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The chronological age estimation of third molar mineralization of Han population in southwestern China

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ABSTRACT

The purpose of the study was to estimate the chronology of third molar mineralization in Han population of southwestern China and find its unique characteristics so that it would provide a reference in several legal cases like forensic age estimation. The study used Demirjian's staging method to study 2192 orthopantomograms of 984 male and 1208 female subjects aged between 8 and 25 years. The statistical data was analyzed by Student's t test and ANOVA.

The conclusions of the study are: (1) The chronological mineralization age of third molars of Han population in Southwestern China is similar to the Turkish and the Japanese, was earlier than the Austrian and Han of South China, but later than the Spanish. (2) The mineralization timing of the third molars between two sides in maxilla or mandible has no significant differences in the same gender group. (3) There is no significant difference in mineralization of third molars between male and female, except for tooth 48 in Demirjian's stage E. (4) The mineralization of third molar in maxilla is earlier than mandible.

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1. Introduction

In recent years, applications of forensic age assessments have increased rapidly in various aspects of forensic medicine.[1] Some examples include estimating the age of unknown victims, determining the right or obligation of society, explicit the penalty of criminal liability and assess the age of immigrants when they are unable to produce valid identity documents proving their real age.

14, 16, 18 and especially 18 are important ages in Chinese law for the juveniles. So, age estimation in this age group holds a significant importance in different legal cases. The methods of chronologic age estimation include a physical examination for sexual maturity, hand-wrist X-ray examination, radiographic or CT examination of clavicular epiphyseal cartilage, and dental examination.[2] The drawback of estimating epiphysis-diaphysis ossification in hand and wrist is that the process is completed around the age of 18 which is quite earlier as compared with third molar development

that continues until the early twenties. Moreover, towards the end of human skeletal growth and development, only a few age-dependent features can be evaluated by morphological methods. On this context, the third molar, the last tooth to initiate and complete development is the last available dental morphologic predictor of age.[3]

The initiation, development and eruption of third molar occur after birth, and are closely related with age. Historically, the third molar was called as 'wisdom tooth' because the eruption time of the third molar usually coincided with the mental maturity, nearly around 18 years of age. Presently, individual chronological age is determined by observing the development and maturity of crown and root of the third molar through orthopantomograms.

Several methods have been described for the determination of dental development status from radiographs.[4–7] Most of these are based on a comparison of the radiographic image of development of teeth with standard charts compiled from a large number of persons, usually in a well-defined geographic region.[2] One widely used method is the one first described by Demirjian et al., in 1973 based on a large number of French–Canadian children.[4] The method evaluates the development of seven mandibular teeth from a panoramic radiograph and calculates dental age.[8]

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In any anthropological analysis, the characteristics of reference population are significant. Influence of genetic, nutritional and geographical factors must be taken into account in benchmarking the development. So, cross-applicability of standards for members of different ethnic groups has been the subject of much discussion.[9] Until now, several studies have been undertaken in different populations and regions to explore the usefulness of the third molar as a reliable age indicator.[10–13] China is vast in territory, and Han is the largest population in the world. Therefore, to estimate the age by evaluating the radiographic features of third molar mineralization in young Han population of a designated area would be very meaningful for forensic age estimation.

In this study, our objective was to evaluate dental development in a sample of adolescents and young adults of southwestern China, make a comparison with previous studies on other ethnic groups or geographical area and try to find any significant trend.

2. Materials and methods

The sample consisted of 2192 conventional individual orthopantomograms from southwestern China taken at the Affiliated Hospital of Stomatology of Chongqing Medical University between the year 2008 and 2011. Individuals' age and sex were recorded and all of them belonged to Han ethnic group in southwestern China, were in good health without any chronic diseases and genetic diseases and without any features of malnutrition. Moreover, none of the third molars were absent in these individuals. All of the orthopantomograms were clearly observed and properly studied by experts in the field. The data set included 1208 females and 984 males and was collected from the individuals ranging from age of 8–25 years. The age and sex distribution of the study population is shown in Table 1.

The development and mineralization of third molars was recorded by Demirjian's method.[4] The method includes description of eight stages (A–H), the first four stages (A–D) comprising crown formation from the beginning of cusp calcification to the crown completion, and the second four stages (E–H) comprising root formation starting from initial radicular bifurcation to apical closure.

The mineralization stages were evaluated by two radiologists; 1100 cases by the first and 1092 cases by the second. The method used to test the assessments consistency of dental development stage between the two radiologists and the reproducibility of the same radiologist was as follows: first, 250 orthopantomograms were randomly selected and evaluated by both the radiologists. Four weeks after the first evaluation, these orthopantomograms were re-evaluated by both radiologists again. Finally, Wilcoxon matched-pairs signed-rank tests were performed to analyze the evaluation results.

The timings of the third molars mineralization were recorded and data analyzed using Statistical Package for the Social Science (SPSS) for windows, Version 13.1 and Microsoft Excel 2003 for Windows. Descriptive statistics was obtained by calculating the mean, standard deviation, and range of the chronological ages for the eight stages of dental development. The difference of two genders was analyzed using Student's t test.

Table 2
Statistic data of chronological mineralization of third molars.

Tooth	Stage	Males			Females			p
		Number	Mean	S.D.	Number	Mean	S.D.	
18	A	30	10.47	1.36	36	10.11	1.88	0.533
	B	148	11.46	1.5	130	11.74	1.19	0.231
	C	164	12.78	1.26	176	12.473	1.43	0.094
	D	164	13.77	1.59	190	13.65	1.73	0.646
	E	132	15.17	1.73	146	15.11	2.15	0.864
	F	42	16.1	1.81	92	16.89	1.92	0.116
	G	46	18.04	2.08	76	18.13	1.44	0.846
	H	258	21.42	2.64	362	21.45	2.41	0.92
28	A	28	10.29	1.38	38	9.79	1.58	0.356
	B	134	11.39	1.48	102	11.78	1.17	0.118
	C	182	12.68	1.25	214	12.45	1.37	0.216
	D	174	13.86	1.53	194	13.69	1.65	0.467
	E	120	15.3	1.78	144	15.44	2.31	0.693
	F	48	16.17	1.79	84	16.98	2.01	0.106
	G	42	18.14	2.06	70	18.31	1.55	0.725
	H	256	21.45	2.64	362	21.4	2.45	0.886
38	A	64	10.63	1.56	54	10.44	1.7	0.672
	B	158	11.97	1.4	178	11.94	1.17	0.876
	C	224	13.14	1.36	260	13.03	1.56	0.554
	D	114	14.3	1.75	116	14.81	1.89	0.131
	E	114	15.82	1.84	150	16.32	2.31	0.186
	F	36	16.83	1.69	58	17.17	1.54	0.483
	G	50	18.64	1.58	92	19.2	1.85	0.207
	H	224	21.92	2.4	300	21.89	2.24	0.927
48	A	54	10.67	1.776	60	10.5	1.61	0.712
	B	192	11.86	1.295	166	11.95	1.18	0.64
	C	224	13.35	1.367	272	13.04	1.62	0.108
	D	92	14.41	1.707	128	14.84	1.65	0.187
	E	106	15.74	1.831	126	16.54	2.35	0.045*
	F	46	17.39	1.751	72	17.33	1.72	0.901
	G	42	18.43	1.535	90	19.31	1.83	0.06
	H	228	21.87	2.419	294	21.92	2.25	0.863

*$p < 0.05$.

3. Results

The mean mineralization ages for various stages of third molar mineralization with their standard deviations and standard error are described in Table 2.

Firstly, the difference of chronological age between all the four third molars were tested using the Student's t test and was found that only 48 in the stage E had significant difference in mineralization between male and female ($p = 0.045$). The comparison of mineralization of third molars with reference to gender group is described in Table 3.

There was significant difference in mineralization ages between maxilla and mandible in between males and females. For males, at stage B, mineralization of 18 was 0.51 years earlier than 38, that of 28 was 0.58 years earlier than 38 and 0.47 years earlier than 48. At stage C, mineralization of 18 was 0.57 years earlier than 48, that of 28 was 0.46 years earlier than 38 and 0.67 years earlier than 48. Lastly, the mineralization of 18 and 28 in stage F were earlier than 48 by 0.73 years and 1.29 years respectively.

For females, at stage C, D, E and G development of 18 and 28 were all earlier than 38 and 48 and the difference was significant. At stage C, development of 18 was 0.557 years earlier than 38, and

Table 1
Number of individuals per age group and sex.

	Age (years)																		Total (n)
	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
Male	8	18	26	70	138	116	132	74	64	50	44	42	38	34	28	22	40	40	984
Female	8	14	24	86	164	154	80	74	96	72	56	74	68	44	54	52	44	44	1208
Total	16	32	50	156	302	270	212	148	160	122	100	116	106	78	82	74	84	84	2192