AGE PREDICTION MODEL FROM THIRD MOLAR TEETH DEVELOPMENT IN THE PESHAWAR POPULATION. A CROSS-SECTIONAL STUDY

Farhan Dil[1], Dila Baz Khan[1], Umar Nasir[2]

[1]Department of Oral Biology Khyber College of Dentistry

[2]Department of Oral Biology Khyber Medical University Institute of Dental Sciences Kohat

ABSTRACT

Objective: *This study aimed to develop an age prediction model of the Peshawar population and to compare the outcome of this study with other studies.*

Materials and Methods: *A total of 741 subjects of the Peshawar population who fulfill the inclusion criteria were selected, in which 356 were females, and 385 were males, and their age range from 13 years to 25 years.*

Results: *The Development of both left and right mandibular third molar teeth were scored using Demirjian tooth developmental stages from D to H. The teeth developed approximately similar in both males and females. Very less difference were found in the left and right mandibular third molar teeth. Multiple regression analysis shows that 81% of the variance in age was explained by the gender and developmental stage of third molar teeth. Age regression model was produced from the regression analysis: [Age=13.83+1.111(stage of tooth)-0.13(sex)].*

Conclusion: *The obtained data of the current study are useful for references and determining the age of unidentified humans. However, further study is required because there is no single parameter available for age estimation.*

Keywords: *Forensic Science, Dental age, Regression model, Third molar teeth, Orthopantogram,*

INTRODUCTION

The identity of a person can be established by assessing one's age, gender, and stature, which is a procedure adopted by anthropologists, archaeologists, and forensic experts.[1] To determine the legal age in criminal cases and human identification, the estimation of age is an essential and useful factor.[2] For legal requirements, both of these factors are associated and could be utilized to assess the age of the living as well as the dead. There are various methods for determining the age of a person from intrauterine life up to old age.[3] So age calculation only is utilized in distinguishing immature person in unlawful acts from adult class, but also for chronological age estimation about school attendance, social benefits, employment, and marriage.[4,5]

Age can be assessed more precisely in children than in adults and adolescents because several teeth are in their different developmental stages.[6] In 1973, Demirjian et al[7] developed a system that estimates the chronological age of a child from the Development of multiple teeth.

According to I. Robetti et al,[8] completion of root structure and closure of their root apices occur in all permanent teeth at the age of 18 years except third molar teeth. If these third molar teeth are present, it provides the only opportunity to estimate the dental age from 15 years to 24 years. Dentists play an important role in age estimation from the teeth in children and young adults and adolescents. Forensic literature also emphasizes the usefulness of third molars for dental age estimation. All methods to estimate the chronological age of individuals using the

Correspondence:
Dr. Farhan Dil
Assistant Professor Department of Oral Biology
Khyber College of Dentistry.
Email: doc_farhandil@hotmail.com
Contact: +92333 9202563

Development of the teeth, it relays on a radiograph, because a single photograph shows the degree of calcification or Development of the multiple teeth.[10, 9]

Few studies have been conducted to determine the age of a person by observing the teeth in our population. The aim of the present study is to generate age prediction model based on Demirjian method of tooth development in population belonging to Peshawar KP, Pakistan.

MATERIALS AND METHODS

In this descriptive cross sectional study, a total of 741 Orthopantograms (356 females and 385 males) of Peshawar population from Peshawar Dental College were screened and their aged range between 13 to 25 years were included in the study. Radiographic artifact (Orthopantogram and Periapical X-ray), congenital disorders and abnormal form of dentition or any pathology observed on Radiograph in mandibular segment were excluded.

All patients, who fulfill the inclusion criteria, were included in this study. For this purpose standard research protocol was followed. Informed consent was taken from the patient or the patient guardian for the study. Patient date of birth, gender, residential address and date of Orthopantogram were recorded on specially design proforma. The date of birth were subtracted from date of Orhtopantogram to get exact age of the patient and recorded in the proforma. The developmental stage of both left and right third molar teeth were properly analyzed from Radiograph according to the method described by Demirjian et al using eight grade schemes where stage A to D describe the crown formation, while stage E to H describe root development. Intra and inter-observer reliability was tested by re-examining 20 OPGs after a week interval.

Kappa Agreement was used to analyze the intra-observer and inter-observer reliability. Side differences (left and right) of age of attainment were assessed by using Spearman' rho' correlation coefficient. Multiple linear regression models were used to predict age with the help of tooth developmental stages and gender of the subject. The data so collected were analyzed by using SPSS 21version.

RESULTS

A total of 741 patients were included in the study. Out of the total sample, 356were females and 385 were males. Minimum age recorded in this study was 13 years and maximum age was 22 years.

Intra-observer reliability was excellent with high value of agreement of Cohen Kappa of 0.97 for both sides. Inter-examiners reliability was also high (K= 0.91). Both were statistically significant

The descriptive statistics for sexual dimorphism for mandibular left third molar are given in table 2. They are similar to mandibular right third molar in table 1.

Correlation between right and left mandibular third molar were perfect for Demirjian's stages i.e 0.992 for females and 0.996 for males. All results were highly significant with p-value <0.001 (Table 3 and 4). Due to these similarities in the right and left side of the results, regression analysis was performed for only right side.

The regression analysis was performed between dependents variable (age = Y) and independent variables (Demirjian's tooth developmental stage and gender) as shown in table 4. The B or beta or slope was calculated for three predictors (constant or alpha, developmental stages of mandibular third molar and sex) and was 13.83, 1.111, and -0.13 respectively. All the results in the table (4) were statistically significant

The derived regression can be explained in the following way.

The general form of linear regression equation is **Y= a + b1X1 - b2X2**

In the current results (table 4);

- Y= is the age of patients
- a= is constant or intercept
- B= slope
- b1 = B of developmental stage of mandibular third molar
- b1 =B of sex
- X1= Code of developmental stage of mandibular third molar. Code in this prediction model was 1 to 5 for D to H
- X2= Code for gender. Code in this prediction model was 1 for male and 2 for female

For example predicted age in stage G for female

Table 1: Descriptive statistics and gender difference in chronological age of right third molar development for males and females

Demirjian's stage	Female			Male			Mean Diff	95%CI	t-statistics	Df	P value
	N	Mean (years)	SD	N	Mean (years)	SD					
Stage D	32	14.52	0.25	45	14.97	0.074	0.45	-0.08 ,0.988	1.724	26	0.097
Stage E	67	15.68	0.620	103	15.97	0.289	0.289	0.074, 0.502	2.71	45	0.009
Stage F	87	16.93	0.375	117	17.06	0.48	0.132	-0.019, 0.283	1.733	136	0.08
Stage G	90	17.84	0.52	67	18	0.67	0.156	-0.091, 0.402	1.254	93	0.213
Stage H	80	19.34	0.96	53	19.12	0.64	0.226	-0.550, 0.098	-1.38	91	0.169

SD, standard deviation; n, sample size; mean diff, mean difference;

CI,confidence interval; df, degree of freedom

Table 2: Descriptive statistics and gender difference in chronological age of left third molar development for males and females

Demirjian's stage	Female			Male			Mean Diff	95%CI	t-statistics	Df	P value
	N	Mean (years)	SD	N	Mean (years)	SD					
Stage D	30	14.50	1.10	42	14.94	0.416	0.443	-0.088,0.973	1.731	22	0.037
Stage E	72	15.64	0.821	105	15.97	0.293	0.329	0.064, 0.593	2.499	47	0.016
Stage F	82	16.93	0.381	121	17.02	0.508	0.097	-0.062, 0.256	1.209	138	0.229
Stage G	74	17.83	0.529	72	18.02	0.661	0.194	-0.051, 0.439	1.575	93	0.119
Stage H	98	19.34	0.963	45	19.12	0.64	0.226	-0.550, 0.098	-1.388	91.08	0.169

SD, standard deviation; n, sample size; mean diff, mean difference;

CI, confidence interval; df, degree of freedom

Table 3: Relationship of tooth developmental stages between sides in both sexes

Gender	Spearman's Correlation co-efficient	P value
Female	0.992	0.000
Male	0.996	0.000

Table 4: Un-standardized co-efficient of multiple regression analysis

Predictors	Unstandardized Coefficients		t-statistics	p-value	95%CI for B	
	B	Std. Error			Lower bound	Upper bound
(Constant)	13.83	0.103	134.4	0.000	13.627	14.031
Stage of development at Mandibular right third molar	1.111	0.022	49.466	0.000	1.067	1.155
Gender	-0.13	0.058	-2.229	0.026	-0.243	-0.015

will (values are put from table 4)

Age of prediction **Y= a + b1X - b2X2**

Y= 13.83 + 1.111 (4) – 0.13 (2) = 18.014

DISCUSSION

The third molar is the last tooth to develop in human dentition. So this tooth may be very helpful in age estimation. The Development of wisdom teeth shows remarkably small diversities among different ethnic groups. Despite of that, it has the importance to study different ethnic groups to verify this observation or to discover differences. Interestingly, in all of the studies completed till date, an individual having third molar teeth with Demirjian stage "H" development had very likely reached the chronologic age of 18 year, indicating that the use of this technique for determining the legal age of majority is valid.[10]

So in this study the age range was set at 13 to 25 years, so that fully estimation of each mineralization stage can be done. Ajmal M et al[11] conducted a study to estimate age using third molar teeth on southern Saudi population. They took age from 13 to 23 years in their study.

In this study, we used Dermirjian's stages of tooth development. Radiograph is 2-dimensional image of three dimensional structures, as consequence, vertical and horizontal displacement of structures occurred, leads to magnification of the objects.[12] Although radiographs were used in this study but Dermirjian's method is devoid of this drawback because it is based on the relative length of crown and root formation and not on the actual size of the tooth.

In the current study perfect intra-observers and inter-observers reliability was recorded, which shows perfection of the researchers and quality of the study. In this study we have a Kappa test for inter and intra-observers reliability.

In the present study males were more in number than females. The reasons may be our social setup, and more out-door activities of males as compared to females so more presentation of males for dental treatment. In Pakistan, male carry a higher education than females so more awareness about dental and more visits to dental hospital. In this study consecutive sampling was done. A study by Priyadharshini, KI et al13 reported a sample of 848 subjects, of which 471 (55.4%) were males and 377 (44.5%) were females; for age estimation using Development of third molars in South Indian population.[13]

Very little difference was observed between right and left side third molar in this study. Human symmetry is a genetically controlled phenomenon, as single gene is responsible for bilateral structure formation120. Similar results are reported by other authors.[13,14,15]

In this study the derived regression equation was; Age of prediction = 13.83 + 1.111 (stage of tooth development) - 0.13 (sex). Similar equation was derived by Johan NA et al16 for Malaysian population but the constant had lesser value than the current study (7.17 instead of 13.83). Genetic and environmental factors may play a role in this difference. In the current study, co-efficient of determination was (R2=0.834)high as compared to previous studies (R2=0.711).[16]

CONCLUSION

It was concluded that with a sample size of 120 subjects, i.e., 30 controls, 30 patients each in with either Rheumatoid Arthritis or Periodontitis or both, there was no difference in mean Osteocalcin and Osteoprotegerin levels. The strength of our study is that there is no published data to the best of our knowledge, which quantified the biomarkers to find a common pathway between two diseases. Limitation of our study is a small sample size, skewed age distribution, and disease severity confounding. A new study taking into account the above limitations may

open new perspectives and may add new interventional modalities in treating these chronic diseases.

REFERENCES

1. Stavrianos, C., et al., Dental age estimation of adults: A review of methods and principals. Res J Med Sci, 2008. 2(5): p. 258-68.
2. Lee, S.-H., et al., Development of third molars in Korean juveniles and adolescents. Forensic science international, 2009. 188(1): p. 107-111.
3. Schmeling, A., et al., Age estimation. Forensic science international, 2007. 165(2): p. 178-181.
4. Ritz-Timme, S., et al., Age estimation: the state of the art in relation to the specific demands of forensic practise. International journal of legal medicine, 2000. 113(3): p. 129-136.
5. Williams, G., A review of the most commonly used dental age estimation techniques. J Forensic Odontostomatol, 2001. 19: p. 9-17.
6. Narnbiar, P., Age estimation using third molar development. Malaysian J Pathol, 1995. 17: p. 31-4.
7. Demirjian, A., H. Goldstein, and J. Tanner, A new system of dental age assessment. Human biology, 1973: p. 211-227.
8. Robetti, I., M. Iorio, and M. Dalle Molle, Orthopantomography and the determination of majority age. Panminerva medica, 1993. 35(3): p. 170-172.
9. Babar, M.G., S. Iqbal, and A. Jan, Essential guidelines for forensic dentistry. Pakistan Oral Dent J, 2008. 27: p. 79-84
10. Lewis, J.M. and D.R. Senn, Dental age estimation utilizing third molar development: a review of principles, methods, and population studies used in the United States. Forensic science international, 2010. 201(1): p. 79-83.
11. Ajmal, M., et al., Age estimation using third molar teeth: A study on southern Saudi population. Journal of forensic dental sciences, 2012. 4(2): p. 63.
12. Otake, Y., et al., Robust 3D–2D image registration: application to spine interventions and vertebral labeling in the presence of anatomical deformation. Physics in medicine and biology, 2013. 58(23): p. 8535.
13. Priyadharshini, K.I., et al., Age estimation using Development of third molars in South Indian population: A radiological study. Journal of International Society of Preventive & Community Dentistry, 2015. 5(Suppl 1): p. S32.
14. Soares, C.B.R.B., et al., Evaluation of third molar development in the estimation of chronological age. Forensic science international, 2015. 254: p. 13-17.
15. Mohammed, R.B., et al., Digital radiographic evaluation of mandibular third molar for age estimation in young adults and adolescents of South Indian population using modified Demirjian's method. Journal of forensic dental sciences, 2014. 6(3): p. 191.
16. Johan, N., et al., The variability of lower third molar development in Northeast Malaysian population with application to age estimation. Journal of Forensic Odonto-Stomatology, 2012. 30(1).