A descriptive study of African American deciduous dentition

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ABSTRACT Descriptive studies of the deciduous dentition morphology have been presented as an inclusion in permanent dentition studies, the focus of archaeological populations or on specific traits within modern populations.

The present study describes 25 morphological traits of deciduous dentition in two African American samples from Memphis, TN and Dallas, TX (N= 218), and a European American sample (N=100) from Cleveland, OH. These traits represent the most commonly used traits in population microevolution studies, describing various ancestral groups.

Results indicate trait frequency variation between the two African American samples, as well as in comparison to European American samples. Traits varying in frequency between the two sample populations include maxillary lateral incisor shovel shape trait (69% vs. 46%), canine tuberculum dentale (40% vs. 22%), canine mesial ridge (3% vs. 7%), and maxillary posterior molar hypocone development (76% vs. 92%). Trait frequencies higher than found in previous studies include maxillary central incisor shovel shape trait (38%) and maxillary lateral incisor shovel shape trait (68%), canine tuberculum dentale (40%), maxillary molar complexity (20%), cusp six (33%) and seven (68%), and the Y-groove on the mandibular posterior molar (69%). Trait frequencies seen lower in previous studies include tuberculum dentale trait on both maxillary incisors (8% and 3%) and the hypocone development of the maxillary posterior molar (76%). The level of trait expression is informative when comparing populations, especially the molar traits. For example, Carabelli's pit/fissure is the most common trait expression in African American samples, unlike European American samples.

There have been very few studies focusing solely upon the morphology of the deciduous dentition. Analyses of the deciduous dentition are usually included as part of a larger study of the permanent dentition, (e.g. Aguirre *et al.* 2006) or as an archaeological study (e.g. Sciulli 1998). A few examples of population studies on the deciduous dentition include Jørgensen (1956), Hanihara (1968), Sciulli (1977, 1990, 1998), Harris (2001), Grine (1986) and Lease (2003). Rarely has African American dentitions been described independently.

The present study examines 25 morphological traits of the deciduous dentition in three samples: two African American samples from Memphis, TN and Dallas, TX (N= 218) and a European American sample (N=100) from Cleveland, OH. These traits represent the most commonly used traits in population microevolution studies, describing various ancestral groups. The goal of the study is to provide a description of deciduous trait presence and trait variation within the African American samples.

MATERIALS

Morphological data were collected from a total of 318 individuals from three samples representing two ancestral groups: African and European. The African American children are represented by 117 individuals from Memphis, Tennessee and 101 individuals from Dallas, Texas. The European American children are represented by 100 individuals from Cleveland, Ohio.

Data were collected from two sources: dental stone casts and photographs. Dental casts were the primary resources for the Memphis, TN and the Cleveland, OH samples. The Dallas, TX sample comprises of 5"x7"photographs taken in a professional laboratory (Condon *et al*. 1998).

Casts were included in the study if they met the following criteria: morphological features were

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clearly visible, there were clear separations between teeth, there was no stretching of the cast or chipping of the cast and at least one member of the antimere was present (Lease 2003). Photographs were included in the study if the morphology was clearly visible and no caries were present. Edgar (2002) tested the viability of using two different materials and found fewer morphological traits were visible for photographs; intra-observer error is no different than twice observing the same dentition in the same format.

The children (57 females and 60 males) who comprise the Memphis sample were routine dental patients seen during the 1990s at the Pediatric Dental Department of the University of Tennessee, Memphis (Lease and Harris 2001). The majority of the children resided in the "greater metropolitan area of Memphis" which includes suburban and urban areas around Memphis. The socio-economic status was described as middle class and they had access to health care at the University of Tennessee Medical Center (EF Harris, personal communication, 2003). Ancestry identification was determined by parents.

The Dallas, TX sample consisted of 101 children buried in the Freedman's Cemetery, the sex of whom was unknown. Individuals buried at the Freedman's Cemetery were residents of urban Dallas. The cemetery was active from 1867 to 1907, with the majority of excavated burials dating from 1900 to 1907 (Condon *et al.* 1998). Juveniles in the study lived post-slavery (HJH Edgar, personal communication, 2003). All socio- economic statuses available to African Americans at the time are represented.

The European American sample was collected at the School of Dentistry, Case Western Reserve University from the Bolton-Brush Longitudinal Growth Study. Ancestry came from parental determination. Data was collected on 50 males and 50 females born between 1920 and 1945 (Bailey 1992). The children resided in the urban areas of Cleveland, OH and were described as having access to good health care, education and nutrition (Bailey 1992).

METHODS

Morphological data consists of the scores of 25 deciduous traits. These 25 traits represent the most commonly used traits in micro-evolutionary studies and are the basis for creating Dental Morphological Complexes describing various ancestral groups (Jørgensen1956, Hanihara 1963, Hanihara 1966, Hanihara 1967, Grine 1986, Sciulli 1998). A complete description of expressions and traits can be found in Lease (2003).

Morphological data were collected following Sciulli (1998). When present, both the right and left teeth of each individual were scored. If the expression of the antimeres was the same, that score was used as the expression of the tooth. If the score of a trait was different between the antimeres, the more complex expression was used to represent the tooth. If only one tooth was present, that expression was used to represent the tooth. No root traits were collected due to the principle sources (casts and photographs).

In the analysis and discussion of the morphological traits, the use of the term "deciduous molar" reflects the historic or traditional usage in dental anthropology and the scoring procedures (Lease 2003). Ontologically these teeth are premolars (Sciulli 1998).

ANALYSIS

Statistical analyses were performed in SAS version 8.02. The range of variation for each trait was calculated by expression frequencies for each sample. The weighted average expression (W) was calculated for each feature: $W = (S c_i x_i / S x_i)$. C_i is the expression value and x_i is the number of individuals with that expression. The weighted average is one method that captures where the range of variation within the sample lies.

For example, the morphological trait of shovel shape for the maxillary central incisor has four expressions: 0, 1, 2, 3. The weighted average for this trait in the Cleveland sample is 1.15.

$W = (\square c_i x_i / \square x_i) = ((0*28)+(1*40)+(2*21)+(3*11))/100 = 1.15.$

Therefore, dichotomization into absence/ presence frequencies is between the expression class 1 and expression class 2 for the maxillary central incisor.

The second analysis was performed to calculate the dichotomization of frequencies of the morphological traits. Dichotomization (presence/absence) frequencies should reflect the weighted averages for each trait.

TABLE 1. Frequency counts and weighted averages

Trait	Expression	Cleveland N= 100	Memphis N= 117	Dallas N=101
	0	28	30	42
	1	40	35	21
i^1ss	2	21	25	26
	3	11	9	12
	W	1.15	1.13	1.46
	0	10	31	31
	1	39	35	23
i^2ss	2	28	39	31
	3	22	11	15
	W	1.63	1.26	1.30
	0	14	35	38
	1	38	30	26
ucss	2	34	36	25
	3	14	16	13
	W	1.48	1.28	1.13
	0	91	69	81
	1	5	4	7
$i_1$ss	2	4	1	4
	3	0	2	5
	W	0.13	0.16	0.26
	0	67	80	69
	1	26	17	11
$i_2$ss	2	6	4	11
	3	1	2	10
	W	0.58	0.30	0.62
	0	34	48	45
	1	44	36	18
lcss	2	19	17	22
	3	3	12	16
	W	0.91	0.94	1.09
i^1ds	0	99	100	98
	W	0.00	0.00	0.00
i^2ds	0	98	114	97
	W	0.00	0.00	0.00
	0	94	114	98
ucds	1	2	1	1
	2	3	0	1
	W	0.08	0.01	0.03
i^1 interruption groove	0	100	100	98
	2	0	1	0
	W	0.00	0.01	0.00

The presence/absence frequency of a trait was calculated as in the following example using the shovel shape of the deciduous maxillary central incisor:

Shovel shape : ui1

0 Absent: lingual surface smooth
1 Semi-shovel: slight
2 Shovel: marginal ridges present
3 Strong shovel: marginal ridges broad and wide

Expressions 0 and 1 were designated as the absence of the shovel shape trait and expressions 2 and 3 were designated as the presence of the trait in the individuals. The frequency of the trait (presence) in the population can then be expressed at p = 2-3 / 0-3, with 2-3 as the number of individuals having the expression 2 or 3 and 0 to 3 being the total number of individuals scored (Sciulli 1998).

The presence frequencies for the anterior dentition traits among the three samples were tested for significance using Student's T test (Tables 3-5). Expression frequencies for the posterior dentition were tested for significance (Tables 6-8).

RESULTS

Of the original 25 traits, nine traits had minimal variation within the samples (Table 1). These traits were: double shoveling, interruption grooves (for both the maxillary and mandibular central and lateral incisors) and posterior mandibular molar number. These traits were eliminated from further analyses.The remaining 16 traits were dichotomized for each sample either by absence/ presence (i.e. shovel shape) or by the feature expressed (i.e. Carabelli's cusp vs. pit) (Table 2).

Five of the 12 anterior traits (Table 3) are significantly different for the Cleveland and Memphis samples. The Memphis sample has greater percentage for the maxillary lateral incisor and mandibular canine shovel shape trait. The Cleveland sample has greater frequency for the maxillary incisors tuberculum dentale and maxillary canine distal ridge.

The analyses of the posterior traits are found in Table 6. The majority of the traits examined for Cleveland and Memphis indicate that the Memphis sample exhibits higher frequencies for the more complex expressions. Regarding hypocone

TABLE 1., cont'd

Trait	Expression	Cleveland N= 100	Memphis N= 117	Dallas N=101
I^2 interruption groove	0	99	115	97
	W	0.00	0.00	0.00
i^1td	0	78	94	92
	1	17	3	6
	2	3	3	1
	3	0	0	1
	W	0.23	0.09	0.11
i^2td	0	83	110	96
	1	15	3	2
	2	1	1	1
	W	0.17	0.04	0.04
uctd	0	44	69	79
	1	29	13	6
	2	25	33	13
	3	2	0	4
	W	0.85	0.69	0.35
ucmr	0	98	114	96
	1	1	2	4
	2	0	1	2
	3	1	0	1
	W	0.01	0.03	0.11
ucdr	0	88	109	100
	1	9	7	1
	2	1	0	1
	3	1	0	0
	4	1	0	0
	W	0.18	0.06	0.03
lcdr	0	99	112	101
	1	0	1	0
	2	1	3	1
	3	0	1	0
	4	0	0	0
	W	0.02	0.09	0.02

development, Cleveland has higher frequencies for only having the eocone and protocone present (corresponding to Hanihara's (1963) maxillary first molar morphology of 2), Memphis has higher frequencies of 4 and 5 (Hanihara's (1963) 3H and 4 -/4) for the maxillary anterior molar. Similar results are seen for the maxillary posterior molar. The Memphis sample has higher frequencies of the accessory cusps 6 and 7, as well as more cusps on the mandibular anterior molar. In addition, the individuals within the sample have higher frequencies of deflecting wrinkle and a pit/groove for the proto-stylid and the Y-5 molar pattern.

For Carabelli's trait, in the Cleveland sample the trait is more likely to be absent or a cusp, and in the Memphis sample,a pit. With regards to the mandibular posterior groove patterns, the Cleveland sample more often exhibited the + pattern and Memphis the Y pattern.

Comparing Cleveland and Dallas samples

Frequencies of 11 of the 12 anterior traits (Table 4) are significantly different between the Cleveland and Dallas samples. Dallas has higher percentages for maxillary and mandibular central incisor shovel shape trait, mandibular lateral incisor and canine shovel shape trait and maxillary canine mesial ridge. Cleveland has higher presence rates for the maxillary lateral incisor shovel shape, the maxillary incisor and canine tuberculum dentale and the maxillary canine distal ridge.

Similar results are found for the analyses of the posterior traits for the Cleveland and Dallas samples (Table 7) with a few exceptions. Unlike the Cleveland/Memphis analysis of Carabelli's trait, there is no statistical significance between the cusp frequencies for Cleveland and Dallas samples.

Comparing Memphis and Dallas samples

When comparing the two African American samples, four of the 12 traits are significantly different (Table 5). The Memphis sample shows the shovel shape trait more often for the maxillary lateral incisor and canine, while the Dallas samples has higher frequencies of that trait in the mandibular central and lateral incisors.

When comparing the posterior dentition traits (Table 8) for the two African American samples,there are small differences in frequency expressions. The Memphis sample has higher frequencies for the less complex expression for hypocone development for both maxillary molars, while Dallas is statistically significant for the more complex development expressions. Memphis

TABLE 1., cont'd

Trait	Expression	Cleveland **N= 100**	Memphis **N= 117**	Dallas **N=101**
	2	61	16	3
	3 (3M1 & 3M2)	22	22	19
m^1hypocone	4 (3H1 & 3H2)	12	57	60
	5 (4- &4)	5	20	20
	W	2.61	3.70	3.95
m^2hypocone	3 (3A)	23	15	1
	4 (3B)	34	12	7
	5 (4-)	22	16	17
	6 (4)	11	70	78
	W	3.47	5.76	5.67
m^2cusp 5	0	79	110	100
	1	11	4	1
	W	0.12	0.04	0.01
m^2Carabelli's trait	0	21	14	13
	1	22	24	44
	2	15	30	6
	3	2	12	2
	4	5	2	8
	5	5	2	6
	6	29	31	22
	W	2.80	2.82	2.53
$m_1$cusp number	3	0	3	5
	4	38	40	27
	5	51	59	54
	6	9	8	15
	7	1	3	1
	W	4.73	4.72	4.80
m_2 groove pattern	1 (+)	64	42	23
	2 (x)	2	5	7
	3 (y)	31	60	68
	W	1.66	2.17	2.46
m_2 cusp number	1	1	0	1
	2	95	87	68
	3	3	26	26
	W	2.02	2.23	2.26
m_2 deflecting wrinkle	0	47	52	52
	1	26	16	4
	2	19	31	25
	3	5	8	18
	W	1.46	0.95	1.09

TABLE 1., cont'd

Trait	Expression	Cleveland N= 100	Memphis N= 117	Dallas N=101
m_2 protostylid	0	90	90	59
	1	0	20	35
	2	5	2	3
	3	4	2	3
	6	1	0	0
	W	0.28	0.26	0.50
m_2 cusp 6 entoconulid	0	89	85	67
	1	6	13	21
	2	1	9	5
	3	0	4	6
	4	0	1	1
	W	0.08	0.42	0.65
m_2 cusp 7 metaconulid	0	39	36	51
	1	15	7	4
	2	30	45	20
	3	15	19	17
	4	1	4	7
	5	0	1	1
	W	1.24	1.56	1.28
m_2 mesial trigonid crest	0	87	88	83
	1	10	16	14
	W	0.10	0.25	0.14

shows a slightly higher frequency for the pit expression while Dallas has a higher cusp expression for Carabelli's trait. Memphis also expresses the + groove pattern more often than Dallas. Dallas has a higher frequency of the Y pattern. Memphis shows a higher frequency for cusp 6 in comparison to Dallas. Dallas has a higher frequency for the mesial trigonid crest.

CONCLUSIONS

The analyses of the three samples indicate that African American deciduous dentition usually has the more complex expression of a posterior trait or has a higher frequency of an anterior trait. In comparison to the European American sample, the African American samples have higher frequencies of:

Shovel shape trait
Mesial canine ridge
Hypocone development on maxillary molars
Carabelli's pit or groove trait
Y posterior mandibular molar groove pattern
Deflecting wrinkle
Pit/groove trait for protostylid
Presence of cusps 6 and/or 7

However, the samples from Memphis and Dallas also have lower frequencies of tuberculum dentale and distal canine ridge traits, as well as the X and + posterior mandibular molar groove patterns in comparison to the Cleveland sample.

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TABLE 2. Dichotomization based on weighted averages

Trait		Absence	Presence	
shovel shape		0, 1	2, 3	
tuberculumdentale	incisor	0	pits/grooves (1)	
	canine		ridge (2)	
maxillary canine mesial ridge		0	1+	
maxillary canine distal ridge		0	1+	
mandibularcanine distal ridge		0	1+	
maxillary anterior molar hypocone				2 = 2, 3M1&3M2 = 3, 3H1&3H2 = 4, 4-and 4 = 5
maxillary posterior molar hypocone				3A = 3, 3B = 4, 4- = 5, 4 = 6
maxillary posterior molar cusp 5		0	1+	
Carabelli's trait				absence (0), pit (1-3), cusp (4-6)
cusp number of mandibular anterior molar				3 or 4 cusps = 1 5+ =2
groove pattern on the mandibular posterior molar				+ (1), X(2), Y (3)
deflecting wrinkle		0, 1	2, 3	
protostylid				absence (0), pit/groove (1-2), cusp (3-4)
cusp 6		0	1+	
cusp 7		0-2	3-5	
mesial trigonid crest		0	1	

TABLE 3. Results: Cleveland and Memphis samples – anterior dentition

	Cleveland %	Memphis %	p<0.05
i^1ss	32	34.4	
i^2ss	51	68.7	0.000
ucss	48	45	
$i_1$ss	4	4	
$i_2$ss	7	6	
lcss	22	38	0.000
i^1td	17	3	0.000
i^2td	15	2.6	0.000
uctd	25	28.7	
ucmr	1	2.6	
ucdr	11	6	0.025
lcdr	1	4.3	

TABLE 4. Results: Cleveland and Dallas samples – anterior dentition

	Cleveland %	Dallas %	p<0.05
i^1ss	32	38	0.014
i^2ss	51	46	0.025
ucss	48	37.3	0.001
$i_1$ss	4	9.3	0.025
$i_2$ss	7	21	0.000
lcss	22	37.6	0.000
i^1td	17	6	0.001
i^2td	15	2	0.000
uctd	25	12.7	0.000
ucmr	1	6.8	0.014
ucdr	11	1.9	0.002
lcdr	1	0	

TABLE 5. Results: Memphis and Dallas samples – anterior dentition

	Cleveland %	Dallas %	p<0.05
i^1ss	32	38	0.014
i^2ss	51	46	0.025
ucss	48	37.3	0.001
$i_1$ss	4	9.3	0.025
$i_2$ss	7	21	0.000
lcss	22	37.6	0.000
i^1td	17	6	0.001
i^2td	15	2	0.000
uctd	25	12.7	0.000
ucmr	1	6.8	0.014
ucdr	11	1.9	0.002
lcdr	1	0	

TABLE 6. Results: Cleveland and Memphis samples – posterior dentition

		Cleveland %	Memphis %	p<0.0.5
um1 hypocone	2	61	13.9	0.000
	3	22	19	
	4	12	49.6	0.000
	5	5	17.3	0.000
um2 hypocone	3	25.5	13	0.000
	4	37.7	10.6	0.000
	5	24.4	13.8	0.001
	6	12	60.9	0.000
Cusp 5		12	3.5	0.004
Carabelli's Trait	absent	21	12	0.002
	pit	39.4	57.9	0.000
	cusp	39.4	30.7	0.004
cusp number of the mandibular anterior molar	1	38	38	
	2	61.6	68	0.014
groove pattern	+	66	39	0.000
	X	2	4.7	
	Y	32	56	0.000
deflecting wrinkle		24.7	38.2	0.000
protostylid	Pit/ groove	5	19.2	0.000
	cusp	5	1.7	
cusp 6		1	24	0.000
cusp 7		16	21	0.025
mesial trigonid crest		10	5.4	0.025

TABLE 7. Results: Cleveland and Dallas sample – posterior dentition

		Cleveland %	Dallas %	p<0.0.5
um1 hypocone	2	61	2.9	0.000
	3	22	18.6	
	4	12	58.8	0.000
	5	5	19.6	0.000
um2 hypocone	3	25.5	0	0.000
	4	37.7	6.8	0.000
	5	24.4	16.5	0.008
	6	12	75.7	0.000
cusp 5		12	1	0.001
Carabelli's Trait	absent	21	12.9	0.004
	pit	39.4	51.5	0.000
	cusp	39.4	35.6	
cusp number of the mandibular anterior molar	1	38	31.4	0.008
	2	61.6	69	0.008
groove pattern	+	66	23.5	0.000
	X	2	7	0.025
	Y	32	69.4	0.000
deflecting wrinkle		24.7	43.4	0.000
protostylid	Pit/ groove	5	38	0.000
	cusp	5	3	
cusp 6		1	33	0.000
cusp 7		16	25	0.002
mesial trigonid crest		10	14	

TABLE 8. Results: Memphis and Dallas sample – posterior dentition

		Memphis %	Dallas %	p<0.0.5
um1 hypocone	2	13.9	2.9	0.001
	3	19	18.6	
	4	49.6	58.8	0.002
	5	17.3	19.6	
um2 hypocone	3	13	0	0.000
	4	10.6	6.8	
	5	13.8	16.5	
	6	60.9	75.7	0.000
cusp 5		3.5	1	
Carabelli's Trait	absent	12	12.9	
	pit	57.9	51.5	0.014
	cusp	30.7	35.6	0.025
cusp number of the mandibular anterior molar	1	38	31.4	0.008
	2	68	69	
groove pattern	+	39	23.5	0.000
	X	4.7	7	
	Y	56	69.4	0.000
deflecting wrinkle		38.2	43.4	0.025
protostylid	Pit/ groove	19.2	38	0.000
	cusp	1.7	3	
cusp 6		24	33	0.002
cusp 7		21	25	
mesial trigonid crest		5.4	14	0.002

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