EPIDEMIOLOGY

The impact of race on tooth formation

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Physiological age is estimated by the degree of maturation of different tissue systems. Dental age is one of the indicators used. The other indicators refer to secondary sex characteristics, bone development, stature or weight.

Dental age can be determined by the formation and emergence of teeth. Tooth formation is superior to tooth emergence for assessing dental maturation, because emergence is also influenced markedly by environmental factors such as loss of primary predecessors and the lack of space in the dental arch.

Dental age determination using tooth formation is used not only in the clinical field, but also forensic dentistry. Many studies of tooth formation have been reported; a comparative study among different races, however, has not been reported to date. This report presents the results of a comparative study on the formation of mandibular first molars among American white, Japanese and Chinese children living in the city of San Francisco in the United States.

SUBJECTS AND METHODS

The subjects consisted of 650 children (American white 245, Chinese 202, Japanese 203) from five to twelve years old, who came to the Department of Growth and Development, University of California, San Francisco (Table 1). They were found free of systemic disease, and defects of their mandibular first molars. Thirteen hundred mandibular first molars were assessed to determine their development by inspecting panoramic radiographs (Orthoralix SD ceph, Gendex of Des Plaines) and assigning a rating according to Kullman's method, which classifies tooth formation in seven stages, according to their growth and development (Figure).[1] Stage 7 is excluded from this study because of the impossibility of determining the age at which this stage is reached. A statistical analysis was undertaken to determine the differences among the three races. The samples in each age-stage were evaluated by their means values. Using a standard deviation according to their nationalities and gender, respectively, a statistical analysis was performed to determine the difference between boys and girls.

Table 1 ☐ Number of children at each age.

Race/Age	American White		Chinese		Japanese	
	Boys	Girls	Boys	Girls	Boys	Girls
5- <6 years	15	17	13	14	15	11
6- <7 years	18	16	18	12	14	13
7- <8 years	15	14	14	16	14	12
8- <9 years	21	20	13	14	17	16
9- <10 years	19	18	16	18	16	18
10- <11 years	17	21	12	17	15	14
11- <12 years	16	18	14	11	14	14
Totals	121	124	100	102	105	98

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Table 2 ☐ Mean ages and standard deviations in years by gender and race in the different stages.

Stages	American White						Chinese						Japanese					
	Boys			Girls			Boys			Girls			Boys			Girls		
	mean	sd	sample	mean	sd	sample	mean	sd	sample	mean	sd	sample	mean	sd	sample	mean	sd	sample
1	5.2	0.7	2			0			0			0			0			0
2	5.2	0.4	9	5.1	1.1	4	5.7	1.2	5	5.5	1.4	6	5.8	1.5	5	5.5	1.4	7
3	5.4	0.7	26	5.2	0.7	17	6.0	1.0	15	5.8	1.0	17	5.7	0.7	8	6.0	0.7	10
4	6.0	1.5	30	5.7	1.5	28	6.8	1.4	20	6.6	1.1	30	7.2	1.7	38	6.6	0.4	38
5	7.3	1.4	37	7.0	1.7	34	8.2	1.3	36	7.7	1.6	42	8.3	1.5	42	7.0	1.3	49
6	8.0	1.6	60	7.6	1.5	54	8.7	1.4	71	8.4	1.2	61	9.0	1.6	60	8.4	1.6	55

*p<0.05 **p<0.01

Table 3 ☐ T-test of significance in years of the three races in the six stages.

Races / Stages	American White			Chinese			Japanese		
	mean	sd	sample	mean	sd	sample	mean	sd	sample
1	5.2		2			0			0
2	5.2	0.5	13	5.6	0.7	11	5.7	1.5	12
3	5.3	0.7	43	5.9	0.6	32	5.9	0.8	18
4	5.9	1.2	58	6.7	0.9	50	6.8	1.1	76
5	7.1	1.6	71	8.0	1.5	78	7.7	1.2	91
6	8.0	0.9	114	8.6	1.3	132	8.6	1.4	115

*p<0.05 **p<0.01

The panoramic radiographs were rated by three examiners, all trained by the same person, who was also one of the examiners. Each examiner rated the same percentage of radiographs from each age-group. At the end of each day, five randomly chosen radiographs were reassessed by each examiner, the results were compared and any discrepancies were discussed. Disagreement between examiners occurred in no more than 10 percent of these films and never differed by more than one stage.

Mean ages and standard deviations were calculated for the development stages of the mandibular first molars for the three races.

RESULTS

- ☐ Mean ages and standard deviations in years for different stages and genders. The results of the mean ages and standard deviations in years for different stages and gender are presented. In the t-test, girls tended to form their teeth earlier than boys in all racial groups from stage 5 to stage 7 (Table 2).
- ☐ The significance of the difference in tooth formation among the three races. In the t-test, tooth formation of American white children showed to be significantly higher than any other race at every stage (except stage 1). The Japanese and Chinese children's results were very similar to each other (Table 3).
- ☐ The coefficient of the correlation between the mandibular first molar's formation stage and chronological age among three races. The coefficient between chronological age and tooth formation stage was shown to be 0.802 ($p<0.05$) in the American white, 0.748 ($p<0.05$) in the Chinese, and 0.703 ($p<0.05$) in the Japanese children.

DISCUSSION

Dental age is defined as the state of emergence and formation of dentition. The eruption of permanent teeth is markedly impeded by defect or radicular lesions of the primary predecessor, or by a narrow arch form. The tooth formation stage, as a means, reflects dental age better than eruption. This investigation was conducted with orthopantomography, which is useful for evaluating the development of teeth. Furthermore, this study was a cross-sectional study with a limited sample, and not a longitudinal survey.

The formation of permanent teeth has been dealt with for many years as first reported by many authors; and more recently by Kullman *et al* and Daito *et al*.[1,2,5,6] This

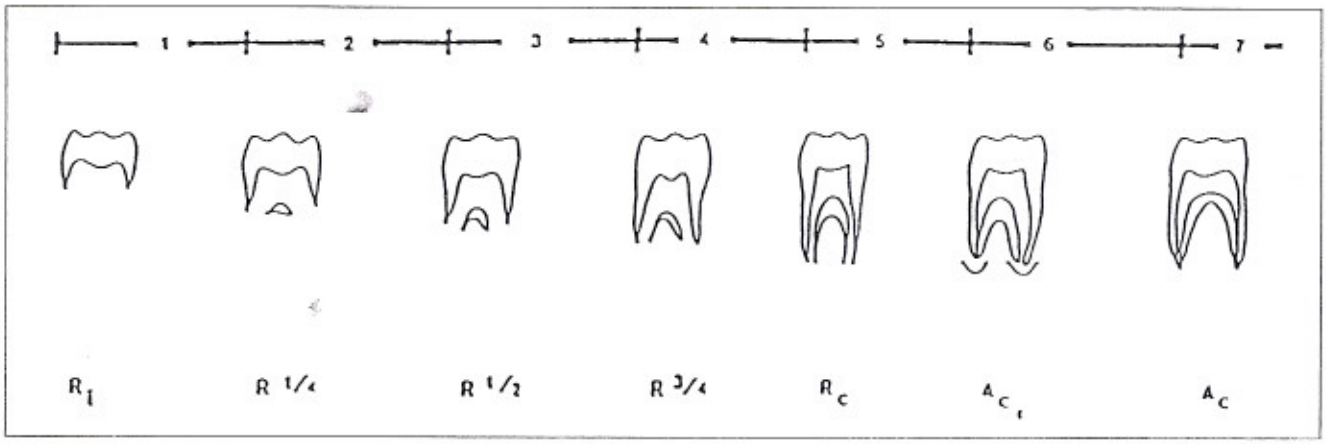

Figure. Classification of the different stages of root development of the mandibular first molar (Kullman's Classification, 1992)

Stage 1: Root development initiated, but less than one-quarter of the estimated root length has been formed.
Stage 2: One-quarter of the estimated full length of the root has been formed, but not yet one-half the estimated root length.
Stage 3: One-half or more of the estimated root length has been formed but not yet three-quarters of the estimated root length.
Stage 4: Three-quarters or more has been formed but not yet the whole estimated root length.
Stage 5: The full estimated root length has been formed but the initiation of apex closure has not started.
Stage 6: Apex closure has been initiated but the apices are not closed.
Stage 7: Apices are fully closed, the root development is compared.

relevent study is becoming more important, because of the current increasing necessity of endodontic therapy and occlusal guidance of permanent teeth.

Many factors may affect the development and growth of teeth. Our results imply that girls tend to form their teeth considerably earlier than boys, in all racial groups from stage 5 to stage 6. In a study of the mandibular permanent molars of Japanese children, using panoramic radiography, Daito *et al* reported that tooth formation in girls was earlier than boys at each stage, especially after the age of puberty.[6] The study was comparable to ours, but different in evaluating methods. Kullman *et al* found no significant differences, apart from stage 1 and stage 3, in an investigation of mandibular third molars, employing the same methods as in our study. If gender differences in tooth formation depended primarily on sex hormone activity, however, we would expect little sexual diomorphism before the tenth year of age. Actually, the gender differences exist well before that time, and are as we have shown. It is desirable to know why there are sex differences in tooth formation. There are reports on the effects of Vitamin A and Urethane on tooth formation, using rat incisors.[7,8] Our study suggested the relationship between complicated factors and tooth formation. Further epidemiological and experimental studies are necessary.

A comparable study within an identical community has not been reported. Our results showed that tooth formation was significantly more advanced in American white children than in Chinese or Japanese, at all stages. The differences in tooth shape between various racial groups have been well-recorded, and our study suggests that tooth formation also shows significant differences among the different races indicating that tooth formation may be affected by the racial factor. It is interesting that significant differences exist among three races, although there was no significant difference between Japanese and Chinese. It may be because the latter are both Asian.

Tooth formation was shown to be highly correlated with chronological age, with a coefficient of more than 0.7 in all of the racial groups. Demirjian *et al* reported the dental development of the third mandibular molar should not be used for estimation of chronological age, due to its high degree of inaccuracy.[9] Another paper also reported its inaccuracy.[10] The third molars correlate poorly with chronological age, because of their congenital absence or their tendency to regressive alteration. In contrast, it has been shown that the first molars are suitable for evaluation of tooth formation because of their consistency of development.

Tooth formation of the mandibular first molar has been shown to be a highly reliable indicator in determining the chronological age, as is suggested by the optimal coefficient results between the three racial groups in this study.

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BENEFITS OF WEIGHT LOSS AMONG OBESE PERSONS

Finally, these studies rarely account for relative weight or other important risk characteristics at study entry. Weight loss among persons who are already underweight may increase mortality risk, for example, and survivors of a heart attack or stroke may voluntarily lose weight but nonetheless have higher mortality rates than persons who gain a modest amount but do not have preexisting cardiovascular disease. A recent prospective study that controlled for many of these potential confounders reported substantial reductions in mortality among middle-aged women with obesity-related health conditions after intentional weight loss.

Intervention studies suggest that patients can achieve a 10 percent weight loss with reduced-calorie diets, exercise, behavioral modification, pharmacological therapy, or programs that combine more than one of these approaches. Relatively few patients, however, seem to be able to maintain their reduced weight over time. It may be argued, therefore, that our analysis is largely irrelevant at this time because lifelong maintenance of a 10 percent weight loss is unrealistic. More effective therapies for obesity are likely to emerge, however, with growing acceptance in the medical community that obesity is in fact a chronic illness requiring long-term management and ongoing research concerning the genetic and biochemical mechanisms regulating body weight. From this perspective, our findings serve to highlight the potential benefits of new therapies and accordingly may serve as a stimulus for biomedical research.

The health and economic consequences of obesity have drawn considerable interest in recent years. To the best of our knowledge, our study is the first to examine the lifetime health and economic benefits of intentional weight loss among persons who are obese. Our findings suggest that a modest (i.e., 10 percent weight loss–maintained for life–would yield important benefits in both human and economic terms.

Oster, G. *et al:* Lifetime health and economic benefits of weight loss among obese persons. Amer J Public Health, 89:1536-1542, October, 1999.