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PREDICTIVE ABILITY OF MANDIBULAR THIRD MOLAR IN ESTIMATION OF CHRONOLOGICAL AGE

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ABSTRACT

Objectives: To determine the predictive ability of mandibular third molar in estimation of chronological age.

Materials and Methods: This is cross sectional descriptive study was conducted at Saidu college of Dentistry, Swat on 120 participants. The inclusion criteria were both males and females, age from 13 to 25 years, having good quality panoramic X-ray clearly showing lower third molar area. Participants with dental anomalies like oligodontia, Dentinogenesis/Amelogenesis imperfecta, fracture affecting angular region of mandible were excluded. Age, sex and tooth mineralization of lower third molar were recorded. Linear regression was applied using age as dependent and maturation stages of third molar as independent variable.

Results: The mean age was 16.85 ± 2.39 years. The females were 78 (65%) and males were 42 (35%). Overall the model shows that in 79.9% participant the variation in age can be explained by maturation stages of third molar and gender. The regression equation for age estimation is $\text{age} = 11.42 + 1.68x(\text{maturation stage}) + 0.13x(\text{gender})$.

Conclusion: Mandibular third tooth maturation stages are useful in prediction of chronological age of the patients.

Key words: Chronological age, age estimation, mandibular third molar, lower molars

INTRODUCTION

Age estimation is of great importance for medicolegal purposes^{1,2}. Many surgical and orthodontic treatment option can varies on basis age of the patient³. Orthognathic surgery and implant placement cannot be done in growing age. Similarly orthodontic growth modification with functional appliance treatment also depends on accurate age estimation.

Two radiographic methods which are bone and dental maturation are routinely used for estimation of age^{4,5}. Assessment of age from bone maturation is based on fusion of diaphysis with epiphysis, calcification of clavicle end and appearance of sesamoid bone. This method require detailed anatomy of the

hand which is not practical for dentists. Use of atlas can help in the assessment of hand wrist radiograph. Extra radiation is another issue with bone maturation method^{6,7}.

Use of panoramic radiograph (OPG) based on Demirjian's stages of third molar is non-invasive technique⁸. Initial radiopaque calcification of lower third molar starts at 7 years of age, amelogenesis happens from 13 to 19 years and root completion varies from 19 to 26 years⁹. Previous studies reported that Demirjian's stages of mandibular third molar can reliably predict the age of individuals^{1,2,8-10}. Ajmal et al.⁸ in a study in Saudi Arabia found that there is positive correlation between age and third molar mineralization stages ($r=0.87$). However it is most important that norms and statistics should be established for each population. There is lack of local literature on this subject. Due to ethnic and genetic variations the results can be non-consistent across

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various populations.

The objective of this study was to determine the predictive ability of mandibular third molar in estimation of chronological age in patients reporting to Saidu College of Dentistry, Swat.

MATERIALS AND METHODS

This study of descriptive cross sectional design was carried out at department of Radiology, Saidu College of Dentistry, Swat from 10th July 2022 to 30th November 2022. Verbal informed consent was obtained from all patients. Ethical approval was obtained from the hospital ethical committee.

One hundred and twenty patients were included in the study by non-probability consecutive sampling technique. The calculated sample size was 10 by correlation sample size calculator by using correlation co-efficient (r=0.93) from study 10 at α (two tail)=0.01 and β =0.01. However for normality purpose we include 120 participants. The inclusion criteria were participants with age from 13 to 25 years, males and females, good quality orthopantomogram clearly showing lower third molars on both sides. Patients with dental anomalies like hypodontai, oligodontia, Amelogenesis/Dentinogenesis imperfecta, pitted fluorosis, previous history of trauma in mandibular angle area and any medical conditions affected dental development or genesis like hormonal imbalances were excluded.

The recorded data were age, gender and the dental maturation stages of lower third molar using Demirjian’s index on OPG. Only right side was assessed for tooth maturation as previous studies show no difference between left and right side.11 All orthopantomograms were places on illuminator for clear visibility for Demirjian’s stages assessment.

Demirjian’s stages are from A to H; stage A initial calcification started, stage B initiation of coronal tooth formation, stage C half crown formed, stage D crown completed and radicular formation initiated, stage E one third root form, stage F two third root formed, stage G root completed with open apex and stage H closed apex.

Data analyses were formed in R programming version 4.1.2. Mean with SD for continuous variable like age and percentages with frequency for qualitative variables like gender and tooth maturation stages. Multiple linear regression was applied using

chronological age as dependent variable and Demirjian’s stages and gender to be independent variables. The significance level was $p \leq 0.05$.

RESULT

The mean age was 16.85 ± 2.39 years with range from 12 to 25 years. The females were 78 (65%) and males were 42 (35%). The most common age category was 15-20 years having 33(27.5%) followed by 10-15 years with 33(27.5%) participants. (Table 1) The most common dental maturation stage was stage C (n=59, 49.17%) followed stage B(n=28, 23.33%) and stage D(n=16, 13.33%). (Fig 1)

Table 2 shows the mean of chronological in

Table 1: Frequency of gender and age group

Variable	Characteristic	N = 120 ¹
Gender	Female	78 (65.00)
	Male	42 (35.00)
Age group	10-15	33 (27.50)
	15-20	75 (62.50)
	21-25	12 (10.00)

Table 2: Mean and SD of age by stages of third molar

Demirjian’s stages of third molar	Age(year) Mean \pm SD
A	13.00 \pm 1.00
B	15.36 \pm 0.83
C	16.20 \pm 0.92
D	18.06 \pm 1.34
E	20.75 \pm 1.89
F	21.67 \pm 1.51
G	23.67 \pm 0.58
H	25.00 \pm 0

Table 3: Regression analysis for individual stages of third molar

Tooth stage	coefficient (β)	SE	t.value	P-value
(Intercept)	13	0.6	21.78	<0.01
B	2.36	0.63	3.75	<0.01
C	3.2	0.61	5.24	<0.01
D	5.06	0.65	7.78	<0.01
E	7.75	0.79	9.82	<0.01
F	8.67	0.73	11.86	<0.01
G	10.67	0.84	12.64	<0.01
H	12	1.19	10.05	<0.01

*R2=0.824, R2 adjusted=0.813

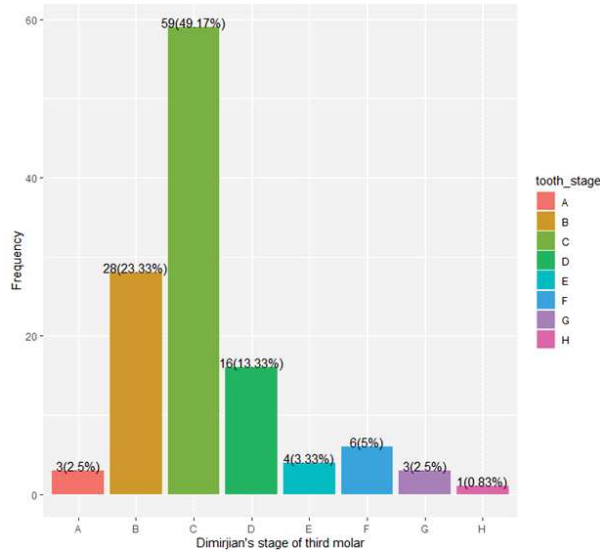


Fig 1: Distribution of various maturation stages of third molar

each maturation stage of mandibular third molar. The mean age increases as the maturation stage of third molar progresses.

Fig 2 & 3 shows Scatter between chronological age and lower third molar stages with coefficient of correlation, coefficient of regression and regression equation for overall study and both genders.

The multivariate analysis for individual stages of third molar shows that in 82.4% participants the variations in chronological age can be explained by tooth mineralization. The model for all maturation stages of third molar were statistically significant ($p < 0.01$). (Table 2)

For overall study our model shows that in 79.9% participant the variations in age can be explained by maturation stages of third molar and gender. The regression equation for age estimation is $\text{age} = 11.42 + 1.68x(\text{maturation stage}) + 0.13x(\text{gender})$. (Table 3)

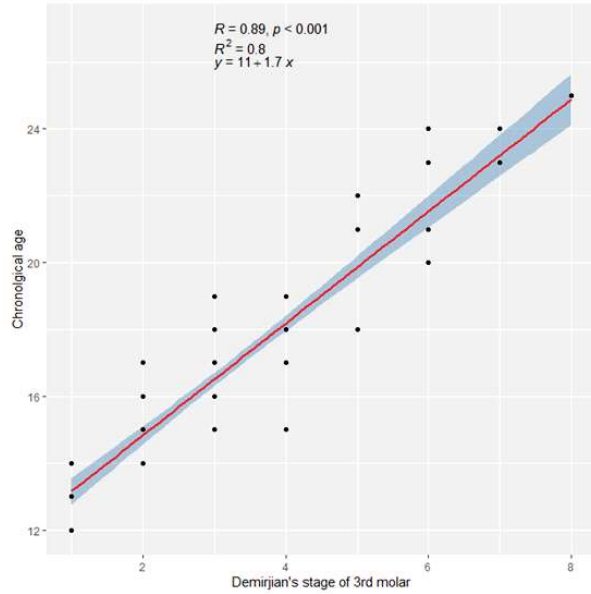


Fig 2: Scatter between chronological age and lower third molar stages

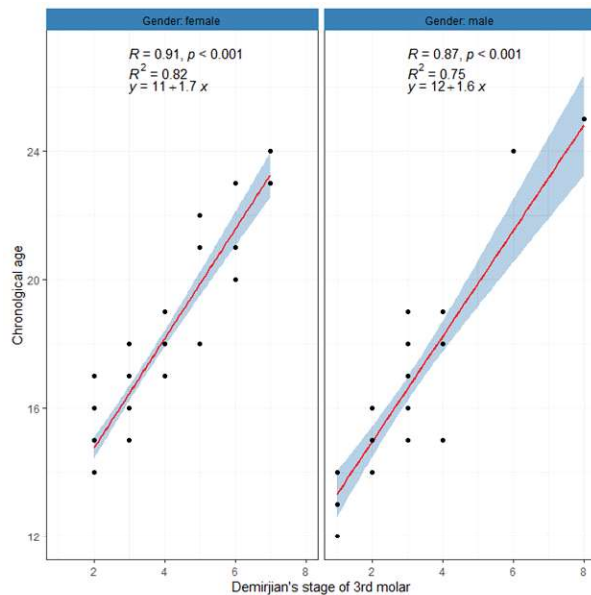


Fig 3: Scatter between chronological age and lower third molar stages stratified by gender

Table 4: Regression analysis for overall stages of third molars

	Units of measurement	Estimate	SE	t.value	P-Value
(Intercept)	-	11.42	0.29	39.79	<0.01
Tooth stage	Dummy (A=1, B=2, C=3, D=4, E=5, F=6, G=7)	1.68	0.08	21.5	<0.01
Gender	Dummy (male=1, female=2)	0.13	0.21	0.64	0.52

*R2 = 0.799, R2 adjusted = 0.796

DISCUSSION

This study was performed to determine the predictive ability of mandibular third molar in estimation of chronological age. Our results showed that in 82.4% participants the age can be estimated from tooth maturation stages.

Age estimation with accuracy is needed in determining time of orthogenetic surgery, time for providing dentofacial orthopedic treatment, and in criminal cases^{12,13}. In many instances patients or their guardians cannot provide accurate age which results in suboptimal treatment. The ideal criteria for best method of age prediction should have high accuracy, acceptable to patients and clinician, cheaper, and reusable on many occasions^{14,15}. Age estimation based on Demirjian's method from OPG is simple and non-invasive with no extra radiation hazard. Panoramic radiographic is normally needed as screening tool for annual assessment of oral diseases¹⁶. The method of Demirjian's stages is based on relative length of crown and root formation like one-third or two-third root or crown formation and not actual length so no problem of magnification errors. The magnification errors due to object and X-rays machine distance and beam angulation cannot affect the results¹⁶.

We used only right side mandibular third molar for age assessment. Lower arch is better than upper due to lack of superimposition of structures in maxilla where sinus overlap buccal roots^{17,18}. Our assumptions for using right side is due to previous studies found no difference between left and right side for tooth maturation^{19,20}.

Our results showed that statistically very highly significant correlation exist between lower third molar and age. Previous literature conducted on difference ethnicities also found positive, high and statistically correlation between these two continuous variables^{1,8-10,21-23}.

The regression equation for age estimation is $\text{age} = 11.42 + 1.68x(\text{maturation stage}) + 0.13x(\text{gender})$. The R² adjusted was 0.796 showing that in 79.6% we can estimate the age from mandibular third molar stages in both males and females. An Indian study also reported in 74.58% cases age prediction is possible from lower third molar mineralization stages²².

We run multiple linear regressions to add gender as covariate to see the effect of gender on age estimation but the gender was not significant covariate. This shows that this regression equation is applicable to both males and females equally. A study on Saudians also found that gender is not significant covariate.⁸ But other studies reported sexual dimorphism for age estimation from mandibular third molar stages^{24,25}.

CONCLUSION

Within limitations of the study it can be concluded that age estimation using the mandibular third molar is a reliable method that can be employed to determine the age of individuals, irrespective of their gender. This non-invasive approach offers several advantages in accurately assessing age, making it a valuable tool in various fields, including forensic science, archaeology, and clinical dentistry.

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