

DENTAL AGE ESTIMATION BASED ON THIRD MOLAR ERUPTION IN FIRST NATIONS PEOPLE OF CANADA.

A Olze¹, BR Pynn², V Kraul¹, R Schulz³, A Heinecke³, H Pfeiffer³, A Schmeling³

¹University Hospital Charité Berlin, Institute of Legal Medicine, Germany

²Pterosaur Healthcare Inc., Thunder Bay, Canada

³University Hospital Münster, Institute of Legal Medicine, Germany

ABSTRACT

Forensic age estimation of living subjects has become an increasing focus of interest in modern society. One main criterion for dental age estimation in the relevant age group is the evaluation of third molar eruption. The importance of ethnic variation in dental development requires population specific data for dental age evaluation. In the present study, we determined the stages of third molar eruption in 347 female and 258 male First Nations people of Canada aged 11 to 29 years based on radiological evidence from 605 conventional orthopantomograms. The results presented here provide data on the age of alveolar, gingival, and complete eruption of the third molars in the occlusal plane that can be used for forensic estimation of the minimum and most probable ages of investigated individuals.

(J Forensic Odontostomatol 2010; 28:1:32-38)

Keywords: Dental age; Tooth eruption; Third molar; First Nations people of Canada

Running title: Third molar eruption in First Nations people of Canada

INTRODUCTION

Forensic age assessment in living subjects has become increasingly important over the last few years¹⁻⁴ The investigated individuals are foreign nationals without valid identification papers whose chronological age is of relevance in legal proceedings. In most countries, the age thresholds of legal importance lie between 14 and 21 years.

In accordance with the updated recommendations for age estimation in criminal proceedings of the Study Group on Forensic Age Diagnostics, for an age estimation a physical examination, an radiograph of the hand as well as a dental examination should be performed. If the skeletal development of the hand is completed, an additional radiological examination of the clavicles should be carried out.⁵

One main criterion for dental age estimation in the relevant age group is the evaluation of third molar eruption. The importance of ethnic variation in dental development requires further population studies in order to reach an adjustment of each method according to the specific population, with an increase in precision and accuracy.⁶

This paper presents statistical measures on the time course of third molar eruption in First Nations people of Canada.

MATERIALS AND METHODS

A total of 605 conventional orthopantomograms of 347 female and 258 male First Nations people of Canada of known age (11 to 29 years) were analyzed retrospectively. The First Nations people of Canada who were investigated belonged to the Ojibwa tribe. Today, the Ojibwa live in local reservations north of the Lake Superior and the Lake Huron as well as in parts of Minnesota, North Dakota, Wisconsin, Manitoba and Saskatchewan. The orthopantomograms were made during the years 1987-2007. Patient identification number, sex, date of birth, date of exposure, and eruption stages of the third molars were recorded for each individual subject. The age and sex distribution of the study population is shown in Table 1.

The eruption stages were evaluated using the classification of stages by Olze et al.⁷ (Fig. 1):

- Stage A Occlusal plane covered with alveolar bone.
- Stage B Alveolar eruption; complete resorption of alveolar bone over occlusal plane.
- Stage C Gingival emergence; penetration of gingiva by at least one dental cusp.
- Stage D Complete emergence in occlusal plane.

Impacted third molars were excluded from the analysis. Mesially, distally and vestibulo-orally angulated third molars were classified as

impacted as recommended by Archer⁸ and Wolf and Haunfelder.⁹ Wisdom teeth with an unclear direction of eruption also were not included in the analysis.

Statistical analyses were performed using the program SPSS 16.0 for Windows. Each individual age was calculated as date of exposure minus date of birth and recorded as years and 1/10 of years. For each stage a minimum and a maximum were found and a median with lower and upper quartiles as well as a mean with standard deviation were calculated. In case of stage D, 50% probability values have been calculated using logistic regression.

RESULTS

The results of the statistical analysis for females are shown in Table 2 and for males in Table 3. Table 4 presents the 50% probability values for stage D.

For both sexes the obtained data show that within the entire observed age interval, the minima and means of the chronological age increased with increasing stage. Thus, they demonstrate a good correlation between the stages and the chronological ages of the subjects.

Stage B was first achieved by females between 12.4 and 13.1 years and by males between 13.0 and 13.4 years. The earliest appearance of stage C was at age 13.7 years in females and between 13.6 and 18.0 years in males. The occurrence of stage D was first found between 15.9 and 17.4 years in females and between 14.5 and 18.3 years in males.

For stage A the means varied for both sexes between 12.8 and 15.1 years. The means of stage B were between 15.9 and 18.4 years. The means for stage C showed a range between 17.2 and 21.6 years. For stage D the means varied between 20.5 and 22.8 years. The 50% probability values for stage D were found between 18.7 and 23.2 years.

DISCUSSION

Tooth eruption is a parameter of developmental morphology which, unlike tooth mineralization, can be determined in two ways: by clinical examination and/or by evaluation of dental radiographs. While 'eruption' incorporates the entire journey of the tooth from its formation in the alveolar crypts to full occlusion, 'emergence' is restricted to the time when any part of the

tooth finally clears the gingival margin and becomes visible in the mouth until the stage when the tooth finally comes into occlusion with its partner tooth from the opposing jaw.¹⁰

Studies on the chronology of third molar eruption are scarce. Rantanen¹¹ investigated the clinical emergence of third molars in a total of 2218 Finnish males and females ranging in age from 16 to 24 years. The median age of upper and lower third molar eruption in the male subjects was determined to be 21.7 and 21.8 years, respectively, compared to 23.3 and 23.0 years in females. In this study population, the third molars of the male subjects emerged roughly 1.5 years earlier than those of the females.

Levesque et al.¹² determined the age of alveolar and gingival eruption and mineralization state of the third molars based on evidence from 4640 orthopantomograms from 2278 male and 2362 female Franco-Canadians of ages ranging from 7 to 25 years. Alveolar eruption occurred at a mean age of 17.7 years in the investigated females and 17.2 years in the male subjects. Complete clinical emergence of the wisdom teeth occurred at the age of 19.0 years in the female subjects and 18.5 years in the males. Thus, alveolar eruption of the third molars occurred 0.2 years earlier and gingival emergence occurred 0.5 years earlier in the males than in the females.

Müller¹³ analyzed third molar emergence in 823 male and female German subjects of ages ranging from 16 to 40 years. The median ages of third molar emergence were found to be 20.36 and 20.29 years, respectively. No emergence of third molars was observed in the group of 16-year-olds; the presence of third molars was first detected in the group of 17-year-olds. More than 50 % of the complete set of third molars had emerged by the age of 21 years.

In a review of literature on growth and development in Japan, Kimura¹⁴ provided Japanese statistics on third molar emergence (mean age: 19.8 years in males and 21.0 years in females).

Olze et al.⁷ analyzed and compared the chronological course of third molar eruption in German, Japanese, and South African populations. They found that the investigated German population has an intermediate rate of dental development as determined by comparing the different ages of third molar eruption. The defined eruption stages occurred

at earlier ages in the investigated South African population, and at later ages in the Japanese population. Statistically significant population differences were observed in males at stages A and B. The South African males were a mean of 3.0 to 3.2 years younger than the German males at these stages of development, and the Japanese males were a mean of 3.1 to 4.2 years older than their South African counterparts. The females exhibited statistically significant population differences at stages A, B and C. The South African women reached the target stages a mean of 1.6 to 1.8 years earlier than the German women, whereas the Japanese women were a mean of 0.9 to 3.3 years older than their German counterparts.

Compared to the data published by Olze et al.⁷ the First Nations people of Canada who were examined in the present study are intermediate between South Africans and Germans in most stages and in both sexes. This means that compared to South Africans the First Nations people of Canada show delayed eruption of the third molars. In comparison to Germans and Japanese, however, the First Nations people of Canada show accelerated eruption of the third molars, with the difference between the First Nations people of Canada and the Japanese being more crucial than between the First Nations people of Canada and the Germans. However, due to the different age structure of the studied sample compared to the populations studied by Olze et al.,⁷ those statements should be made very carefully.¹⁵

CONCLUSION

The results of our study show the necessity of generating population-specific data for forensic age diagnostics in living individuals. According to the authors' knowledge, this research paper is the first study of the time course of third molar eruption in First Nations people of Canada.

Our results provide data on the age of alveolar, gingival, and complete eruption of the third molars in the occlusal plane that can be used for dental age estimation. As the mean values and medians of stage D of the third molar eruption depend on the upper limit of age of the investigated sample, the 50% probability value was also set for this stage. This value refers to the most probable minimum age of a person whose third molars show stage D.

Table 1: Age and sex distribution of the sample

Age (Years)	Number Male	Number Female
11	1	9
12	7	12
13	8	13
14	10	18
15	14	23
16	19	33
17	22	33
18	33	45
19	26	32
20	18	28
21	24	29
22	17	21
23	18	22
24	14	9
25	10	6
26	6	3
27	3	8
28	6	1
29	2	2

Table 2: Statistical data on the age of emergence of teeth 18, 28, 38 and 48, by stage, in females

Tooth	Stage	n	Min	Max	Mean	SD	LQ	Median	UQ
18	A	53	11.3	25.5	15.1	2.6	13.4	15.0	16.6
	B	100	13.1	27.0	18.2	2.7	16.0	18.3	19.8
	C	38	13.7	27.4	20.2	2.9	18.6	19.7	22.5
	D	52	17.4	29.4	22.3	2.9	20.2	22.3	23.8
28	A	50	11.0	23.3	14.8	2.5	12.6	14.6	16.6
	B	109	13.1	27.5	18.4	2.9	16.1	18.2	20.1
	C	36	13.7	27.3	20.0	3.0	18.2	19.7	21.6
	D	56	17.4	29.3	22.2	3.0	19.7	21.9	24.1
38	A	13	11.1	17.1	13.3	1.9	11.8	13.0	14.8
	B	48	12.4	26.2	17.3	2.9	15.1	16.9	18.0
	C	9	13.7	23.7	17.5	3.0	15.2	16.7	19.0
	D	20	15.9	27.4	20.6	3.3	18.3	19.2	22.8
48	A	15	11.1	17.3	13.7	2.3	11.7	12.2	15.8
	B	39	12.4	26.2	16.7	2.8	14.3	16.5	18.8
	C	17	13.7	23.7	18.5	2.5	16.6	18.9	20.2
	D	24	15.9	29.4	21.3	3.9	18.2	19.6	25.1

n = number of cases
SD = standard deviation

Min = minimum age
LQ = lower quartile

Max = maximum age
UQ = upper quartile

Table 3: Statistical data on the age of emergence of teeth 18, 28, 38 and 48, by stage, in males

Tooth	Stage	n	Min	Max	Mean	SD	LQ	Median	UQ
18	A	29	11.7	18.9	14.9	2.0	13.0	14.8	16.8
	B	61	13.4	25.4	17.8	2.2	16.5	17.8	19.1
	C	18	18.0	29.8	21.6	3.0	19.4	21.5	23.5
	D	83	14.5	28.8	22.2	2.6	20.7	22.1	23.7
28	A	26	11.7	18.9	14.6	2.1	12.8	14.6	16.6
	B	81	13.4	26.7	18.1	2.5	16.5	17.9	19.3
	C	30	13.6	26.3	20.6	2.7	18.7	20.8	22.5
	D	73	14.5	29.8	22.8	2.8	20.9	22.5	24.8
38	A	5	12.2	13.5	12.8	0.5	12.4	12.9	13.2
	B	20	13.0	19.3	15.9	1.7	14.7	15.4	17.2
	C	3	16.7	19.5	18.1	1.4	16.7	18.3	19.5
	D	20	18.0	29.3	21.6	2.8	19.6	21.2	22.6
48	A	5	12.0	17.1	13.6	2.1	12.1	13.0	15.4
	B	20	13.0	19.5	16.2	1.8	14.9	16.3	17.5
	C	3	15.0	18.5	17.2	1.9	15.0	18.0	18.5
	D	17	18.3	26.3	20.5	2.1	19.0	19.6	21.3

n = number of cases
SD = standard deviation

Min = minimum age
LQ = lower quartile

Max = maximum age
UQ = upper quartile

Table 4: 50% probability values for stage D

	Tooth 18	Tooth 28	Tooth 38	Tooth 48
Females	23.0	23.2	22.0	21.3
Males	20.5	21.6	18.8	18.7

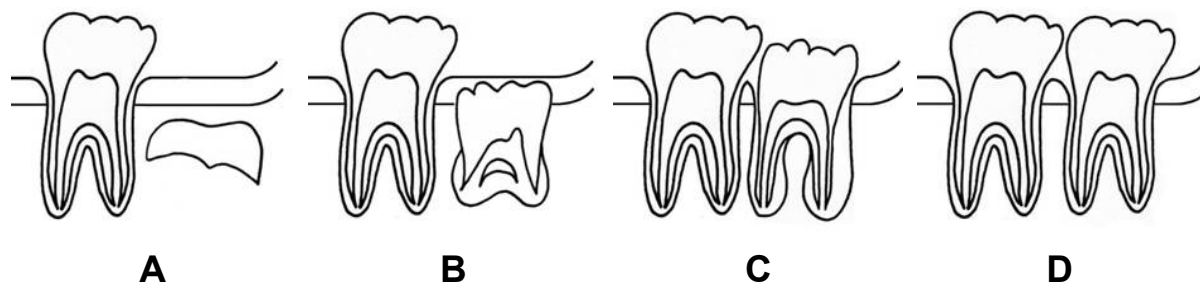


Fig. 1: Stages A to D of third molar eruption

REFERENCES

1. Willems G. A review of the most commonly used dental age estimation techniques. *J Forensic Odontostomatol* 2001;19:9-17.
2. Teivens A, Mörnstad H. A modification of the Demirjian method for age estimation in children. *J Forensic Odontostomatol* 2001;19:26-30.
3. Teivens A, Mörnstad H. Comparison between dental maturity rate in the Swedish and Korean populations using a modified Demirjian method. *J Forensic Odontostomatol* 2001;19:31-35.
4. Rai B, Krishan K, Kaur J, Anand SC. Age Estimation from Mandible by Lateral Cephalogram: A Preliminary Study. *J Forensic Odontostomatol* 2008;27:24-28.
5. Schmeling A, Grundmann C, Fuhrmann A, Kaatsch H-J, Knell B, Ramsthaler F, Reisinger W, Riepert T, Ritz-Timme S, Rösing FW, Rötzscher K, Geserick G. Criteria for age estimation in living individuals. *Int J Legal Med* 2008;122:457-460.
6. Cunha E, Baccino E, Martrille L, Ramsthaler F, Prieto J, Schuliar Y, Lynnerup N, Cattaneo C. The problem of aging human remains and living individuals: a review. *Forensic Sci Int* 2009;193:1-13.
7. Olze A, van Niekerk P, Ishikawa T, Zhu BL, Schulz R, Madea H, Schmeling A. Comparative study on the effect of ethnicity on wisdom tooth eruption. *Int J Legal Med* 2007;121:445-448.
8. Archer WH. *Die Chirurgie des Mundes und der Zähne*. Stuttgart: Medica, 1955.
9. Wolf H, Haunfelder D. *Zahnärztliche Mundchirurgie für Studierende der Zahnheilkunde*. Berlin: Berlinische Verlagsanstalt, 1960, pp. 59-67.
10. Scheuer L, Black S. *Developmental Juvenile Osteology*. London: Academic Press, 2000.
11. Rantanen AV. The age of eruption of the third molar teeth. *Acta Odontol Scand* 1967;25(Suppl):1-86.
12. Levesque GY, Demirjian A, Tanguay R. Sexual dimorphism in the development, emergence, and agenesis of the mandibular third molar. *J Dent Res* 1981;60:1735-1741.
13. Müller HR. *Eine Studie über die Inkonstanz des dritten Molaren (Fehlen, Anlage, Durchbruch)*. Dresden, 1983.
14. Kimura K. Studies on growth and development in Japan. *Yearbook Phys Anthropol* 1984;27:179-214.
15. Gelbrich B, Lessig R, Lehmann M, Dannhauer K-H, Gelbrich G. Altersselektion in Referenzstichproben. Auswirkung auf die forensische Altersschätzung. *Rechtsmedizin* 2010; doi 10.1007/s00194-010-0703-3.

Address for correspondence:

Prof. Dr. Andreas Schmeling
 Universitätsklinikum Münster
 Institut für Rechtsmedizin
 Röntgenstr. 23, 48149 Münster, Germany
 T +49 251 83 55 156
 F +49 251 83 55 158
 Email: andreas.schmeling@ukmuenster.de