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AGE ESTIMATION FROM MANDIBULAR SECOND MOLAR TOOTH MINERALIZATION STAGES

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ABSTRACT

Objectives: *The objective of this study was to estimate the age from mandibular second molar tooth mineralization stages and make a regression equation for our population.*

Materials and Methods: *This descriptive cross sectional study was conducted at Rehman college of dentistry on 150 samples from both genders, ages range 8-16 years, good quality panoramas (OPGs). OPG was used to determine the Demirjian's stages of right mandibular second molar and age was asked from patients/parents. Correlation was determined between age and mineralization stages using Spearman rho test. Age estimation was done through linear regression by using age as dependent variable and tooth mineralization and gender as independent variables. The level of significance was set at P≤0.05.*

Results: *The mean age of the study was 11.5±2.2 years. The males were 85(56.3%) and female were 65(43.7%). The correlation between age and tooth mineralization was highly statistically significant (r=0.725, P<0.001). In only 48.5% cases the model significantly (P<0.001) estimated the age from Demirjian's stage. The regression equation between age as a dependent variable (Y) and independent variables tooth mineralization stages (X1) and gender (X2) was* $Y=7.73+1.198X_1-0.147X_2$.

Conclusion: *From our findings we can conclude that the correlation between age and tooth mineralization was highly statistically significant. The mandibular second molar can be used in age estimation but its predictive value is low (48.5%).*

Key words: *Age estimation, Demirjian's method, tooth mineralization stages, mandibular second molar*

INTRODUCTION

For legal purposes to recognize victims during catastrophes and for anthropological studies, age estimation is required in both lived and dead individual[1]. In developing countries like Pakistan most of the people are inhabitant of rural areas where the registration awareness of childbirth is negligible. That's why, these people are knowing their definitive children's birth date[2]. In case of dead, age estimation for individuals is very difficult because post-mortem environment can alter the dead body parts. In order to estimate age from various parts of the body, tooth structure is found the most durable and post-mortem environment can affect it very least[3].

Many methods are available in literature to determine age of individuals[1,4-7]. The techniques commonly used for dental age estimation are eruption sequence of the teeth, gingival emergence of

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dentition, or their developmental stage analysis using OPG assessment by Demirjian[8] and Nolla[9]. These radiographs have higher accuracy and less subjects to inter-examiner disagreement[2]. Demirjian's scoring method is considered to be the gold standard and is based on the mineralization of the permanent dentition[10]. This scoring system of tooth is categorized into eight stages from A to H each having specific features[11].

Fins et al[12] conducted a study to determine forensic age estimation from mandibular second molar tooth mineralization according to Demirjian et al on 367 panormic radiographs in Portuguese population. Their age range was 3 to 19 years and they used logistic regression. They derived formula for age prediction using 14-years as a threshold. Their models were statistically significant. Similarly, another study was conducted to determine forensic age estimation from mandibular second molar tooth mineralization in Chines population on 1657 panoramic radiographs with age range of 5 to 25 years. Their results showed that in both genders, full development of second molars occurred before the 14 year of age[13].

The rationale of this investigation is that age estimation is an important requirement in many instances like criminal and forensic cases. Most of the uneducated parents usually do not know the real age of their child. Mandibular second molar mineralization status can usually be assessed easily with minimal radiation to subject with the help a single periapical radiograph. In Demirjian's method magnification error is not issue because this scale depend how portion of crown and root form not measurement in millimeter.

The objective of this study was to estimate the age from mandibular second molar tooth mineralization stages and derive the formula for it in our population.

Table 1: Simple linear regression models to predict the age (in years) of patients in the sample based on Demirjian's score for the mandibular second molars

Tooth	Explanatory variable	B Coefficient	SE	P-value
Mandibular second molar	constant	7.569	.363	<0.001
	Demirjian's stage	1.183	.100	<0.001
	R^2=48.5			

MATERIALS AND METHODS

This descriptive cross sectional study was conducted at Oral surgery department, Rehman College of Dentistry, Peshawar on total of 150 cases. The ethical approval was obtained from hospital ethical review committee. The sampling was done through non-probability consecutive technique. Verbal informed consent was obtained after detailed explanation about the aims and benefits of the study. The participants were assured of confidentialities.

The detailed history for demographic and systemic conditions was taken. Participants/parents were asked about their medical conditions and any medications they are taking. The age was asked from participants or their parents. The inclusion criteria was those patients visiting Oral surgery department, Rehman college of dentistry, both genders, with ages between 8-16 years, patients having good quality panoramas (OPGs) showing mandibular second molar tooth germs bilaterally. Cases with hypodontia, oligodontia, Amelogenesis Imperfecta, Dentinogensis Imperfecta, history of trauma /fracture in second molar region and any systemic disease affecting tooth development were excluded from the current study.

OPGs were examined under illuminator light to determined the Demirjian's stage of mineralization of right mandibular second molar as follows: Stage A; Mineralization of cusp tips but no coalescence; Stage B; Coalescence of mineralized cusps with well defined mature coronal morphology; Stage C; Half coronal portion formed; Stage D; Crown completed upto to the cementoenamel junction; Stage E; the coronal length is more than the radicular length, root bifurcation has semi-lunar looking; Stage F; The coronal length equal to or lesser than the radicular length; Stage G: Root complete with open apical;

Table 2: Multilinear regression models to predict the age (in years) of patients in the sample based on gender and Demirjian's score for the mandibular second molars

Tooth	Explanatory variable	B Coefficient	SE	P-value
Mandibular second molar	constant	7.730	.476	<0.001
	Demirjian's stage	1.198	.104	<0.001
	Gender (1=male)	-.147	.280	.599
	R^2=48.6%			

and Stage H; Closed apex.

Data were analyzed in SPSS version 20. Continuous variables like age were computed as mean and SD while categorical variables as like gender and tooth mineralization stages were computed as frequencies and percentages. Correlation was determined between age and mineralization stages using spearman rho test. Age estimation was done through linear regression by using age as dependent variable and tooth mineralization and gender as independent variables. The level of significance was set at P≤0.05.

RESULT

The mean age of the study was 11.5±2.2 years with range from 8 to 16 years. The males were 85(56.3%) and female were 65(43.7%). The correlation between age tooth mineralization was high and very highly statistically significant. (r=0.725, P<0.001).

Fig 1 shows scatter plot between age and tooth mineralization stages. The co-efficient of determination was 0.485 (r2=0.485).

Simple linear regression showed that in 48.5% cases the model significantly (P<0.001) estimated age from Demirjian's stages. The regression equation between age as a dependent variable (Y) and tooth mineralization stages independent variable (X) was Y=7.57+1.18X. The details are shown in table 1.

Multiple linear regression models to predict the age (in years) of patients in the sample based on gender and Demirjian's score for the mandibular second molars showed that in 48.6% cases the model significantly (P<0.001) estimated age from Demirjian's stages and gender. The regression equation between age as a dependent variable (Y) and tooth mineralization stages (X1) and gender (X2) as independent variables was $Y=7.73+1.198X_1-0.147X_2$. The details are shown in table 2.

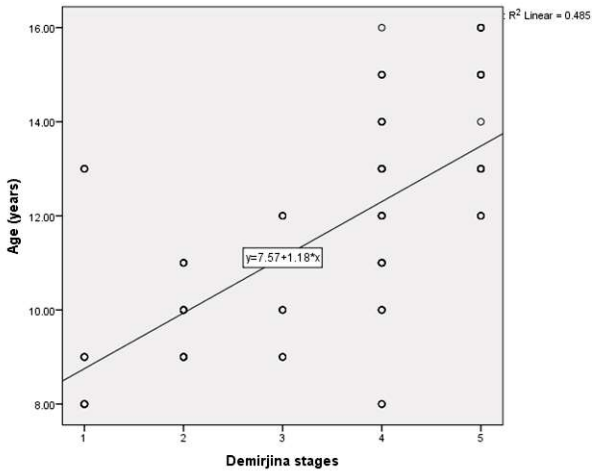

Fig 1: Scatter Plot between age and tooth mineralization

(Where 1=stage D, 2=E, 3=F, 4=G, and 5=F)

DISCUSSION

The current study was aimed to estimate age from mandibular second molar calcification stages. Our results showed that the correlation between age and tooth mineralization was high and very highly statistically significant (r=0.725, P<0.001). Simple linear regression showed that in 48.5% cases the model significantly (P<0.001) estimated age from Demirjian's stages. Multiple linear regression model to predict the age (in years) of patients in the sample based on gender and Demirjian's score for the mandibular second molars was applicable in 48.6% cases and was statistically significant (P<0.001).

Age estimation has many applications like identification of burned bodies[13] to predict how much growth remained in orthodontic cases and for medicolegal purposes[7].

In our study the males were more than females. While in previous studies females were more than males[14,15]. The difference can due to ethnic variability, level of education and male to females ratio in espective population.

Kerman et al[16] assessed the applicability of Demirjian's methods in Iranian population and their results showed that the use of Demirjian's method in estimating the age of children in the city of Shiraz has acceptable accuracy.

Another study was conducted in Korean population on age estimation from Demirjian's score for the mandibular second and third molars. Their results showed that in multiple regression analysis, a strong positive relationship was observed between age and mineralization of mandibular second molar[14]. These results are similar our study. Our correlation was positive, high and very highly statistically significant (r=0.725, P<0.001).

The intercept in our study was 7.569. A previous study on Korean population on age estimation from Demirjian's score for the mandibular second molar

reported that intercept was 19.65[14]. This difference can due to statistical method, age range difference, ethnic and genetic variability. They used multiple regression analysis for both mandibular second and third molars while in current study we only include lower second molar. Their age range was from 3 to 23 years.

The value of R2 in our study was 48.5% and was highly statistically significant (P<0.001). This showed that in only 48.5% of cases age can be estimated from lower second molar mineralization stages. This reveals that mandibular second molar is not good tooth for age evaluation purposes. For high accuracy in age assessment the value of R2 should be higher than 90%. In previous study the value of R2 was 92.0%. The difference can due to statistical method used in their study. They used logistic regression to predict age above 14 years. They recoded age into a binary variable (0: age less than 14 years, and 1: age 14 years and above). Their dependent variable was age and mineralization of second molar and genders were the explanatory variables[12]. Another study reported the value of R^2 to be 70.8%. But that study was performed on maxillary second molar tooth. Their dependent variable was age, and mineralization of second molar and genders were the independent variables[15].

No study was traced who used age as a continuous variable and mineralization of lower second molar and genders were the independent variables to derive regression equation. So our study is first kind in this sense.

As our regression model has low predictive value for age so we recommend to further tested this regression equation and make adjustments to improve its accuracy. Factors that might improve accuracy include patients' height and other possible explanatory variables like combination of teeth and ethnicity[17].

CONCLUSION

From our findings we can conclude that the correlation between age and tooth mineralization highly statistically significant. The mandibular second molar can be used in age estimation but its predictive value is low (48.5%). The regression equation of age from lower second molar was as follows;

Age=7.73+1.198 (Demirjain's stage of lower 2nd molar)-0.147(gender)

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