensic

Age Diagnostics (AGFAD) issued recommendations for age estimation of living persons for the purpose of criminal, civil, asylum and old-age pension procedures as well as for determining the sex and age of skeletons [3].

Teeth present with peculiar and comparable features of age-associated regressive changes along with dental procedures, which make them a mirror reflection of age changes from cradle to the grave of an individual. Age estimation in adults poses an enigma to forensic dentists because as the age advances, the dentitions get influenced by numerous exogenous and endogenous factors which may lead to discrepancies between dental age and chronological age [4].

Coming to the methods of age estimation, Demirjian's method is one of the most commonly used methods to evaluate dental age and has been widely used in many countries. It is found that compared with the chronological ages, most of the estimated ages are overestimated. By combining research results of many scholars and by analyzing, it can be assumed that this situation may be related with race, region, sex, etc. [5].

In a substantial re-working of Gustafson's data, Maples and Rice corrected Gustafson's regression statistics and found that the error associated with the age estimate was nearly double that claimed by Gustafson [6].

In our study we have taken up modified Anderson's method for age estimation. In this method we estimate the chronological age of teeth based on the developmental stage of teeth. The advantage of this system is that, being based on all deciduous and permanent teeth, it is far more versatile than many derived in the previous studies. This versatility lies in the fact that any teeth can be used in the assessment. This can be very useful from a clinical point of view in forensic cases when fragmentation, decomposition or predation of the remains may mean that not all teeth are actually recovered [7].

Many studies have been conducted previously to determine age using different methods of age estimation with teeth. Our team has extensive knowledge and research experience that has translate into high quality publications [8-27]. The aim of our study is to use the modified Anderson's method to evaluate the accuracy of age estimation.

MATERIALS AND METHODS

100 OPGs, 50 male and 50 female from the age group 10-20 were taken for age estimation. The population taken for the study was from South India. They were divided into the following groups according to age - 10-10.9, 11-11.9, 12-12.9, 13-13.9, 14-14.9, 15-15.9, 16-16.9, 17-17.9, 18-18.9, 19-19.9 9. Table 1 represents the age distribution of the samples tested. The teeth taken for the study were 38 and 48. They were compared to Anderson's chart given below Table 2. Anderson's chart consists of tooth staging based on the developmental stages of the teeth. They were staged using the multirooted stages by comparing the image in the chart with the OPG image. Figure 1 shows a sample OPG. Data was tabulated in excel sheet and then transferred to SPSS for statistical analysis. The mean, standard deviation, standard error mean and p value were determined and value less than 0.05 was considered to be statistically significant.

RESULTS

The mean chronological age of 50 male samples was found to be 14.84. The mean estimated age of 50 male samples for 38 was found to be 7.34 (Table 3) and for 48 was found to be 7.40 (Table 4). The mean chronological age of 50 female samples was found to be 14.81. The mean estimated age of 50 female samples for 38 was found to be 6.64 (Table 3) and for 48 was found to be 6.72 (Table 4). Upon comparison of tooth staging of 38 in males and females, p value was found to be 0.015 (<0.05) and was hence statistically significant (Table 5). Similarly on comparing tooth staging of 48 in males and females p=0.552 (>0.05) which was not statistically significant (Table 5).

Table 1: Sample distribution.

Groups	Age (years)	Male	Female
1	10-10.9	5	5
2	11-11.9	5	5
3	12-12.9	5	5
4	13-13.9	5	5
5	14-14.9	5	5
6	15-15.9	5	5
7	16-16.9	5	5
8	17-17.9	5	5
9	18-18.9	5	5
10	19-19.9	5	5
	Total	50	50

Table 2: Staging of teeth according to modified anderson's method.

Single rooted teeth stages		Descriptors	Multirooted teeth stages	
Ci	1	Initial cusp formation: Mineralization of cusp tps has begun	Ci	1
Cco	2	Coalescence of cusps: Mineralization centers are beginning to unite	Cco	2
Coc	3	Mineralizaed cusp outline is complete	Coc	3
Cr 1/2	4	1/2 of estimated crown mineralization is complete	Cr 1/2	4
Cr 3/4	5	3/4 of estimated crown mineralization is complete	Cr 3/4	5
Crc	6	Crown mineralization complete; but, root formation has not begun	Crc	6
Ri	7	Initial root formation	Ri	7
-	-	Initial cleft formation: Mineralization visible in inter-radicular area	Cli	8
R 1/4	8	1/4 of estimated root formation is complete	R 1/4	9
R 1/2	9	1/2 estimated crown mineralization is complete	R 1/2	10
R 3/4	10	3/4 os estimated crown mineralization is complete	R 3/4	11
Rc	11	Root length complete: Ape remains funnel shaped	Rc	12
A 1/2	12	Apex 1/2 closed: Root walls are parallel	A 1/2	13

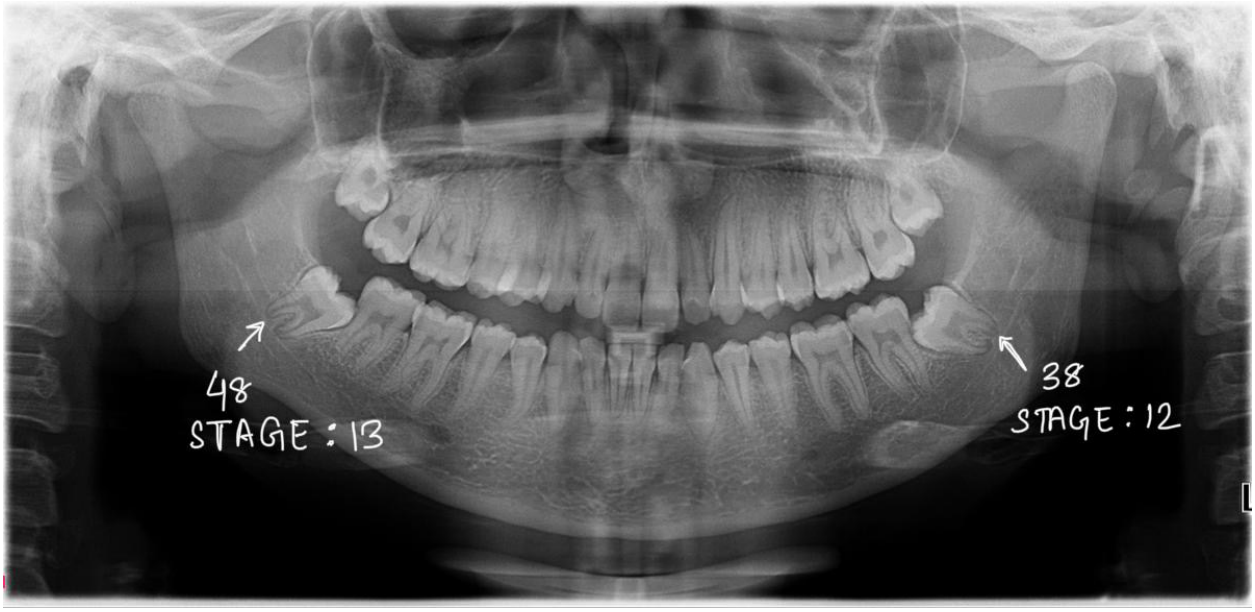

Figure 1: OPG with chronological age 17.9 years, showing staging of 38 as 12 and staging of 48 as 13.

Table 3: Standard deviation and standard deviation error for tooth staging 38 in males and females. For 38 male, mean was found to be 7.34, standard deviation was found to be 3.526 and standard deviation error was found to be 0.499. For 38 females, mean was found to be 6.64, standard deviation was found to be 3.646 and standard deviation error was found to be 0.516.

	Mean	SD	SD Error
Male	7.34	3.526	0.499
Female	6.64	3.646	0.516

Table 4: Standard deviation and standard deviation error for tooth staging 48 in males and females. For 48 in males, mean was found to be 7.40, standard deviation was found to be 3.620 and standard deviation error was found to be 0.512. For 48 in females, mean was found to be 6.72, standard deviation was found to be 3.603 and standard deviation error was found to be 0.510.

	Mean	SD	SD Error
Male	7.4	3.62	0.512
Female	6.72	3.603	0.51

Table 5: P values for tooth staging 38 in males and females and tooth staging 48 in males and females. P value for 38 showed statistical significance (p=0.015<0.05) while that for 48 was not statistically significant (p=0.552>0.05).

	38 Males and Females	48 Males and Females
P-Value	0.015	0.552

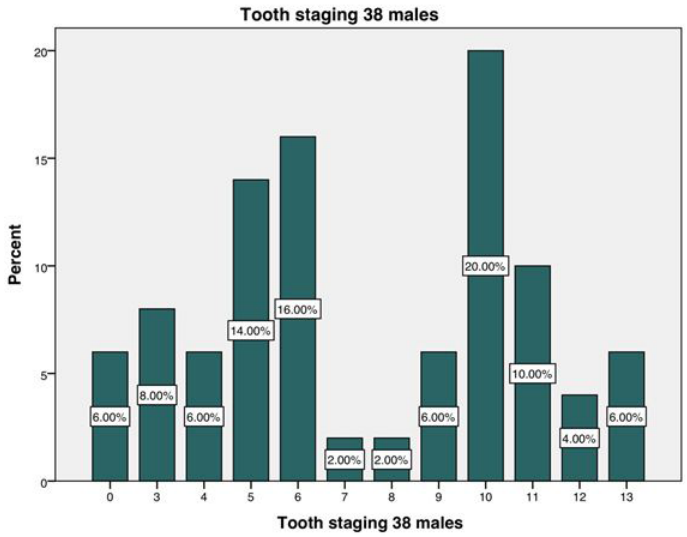

Figure 2: Tooth staging of 38 males vs the percentage of males with 38 in that stage. X axis represents the tooth staging number of 38 while the Y axis represents the percentage of males. Highest prevalence was found in stage 10.

In the present study, it was observed that there is statistical significance upon comparison of tooth staging of 38 in males and females while there is no statistical significance between 48 of males and females. The standard deviation for male 38 staging is 3.526 (Table 3) while that for females is 3.646 (Table 3). The standard deviation for male 48 staging is 3.620 (Table 4) and that for females is 3.603 (Table 4). The mean of estimated age for 38 in males was found to be 7.34 (Table 3) while that of females for 38 was found to be 6.64 (Table 3). Similarly the mean estimated age for 48 in males was found to be 7.40 (Table 4) and that for females was found to be 6.72 (Table 4).

Figure 2 shows tooth staging of 38 males vs. the percentage of abundance of samples in each stage and it was found that most abundance was seen in 10th tooth stage with 20%. Figure 3 shows the tooth staging of 48 males vs the percentage of abundance of samples in each stage. Most abundance was found in tooth stage 10 with 18% of samples. Similarly Figure 4 shows the tooth staging of 38 females vs the percentage of abundance of samples in each stage and it was found that most abundance was found in tooth stage 4 with 24% of total samples. Figure 5 shows the tooth staging of 48 females vs. the percentage of abundance of samples in each stage.

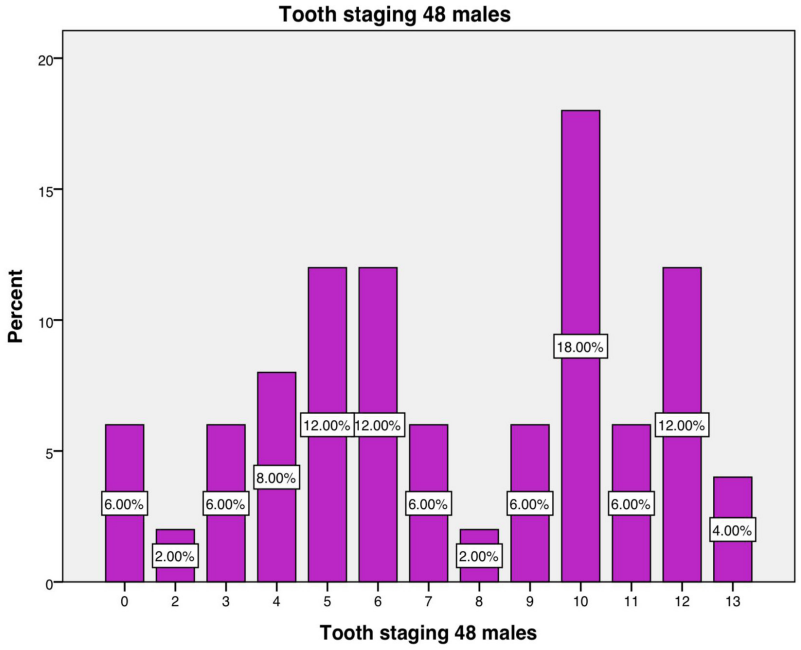

Figure 3: Graph showing tooth staging of 48 males vs. the percentage of males with 48 in that stage. X axis represents the tooth staging number of 48 while the Y axis represents the percentage of males. Highest prevalence was found in stage 10.

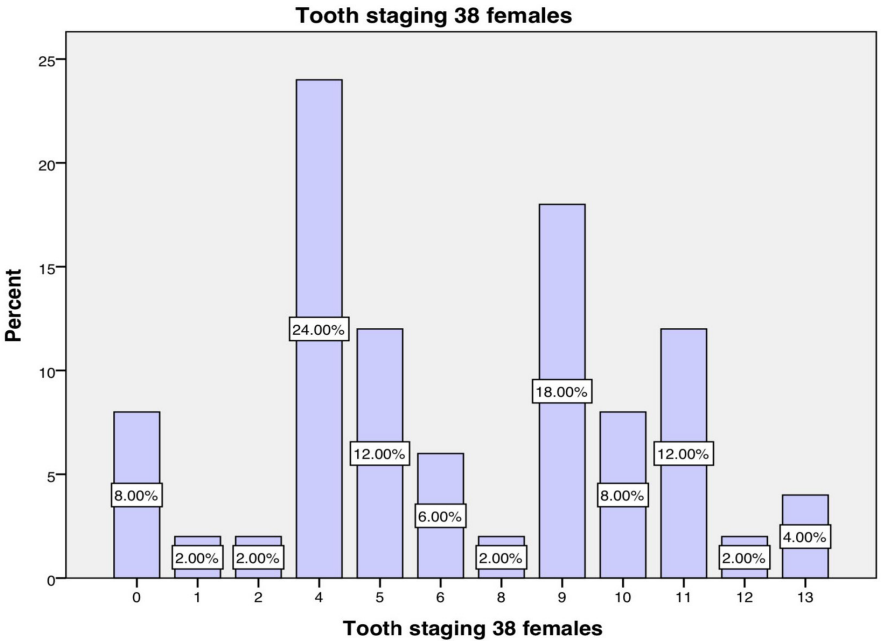

Figure 4: Graph showing tooth staging of 38 females vs. the percentage of females with 38 in that stage. X axis represents the tooth staging number of 38 while the Y axis represents the percentage of females. Highest prevalence was found in stage 4.

Most abundance was found in tooth stage 4 with 20% of total samples.

We have taken ages 12-12.9, 14-14.9 and 18-18.9 for comparison between males and females in the graphs as these ages are the legally approved standard for comparison, from Figure 6 and Figure 7 we find that not much variation is seen between males and females in ages 12-12.9 and 14-14.9, however in the age group 18-18.9, dental maturity in males was found to be significantly higher in males than females for both 38 and 48.

DISCUSSION

In a recent study conducted by Abirami et al, 2020 to estimate the age of second and third molars by modified Gleiser and Hunt method, it was found that there was a difference between Male and Female root maturation in relation to 38 and combination of 37 & 38 (nearly 1.2yrs variation). So, males are showing more accuracy than females in root maturation. The Standard deviation for Male 37 staging was ± 2.15years and for 38 staging was ± 1.29 years. And, the Standard deviation for Female 37 staging was ± 2.58 years and in 38 staging was ± 2.24 years [28]. According to Jain, et al. [29] although the mineralization

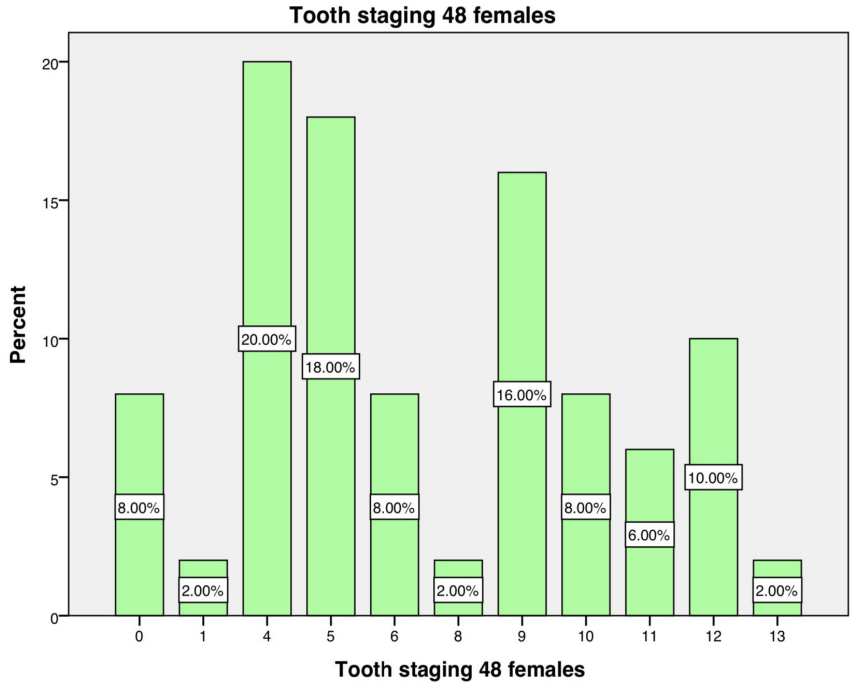

Figure 5: Graph showing tooth staging of 48 females vs. the percentage of females with 48 in that stage. X axis represents the tooth staging number of 48 while the Y axis represents the percentage of females. Highest prevalence was found in stage 4.

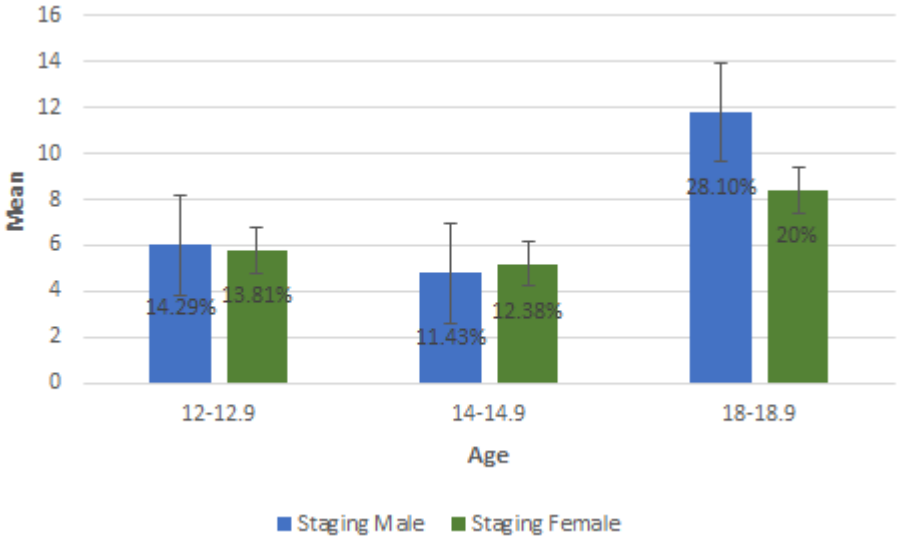

Figure 6: Bar Graph depicts the association between the chronological age of males and females and the mean of tooth staging of 38 males and females. X axis represents the chronological age of the samples and Y axis represents the mean of tooth staging of 38. Blue denotes tooth staging of 38 males and green denotes tooth staging of 38 females. Not much variation was seen between males and females in the groups 12-12.9 and 14-14.9. However males were found to have higher dental maturity in the age group 18-18.9 when compared to females. The difference was statistically significant (Chi-Square test; p-value = 0.015-significant).

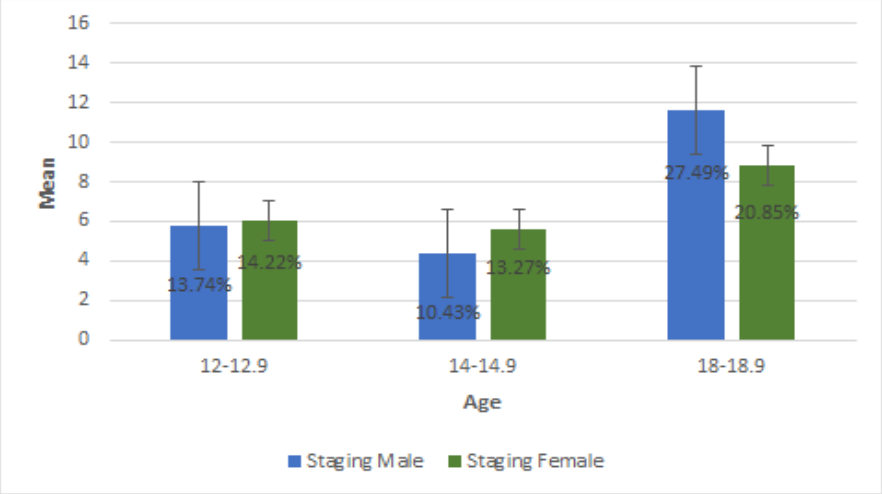

Figure 7: Bar Graph depicts the association between the chronological age of males and females and the mean of tooth staging of 48 males and females. X axis represents the chronological age of the samples and Y axis represents the mean of tooth staging of 48. Blue denotes tooth staging of 48 males and green denotes tooth staging of 48 females. Not much variation was seen between males and females in the groups 12-12.9 and 14-14.9. However males were found to have higher dental maturity in the age group 18-18.9 when compared to females. The difference was however not statistically significant (Chi-Square test; p-value = 0.552-not significant).

stages of the teeth indicated physiologic development more than chronological age, the dental mineralization stages are closely related to chronological age.

In a study conducted by Maber et al, 2006 conducted to determine the accuracy of age estimation using teeth it was found that Demirjian overestimated age, while Nolla, et al. methods under-estimated age . For individual teeth using Haavikko's method, the first premolar and second molar were most accurate; and more accurate than the mean value of all developing teeth [30].

In a recent study conducted by Cameriere, et al. using Cameriere method, the method yielded a mean prediction error of 0.407 years for girls and 0.380 years for boys. Although the accuracy of this method was better for boys than for girls, the difference between the two mean prediction errors was not statistically significant [31]. In another study conducted by Fernandes et al, 2011 to determine the accuracy of the Cameriere method there was no statistically significant difference between chronological and estimated ages on considering boys and girls separately. However, on analyzing each age group, the estimated age was significantly higher than chronological age from 5 to 10 years old and significantly lowers from 11 to 14 years old [32].

Developing teeth are commonly the criteria used for age estimation in children and young adults. The limitations of our study are that we have taken only 100 samples, i.e., the sample size is limited. Coming to the future scope of our study, it helps us determine the accuracy of age estimation of the modified Anderson's method.

CONCLUSION

The modified Anderson's method of age estimation showed significance for tooth staging of 38 between males and females. Overall it slightly underestimated the ages of the participants. However with greater sampling size and further research, development of a more accurate formula can be done for efficient age estimation of OPG samples.

ACKNOWLEDGEMENT

We thank Saveetha Dental College and Hospitals for providing us the support to conduct the study.

CONFLICT OF INTEREST

The author declares that there was no conflict of interest in the present study.

SOURCE OF FUNDING

The present study was funded by the following agencies

- Saveetha Institute of Medical and Technical Sciences.
- Sarkav Health Services.

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