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Reliability of Third Molar Development for Age Estimation in a Texas Hispanic Population: A Comparison Study*

ABSTRACT: Evaluating third molars from 950 Hispanic individuals aged 12–22 years using Demirjian's schematic for crown and root formation found that Hispanic third molar development was 8–18 months faster than American Caucasians as reported by Mincer, Harris and Berryman in 1993. This represents a statistically significant increase. Earlier development was more apparent in the later stages F through H. Hispanic males reach developmental stages faster than Hispanic females and maxillary third molars reach developmental stages faster than mandibular third molars in both sexes. The earliest age observed for stages B–H (e.g., Stage H first observed at age 13.92 years in females) and the oldest age observed for Stages B–G were developed to facilitate age prediction of unknown individuals. Prediction tables for minimum and maximum age for an observed stage (e.g., if a female maxillary third molar is stage F it means she is older than 13 years) for each sex-jaw group were calculated.

KEYWORDS: forensic science, age estimation, third molar development, Hispanic population, tooth formation, dental development, panoramic radiographs, Demirjian's method, chronologic age, dental age estimation, human identification, forensic odontology, forensic anthropology

Age estimation of living and dead individuals utilizes growth and developmental indicators that can be active until the early fourth decade in humans. Data regarding the development of the third molar compliments the skeletal data available to estimate the age of unknown juveniles and young adults. Third molar development is most significant for age estimation of individuals from the mid teens to early twenties, a time when aging methods based on skeletal development include epiphyseal development and fusion in multiple regions of the body (1–10). The early phases of morphological change in the sternal rib end (11) and pubic symphysis (12) are also useful aging methods for this age span. Several authors have stated that the formation of the third molars are the only quantitative biologic variable available for estimating the age of an individual in the late teens or early twenties (13,14); however, a review of the medical and anthropology literature contradicts this notion. Additional argument for utilizing dental data over skeletal maturity data is that tooth formation appears to be less affected by nutritional stressors (15). However, it has also been suggested that age estimates based on skeletal development of the hand and wrist (5) are more accurate than those using the development of the lower third molar (15). These data sets are not mutually exclusive, however, as hand and wrist development is completed by the late teenage years and third molar root development can remain active into the early twenties. Similarly, epiphyseal union is completed in the elbow and ankle by age 18 in males and earlier in females (9,16). Comprehensive age estimation will utilize all available methods for the particular case and third molar development data compliments the skeletal indicators to give a complete assessment of age of unknown individuals.

Third molar emergence spans the age interval of 12–22 years (17,18). Radiographic analysis of third molar development expands the years of age estimation to 9–23 years as crown and root development can be studied independent of eruption (17,19). The stages designed by Demirjian et al. (20) for first and second molars are used to stage the root apex development of the third molars (21–23). Alone, the usefulness of predicting chronological age from third molar development stages is low (24,25); however, in combination with an overall picture of skeletal and dental maturity, a more narrow range is possible.

The range of ages of eruption of deciduous and early permanent teeth is considerably smaller than seen in later emerging teeth (26). Likewise, formation stages vary more in later forming teeth with the most variation seen in the third molar (26). In eruption patterns, females are advanced over males between the ages of 6 and 12 years (27). It has been established that males are advanced in third molar development over females (13,14,25,28–34). Maxillary development was found to be advanced over mandibular development for third molars in Japanese (32), United States (13,31,35), and European populations (29,30,34). However, in a study of American Black and White children, the first stages of crown calcification occurred earlier in mandibular teeth, with maxillary

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development becoming more advanced in the later stages of crown development (28). When multiple teeth are used in multiple regression equations to predict age, there is a slight but statistically significant improvement in accuracy (13).

Several studies have compared dental maturity in children of different genetic ancestries using the Demirjian method (20, 21, 36–38). These studies found that the tempo of formation of crown and root varied among genetic ancestry groups for third molars (14,25,28,31,35). Harris (39) suggests that there is a secular trend toward increased tempo of development for Westernized countries. Different comprehensive studies of mandibular third molars show that Blacks were advanced in crown formation (14,25,28) and root apexification over Whites (14,25). Blankenship et al. (14) found a more complex relationship in African American male third molar development. Blacks were advanced in earlier stages and Whites developed the later stages sooner. Also, unlike other groups, Blankenship et al. found that Black females achieved mineralization earlier than Black males, even in the third molars (14). Sex differences were not noted in other studies (25,28). Similarly, a recent study of Texas Hispanics (31) showed that Hispanics exhibited earlier dental maturation than samples studied by both Demirjian (20) and Mincer et al. (13). These studies suggest that a homogeneous tempo among different ancestral groups is unproven and greater sampling is needed (39).

Forensic age estimation is necessary when individuals without valid documentation of their age are involved in criminal or immigration investigations (13,23,24,40). The determination of adult or juvenile status is a legal question, not a scientific one, and is best left to those agencies responsible for making such decisions. These agencies should consult professionals who are able to provide age estimation services using the latest and most dependable biometric methods. The age estimation reports from those professionals should provide reliable scientific information to assist those agencies in making their determination. In cases of living individuals, third molar maturity is likely to be the best age estimation method as it is noninvasive, and usable dental images are easily obtained whereas many of the skeletal aging indicators cannot be evaluated radiographically. It has been found that root maturity in the third molar (stage H) may be one marker that indicates an individual is at least 18 years of age (13). The U.S. Immigration & Customs Enforcement routinely uses dental age estimation to classify juvenile detainees, defined as less than 18 years of age, in cases where age is not verifiable by legal documentation (23). It is estimated that for 2005 there were 700,000 unauthorized arrivals via the U.S.–Mexican border (41). Of 11.1 million unauthorized individuals, 8.7 million are estimated to be of Mexican or other Latin American origin (41–43). Published studies on U.S. Caucasian (13), U.S. Hispanic (31), Japanese (32), and Belgian Caucasian (34) samples generated empirical probability percentages to estimate if an individual has reached an 18th birthday. More current studies indicate that ancestry affects the development of third molars and new reference data should be collected and published (23).

The current study evaluated age estimation accuracy using third molar development of a North Texas (Dallas) and a South Texas (Cameron County) Hispanic population. It augments the study of Solari et al. (31) on third molar development in Hispanics, focuses the target age range by limiting the subject maximum age to 22 years, uses a greater number of subjects (950) from two separate geographical regions in Texas, and concentrates a higher percentage of subjects in the 16–19 year age groups. The data were compiled and compared with the 1993 ABFO study of third molar development in American Whites (13).

Materials and Methods

In total, panoramic radiographs of 950 Hispanic individuals of known age and sex were evaluated; 528 were from North Texas (Dallas) and 422 were from South Texas (Cameron County). There were 535 (56%) females and 415 (44%) males in this study. The ages ranged from 12 to 22 years. The age of subjects was verified by one of the following methods: birth certificates, Medicaid documentation, or birth date listed on the patient demographic information section of the subject's dental record. The mean age for females was 17.88 years. The mean age for males was 17.55 years. The distributions for age and sex are presented in Table 1.

Hispanic ancestry was established by one of the following methods: surname of unmarried individuals, and if married and female, maiden name taken from the patient demographic section of the subject's dental records. Parental verification and health provider assessment was used in some instances.

The data were collected in two separate studies. In both studies all radiographs were digitized and coded to ensure that examiners were blind to sex, name, and age of subjects. Radiographic images (n = 528) from North Texas were compiled from four dental offices in the Dallas area. A pool of forensic odontologists was calibrated for congruent staging estimations with a small subset of radiographs. Of this pool, four examiners were selected for the study. The examiners were given written instructions for staging, including drawings and written descriptions of the eight stages of root development, and a dental development chart modified from Demirjian et al. (20) that supplements the graphic representations with archetypical radiographs for each stage (Fig. 1) (22,23). Examiners were given two CDs of images and instructed to complete staging for all images. Further instruction was to examine the CDs on different days. Three examiners staged 130 images and one examiner staged 128 images.

Radiographic images (n = 422) from South Texas were collected from the Brownsville Community Health Center and several dental offices in Cameron County, TX. Seven examiners, one of which was also used for the North Texas study, were not calibrated prior to staging. Each examiner was provided with drawings and written descriptions of the eight stages of root development (20).

In all cases where multiple examiners staged the same tooth, an average value was obtained. For statistical computations, stages were assigned a numeric value where Stage A = 1, Stage B = 2, Stage C = 3, Stage D = 4, Stage E = 5, Stage F = 6, Stage G = 7, and Stage H = 8. If the average value remainder was greater than or equal to 0.5 then the stage was rounded up, conversely average value remainders less than 0.5 were rounded down. Staging data

TABLE 1—*Distribution of subjects by sex, age, and percent of population.*

Age	12	13	14	15	16	17	18	19	20	21	22
Male	5 (0.5)	16 (1.7)	46 (4.8)	44 (4.6)	61 (6.4)	66 (6.9)	67 (7.1)	35 (3.7)	30 (3.2)	22 (2.3)	23 (2.4)
Female	10 (1.1)	17 (1.8)	41 (4.3)	51 (5.4)	74 (7.8)	86 (9.1)	75 (7.9)	67 (7.1)	48 (5.1)	34 (3.6)	32 (3.4)
Total	15 (1.6)	33 (3.5)	87 (9.1)	95 (10)	135 (14.2)	152 (16)	142 (15)	102 (10.8)	78 (8.3)	56 (5.9)	55 (5.8)

Parentheses indicate percent of n.

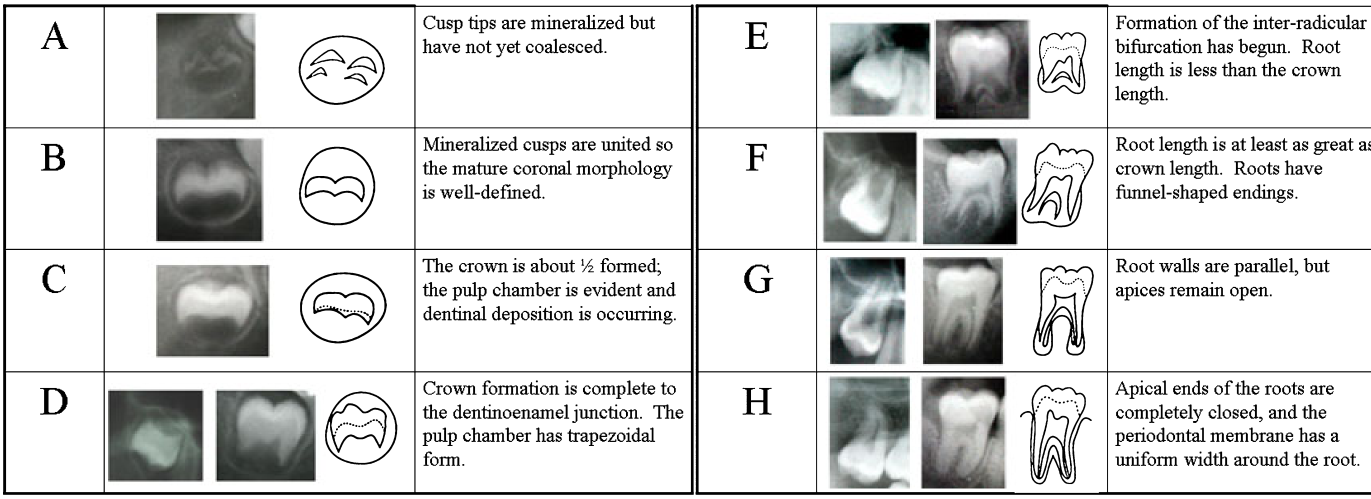

FIG. 1—*Third molar development chart with archetypical radiographic images (modified from Demirjian et al. [20]).*

TABLE 2—*Distribution of teeth analyzed.*

	Tooth #1	Tooth #16	Tooth #17	Tooth #32
415 Males (1589 molars)	388 (93.5)	397 (95.7)	402 (96.9)	402 (96.9)
535 Females (1997 molars)	483 (90.3)	495 (92.5)	507 (94.8)	512 (95.7)

Parentheses indicate percent of population by sex with that tooth observable.

was compiled from the 10 examiners and results and analysis were tabulated.

Table 2 shows the distribution of teeth that were analyzed. From one to four third molars were visible and stageable on the radiographs. Of 950 panoramic radiographs containing 3586 third molars, 83% (793) had all four third molars available for staging.

Combined, the examiners included eight experienced forensic odontologists, one oral surgeon, and a physician. To test for inter-examiner reliability ten identical radiographs were given to all examiners in the North and South Texas studies. To test intra-examiner reliability, each examiner unknowingly re-evaluated 20 of their images. Inter-examiner and intra-examiner reliability were analyzed using weighted kappa as the categories (tooth stages) in this study were ordered. The weighted kappa looks at the examiners' classifications over multiple examinations of the same tooth and assigns a weighted value that measures the level of agreement (0 = total disagreement, 1 = total agreement). Stages for teeth were ordinal and had a ranking, that is why weighted kappa worked well for inter- and intra-examiner reliability tests in this study. A weighted kappa score between 0.61 and 0.80 (inclusive) is classified as good (44). Results for weighted kappa in this study for inter-examiner reliability is $p = 0.676$ (good) and for intra-examiner reliability, $p = 0.766$ (good).

Results and Discussion

Mean ages were calculated for appropriate sex, jaw, and stage of development (see Table 3). Mean ages of Hispanics were compared with the mean ages of Caucasians from Mincer et al. (13) using *t*-tests ($p < 0.05$). Based on observed mean age differences third molar development is completed earlier in Hispanics compared with Caucasians in the following stages and jaws:

TABLE 3—*Mean ages* t-*test comparison.*

		n		Mean Age		*t*-test
Stage	Jaw-Sex	Kasper et al.	Mincer	Kasper et al.	Mincer	*p*-Value
C	Max-Female	9	2	16.60	17.30	0.7837
	Mand-Female	12	2	15.71	14.92	0.2464
	Max-Male	6	4	14.82	15.06	0.7940
	Mand-Male	11	4	15.17	16.17	0.2443
D	Max-Female	59	41	15.19	15.88	0.0405*
	Mand-Female	80	52	15.36	16.01	0.0506
	Max-Male	33	30	14.94	15.67	0.0723
	Mand-Male	44	31	14.75	15.37	0.0590
E	Max-Female	54	61	16.44	16.58	0.6909
	Mand-Female	69	55	16.53	16.52	0.9736
	Max-Male	64	29	15.54	16.28	0.0928
	Mand-Male	68	37	15.77	16.44	0.0596
F	Max-Female	91	59	16.96	17.55	0.0793
	Mand-Female	99	70	17.38	17.67	0.3130
	Max-Male	57	47	16.39	17.44	0.0047*
	Mand-Male	70	45	16.79	17.73	0.0387*
G	Max-Female	103	81	17.98	18.78	0.0114*
	Mand-Female	131	79	18.44	19.19	0.0194*
	Max-Male	63	52	17.25	18.13	0.0207*
	Mand-Male	87	74	17.89	18.43	0.0654
H	Max-Female	199	138	19.55	21.05	0.0000*
	Mand-Female	134	132	20.07	21.23	0.0000*
	Max-Male	182	154	19.31	20.74	0.0000*
	Mand-Male	132	135	19.88	20.93	0.0000*

*Mean ages are statistically different if *p*-value < 0.05.

Stage D: Female-Maxilla
Stage F: Male-Maxilla/Mandible
Stage G: Female-Maxilla/Mandible
Stage G: Male-Maxilla
Stage H: Female-Maxilla/Mandible
Stage H: Male-Maxilla/Mandible

The age differences showed an 8–18 month earlier maturation for Hispanics that is consistent for males and females in the latter stages (G and H) with the exception of Stage G in the male mandible.

One current theory to explain this finding involves precocious maturation as a result of body mass index Thus, in Hispanic populations where higher body mass levels may be achieved earlier, maturation may be earlier (9,19).

In this study, all stages of development for both jaws showed the mean ages for males to be lesser than female mean ages. In addition, the maxillary arch mean ages at each stage in development were lesser than mandibular arch mean ages in both sexes, with the following exceptions: female stage C and male stage D. The difference in tempos of formation between males and females and maxillary and mandibular arches have been reported in previous studies of third molar development (9,10,12,17–19). This finding confirms the dimorphism of third molars by jaw and sex and justifies keeping each separate when using third molars to estimate age.

There are large spans of chronologic ages observed for each stage of third molar development. Tables 6–9 demonstrate age spans as large as 11 years for female and male mandibles in Stage F. Age spans of 10 years are observed for Stage E in female mandibles and Stage G in both female jaws and Stage F in male maxillae. This justifies using an age interval rather than a point age estimate in estimating the age of an unknown person. Further justification is demonstrated as ages were overestimated by as much as 5.3 years in the younger age groups and underestimated by as much as 4.85 years in the older age groups when mean values were used for the estimated age. The need for a range surrounding the mean that incorporates 95–99% of the statistical population (± 2 or 3 SD) has been previously reported (10,25). Odontologists should understand, report, and explain the significance of means and ranges when providing age estimation services.

Table 4 presents the earliest age that a stage was obtained. The earliest age for completion of any third molar root (stage H) was 13.92 years in females and 14.58 years in males. These values can be used as a lower age limit in an estimation of the biological profile. In combination with other biological age indicators such as epiphyseal union, a narrow, yet accurate age interval can be constructed.

Table 5 presents the oldest age that each stage was observed. These data are useful for establishing an upper age limit for unidentified individuals. Stage H evaluation is not applicable to an upper age limit due to the fact that the sample was cut off at age 22 and Stage H is the end stage of development of a third molar. On reaching stage H, a tooth will remain at Stage H for the span of its existence both before and after the death of the host.

TABLE 4—*Earliest age observed per stage.*

Tooth				
Stage	#1	#16	#17	#32
Female				
B	14.83	14.08	13.25	13.25
C	14.00	12.25	13.33	12.92
D	12.25	12.25	12.25	12.25
E	12.67	12.92	12.67	13.08
F	12.67	12.67	12.75	12.67
G	12.75	12.75	13.58	13.58
H	14.00	14.00	15.92	13.92
Male				
B	14.00	13.17	13.17	13.17
C	13.17	13.17	13.17	12.33
D	12.17	12.50	12.17	12.17
E	12.33	12.33	13.08	13.08
F	13.58	13.58	13.92	12.50
G	14.00	14.00	14.83	14.83
H	14.58	14.58	16.00	16.00

TABLE 5—*Oldest age observed per stage.*

Tooth				
Stage	#1	#16	#17	#32
Female				
B	18.50	18.33	18.50	18.50
C	18.75	18.75	17.42	17.83
D	20.50	20.17	20.58	20.58
E	20.75	20.67	21.42	21.42
F	21.42	21.42	21.83	22.25
G	22.17	22.33	22.75	22.75
Male				
B	14.00	13.17	13.17	16.08
C	17.83	16.50	17.08	16.08
D	18.67	18.33	18.50	17.83
E	20.17	20.58	20.17	18.58
F	20.58	22.67	20.58	22.00
G	20.83	22.08	22.00	22.17

TABLE 6—*Female maxilla—number of teeth observed per stage/age.*

Age at Last Birthday (years)	Stage							Total
	B	C	D	E	F	G	H	
12	0	1	12	2	3	2	0	20
13	0	2	10	12	1	4	0	29
14	3	7	31	15	12	7	2	77
15	0	3	18	19	32	14	8	94
16	0	5	26	26	25	30	26	138
17	0	0	6	18	45	46	36	151
18	2	3	6	9	19	31	66	136
19	0	0	2	10	11	25	76	124
20	0	0	3	3	11	20	52	89
21	0	0	0	0	5	11	42	58
22	0	0	0	0	0	6	55	61
Total	5	21	114	114	164	196	363	977

TABLE 7—*Female mandible—number of teeth observed per stage/age.*

Age at Last Birthday (years)	Stage							Total
	B	C	D	E	F	G	H	
12	0	1	14	1	3	0	0	19
13	2	2	18	8	0	3	1	34
14	2	4	44	14	10	6	0	80
15	0	7	29	29	16	15	3	99
16	3	6	21	31	38	31	8	138
17	1	3	10	35	51	49	12	161
18	2	0	10	16	35	51	30	144
19	0	0	7	6	21	48	47	129
20	0	0	5	3	11	32	42	93
21	0	0	0	2	7	13	39	61
22	0	0	0	0	1	13	47	61
Total	10	23	158	145	193	261	229	1019

Tables 6–9 display the distribution of stages possible for each chronological age/year. Patterns of the most common stage for a chronological age can be used to estimate the age of an unknown person and the distribution provides accurate age interval estimation. For instance, a female maxillary third molar in stage E could accurately be estimated to be less than 21 years (Table 6) providing a reliable upper age limit in this scenario. Likewise, any third molar from a male or female child that exhibits Stage B or above is known to be greater than 12 years of age (Tables 6–9). Tables 10 and 11 show computed prediction intervals at the 95% confidence which can be used as accurate age guidelines for Hispanic children and young adults.

TABLE 8—*Male maxilla—number of teeth observed per stage/age.*

Age at Last Birthday (years)	Stage							Total
	B	C	D	E	F	G	H	
12	0	0	3	3	0	0	0	6
13	1	2	14	10	4	0	0	31
14	1	5	26	28	12	13	3	88
15	0	1	8	36	24	13	3	85
16	0	2	14	17	35	23	28	119
17	0	1	9	17	17	37	41	122
18	0	0	2	5	11	23	86	127
19	0	0	0	0	1	10	53	64
20	0	0	0	3	1	10	45	59
21	0	0	0	0	0	1	37	38
22	0	0	0	0	1	1	44	46
Total	2	11	76	119	106	131	340	785

TABLE 9—*Male mandible—number of teeth observed per stage/age.*

Age at Last Birthday (years)	Stage							Total
	B	C	D	E	F	G	H	
12	0	1	8	0	1	0	0	10
13	2	3	19	7	1	0	0	32
14	0	10	28	31	16	2	0	87
15	0	4	18	38	19	8	0	87
16	1	6	10	31	30	28	11	117
17	0	1	13	19	23	50	21	127
18	0	0	1	10	21	48	51	131
19	0	0	0	1	8	26	34	69
20	0	0	0	1	8	8	41	58
21	0	0	0	0	0	4	38	42
22	0	0	0	0	1	3	40	44
Total	3	25	97	138	128	177	236	804

TABLE 10—*Predictions of minimum age for a new subject.*

Female Maxilla		Female Mandible	
If Molar is	Prediction*	If Molar is	Prediction*
Stage B	Greater than 10	Stage B	Greater than 11
Stage C	Greater than 12	Stage C	Greater than 12
Stage D	Greater than 11	Stage D	Greater than 11
Stage E	Greater than 12	Stage E	Greater than 13
Stage F	Greater than 13	Stage F	Greater than 14
Stage G	Greater than 14	Stage G	Greater than 14
Stage H	Greater than 15	Stage H	Greater than 16
Male Maxilla		**Male Mandible**	
If Molar is	Prediction*	If Molar is	Prediction*
Stage B	Greater than 8	Stage B	Greater than 8
Stage C	Greater than 12	Stage C	Greater than 12
Stage D	Greater than 12	Stage D	Greater than 11
Stage E	Greater than 12	Stage E	Greater than 13
Stage F	Greater than 13	Stage F	Greater than 13
Stage G	Greater than 14	Stage G	Greater than 15
Stage H	Greater than 15	Stage H	Greater than 16

*We are 95% confident that the age at last birthday of a new subject is:

Specific to the legal issue of whether or not a detainee is of legal age, Tables 6–9 can be evaluated to see if third molar development is useful to predict whether an individual is 18 years of age or less. The data show that Hispanic females can be reliably shown to be less than 19 years of age if the third molars are in Stage B or C in both jaws. Hispanic males, on the other hand, can be reliably shown to be less than 18 years of age if Stage B or C is observed in the maxilla or mandible.

TABLE 11—*Predictions of maximum age for a new subject.*

Female Maxilla		Female Mandible	
If Molar is	Prediction*	If Molar is	Prediction*
Stage B	Less than 21	Stage B	Less than 20
Stage C	Less than 18	Stage C	Less than 18
Stage D	Less than 19	Stage D	Less than 19
Stage E	Less than 20	Stage E	Less than 19
Stage F	Less than 20	Stage F	Less than 21
Stage G	Less than 21	Stage G	Less than 22
Male Maxilla		**Male Mandible**	
If Molar is	Prediction*	If Molar is	Prediction*
Stage B	Less than 19	Stage B	Less than 20
Stage C	Less than 17	Stage C	Less than 17
Stage D	Less than 18	Stage D	Less than 18
Stage E	Less than 18	Stage E	Less than 18
Stage F	Less than 19	Stage F	Less than 20
Stage G	Less than 20	Stage G	Less than 21

*We are 95% confident that the age at last birthday of a new subject is:

TABLE 12—*Probabilities of being at least 18 years of age, Kasper et al.*

	Stage						
	B	C	D	E	F	G	H
Individual Teeth—Maxilla Right (#1)							
Male (%)	0.0	4.8	2.5	5.2	13.2	30.6	71.4
Female (%)	30.3	6.9	8.4	19.2	29.5	51.7	78.8
Individual Teeth—Maxilla Left (#16)							
Male (%)	0.0	0.7	2.8	7.7	12.9	40.6	74.7
Female (%)	16.0	9.3	7.2	18.1	34.8	49.3	78.8
Individual Teeth—Mandible Left (#17)							
Male (%)	0.0	1.4	2.4	7.5	27.0	48.8	85.8
Female (%)	21.1	1.2	11.3	21.3	36.8	60.4	89.8
Individual Teeth—Mandible Right (#32)							
Male (%)	5.0	0.1	0.7	5.5	29.0	52.0	86.4
Female (%)	9.5	7.0	9.3	18.3	42.8	59.9	87.1

Table 12 with probability values for Hispanics suggests a percent possibility that an individual has attained their 18th birthday. It assumes a normal distribution of age. As mean ages for Hispanics in this study are significantly different from the mean ages for Caucasians in 10 of 24 categories (Table 3), Hispanic individuals should be evaluated using the data developed in this study. Table 13 uses Caucasian data (Mincer, personal communication) to compute the probability of having reached the 18th birthday on individual teeth rather than pooled side data. In comparing Hispanics (Table 12) and Caucasians (Table 13) we see a decrease in predictability with Hispanics because they are achieving complete maturation at an earlier age.

Cross-tabulation of the data comparing Tooth #1 to Tooth #16 and Tooth #17 to Tooth #32 indicated that antimere teeth exhibited a similar stage in as little as 33% or 1/3 of the sample. In the female maxilla, concordance was 78% and in the mandible it was 76%. For males, concordance in the maxilla was 82% and in the mandible 78%. When the degree of left-right symmetry includes one stage above and below concordance, the degree of correlation increases to 97% and 98% in the maxilla and mandible respectively, regardless of sex.

These results are different from trends established in previous studies which report a higher percent concordance of right and left sides (13,14,21,24,29–32,34). Individuals staging third molars for age estimation should be mindful that asymmetry is possible and therefore both sides should be evaluated independently.

TABLE 13—*Probabilities of being at least 18 years of age, Mincer et al.*

	Stage						
	B	C	D	E	F	G	H
Individual Teeth—Maxilla Right (#1)							
Male (%)	2.5	9.1	26.8	38.6	51.7	85.6	
Female (%)	39.6	5.7	24.5	39.8	64.4	92.2	
Individual Teeth—Maxilla Left (#16)							
Male (%)	1.1	19.4	16.1	39.4	56.4	85.9	
Female (%)	39.6	9.7	22	41.9	61.3	92.4	
Individual Teeth—Mandible Left (#17)							
Male (%)	4.5	2.2	20.5	47.3	58.2	91.6	
Female (%)	0	11	23.9	42.9	71.5	94.3	
Individual Teeth — Mandible Right (#32)							
Male (%)	8.2	1.5	13.5	46.1	59.1	90.8	
Female (%)	35.5	10.6	18.6	39	71.4	94.6	

Due to the noted asymmetry, all third molars are included in the probabilities table tables (Tables 12 and 13). Thus, contrary to the method of Mincer et al. (13), the pooling of sides of each jaw was not used to compare percent probabilities of an individual being at least 18 years of age.

Conclusions

Third molar development of 950 Texas Hispanic individuals was studied to determine if the rate of development differed from earlier reported Caucasian data. Results of the study indicate that, in general, the third molars of individuals in the Texas Hispanic population studied reached the stages of development at earlier chronological ages than the third molars of the Caucasian population studied by Mincer et al. (13). This trend was found to be consistent in both males and females for the Dimirjian stages G and H. The third molars of males matured earlier than those of females for all stages and in both the maxilla and mandible. The individual mean ages at which the Texas Hispanics achieved stage development were significantly different from those of the Caucasians studied earlier, indicating that population-specific data should be used in estimating age from the development of third molars. If ancestry-appropriate data sets are not used the age of Hispanics may be overestimated. This potential overestimation of age has negative implications for immigration adult/juvenile cases and for medical examiner/coroner unidentified body cases.

Objective and practical age estimation of individuals of unknown age requires a reliable method to estimate age that is safe and noninvasive on living subjects. Third molar root development can be reliably used to generate mean age and the estimated age range for an individual of unknown chronological age. This study provides data for the Texas Hispanics studied and indicates the earliest and the latest age observed for each stage. The range of chronologic ages observed for each stage of third molar development is large, justifying reporting mean ages and age intervals instead of reporting a specific age estimate. In unidentified deceased individuals third molar development is useful in conjunction with age indicators in other areas of the body.

In cases where living individuals are evaluated for age, the determination of adult or juvenile status is a legal question, not a scientific one. These cases in the U.S. may involve Hispanic individuals. The data generated in this study indicate that Hispanic females can be reliably shown to be less than 19 years of age if the third molars are in Stage B or C in both jaws. No such clear determination is observed for the 18th year. Hispanic males, on the other hand, can be reliably shown to be less than 18 years of age if Stage B or C is observed in the maxilla or mandible. Considering that no other noninvasive biometric method is currently known for evaluating living persons around the age of transition from juvenile to adult status, analysis of the development of third molars is a useful and reliable method of age estimation.

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