Comparative study on the effect of ethnicity on wisdom tooth eruption

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Abstract

The current knowledge base for evaluating the influence of ethnic origin on wisdom tooth eruption is still inadequate. We therefore analyzed and compared the chronology of wisdom tooth eruption in three ethnic populations—German, Japanese, and black South African—based on evidence from 2,482 conventional orthopantomograms. The investigated German population ranked in the middle in terms of the age of wisdom tooth eruption. The black South African population was the fastest and the Japanese population the slowest in terms of reaching the respective eruption stages. Population-specific reference data should be used when evaluating wisdom tooth eruption for the purpose of forensic age estimation.

Introduction

Forensic age estimation in living subjects is a current focus of research interest [2, 4, 5, 11, 12, 14–18]. Wisdom tooth mineralization has been the main criterion used for dental age diagnosis in adolescents so far. Olze et al. [13] studied the effects of ethnicity on wisdom tooth mineralization. To summarize, the authors concluded that their Caucasoid population ranked in the middle of the investigated ethnic groups in terms of dental development as defined by their age at reaching the large majority of mineralization stages. The investigated Asiatic subjects were a mean 0.5–3 years older and the investigated African subjects 0.5–2 years younger than their Caucasian counterparts when they reached the same stages of dental development. The influence of ethnic origin on wisdom tooth eruption is still poorly understood. In the present study, we therefore analyzed and compared the chronological course of wisdom tooth eruption in German, Japanese, and South African populations, respectively.

Materials and methods

We analyzed a total of 2,482 conventional orthopantomograms from 666 German, 1,300 Japanese, and 519 black South African subjects aged 12–26, with known dates of birth. The patient identification number, sex, date of birth, and date of X-ray were recorded for each test subject. Each patient's age was calculated based on the date of birth and the date of X-ray. Table 1 shows the age, sex, and ethnic distribution of the sample sets.

Table 1 Age and sex distribution of the ethnic populations studied

Age (years)	German		Japanese		Black South African	
	Men	Women	Men	Women	Men	Women
12	0	13	0	0	5	3
13	0	28	0	0	8	4
14	2	33	2	3	3	4
15	5	48	9	11	8	5
16	5	45	12	23	9	12
17	1	49	9	14	15	6
18	5	41	32	57	21	7
19	11	51	69	98	34	6
20	19	39	69	108	37	11
21	22	60	71	119	48	9
22	18	31	73	118	63	12
23	18	42	98	110	55	12
24	19	33	68	54	58	7
25	14	9	34	33	33	6
26	5	0	3	3	13	2
Total	144	522	549	751	410	106

The following staging system was used for the classification of third molar eruption (Fig. 1):

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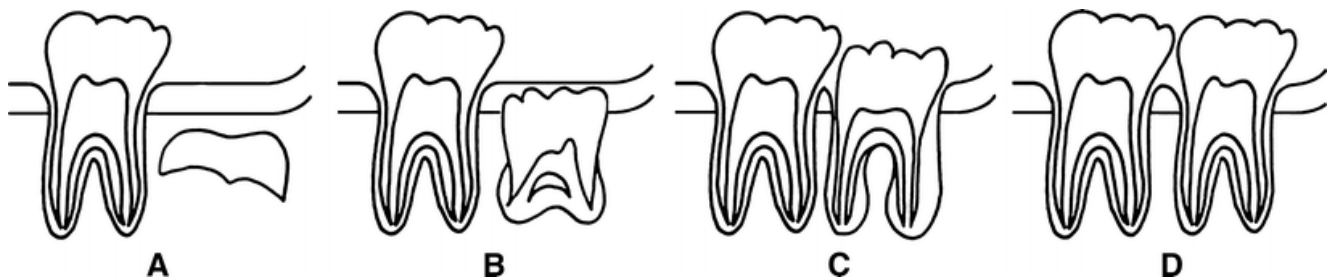Stage D Complete emergence in occlusal plane

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

Impacted wisdom teeth were excluded from the analysis. Mesially, distally, and vestibulo-orally angulated third molars were classified as impacted as recommended by Archer [1] and Wolf and Haunfelder [19]. Wisdom teeth with an unclear direction of emergence also were not included in the analysis. All staging was carried out by the same observer (Olze).

Statistical analyses were performed using the SPSS software. To cope with outliers and/or skew distributions, differences between groups of interest were analyzed using nonparametric tests (Kruskal–Wallis test for multiple groups, Mann–Whitney U test for two independent groups, and Wilcoxon test for paired observations). Exact versions of the tests were used to handle major differences in sample sizes. The level of significance was defined as $p < 0.05$ (two-sided tables).

Results

Table 2 provides various statistical data on the age of emergence of tooth 18 in the different population groups defined by ethnic origin and sex. Mean values with standard deviation ranges and median values with lower and upper quartiles are given. Statistically significant differences between different ethnic groups are also indicated. A similar structure of significance was derived for teeth 28, 38, and 48.

Table 2 Statistical data on the age of emergence of tooth 18, by stage, and significant population differences

Stage	Sample	n	Mean age[a]	Median, LQ, UQ
A	German men	14	18.9±3.4[c]	18.3, 15.5, 21.9
	German women	146	16.6±3.0[b,c]	16.0, 14.1, 18.8
	Japanese men	43	19.9±2.9[d]	20.1, 17.5, 22.0
	Japanese women	98	19.9±2.7[b,d]	20.0, 18.3, 22.1
	South African men	18	15.7±3.5[c,d]	14.6, 13.0, 17.6
	South African women	15	14.8±1.9[c,d]	14.9, 13.0, 16.0
B	German men	32	20.8±2.7[c]	21.2, 19.7, 22.9
	German women	172	18.9±3.2[b]	18.4, 16.3, 21.4
	Japanese men	93	20.9±2.8[d]	20.6, 19.0, 23.3
	Japanese women	129	20.6±2.2[b,c]	20.4, 19.3, 22.3
	South African men	44	17.8±2.8[c,d]	17.7, 16.2, 19.3
	South African women	16	18.0±3.0[d]	17.2, 15.4, 21.3
C	German men	15	22.1±2.3	21.3, 20.1, 24.2
	German women	45	20.3±2.1[b,c]	20.2, 18.8, 21.8
	Japanese men	91	21.5±2.2	21.5, 19.6, 23.5
	Japanese women	133	21.2±2.0[b,d]	20.9, 19.4, 22.7
	South African men	24	20.7±2.5	20.5, 18.6, 22.6
	South African women	6	18.7±1.6[c,d]	19.2, 17.2, 19.7
D	German men	31	23.4±2.3	24.0, 21.9, 25.2
	German women	3	24.0±0.8	24.2, 23.2, 24.7
	Japanese men	204	22.4±2.0	22.7, 21.0, 23.9
	Japanese women	223	22.3±1.8	22.4, 21.2, 23.6
	South African men	284	22.7±2.1	22.8, 21.3, 24.3
	South African women	60	22.0±2.6	22.3, 20.4, 23.8

Discussion

Only a few comparison studies on wisdom tooth eruption have been published so far, and these studies are limited to gingival eruption.

Fanning [*7*] investigated gingival third molar emergence in American white men (*n*=2,370) and women (*n*=1,053) from the Boston area (age = 13–22 years) and compared the data with that from a black African population described by Chagula [*6*]. The Americans' upper wisdom teeth emerged at a mean age of 20.5 years in both men and women, and the lower wisdom teeth emerged at mean ages of 19.8 years in men and 20.4 years in women. According to the figures published by Chagula [*6*], dental development in Africans is faster: Their upper and lower wisdom teeth erupted at the ages of 13–16 and 17–20 years, respectively, which is 2.5 and 1.25 years earlier than in their white American counterparts.

Similarly, Garn et al. [*8*], who investigated the eruption of permanent teeth in 953 black and 998 white Americans, found that upper wisdom teeth of black Americans emerged 3.7 years earlier and lower wisdom teeth 5.6 years earlier than in white Americans.

In a review of the literature on growth and development in Japan, Kimura [*10*] provided Japanese statistics on third molar emergence (mean age = 19.8 years in men and 21.0 years in women). After comparing his data with that of Fanning [*7*] for white North Americans, Kimura concluded that the figures are in close agreement.

Hassanali [*9*] compared third molar eruption in 1,343 Africans and 1,092 Asians from Kenya. In the African subjects, the lower wisdom teeth emerged at a mean age of 17.6–18.3 years and the upper wisdom teeth at 18.5–18.9 years. The corresponding ages in the Asian subjects were 19.9–20.3 years for the lower wisdom teeth and 20.7–21.0 years for the upper wisdom teeth. Accordingly, dental development in the African Kenyans occurred roughly 2–3 years faster. Hassanali therefore concluded that wisdom tooth eruption began at the age of 13 in the investigated African subjects and that all four wisdom teeth had erupted in 50% of these subjects by the age of 18.5 years. In the investigated Asian subjects, on the other hand, wisdom tooth eruption began at the age of 15, and all four wisdom teeth had erupted in 50% of the group by the age of 21.5 years.

In our study, the assessment of stage C (gingival eruption) turned out to be quite difficult in some cases. In the cases, in which the gingiva was not clearly recognizable and the dental surface was at the level of the expected gingiva, no assessment was made. When the surface of the teeth was clearly above the expected gingiva and below the occlusal plane, the teeth were classified as stage C. This method might have led to the fact that the statistical scores for stage C are a little to high in our study. However, this would not have a

negative effect on the examined individuals in case of age estimations in criminal proceedings.

The present study is, to the best of our knowledge, the first to supply comparative reference data on wisdom tooth eruption for Caucasian, Asian, and African subjects of forensically relevant age whose dates of birth have been verified under standardized conditions. All age estimates were performed by the same observer to eliminate potential interobserver error. We 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 women at stages A, B, and C. The South African women reached the target stages a mean 1.6–1.8 years earlier than the German women, whereas the Japanese women were a mean 0.9–3.3 years older than their German counterparts. The men also exhibited statistically significant population differences at stages A and B. The South African men were a mean 3.0–3.2 years younger than the German men at these stages of development, and the Japanese men were a mean 3.1–4.2 years older than their South African counterparts.

The population differences observed here may be due to differences in palatal dimensions between the ethnic groups surveyed. The largest palatal dimensions are observed in Africans and the smallest in Asians, with Caucasians ranking in the middle [3]. Inadequate space in the maxillary crest may lead to delayed wisdom tooth eruption or impaction [7].

According to our study results, we conclude that forensic age assessments should be based on population-specific reference data.

Acknowledgments

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