JOURNAL OF FORENSIC SCIENCES

J Forensic Sci, September 2011, Vol. 56, No. 5
doi: 10.1111/j.1556-4029.2011.01833.x
Available online at: onlinelibrary.wiley.com

TECHNICAL NOTE

ODONTOLOGY; ANTHROPOLOGY

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Testing the Demirjian and the International Demirjian Dental Aging Methods on a Mixed Ancestry Urban American Subadult Sample from Detroit, MI*,‡

ABSTRACT: This paper tests the Demirjian and international Demirjian dental aging methods for forensic use when ancestry and ethnicity are unknown. A radiographic sample of 187 boys and girls was collected from the Department of Pediatric Dentistry at the University of Detroit Mercy and aged using both methods. The total sample and the sample by age categories (young, middle, and old) were analyzed using *t*-tests. The Demirjian method was found to better estimate age to a statistically significant degree for the total sample, as well as the middle and old age categories. The young category was aged better using the international Demirjian method. The results indicate that while the Demirjian method accurately estimates age, caution must be used with the method. Further research is needed to determine whether the international Demirjian method can be used for forensics in the U.S.

KEYWORDS: forensic science, forensic anthropology, dental aging, mixed ancestry, Demirjian method, subadults

Dental aging methods are important tools for forensic anthropologists working to form a biological profile for subadults. The Moorrees, Fanning, and Hunt method (1,2) is commonly used. However, this method was formed on a very small population consisting of 136 boys and 110 girls. For this reason, it is important to continue to investigate other dental aging methods. The Demirjian method (3–5) was formed on a large French-Canadian sample consisting of 2407 boys and 2349 girls. This method has been used and studied extensively in Europe, although the application in the U.S. has been limited. The Demirjian method has been further modified to better fit the uses of forensic anthropologists in Europe through the creation of the international Demirijian method (6). The large sample size of both these methods makes them ideal for forensic work, as does the ease of applying the method.

The aims of this study are to determine whether the Demirjian method and the international Demirjian method can be used without modification for forensic purposes in the U.S. It was originally hypothesized that the international Demirjian method designed to work on populations of any ancestry would be valid for use in the sample population, but that the Demirjian method would exhibit similar over or under aging problems as described in the literature.

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*Presented at the 60th Annual Meeting of the American Academy of Forensic Sciences, February 18–23, 2008, in Washington, DC.

‡Research supported by Research Enhancement Award issued by Michigan State University Graduate School.

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Received 25 April 2010; and in revised form 20 July 2010; accepted 5 Sept. 2010.

Background

Many researchers have tested the Demirjian method in groups of varying ancestry and ethnicity. The results of these studies were inconclusive on the overall accuracy of the Demirjian method, as some studies found statistically significant differences between chronological age (CA) and dental age, while many others found none (6–12). It is interesting that often different researchers working on the same overall population found that their samples departed in different ways from the Demirjian sample. When these studies are looked at together, it is not clear whether ancestry is the factor causing the variation.

An interesting group of studies was conducted on Bangladeshi and Caucasian British children in London (9,10,12). These studies found that both British groups were developmentally different from the Demirjian sample to a statistically significant degree in the same level and direction. Liversidge et al. (9) found that the sample of British children was developmentally advanced to the French-Canadian sample. A follow-up study on a larger sample found no developmental differences between the Caucasian and the Bangladeshi despite the ancestral differences in these populations (10). Maber et al. (12) had similar results with no differences being found between the Bangladeshi and the Caucasian children and statistically significant over aging of the entire sample by the Demirjian method.

Studies of the Demirjian method have also shown interesting statistical differences between populations of the same ancestry or ethnicity. Nyström et al. (7) found that the dental development of rural Finish children from Kuhmo differed to a statistically significant degree from the urban children from Helsinki. This study is strong evidence that environment may have more effect on the rate of dental development than previously thought, to the point of

overriding genetic similarity. This is not the only time differences were found within an ancestral group. Koshy et al. (8) and Prabhakar et al. (11) tested the method on two samples taken from different areas of southern India. One sample was overestimated by 3 years and the other by just 1 year, indicating a developmental difference between these groups of similar heritage.

Studies of this kind are what prompted the development of the international Demirjian method (6). This method uses the same aging system as the Demirjian method, but introduces new maturity scores and age tables intended to allow accurate aging of multiple ancestry groups. This method used the original Demirjian French-Canadian data and data from Australia, Belgium, England, Finland, France, South Korea, and Sweden in an effort to eliminate the issue of inter-ethnic variability. This new method was created for forensic use when ancestry is unknown. Chaillet et al. (6) formed a large sample using radiographs gathered in previous studies of the Demirjian method from around the world.

These contradictory findings indicate the need to test the Demirjian method for forensic use in the U.S. A sample of multiple ancestry was chosen to reflect the actual makeup of urban American cities. Because of the mixed finding in previous studies, both the Demirjian and international Demirjian methods were tested using an urban American population.

Sample and Collection

Panoramic dental radiographs of 200 individuals of known age and sex between the ages of 6 and 12 years were collected from the University of Detroit Mercy (UMD) Dental School, Detroit, Michigan, for the analysis. After the sample was collected, 13 individuals were excluded for problems with X-ray quality, bilaterally missing second premolars, or having a CA that did not fall within the study range. The final sample consisted of 98 boys and 89 girls (Table 1). The individuals in this sample were patients either of the Department of Pediatrics or of the Department or Orthodontics at UDM. The radiographs were taken from 1992 to the present. The panoramic radiographs were reproduced digitally by scanning. Files were labeled in the order they were scanned without any other identifiers placed on the radiographs to ensure later age assessments would be blind.

CA at time of X-ray was taken from the patients file if available. If CA was not readily available, it was determined by using date of X-ray and date of birth for each individual to determine an individual's age to the month. All available panoramic dental radiographs of individuals between 6 and 12 years and without dental pathology were included in this study.

Ancestry was not regularly recorded in patient charts, but was available for *c.* 90 individuals. The exact percentage of each ancestral group in the sample cannot be determined, but even with limited recording it is clear that the sample is very diverse, being made up of individuals of European, African, Latino, Middle Eastern, and Asian ancestry. All individuals in the sample live in the immediate Detroit area at the time the radiographs were taken.

TABLE 1—*Sample by age and sex.*

	Male	Female	Total per Year
6 years	3	3	6
7 years	2	4	6
8 years	14	12	26
9 years	29	23	52
10 years	24	16	40
11 years	21	19	40
12 years	5	12	17
Total M/F =	98	89	Sample total = 187

Methods

The Demirjian method and the international Demirjian method were used to determine dental age for the entire sample (3–6). The seven left mandibular teeth M_2, M_1, PM_2, Pm_1, C, I_2, and I_1 were examined for this study as is specified in these methods, with a right mandibular tooth being substituted for any missing tooth or any tooth unreadable because of the quality of the radiograph as outlined by Demirjian et al. (3–5). All radiographs were examined in digital form at actual size and at 175% magnification to look at root closure.

The detailed description of the method can be found in the Demirjian articles (3–5). In the current study, the written criteria were always consulted to make an assessment and the X-rays and diagrams were only used as an aid as stipulated by Demirjian et al. (5). In cases where a choice had to be made between two stages, the earlier stage was always assigned. The first author used the training test included in Dental Development software developed by Demirjian (13). This author found her assessments of dental maturity to agree with the original assessments provided in the test.

Once calcification stages for each tooth were determined and recorded, a total dental maturity score for each individual was calculated. Dental maturity was then converted into dental age. The seven-tooth method developed by Demirjian et al. (3–5) requires the investigator to use percentile graphs provided for each sex to determine dental age. Demirjian et al. (4,5) suggest using the 50th percentile. The Dental Development: Interactive Multimedia Courseware in Dentistry and Medicine CD (13) was used to calculate dental age. The dental maturity score recorded for each individual was entered into the program along with the sex of the individual, and dental age was determined to the month by the software. This age corresponds to the 50th percentile given by the percentile graphs published with the Demirjian method (3–5).

The international Demirjian method uses different dental maturity scores and dental age tables than the original Demirjian method, but is otherwise unchanged (6). Dental age was determined using the revised age charts for boys and girls found in Chaillet et al. (6). As with the original Demirjian method, age at the 50th percentile was used for all conversions from dental maturity score to dental age.

Several statistical tests were used to determine how well each method was able to estimate CA in the study sample. All statistics were calculated using the SPSS statistical software package (IBM Corporation, Armonk, NY). Pearson's r correlations were run to better understand the relationship between CA and dental age estimated using the Demirjian method (DA) and between CA and dental age estimated using the international Demirjian method (IDA). Paired *t*-tests were also run to determine whether the mean DA and IDA values for the study population differed significantly from mean CA. A paired *t*-test was used because estimated age is related to CA, as both are dependent on development.

The differences between mean DA and mean CA (DA–CA) and between mean IDA and mean CA (IDA–CA) were also assessed using an independent sample *t*-test to discover whether either method was systematically under aging or over aging the sample. This test was also used to evaluate the differences between estimated age and CA by sex for both methods revealing whether a method produced different results for boys and girls in the sample.

Paired and independent sample *t*-tests were also conducted on the sample after it was divided into age specific categories. Because of small sample size, these categories were not single years, but

combinations of multiple ages: young (6-, 7-, and 8-year-olds), middle (9- and 10-year-olds), and old (11- and 12-year-olds). However, even when ages were combined, the sample sizes for the "young" category, 38 individuals, were quite small given what is recommended for good statistical power (14–16). The problem of sample size only increased when the sample was further split by sex for the independent sample *t*-test. It was therefore necessary to deal with the results of statistical tests run after the sample was split into categories cautiously, despite their ability to present a more nuanced view of what was happening in the sample.

Results

Total Sample Results: Demirjian Dental Age

Using Pearson's r correlation, a significant positive correlation is seen between CA and DA (age determined using the Demirjian method). The paired *t*-test results for the Demirjian method are reported. Although the mean DA value slightly exceeds the mean CA value, indicating a slight over aging of the sample as a whole, the difference is not statistically significant ($t = 5.849$, $p > 0.01$) (Table 2). Therefore, the Demirjian method seems to be an accurate method of estimating CA in this sample. The results of the independent sample *t*-test of (DA–CA) are presented in Table 3. Although male ages were overestimated to a somewhat greater degree than the female ages, there is no significant difference between the aging of boys and girls using this method.

Total Sample Results: International Demirjian Method

Pearson's r correlations show that age estimated by the IDA has a significant positive correlation with CA at the 0.01 level. Although there is a strong correlation, the sample is slightly under aged. The paired *t*-test confirms that mean IDA differs significantly from mean CA, indicating that the international Demirjian method is inappropriate for estimating age in this particular sample of mixed ancestry (Table 2). The independent sample *t*-test of the difference between IDA and CA (IDA–CA) by sex found that girls were under aged by the international Demirjian method to a greater extent than the boys (Table 3). However, this difference is not significant at the 0.01 level (Table 3).

Results by Category: Demirjian Method

All tests were re-run after the sample was split into three categories (young, middle, and old). As described in the methods section, dividing the sample by age produced fairly small categories. The young category had the smallest sample size of 38, the middle category had a sample size of 92, and the old category had a sample size of 57 (Tables 4–6).

Paired *t*-tests were run on the Demirjian method ages of all three age categories with the following results. The young category was slightly over aged (Table 4). This was a statistically significant at the 0.01 significance level (Table 4). The middle category was also slightly over aged, but not to a statistically significant degree (Table 5). The old category was slightly under aged; however, the difference was not statistically significant (Table 6).

Independent sample *t*-tests of the difference between DA and CA (DA–CA) by sex were also run for each age category. In the young category, boys were slightly more over aged than girls, but the difference is not statistically significant (Table 7). In the middle category, boys were also over aged slightly more than girls, with the difference being greater than that seen in the young category but still not statistically significant (Table 8). In the old category, girls were more under aged than boys, but again there was no statistically significant difference (Table 9).

Results by Category: International Demirjian Method

Paired *t*-tests and independent sample *t*-tests were conducted on the IDA results using the same age categories and significance

TABLE 2—*Paired sample statistics and* t*-test results for chronological age (CA), Demirjian dental age (DA), and international Demirjian dental age (IDA).*

Paired Sample Statistics				
	Mean	*N*	Std. Deviation	Std. Error Mean
CA	10.0972	187	1.41324	0.10335
DA	10.187	187	1.3078	0.0956
IDA	9.6760	187	1.27007	0.10335

Paired Sample *t*-Test			
	d.f.	*t*	Sig. (2-tailed)
CA–DA	186	−1.2	0.232
CA–IDA	186	5.849	0.000

At 0.01 significance level $p \leq 0.01$.

TABLE 3—*Group statistics and results for independent sample* t*-test of sex difference between Demirjian dental age (DA) and chronological age (CA), sex difference between international Demirjian dental age (IDA) and CA.*

Group Statistics for Independent Sample Test				
	N	Mean	Std. Deviation	Std. Error Mean
Difference DA–CA				
Males	98	0.1356	0.97295	0.09828
Females	89	0.0397	1.08343	0.11484
Difference IDA–CA				
Males	98	−0.2895	0.91417	0.09235
Females	89	−0.5663	1.04311	0.11057

Independent Sample *t*-Test			
	d.f.	*t*	Sig. (2-tailed)
Difference DA–CA	177.653	0.635	0.526
Difference DA–IDA	175.926	1.921	0.056

At 0.01 significance level $p \leq 0.01$.

TABLE 4—*Young category paired sample statistics and paired sample* t*-test results for chronological age (CA), Demirjian dental age (DA), and international Demirjian dental age (IDA).*

Paired Sample Statistics				
	Mean	*N*	Std. Deviation	Std. Error Mean
CA	8.0489	38	0.71254	0.11559
DA	8.787	38	1.0439	0.1694
IDA	8.3687	38	1.02518	0.16631

Paired Sample *t*-Test			
	d.f.	*t*	Sig. (2-tailed)
CA–DA	37	−5.468	0.000
CA–IDA	37	−2.595	0.013

At 0.01 significance level $p \leq 0.01$.

TABLE 5—*Middle category paired sample statistics and paired sample* t-*test results for chronological age (CA), Demirjian dental age (DA), and international Demirjian dental age (IDA).*

Paired Sample Statistics				
	Mean	*N*	Std. Deviation	Std. Error Mean
CA	9.9435	92	0.56009	0.05839
DA	10.051	92	0.8639	0.0901
IDA	9.5024	92	0.80536	0.08396

Paired Sample *t*-Test			
	d.f.	*t*	Sig. (2-tailed)
CA–DA	91	−1.155	0.251
CA–IDA	91	5.107	0.000

At 0.01 significance level $p \leq 0.01$.

TABLE 6—*Old category paired sample statistics and paired sample* t-*test results for chronological age (CA), Demirjian dental age (DA), and international Demirjian dental age (IDA).*

Paired Sample Statistics				
	Mean	*N*	Std. Deviation	Std. Error Mean
CA	11.7109	57	0.50238	0.06654
DA	11.340	57	1.0165	0.1346
IDA	10.8368	57	1.00931	0.13369

Paired Sample *t*-Test			
	d.f.	*t*	Sig. (2-tailed)
CA–DA	56	2.517	0.015
CA–IDA	56	6.204	0.000

At 0.01 significance level $p \leq 0.01$.

TABLE 7—*Young category group statistics for independent sample test of sex difference and independent sample* t-*test results between Demirjian dental age (DA) and chronological age (CA), and sex difference between international Demirjian dental age (IDA) and CA.*

Group Statistics for Independent Sample Test				
	N	Mean	Std. Deviation	Std. Error Mean
Difference DA–CA				
Males	19	0.7568	0.71171	0.16328
Females	19	0.7189	0.95797	0.21977
Difference IDA–CA				
Males	19	0.2979	0.65380	0.14999
Females	19	0.3400	0.86973	0.19953

Independent Sample *t*-Test			
	d.f.	*t*	Sig. (2-tailed)
Difference DA–CA	36	0.138	0.891
Difference DA–IDA	36	−0.169	0.867

At 0.01 significance level $p \leq 0.01$.

levels as for the Demirjian method. The paired *t*-test results for the young category indicated slight over aging, although the difference just fails to reach significance at the 0.01 significance level (Table 4). The results for the middle category indicated slight under aging to a statistically significant degree (Table 5).

TABLE 8—*Middle category group statistics for independent sample test of sex difference and independent sample* t-*test results between Demirjian dental age (DA) and chronological age (CA), and sex difference between international Demirjian dental age (IDA) and CA.*

Group Statistics for Independent Sample Test				
	N	Mean	Std. Deviation	Std. Error Mean
Difference DA–CA				
Males	53	0.1387	0.90567	0.12440
Females	39	0.0654	0.88645	0.14195
Difference IDA–CA				
Males	53	−0.3494	0.81562	0.11203
Females	39	−0.5782	0.84872	0.13590

Independent Sample *t*-Test			
	d.f.	*t*	Sig. (2-tailed)
Difference DA–CA	90	0.387	0.700
Difference DA–IDA	90	1.307	0.195

At 0.01 significance level $p \leq 0.01$.

TABLE 9—*Old category group statistics for independent sample test of sex difference and independent sample* t-*test results between Demirjian dental age (DA) and chronological age (CA), and sex difference between Demirjian international dental age (IDA) and CA.*

Group Statistics for Independent Sample Test				
	N	Mean	Std. Deviation	Std. Error Mean
Difference DA–CA				
Males	26	−0.3246	1.04333	0.20461
Females	31	−0.4090	1.18158	0.21222
Difference IDA–CA				
Males	26	−0.5965	1.08776	0.21333
Females	31	−1.1068	1.00160	0.17989

Independent Sample *t*-Test			
	d.f.	*t*	Sig. (2-tailed)
Difference DA–CA	55	0.283	0.778
Difference DA–IDA	55	1.842	0.071

At 0.01 significance level $p \leq 0.01$.

The old category was under aged to a statistically significant degree as well (Table 6).

The independent sample *t*-test of the difference between IDA and CA (IDA–CA) by sex for the young category indicated that while boys were slightly less over aged than girls, no statistically significant difference is seen (Table 7). Boys were under aged less than girls to a slightly greater degree in the middle category of age, although the difference was still not statistically significant (Table 8). Results indicated under aging for the old category with girls being more under aged than boys, although there was no statistically significant difference (Table 9). In sum, IDA values for all three age categories showed under aging for both boys and girls, although none of it was to a statistically significant degree.

Discussion

There were two outliers found in the study. These cases appear to be developmentally slow and were reanalyzed from initial dental

maturity assessment to age assignment for all methods to ensure there was no error made. No error was found, and no pathology seemed to be affecting the individuals. For these reasons, the outliers were considered to be normal variants in development and were left in the study with no changes being made to them.

The independent *t*-tests of difference in DA and CA grouped by boys and girls showed that the Demirjian method and the international Demirjian method were appropriate for both groups (Table 3). This still held true when the sample was divided by category: young, middle, old. There is no significant difference between the sexes at any stage (Tables 7 and 9). There is a difference in degree of over aging between boys and women, even in these nonsignificant results.

The paired *t*-tests of the entire sample using the Demirjian method found no statistical difference, meaning that it could be used in Detroit even if ancestry cannot be determined, which is often the case with subadults. The paired *t*-test on the Demirjian method separated by category, young, middle, and old had some interesting results. The young category found a significant difference between CA and DA. The category contained only 38 individuals, which is fairly small. Small sample size increases the probability of error or that chance will appear to be a statistically significant difference (14–16). The actual difference between the mean CA and DA is 0.74 or *c.* 9 months. No age estimation method is going to give the exact age for every individual as development naturally varies between individuals. Forensic science uses age ranges for just this reason when estimating age for the biological profile. However, this does mean the method is less accurate for the young category and should be used with caution on young individuals. The middle category had no statistical difference. The old category was very close to having a statistical difference at the 0.01 significance level, but had a value slightly >0.01. This means that a forensic scientist may wish to be careful with the results in this age category as well. The method does not appear to estimate age as accurately for the young ages in this sample, but as the difference is only a matter of months the range given in the biological profile should be more than accurate enough.

The international Demirjian method was found to be significantly underestimating age. This resulted in the rejection of the null hypothesis and the rejection of the international Demirjian method for use in Detroit. Once again, when the paired *t*-tests for each category are examined some interesting trends are noticed. For the young category there is no significant difference at the 0.01 significance level using the international Demirjian method. This is a barely nonsignificant finding, but this method does seem to be estimating age the best for the young category. For the young age category, the international Demirjian method is the best estimator of age. Once again, this category has a very small sample size so there is a higher chance of error. Significant differences were found in the middle and old categories. The differences in means between CA and IDA were 0.441 for the middle category and 0.874 for the old and/or under aging of *c.* 5.5 months and *c.* 10.5 months, respectively. In a forensic science context, where an age range is given, the international Demirjian method could probably still be used safely on multiple ancestry samples in Detroit. However, as the Demirjian method seems to estimate age more accurately for the majority of the categories and the total sample estimate does not differ significantly from CA, it should be used preferentially. Even though the international Demirjian method worked more accurately in the young category, it is not more accurate overall and does not seem to represent the sample best. If an individual is estimated to be in the young category between six and eight using the Demirjian method, it could be prudent to reanalyze the individual using the international Demirjian method, as it is the most accurate estimate of CA for this category.

The only other study to compare American to the French-Canadian sample reported an underestimation of age, although it was not reported if this was statistically significant (17). The Detroit sample showed no significant underestimation and had significant overestimation. This might be a variation within the American population or it could just be sampling error because of low sample size in some categories (14–16).

The literature suggests two possible reasons for differences in dental development found in many populations that could provide forensic anthropologists with erroneous results when calculating subadult age for the biological profile: ancestry or ethnicity and environment. The results found in this study are interesting for a number of reasons, especially when compared with the previous literature. The first is that the Demirjian method, which was found to either over- or underestimate many other samples from different ancestries and ethnic groups to a statistically significant degree (6–12), did not have an overall statistical difference from the Detroit sample, despite it being composed of individuals with varied ancestries. In contrast, the method devised to work on a sample of multiple ancestries, the international Demirjian method (6), resulted in age estimations that were statistically different from the CA of the Detroit sample of multiple ancestries. If ancestry is the actual source of difference in the literature, neither of these findings should occur. However, if something else is actually effecting the development, such as environmental or cultural factors, these results would make more sense. The international Demirjian method (6) was formed using people from many areas of Europe, while the French-Canadians and American samples are both located in North America.

Despite all the reported differences because of ancestry found in the literature, ancestry is not necessarily the cause of the differences being found. It was originally hypothesized that the Detroit sample would not fit the development pattern of the French-Canadian children, but this was not the case. The two samples are clearly not from the same population, so in this case ancestry seems to be a nonissue. If all differences reported in the literature were purely genetic resulting from normal human variation, there should be differences. Some other factor is influencing development in these cases. This is supported by the findings of Liversidge et al. (18) who found no difference in the timing of the tooth formation stages using the Demirjian method in a sample containing all the radiographs used to form the international Demirjian method. However, the individual studies using these samples did report significant differences. The exact effect of human variation and ancestry on age assessment and development is unclear, although it is the focus of so much scientific and anthropological research. Environmental factors may play an important role in development that is often being misattributed to ancestry or ethnicity differences, because this is what the studies are organized to find. By looking at a sample of multiple ancestries with no regard to ancestry, other important factors for developmental differences can be examined.

Environmental factors are very difficult to determine. The French-Canadian sample is geographically close to the Detroit multiethnicity sample and an argument could be made for similar lifestyles and culture. The international Demirjian method was developed using radiographs from nine countries, and while the French-Canadian sample was included in this, it made up only 19% of the total sample. A further 10% came from Australia or Asia and the majority 71% came from Europe. It is possible then that some kind of environmental or geographic differences are being seen with these results. The diet and behavior of the French-Canadian population may be more closely related to the American

population than to the European populations. It is interesting to note that while Liversidge et al. (9,10) and Maber et al. (12) both found that the French-Canadian sample was not comparable to their mixed Bangladeshi and Caucasian British populations, both ancestral groups were different to the same degree from the French-Canadian sample. These results are powerful support to the environmental effects on development being greater than the effects of human variation and ancestry in some cases.

There are some other factors that may have contributed to the results of this study. The sample size of this study was much smaller than those used to create either the Demirjian method or the international Demirjian method and this may have biased the results. This is particularly true of the paired and independent sample *t*-tests performed on the young category as it contained so few individuals. These results must be interpreted with caution.

Conclusions

The original question posed was: Is the Demirjian method applicable to an urban American population from Detroit? It was expected that the Demirjian method would not accurately estimate DA for the sample, while the international Demirjian method would have no statistical difference between CA and DA because it was developed on a more eclectic sample. This was the opposite of what was found in this paper with the exception of the young category, where the international Demirjian method did not have statistical difference between CA and DA. The results of this study do indicate that the Demirjian dental aging method can be used to accurately age subadults in Detroit, while the international Demirjian method cannot be used with confidence, the exception to this in the young category where it is better to use the international Demirjian method. Research on other population similar to the Detroit sample should be able to use the Demirjian method without modification to estimate subadult age.

Hopefully, the results of this study will encourage the use of the Demirjian method by forensic anthropologists in the U.S. The method was made on a large modern sample making it ideal for forensic work. This paper provides statistical evidence that the Demirjian method accurately estimates age in Detroit when ancestry is unknown. One of the advantages of using dental radiographic formation age estimation methods is that they can be used on living individuals, skeletonized remains, and fleshed remains. This allows these methods to be used in a variety of casework and anthropological settings.

Acknowledgments

A special thanks goes out to Dr. Gail Molinari and the Department of Pediatric Dentistry at the University of Detroit Mercy for allowing access to the UDM files that allowed this research to be carried out. We thank Dr. Christina DeJong of Michigan State University for her help with this research, in particular, the statistical analysis. Finally, thanks go to Dr. Sandra Garvie-Lok of the University of Alberta for support and insight during the writing of this manuscript.

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