Volume 20, Number 2-3, 2007 ISSN 1096-9411

Dental Anthropology

A Publication of the Dental Anthropology Association

Dental Anthropology

Volume 20, Number 2-3, 2007

Dental Anthropology is the Official Publication of the Dental Anthropology Association.

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The Relationship between Crown Size and Complexity in Two Collections

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ABSTRACT Many studies show human tooth crown size increases with increasing crown complexity (*i.e*., extra cusps, tubercles or grooves). Plio-Pleistocene hominid tooth size reduction has also incurred reduction in complexity, which plays into many theories that attempt to explain this well known, sustained odontometric reduction. We correlated various types of tooth complexity with measured tooth size in two collections: the widely used ASU dental models (238 MD and BL dimensions of 119 teeth involved in 19 post-incisor model plaques), and in Newton Plantation slave remains from Barbados (736 dimensions of 368 teeth from *ca*. 100 individuals consisting of 8 post-canine types: mandibular premolars and molars, and maxillary molars). Significant positive correlations show crown size and crown complexity decrease together, thus either type of data might serve to document this decline. However the degree and pattern of this positive correlation was distinct in the two samples. *Dental Anthropology* 20:29-32.

Beginning in the Paleolithic and continuing through the present, a Pleistocene through Holocene trend within the human dentition has been recognized. Dental reduction, a reduction in tooth crown diameter, dramatically changed the morphology of teeth. Though Europe demonstrated a dramatic form of this trend between the Early and Late Upper Paleolithic, other areas expressed this change as well, including Nubia where dental reduction occurred most dramatically from 12,000-10,000 B.P. and 5,300-3,000 B.P. (Calcagno, 1986; Hillson, 1996). Dental reduction is a clear representation of morphological change seen within the fossil record, the cause of which has been debated.

Many scholars have attempted to explain dental reduction (Armelagos *et al.,* 1989, Bailit and Friedlaender, 1966; Brace and Mahler, 1971; Calcagno, 1986, Calcagno and Gibson, 1988, 1991; Frayer, 1977, 1978; Smith 1982; Smith *et al*., 1986; Greene, 1970) without agreement. One possible explanation lies within the archaeological record. Increased tool quality during the Upper Paleolithic reduced the masticatory demand on teeth (Frayer, 1978; Brace and Mahler, 1971; Brace, 1963). Because no selective pressures existed to maintain large tooth size, reduction resulted from the Probable Mutation Effect (PME), which suggests that, "through random mutations, the developmental processes controlled by complex genetic mechanisms will be disrupted with the final result being an incomplete or simplified structure" (Brace and Mahler, 1971:192). This theory became quite controversial because of its rejection of the selection-based synthetic theory of evolution, which remains the accepted mode (Bailit and Friedlaender, 1966).

Another explanation for crown size reduction also relates to changes seen within the archaeological record (Calcagno and Gibson, 1991), changes resulting from positive selective pressures for small teeth. As tool use reduced the functions that were placed upon the jaw, large chewing muscles and a robust jaw forms were no longer necessary. The teeth develop cryptically as a result of genetic pressures, independent from jaw size selection. The large teeth that were adaptive previous to the tool technology revolution crowded the smaller jaws. As a result of this malocclusion, dental infection and disease emerged, causing selection for smaller teeth (Calcagno and Gibson, 1991). Countless other theories exist which attempt to explain dental reduction, though debate still surrounds the trend.

Garn *et al*. (1966) suggest that morphologically complex (hyperodontic) tooth crowns are usually seen within larger teeth (1966). A recent study by Harris tracks one such trait, Carabelli cusp (2007). Carabelli's trait may sometimes be as large as the principal cusp of the crown, and Harris (2007) found that the greater the expression of Carabelli's trait, the larger the overall crown size of the tooth. Harris measured teeth in the living which may not reflect the trend within teeth over time in the Upper Paleolithic; however, others suggest that the reducing dentitions during the Upper Paleolithic moved toward relatively simple crown morphologies. Cucina *et al*., (1999) and Coppa *et al*. (1998) contrast gene flow versus in situ selection models for the Italian Neolithic and later stages, and Coppa *et al*. (1999, 2007) analyze dental traits changing from the Italian Paleolithic through Mesolithic and Neolithic to almost contemporary agricultural times,

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but the progressively hypodontic traits they use may merely signal tooth size reduction.

To further investigate the trend of dental reduction, the present study analyzes several different dental traits and their effect on overall dental size. Our hypothesis is that hyperodontic teeth will be larger in both breadth and width than crowns showing hypodontic traits.

MATERIALS AND METHODS

Two trials were organized in order to analyze dental traits. Part A involved data concerning the ASU Dental Anthropology System (Turner *et al.*, 1991). Part B analyzed a dental collection from Barbados on loan to the SIUC Anthropology department.

Part A

The ASU Dental Anthropology System is the primary plaster cast system for standardized grading of varying dental complexity (Turner *et al.*, 1991). This system displays 27 different dental traits in upper and lower teeth grading the increasing complexity of a given trait from 0 to 5 in most cases, with some plaques measuring up to 9 grades of complexity for a single trait (Turner *et al.*, 1991). The traits described within the ASU Dental Anthropology System represent traits that are easily standardized for study among many different dental specimens. Also, they are easily observed in teeth reducing potential for inter-observer error.

Of the 27 traits displayed within the system, 19 were chosen for analysis. The traits included: upper molar cusp 5, hypocone cusp 4, metacone cusp 3, parastyle, Carabelli's trait, anterior fovea lower M1, distal accessory ridge upper canine and lower canine, tuberculum dentale upper I1, bushman canine, deflecting wrinkle, protostylid, lower molar cusp 5, cusp 6, cusp 7, mid trigonid crest (lower M1), mid trigonid crest (lower M2), mesial lower premolar cusp number ("p/1" plaque, or trait 16 as described with the associated sheet), and distal lower premolar cusp number ("p/2" which is trait 17). The remaining 8 plaques which were not measured are related to shovel-shaped incisors and were excluded from the study because these traits are not clearly known to be present in dentitions prior to the Upper Paleolithic and do not clearly relate to increased crown complexity of the incisors.

Each tooth displayed on a given plaque was analyzed for standard maximum mesiodistal and buccolingual measurements. Two different sets of calipers, a digital model, Mitutoyo Absolute Digimatic and analog model Mitutoyo No. 505-636 calibrated to 0.05 mm were used. The digital model was the primary set used for measurements; however the tips on this model were fairly wide and blunt (better for measuring buccolingual breadths) and could not properly mesiodistally measure some of the teeth on the plaques because of their closeness to one another. In these cases the sharpened-point analog model was used to measure the tooth. In order to ensure reliable readings for each measure, the calipers were calibrated to 0.00 before taking each measurement. Both the mesiodistal and buccolingual measurements were taken at least twice for each tooth to ensure reliable measurements were being recorded. All data were entered into a spreadsheet. Mesiodistal and buccolingual measurements were each entered on a separate line independent of each other in order to assess the significance that the crown complexity had on each tooth measurement independent of the other.

After all of the plaques were measured, we proceeded to correlate complexity compared to tooth size measurements using a collection of teeth in an actual single population.

Part B

The Department of Anthropology excavated a large collection of remains from Newton Plantation, Barbados that pertained to slaves from the island country (Corruccini and Handler *et al.*, 1982). These remains had been analyzed previously for more traditional cusp number and tooth mesiodistal and buccolingual measurements. No detailed, highly multi-state traits were analyzed from these remains, unlike the ASU system. This grading system was much simpler, consisting of 3 or 2 cusped mandibular premolars, 5 or 4 cusped mandibular molars, and 4 or 3-cusped maxillary molars. As there was no variation to the 2-cusped mesial mandibular premolars, they were considered to be a 2+ (entered as 2.5) when adjacent to a canine tooth with a prominent accessory ridge or tubercle. Similarly, maxillary first molars did not vary from showing the 4 basic cusps but were coded as 4.5 when clearly showing a Carabelli cusp. The original data for cusp numbers and mesiodistal and buccolingual measures were already in existence for mesial and distal lower premolars and upper and lower molars 1, 2, and 3, so the teeth themselves were not measured for this particular study (Corruccini *et al.*, 1982). A total of approximately 100 individuals available in the collection were analyzed. For most individuals only the measurements and cusp number for the left tooth were used. In cases where no data existed for the left, the numbers for the right tooth were collected instead. For some individuals not all premolars and molars were present to measure, in this case all available measurements for the left (if available) and the right (if not) were taken. The measures were entered into a database in the same manner as the ASU measures.

RESULTS

Part A

A total of 119 individual teeth on 19 ASU plaques were measured for both mesiodistal and buccolingual

TABLE 1. MANOVA with tooth size (MD or BL dimension in mm) as the dependent variable[1]

PART A: ASU Plaques

Source	Sum Squares	df	Mean square	F Value	P Value
Ordinal score	81.3	21	3.87	1.79	0.021
Plaque (trait)	139.2	1	139.2	64.4	0.000
MD vs. BL	2.1	1	2.1	0.981	0.323

PART B: Newton Plantation

Source	Sum Squares	df	Mean square	F Value	P Value
Cusp number	5155054	3	1718351.	186.0	0.000
Tooth	1528223	1	1528223.	64.4	0.000
MD vs. BL	450879	1	450879.	49.0	0.000

[1]Crown dimension codes are mesiodistal (MD) and buccolingual (BL).

dimensions, hence 238 total cases yielding 237 degrees of freedom. The overall multiple correlation between increased crown complexity and an increase in overall crown size for the 19 traits in total was 0.640 (Table 1), thus over these ASU plaques there is a significant multiple R between tooth size (both mesiodistal length [L] and buccolingual breadth [B]) and the combined effects of MD Length versus BL Breadth, crown complexity, and the individual plaque. The interaction of MD versus BL dimensions in fact did not contribute significantly to this; in theory either measure could be used to the exclusion of the other, and there is considerable redundancy. The contribution of heterogeneity over different plaques was quite a bit stronger than the contribution of crown complexity score, but the latter nevertheless was significantly greater than zero ($F = 1.79$, $P < 0.02$; even with the degrees of freedom halved to acknowledge the redundancy, $P < 0.03$). Complexity-size correlations ranged above $r = +0.7$ for several plaques, but the sample size per plaque was technically very small. The pooled weighted correlation was $r = 0.41$.

Part B

A total of 368 teeth from the Newton Plantation population were analyzed for buccolingual and mesiodistal dimensions. In this much larger (but probably much more redundant) sample of teeth, there was a very significant multiple $R = 0.792$ between size on the one hand and complexity, tooth type, and L-versus-B, with the latter factor relatively small ($F = 48$) but significant, meaning mesiodistal and buccolingual dimensions offered a significantly large amount of independent information. The complexity contribution to the multiple R (unlike Part A above) is slightly larger than the tooth type contribution and is highly significant even when drastically reducing the degrees of freedom. Partial correlation (holding tooth type constant) between cusp number and size was $r = +0.639$.

DISCUSSION

Thus in different ways, the two data sets indicate highly significant positive correlation between hyperodontic aspects of crown complexity and larger crown size.

Dental reduction is a trend that baffles many researchers. Within early (Pliocene) hominid history, teeth were selected to become larger in order to combat effects of attrition; however, within the Paleolithic and Mesolithic the dramatic change to smaller teeth contradicts the previous evolution of the dentition. To explain this trend, which is clearly seen in the fossil record, several researchers have proposed similar ideas. Harris (2007) shows Carabelli's cusp has more complex expression when the overall diameter of the tooth crown becomes larger. Garn *et al.* (1966) found that mesiodistal crown diameter is significantly related to cusp number, with larger teeth in general possessing more cusps. That human teeth became not only smaller but less complex is not inconsistent with various theories, for instance those highlighting body size, caries resistance, and PME.

With the present study, attempts have been made to establish what relationship exists between crown complexity and overall mesiodistal and buccolingual diameters. Results from the ASU system suggest that there is indeed a positive correlation between morphologically complex teeth and large tooth size across different teeth and traits. There is admittedly some inconsistency with measurements of the ASU dental system because these plaques were created with ordinal examples of crown complexity, and there was no alternative to correlating ordinal with continuous data.

The Newton plantation data allowed independent tracking of the correlation between crown complexity and tooth size in a relatively homogeneous population. These data repeat the positive correlation between crown complexity and larger teeth.

This study does indicate a significantly strong relationship between increased crown complexity and larger teeth; however, more research should be conducted, especially with populations from the Paleolithic to determine if this relationship is seen to the same extent over time within the fossil record. Until contradicting evidence emerges, it may be seen as equivalently valid to measure teeth or to use nonmetric traits for genetic purposes. It is also pointed out that buccolingual tooth dimensions are much more standardized, and much more resistant to change from attrition than other traits (Hill, 2004).

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Asymmetrical Eruption of Permanent Teeth in Australian Aborigines

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ABSTRACT: A better understanding of the factors influencing tooth eruption is important given the association between altered eruption patterns and crowded or decayed teeth. Hence, the aims of this study were to quantify the extent of asymmetry in tooth eruption and to determine whether eruption asymmetry was significantly influenced by sex, tooth position or timing of emergence. Additionally, directionality of asymmetry and variation between ethnic groups were also explored. Data collection was based on the examination of serial dental casts from a sample of 90 Aborigines (50 male, 40 female) aged 6 to 18 years from the Yuendumu settlement in the Northern Territory of Australia. These casts were obtained at yearly intervals from the 1950s to the early 1970s. Tooth antimeres on each cast were compared using a 4-grade eruption score. Relatively high (> 70%) inter- and intra-observer concordances confirmed reliability of the recording system. Asymmetry frequencies were calculated and associations between variables assessed using chi-square analyses, with statistical significance set at alpha = 0.05. Evidence of patterned asymmetry for permanent tooth eruption was noted among the sample of Australian Aborigines, with the distally positioned, later-forming teeth showing the highest levels of asymmetry. *Dental Anthropology* 2007;20:33-41.

The human dentition is a good model system for examining the nature and extent of asymmetries in morphology and development because teeth are arranged in the dental arches as antimeric pairs within different tooth classes, *i.e.*, incisors, canines, premolars and molars. Dental asymmetry has been studied in relation to asymmetry type (fluctuating versus directional), dentition (primary or secondary), causes (genetic and environmental) and associated factors (sex, ethnicity and tooth or arch type). Previous studies of asymmetry in the human dentition have considered dental crown size, crown morphology and dental development, including tooth emergence and eruption (Garn and Bailey, 1977; Corruccini and Potter, 1981; Boklage, 1987; Kieser, 1990; Harris and Bodford, 2007).

Asymmetry is said to be directional when one side regularly displays greater and/or earlier development than the other. Directional asymmetry (DA) has been reported in the primary dentition (Townsend *et al*., 1999) while studies of the secondary dentition have shown both the presence (Lauterstein *et al*., 1967; Staley and Green, 1971; Harris, 1992) and absence (Townsend, 1985) of DA. Significant links between DA and emergence/eruption timing have been described (Garn and Smith, 1980; Heikkinen *et al*., 1998) while more recent investigations have considered the relationship between DA and broader functional lateralities such as eyedness and handedness (Heikkinen *et al*., 2001). Random, non-directional differences termed *fluctuating asymmetry* (FA) are thought to indicate an inability of the individual to buffer against developmental disturbances (Van Valen, 1962). Hence, FA is considered to reflect the magnitude of developmental disturbances or, as Waddington (1957) termed, developmental *noise*. The effects of developmental noise or environmental stresses on dental asymmetry have been established using animal experiments with stressors such as noise, cold and heat (Bader, 1965; Siegel and Smookler, 1973; Siegel and Doyle, 1975; Siegel *et al*., 1977). Human studies, however, have measured the effects of stress using ethnicity, age and degree of modernization as proxies for stress. Studies have mostly cited greater asymmetry among indigenous (Kieser and Groenevald, 1988; Townsend, 1981), less contemporary (Black, 1980b) and older (Kieser *et al*., 1986) populations. Kieser and Groenevald (1988) proposed that it was not only the 'nature and severity of stress' but the 'ability of the individual to buffer against stress,' which may be useful in explaining results where either nil, or surprisingly significant associations between ethnicity and asymmetry (De Melo *et al*., 1975; Black, 1980b; Kieser *et al*., 1986; Kieser and Groenevald, 1988) have been found.

Local factors such as caries-infected primary teeth (Adler, 1963; Lauterstein *et al*., 1967), space constraints (Sofaer *et al*., 1971) and more general factors such as duration of odontogenesis (Townsend and Brown, 1980) have been used to explain why asymmetry is greater in the secondary dentition compared to the primary

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dentition (Garn and Bailey, 1977). It is thought the more time spent in the pre-calcification stage may be linked to greater asymmetry between teeth (Mizoguchi, 1983, 1986) due to increased opportunity for environmental disturbances to deviate developing teeth away from their genetically determined paths.

While early studies by Garn *et al*. (1965) proposed the female double-X chromosome provided greater buffering capacity and hence resulted in less asymmetry in females compared to males, more recent studies have not found significant variation by sex for either primary (Townsend, 1981; Townsend *et al*., 1999) or secondary (Lauterstein *et al*., 1967; Staley and Green, 1971) teeth. While some researchers have found no significant differences in dental asymmetry (cusp occurrence) between monozygotic, dizygotic and non-twins (Staley and Green, 1971), others have claimed that there are differences in dental asymmetry not only between different types of twins but also between twins and singletons (Boklage, 1987). Examples of genetically-linked dental asymmetries, for example in Down Syndrome, have also been reported (Garn *et al*., 1970; Townsend, 1983). Studies reporting on arch-related asymmetry (Townsend, 1981; Kieser and Groenevald, 1988) have shown inconsistent findings while tooth-related asymmetry seems to strongly support the concept of morphogenetic fields proposed by Butler (1939) and subsequently modified by Dahlberg (1945). This pattern of asymmetry is well cited in the literature (Garn and Bailey, 1977; Townsend, 1981) with few exceptions (Kieser and Groenevald, 1988).

In regards to tooth form, numerous studies can be found concerning antimeric variation in tooth size and shape (Garn and Bailey, 1977; Black 1980a,b; Harris and Nweeia, 1980; Townsend, 1981, 1985; Kieser *et al*., 1986; Kieser and Groenevald, 1988; Townsend *et al*., 1999; Khalaf *et al*., 2005) but relatively fewer investigations that have considered asymmetry in the timing of tooth eruption among human populations (Tomes, 1859; Lysell *et al*., 1962; Lauterstein *et al*., 1967; Staley and Green, 1971; De Melo *et al*., 1975; Nystrom, 1977; Garn and Smith, 1980; Heikkinen *et al*., 1998, 2001). Tomes (1859) suggested that teeth on the left side erupt earlier than those on the right while Lysell *et al*. (1962) also reported similar findings in their study of primary tooth emergence in Swedish children. Still, there are studies that have failed to detect any significant differences in timing of emergence between antimeric pairs (Staley and Green, 1971; De Melo *et al*., 1975; Nystrom, 1977). More recent studies by Heikkinen *et al*. (1998) have established significant associations of sex and ethnicity on timing of tooth eruption by comparing samples of Finnish and US children. An exciting recent development has been the link made between eruption asymmetries and functional lateralities by examining tooth eruption sequence as an indicator in the timing of overall laterality (Heikkinen *et al*., 2001).

While information regarding the existence of systematic relationships or *patterned asymmetry* is growing, there are still many aspects of odontogenic mechanisms—one of which includes dental eruption asymmetry—that are yet to be fully understood.

Hence the aims of this study were to describe the nature and extent of asymmetry in permanent tooth eruption among a sample of Australian Aborigines.

Several specific hypotheses were considered in relation to tooth eruption:

1. More distally placed teeth within each tooth class will display greater asymmetry than more mesially placed teeth (Butler's field theory)
2. Females will exhibit greater symmetry than males (better buffering with two X chromosomes)
3. Later-erupting teeth will have higher levels of asymmetry compared to earlier-erupting teeth (longer time spent in development increases exposure to environmental disturbances)
4. Directional asymmetry in tooth eruption will exist for some teeth (some evidence from previous studies)
5. Variation in tooth eruption symmetry will exist between Australian Aborigines and other ethnic groups (previous findings in other ethnic groups)

STUDY POPULATION AND METHODS

This study was based on the examination of serial dental casts obtained at approximately yearly intervals of 90 Australian Aborigines, 50 males and 40 females, stored in the Murray Barrett Laboratory of the Adelaide Dental Hospital. The casts had been prepared during visits of anthropological research teams from the University of Adelaide to the Yuendumu settlement from the 1950s until the early 1970s. Yuendumu settlement, situated approximately 300 km northwest of Alice Springs in the Northern Territory of Australia, was created in 1946 and comprised a relatively self-contained Aboriginal population. The people belonged predominantly to the Wailbri and Pintubi tribes and were of pure Aboriginal ancestry as far as could be ascertained. From a cultural point of view, the group was still in a transition stage—from a food gathering/hunting society to a reliance on Western civilization for its basic needs. The geographically isolated conditions at Yuendumu provided a rare opportunity to study a group of people who had not yet been influenced to any great extent by the effects of European culture.

Damaged casts and those displaying missing teeth were excluded from the sample. Every effort was made to include individuals with the maximum number of available serial dental casts during the period of eruption of the permanent teeth. The ages of the subjects were between 6 and 18 years. The method of scoring tooth eruption followed that of Heikkinen *et al*. (1999) where tooth antimeres on each cast were compared using a 4-grade eruption score. Each of the eight pairs of permanent teeth in both the maxilla and mandible were scored for eruption status. The eruption stages were defined as follows:

1. Tooth not emerged
2. Occlusal surface of the tooth recently emerged
3. Tooth crown half erupted
4. Eruption of tooth complete or nearly complete

The term “emergence” is used to refer to the point at which a tooth appears in the oral cavity, and the term “eruption” refers to the process by which a tooth moves into occlusion with its opponent(s). The cast on which a tooth was first evident was used for scoring the stage of eruption of that particular tooth. Teeth were given a score of 1 to 4 according to their eruption status. Most of the tooth pairs that were included in the analysis were in the erupting phase; that is, they were scored as 2 or 3, but a small number of tooth pairs where one tooth was scored as a 1 and the antimere as a 4, were also included. Tooth pairs were not included if they were both scored as 1 or 4. Inter- and intra-observer reliability in scoring was determined from double determinations on 20 randomly selected casts. Where discrepancies occurred, the casts were re-examined, and a decision was made as to the appropriate score.

Chi-square tests were used to test for significant variation in tooth eruption status between:

- teeth within a tooth class, namely I1 versus I2, P1 versus P2, M1 versus M2;
- Australian Aboriginal male and female children; and
- Australian Aboriginal, American and Finnish children (where data reported by Heikkinen *et al*. (1999) were used for making comparisons).

Statistical analysis was conducted using SPSS software with significance set at the conventional level of alpha = 0.05.

RESULTS

Table 1 presents the inter-observer and intra-observer percentage concordances for scoring eruption status based on double determinations. Generally, the concordance percentages were higher in the mandible compared with those in the maxilla. For example, concordance for scoring eruption of the lower laterals

TABLE 1. Inter- and intra-observer percentage concordances for eruption status[1]

Tooth number	Inter-observer (% concordance)[2]		Intra-observer (% concordance)[2]	
11, 21	85	85	90	95
12, 22	85	75	70	85
13, 23	95	80	100	90
14, 24	95	95	100	100
15, 25	75	90	85	90
16, 26	85	80	95	95
17, 27	90	85	95	95
18, 28	85	90	95	95
31, 41	90	90	95	95
32, 42	100	100	100	100
33, 43	95	95	95	95
34, 44	75	75	80	90
35, 45	95	95	100	95
36, 46	85	85	90	90
37, 47	80	90	95	100
38, 48	80	90	85	100

[1]Notes:

a) Sample size for comparisons = 20 subjects

b) Number of individual teeth = 17 to 20

c) The notation system used for tooth identification in Tables 1-5 is the Federation Dentaire Internationale (FDI) notation that is based on a two-digit system. The first digit identifies the quadrant (numbered 1-4 for permanent teeth, beginning at the patient’s upper right and proceeding in a clockwise direction) while the second digit identifies the tooth within the quadrant (numbered 1-8 and beginning from the midline) *e.g.*, a maxillary right permanent central incisor is a 11 and a mandibular left permanent third molar is a 38.

[2] The two numbers refer to percent concordance scored on each of the two teeth (homologous teeth on left and right quadrants). For example, there was 85% inter-observer concordance for the right (tooth 11) and left (tooth 21) maxillary central incisor, whereas intra-observer concordance was 90% and 95%, respectively for teeth 11 and 21.

TABLE 2. Symmetrical-asymmetrical eruption by tooth class

Tooth class	Tooth number	Teeth in active phase n	Symmetrical eruption n	%	Asymmetrical eruption n	%
Incisor	11, 21, 31, 41	98	78	80	20	20
	12, 22, 32, 42	132	91	69	41	31
Premolar	14, 24, 34, 44	109	45	41	64	59
	15, 25, 35, 45	99	30	30	69	70
Molar *	16, 26, 36, 46	74	49	66	25	34
	17, 27, 37, 47	138	76	55	62	45
	18, 28, 38, 48	98	40	41	58	59

*chi-square analysis ($P < 0.05$)

was 100% for both sets of observations. Generally, there was higher concordance for intra-observer comparisons than for inter-observer comparisons but, overall, the percentage concordances were relatively high indicating that the scoring system was reliable and that errors in scoring were unlikely to bias the results.

Table 2 presents the percentages of teeth showing symmetrical and asymmetrical eruption in the Australian Aboriginal sample with results categorized by tooth class. Initial analyses did not uncover significant variation by sex and therefore data were combined to increase sample sizes. The results indicate significantly higher asymmetry for the more distal teeth in the molar tooth class supporting the theory of morphogenetic fields (Dahlberg, 1945). For example, less than half (41%) of third molars exhibited symmetrical eruption

TABLE 3. Symmetrical eruption by sex and emergence phase[1]

Tooth number	Mean emergence males (years)	Mean emergence females (years)	Symmetrical eruption, males n	%	Symmetrical eruption, females n	%
		First Emergence Phase[2]				
36, 46	6.4	5.1	8	44	5	83
16, 26	6.4	5.7	22	81	14	82
31, 41	6.6	6.4	15	71	11	79
11, 21	7.0	7.3	32	82	20	83
32, 42	7.2	7.3	29	76	18	72
12, 22	8.5	8.1	21	57	23	72
		Second Emergence Phase				
33, 43	10.0	9.1	20	49	21	62
14, 24	10.3	9.8	13	41	15	48
34, 44	10.5	9.9	9	36	8	38
13, 23	10.5	10.1	24	59	13	38
37, 47	11.2	10.8	16	46	17	63
15, 25	11.4	11.0	8	30	9	38
35, 45	11.5	11.0	8	28	5	26
17, 27	11.5	11.0	25	61	18	51
18, 28	16.8	16.1	9	38	8	36
38, 48	16.5	16.1	11	37	12	55

[1] No significant association between sex and symmetrical eruption ($P > 0.05$) but significant assocation between emergence phase and symmetrical eruption status ($P < 0.05$) based on chi-square analyses.
[2]First emergence phase refers to the time interval during which the tooth groups 36, 46 to 12, 22 emerge, between 5.1 and 8.5 years. Second emergence phase refers to the time interval during which the tooth groups 33, 43 to 38, 48 emerge between 9.1 and 16.8 years of age.
Reference: Mean emergence times (Brown *et al*., 1979)

TABLE 4. Distribution of directionality among asymmetrically erupting antimeres

Tooth number	Teeth in active phase n	Asymmetrical eruption R > L n	%	Asymmetrical eruption L > R n	%
11, 21	11	7	64	4	36
12, 22	25	16	64	9	36
13, 23	38	21	55	17	45
14, 24	35	17	49	18	51
15, 25	34	18	53	16	47
16, 26	8	4	50	4	50
17, 27 *	33	5	15	28	85
18, 28	29	11	38	18	62
31, 41	9	5	56	4	44
32, 42 *	16	12	75	4	25
33, 43 *	34	23	68	11	32
34, 44 *	29	20	69	9	31
35, 45 *	35	25	71	10	29
36, 46 *	17	2	12	15	88
37, 47	29	14	48	15	52
38, 48	29	15	52	14	48

*chi-square analysis ($P < 0.05$)

compared to two thirds (66%) of first molars.

Results comparing the percentage of antimeric pairs showing symmetrical eruption against mean emergence times for Australian Aboriginal males and females (Brown *et al*., 1979) are presented in Table 3. While no significant association was found between symmetrical eruption frequencies and sex, there was a significant association between phase of emergence and symmetrical eruption, with later-erupting teeth (represented in the second emergence phase) displaying significantly higher levels of asymmetrical eruption than the earlier-erupting teeth (represented in the first phase of emergence).

Table 4 provides percentages of teeth showing directional eruption asymmetry in Australian Aborigines. Initial analyses did not uncover significant variation by sex and therefore data were combined to

TABLE 5. Symmetrical eruption by ethnic group

Tooth number	US Caucasian n	%	US African American n	%	Finnish n	%	Australian Aboriginal n	%
11, 21 *	123	51	117	58	262	86	52	83
12, 22 *	87	52	116	46	222	74	44	64
13, 23 *	10	53	45	42	202	66	37	49
14, 24 *	6	16	39	28	175	58	28	44
15, 25 *	2	7	4	5	158	54	17	33
16, 26	276	78	359	83	253	83	36	82
17, 27	11	61	123	72	205	68	43	57
31, 41 *	481	93	333	98	270	89	26	74
32, 42 *	145	53	154	63	234	77	47	75
33, 43 *	9	29	124	57	195	64	41	55
34, 44 *	17	45	32	24	183	60	17	37
35, 45 *	2	13	4	5	180	62	13	27
36, 46 *	142	66	133	72	256	84	13	43
37, 47	10	63	64	57	202	67	33	53

*chi-square analysis ($P < 0.05$)

increase sample sizes. Significantly advanced right-sided eruption was found for the mandibular lateral incisors, canines and first and second premolars, while significantly advanced left-sided eruption was evident for the maxillary second molars and lower first molars.

Proportional estimates of symmetrically erupting antimeric tooth pairs from a cross-sectional sample of 2092 African American and Caucasian American children and a longitudinal sample of 481 Finnish children (Heikkinen *et al*., 1999) are presented alongside estimates obtained for Australian Aborigines in the current study (Table 5). Chi-square tests comparing the extent of asymmetry between the four samples yielded statistically significant results, with all teeth except the maxillary first and second molars and mandibular second molars exhibiting significant variation by ethnic group. There were, however, limitations in comparing between these studies, including differences in sample sizes and sex distribution within the samples. Although the same recording system was used, inter-observer comparisons could not be carried out to determine reliability. Hence, significant findings should be considered with caution given the limitations in making comparisons between studies. Overall trends included generally higher levels of eruption symmetry among the Finnish and Australian Aboriginal samples compared to the US African American and Caucasian samples. Antimeric tooth pairs that were found to exhibit the greatest level of stability across ethnic groups included the early emerging lower central incisors and upper first molars. In almost all cases, the more distal teeth in each morphogenetic field tended to be more asymmetrical across all samples. There were, however, exceptions: upper lateral incisors (US Caucasian sample), lower second premolars (Finnish sample) and lower lateral incisors and second molars (Australian Aboriginal sample).

DISCUSSION

This study adds to the available information regarding patterns of asymmetry observed for permanent tooth eruption, which relates to: morphogenetic fields, increased buffering capacity of females, timing of emergence, and directional asymmetry. The influence of ethnicity, as an indicator of environmental stress influencing eruption symmetry, was less clear. There were obvious limitations when comparing samples from different studies related to differences in methodological approaches. Despite these limitations, some apparent general trends were evident.

The results pertaining to our first hypothesis (Table 2) are in support of Butler's field theory (Butler, 1939; Dahlberg, 1945), based on the concept that distal teeth within each morphogenetic class tend to be more variable than the more mesially positioned key tooth. This tends to occur with the exception of the lower lateral and central incisors, which exhibit the opposite pattern and are often considered to be an exception to the rule. These findings are also well in accordance with the general literature (Garn and Bailey, 1977; Townsend, 1981; Kieser *et al*., 1986; Khalaf *et al*., 2005). The second hypothesis was not supported in that no significant difference was found to exist between males and females (Table 3), while later-emerging teeth did exhibit significantly greater asymmetry (Table 3) lending support to the third hypothesis related to timing of tooth emergence and degree of eruption asymmetry. Heikkinen's study (1998) derived similar findings with regards to the proportion of symmetrically erupting antimeric pairs, which was found to be approximately 90% in mandibular central incisors, while the maxillary lateral incisors, which are the last teeth to emerge in the first phase of the mixed dentition, showed a symmetrical proportion of approximately 50%. With later-emerging teeth, the proportion of symmetrically erupting antimeres decreased, being the lowest in second premolars. Interestingly, the last emerging permanent teeth in the second phase of the mixed dentition, the second molars, appeared to be more symmetric. Given that the more distal teeth in each class tend to emerge later in life and spend relatively more time erupting, it is plausible that asymmetry will be greater due to the larger window of opportunity for environmental influences to interfere with the eruption patterns of these teeth. Recent research by Parner *et al*. (2002) has reported on the apparent correlation between emergence times of teeth belonging to the same jaw innervation group. The authors also suggested that maxillary teeth may exhibit greater stability as their nerve innervation is more distinct for individual teeth. These findings might then be extended in relation to dental asymmetry patterns. For example, arch-specific findings related to dental asymmetry have shown the maxillary arch to exhibit greater asymmetry compared to the mandibular arch (Townsend, 1981; Kieser *et al*., 1986).

Broader links between prenatal factors and dental eruption patterns have also been identified (Garn *et al*., 1965; Heikkinen *et al*., 1998). Heikkinen *et al*. (1995) found the early clinical eruption of permanent central incisors was slightly affected in children born to mothers who smoked during pregnancy, while Garn *et al*. (1965) explained the large differences found between monozygotic twins as being possibly due to the effects of steroids on root formation and tooth movement. More research investigating the broader links between dental asymmetry patterns and other developmental disturbances should be considered for the future.

Garn *et al*. (1967) studied dental crown dimensions in males and females and proposed that increased dental asymmetry observed in males may be related to the presence of only one X-chromosome. Females with a pair of X-chromosomes were found to be more symmetrical in tooth size and it was proposed this may be related to the extra X-chromosome leading to increased buffering capacity. As discussed earlier, several studies following Garn *et al*. (1967) do not report significant sex variation. No significant difference between males and females was noted in our study, while more recent studies by Heikkinen *et al*. (1998) do show significant difference by sex with females being more symmetric than males. Heikkinen found this pattern for the maxillary lateral incisor and first premolar, and the mandibular central incisor and canine in US children, and for the maxillary first premolar and mandibular central incisor and first molar in Finnish children. Similar findings with respect to greater symmetry among females have been documented by Bailit *et al*. (1970) and Townsend and Brown (1980), lending further support to Garn's theory. Overall, there appears to be inconsistency in regards to the influence of sex on asymmetry patterns.

Our fourth hypothesis regarding directionality in tooth eruption was also supported with results indicating left-sided dominance for the maxillary second and third molars and mandibular first molar, and right-sided dominance for the maxillary incisors and mandibular lateral incisors, canines and premolars. While our findings do indicate the existence of directionality, the underlying pattern is less clear. Harris (1992) and Townsend *et al*. (1999) suggested left-sided dominance in tooth size in one arch may be associated with right-sided dominance in the opposite arch however this did not seem evident in our sample.

For testing the last hypothesis, comparisons were drawn between data from the present study and those from Heikkinen *et al*. (1998) for US and Finnish children. Overall trends included generally greater eruption symmetry among the Finnish and Australian Aboriginal samples compared to the US African American and Caucasian samples. Antimeric tooth pairs that were found to exhibit the greatest level of stability across ethnic groups included the early emerging lower central incisors and upper first molars. In almost all cases, the more distal teeth in each morphogenetic field tended to be more asymmetrical across all samples. It is plausible that the upper first molars would show similar trends across samples given that these teeth are important in stabilizing occlusion and are also less likely to be interrupted in their eruption path as they do not succeed primary teeth. However, other results are more surprising. For example, the lower central incisors tend to be more variable than lower lateral incisors in one sample (Australian Aborigines) but not so for the other three samples. Similarly, it is not immediately obvious why the Finns and Australian Aborigines would be more similar in their patterns of symmetry compared with the American samples.

A confounding factor in making these comparisons is that each of the three samples was scored by a different researcher. Whilst the same scoring system was used in each case, it is possible that inconsistencies exist between scorers. Hence, considerable caution should be exercised when making inter-population comparisons of existing data on eruption asymmetry due to these limitations. Further studies based on larger sample sizes and consistent methodology across samples are required before true inter-population variation in eruption asymmetry can be described accurately.

Overall methodological considerations should also be taken into account. The number of subjects included in this study was limited to 90 from a total sample of 450 individuals. Many individuals were excluded because of limited numbers of serial casts being available during the mixed dentition phase, and casts for some individuals could not be included because they were damaged or had missing teeth. Teeth were scored using the cast on which they first became evident, although subsequent casts, that were usually obtained at annual intervals, were used to confirm presence of teeth and assist in scoring. While limitations of the scoring system were noted, accurate assessment of the degree of eruption was not always possible. There were several teeth that displayed gingival recession or inflamed gingivae, which in turn led to more challenging judgement of whether eruption was full or partial. In some instances, examination of the level of the occlusal plane and physically occluding the upper and lower casts was necessary in order to determine whether a tooth was fully or partially erupted. There were problems in some cases in distinguishing between categories 2 and 3, and categories 3 and 4. It would be worthwhile considering the addition of an extra score(s) to define more precise points of eruption, although this may reduce the level of reliability of scoring.

CONCLUSION

Our findings provide evidence of patterned tooth eruption asymmetry among a sample of Australian Aborigines with the distally positioned, later-forming teeth showing the highest levels of asymmetry. While directional asymmetry was shown to be present, no clear pattern could be ascertained. Despite limitations in making comparisons across different studies, there was some evidence to suggest stability of the upper first molars and the lower central incisors when investigating the influence of ethnicity on asymmetry patterns.

ACKNOWLEDGEMENTS

The dental casts were collected by the late M. J. Barrett during a growth study which was supported by Research Grant DE 02034 from the National Institute of Dental Research, Bethesda, MD, and by grants from The University of Adelaide and the Australian Institute of Aboriginal Studies, Canberra. Ethical approval was obtained at the time of data collection for the study.

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Short Communication: Dental Trait Variation and Age Determination Based on Dental Wear: A Preliminary Study of Javanese

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ABSTRACT This preliminary study describes the dental crown morphology of 14 Javanese of known sex and age. The purpose was to suggest what dental traits to look for when studying a bigger sample from Java. Of 21 traits looked for, traits occurring in the sample were shovel shape, winging, tuberculum dentale, interruption groove, canine distal accessory ridge, premolar accessory ridges, premolar accessory marginal tubercles, premolar multiple lingual cusps, cusp 5, cusp 6, Y5 pattern, cusp 7, protostylid, deflecting wrinkle, anterior fovea, hypocone, and Carrabelli's cusp. Dental wear overestimated actual ages because the observed rate of wear was less than in the reference sample. *Dental Anthropology* 2007;20:42-44.

Studies in dental anthropology have never been conducted on Indonesians even though the area has a rich variety of peoples and cultures (Muttaqin, 2007). The variety of populations may provide valuable data regarding human evolution (Hillson, 2002), migration patterns (Scott and Turner, 2000), and for solving forensic cases (Brown, 1992), so it is useful to initiate studies in dental anthropology. Before a bigger sample is studied, it is useful to know which dental traits to focus on.

Additionally, the extent of dental wear is useful for estimating an individual's age, especially in skeletal material (Maples and Browning, 1994), so this study also assessed the suitability of a reference base of dental wear rates (Brothwell, 1965, cited in Bass, 1987:287).

MATERIALS AND METHODS

The sample was 14 individuals (12 females, 2 males) from the island of Java (Indonesia), whose sex and age were known (age range 19 to 26 years). The dental traits examined were shovel shape, incisor winging, tuberculum dentale, interruption groove, canine distal accessory ridge, premolar accessory ridges, premolar odontomes, premolar accessory marginal tubercles, premolar multiple lingual cusps, accessory marginal tubercles, parastyle, cusp 5, cusp 6, Dryopithecus Y5 pattern, cusp 7, protostylid, deflecting wrinkle, anterior fovea, distal trigonid crest, hypocone, and Carabelli's cusp. Dental traits were scored using the descriptions in Scott and Turner (2000). Age estimations from occlusal tooth wear was based on the reference data in Brothwell (1965, cited in Bass, 1987).

RESULTS AND DISCUSSION

Shovel shape was very common. This is expected given the Asian ancestry of the group. Even the canine showed a high incidence of shoveling (Table 1).

Incisor winging occurred in 8 of 14 individuals (57%). Very high frequencies of winging are usually found in Sinodont dentitions. The people of Java are labeled Sundadont, and these data suggest that Sundadont groups may also have quite high frequencies.

Expression of tuberculum dentale was weak to moderate; only one individual showed a pronounced canine tuberculum dentale. Most individuals lacked a tuberculum dentale on their incisors (Table 2). An interruption groove on the upper second incisors occurred in half the sample (7/14 cases).

TABLE 1. The number of teeth with shovel-shape

	Maxilla			Mandible		
	I1	I2	C	I1	I2	C
No shovel	1	1	1	12	12	1
Shovel	13	13	13	2	1	13
Total	14	14	14	14	13	14

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TABLE 2. The occurrence of tuberculum dentale

	I1	I2	C
No tuberculum dentale	13	12	1
Weak	0	1	4
Moderate	1	1	8
Pronounced	0	0	1
Totals	14	14	14

TABLE 3. The occurrence of canine distal accessory ridge

	0	1	2	3	4	5
Upper	9	1	3	1	0	0
Lower	11	1	2	0	0	0

Canine distal accessory ridge was uncommon, and when it appeared, the expression was not very strong (score 1 to 3) (Table 3). Premolar accessory ridges appeared mostly in the lower premolars. The occurrence was 1/14 on P1 and 7/14 in the maxilla, while frequncies of 7/14 and 6/14 occurred on the mandibular premolars.

Three-cusped second molars were found (1/26 M2), but most molars had 3 or 4 main cusps (Table 4). Carabelli's trait complex was expressed in half of the cases. However, the expression was in the form of the most subtle expression (A).

The expression of several dental traits is summarized in Table 5. Anterior fovea was expressed in most cases. A second trait that was expressed quite often (8 instances) was lower premolar multiple lingual cusps. Dental traits not found in the sample were accessory marginal tubercles, parastyle, and odontome.

Occlusal dental wear was less severe than in the reference data (Brothwell, 1965, cited in Bass, 1987). It would be logical to predict that most teeth in modern humans have less dental wear due to the softer, cooked material eaten, compared to their predecessors. However, modern humans may exhibit tooth abrasion if brushing with an abrasive toothpaste (Hillson, 2002).

The finding of little dental wear in these Javanese compared to the reference sample emphasizes variations in rates among populations, based on tooth cleaning practices, nature of the diet, and cultural practices related to utilizing teeth as tools. We used Brothwell's occlusal wear rates that were derived from British archeological material. The present results show that dental wear reference data should be used cautiously, taking into account the origin of the individual being assessed. It seems that the cultural practices and habits of contemporary Javanese do not cause as much dental wear as from harder food material eaten by more ancient humans.

CONCLUSIONS

Based on the dental traits, most (6 out of 7) of the dental characteristics of Southeast Asian people (Scott and Turner, 2000) have been found in the sample. Besides these seven dental traits, tuberculum dentale, canine distal accessory ridge, premolar accessory ridges, premolar multiple lingual cusps, protostylid, and anterior fovea were also found in the sample. Further research on this area should be done with larger sample sizes, and the traits looked for need not be limited to the dental traits indicated as the characteristic of Southeast Asian people.

Dental wear in this sample indicated older age of individuals compared to the real ages because of slow

TABLE 5. The occurrence of several dental traits

Dental Trait	Frequency (individuals)
Odontome	0
Premolar accessory marginal tubercle	3
Lower premolar multiple lingual cusps	8
Accessory marginal tubercles	0
Parastyle	0
Cusp 5	1
Cusp 6	3
Y-5 Pattern	1
Cusp 7	1
Protostylid	2
Deflecting wrinkle	1
Anterior fovea	13
Distal trigonid crest	0

TABLE 4. Size gradations of the hypocone

	Right Side						Left Side					
Molar	0	1	2	3	4	5	0	1	2	3	4	5
M1	0	0	0	1	11	1	0	0	0	1	13	0
M2	1	0	2	9	0	0	2	0	0	11	1	0

wear rates, so aging an individual using dental wear reference data should be done cautiously. However, because of the small sample size, more people should be included in the future study.

ACKNOWLEDGEMENTS

My gratitude to all the students that have been willing to give their dental impressions. My greatest appreciation to Susy Kristiani, drg., MKes who have given her time and suggestions for the techniques in making dental casts.

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Obituary: Melvin L. Moss (1923-2006)

Fig. 1. Mel Moss, mid-1980s.

Melvin L. Moss passed away June 25, 2006, at the age of 83. Mel was an anatomist (and former dean) at the dental school at Columbia University, New York (Fig. 1). Indeed, he was very much a home-town success: Born in New York (January 23, 1923), he received his A.B. from New York University (1942), and then his D.D.S. (1946) and his Ph.D. (Anatomy, 1954) from Columbia University. Mel taught at Columbia for the whole of his professional career (Fig. 2), even after receiving his emeritus status in 1993, giving his last formal anatomy lecture in 1993 (Fig. 3).

Labeling Mel as an anatomist is strictly true, but his interests—and his intellectual influence—are more far-ranging. His over-200 publications spanning some 60 years (including many invited book chapters) is itself a testament to his scientific contributions, but those who were fortunate enough to hear him speak at meetings recognize that his sphere of influence was much broader than can be extracted from his writings alone.

Moss' spectrum of research interests ranged from dental histology, tooth formation, odontometrics, bone biology, growth and development, mathematical modeling, branchial arch syndromes, the etiology of malocclusion, anatomical consequences of orthocephalization, and a host of other topics. Mel's command of German provided a valuable prelude into the scientific European literature, so his papers are well-peppered with insights and citations that are less accessible to the rest of us who wrestle with a single language. However, it is Mel's development and vociferous promotion of the functional matrix theory that is his foremost contribution (*e.g.*, Moss-Salentijn, 1997). This involved a true paradigm shift (Kuhn, 1962). Previously (and persistently in some circles), the size and shape of bones were perceived to be the consequence of their genetic endowment. Instead, Moss argued—along with insightful animal experimentation—that bone is "dumb" (an often-repeated metaphor of his), meaning that bone merely responds to the environment (the soft tissues, mechanical demands, *etc*.) that it finds itself in.

I'm fond of dwelling on this "Moss-ism" in my own lectures, partly because of its interesting structure but also because it is so pithy:

> The size, shape, position and maintenance in being of all skeletal units are compensatory, secondary and mechanically obligatory responses to the primary morphogenetic demands of their specifically related functional matrices.

This meshes with the bone biologists' refrain that "function is dominant over form."

Moss' functional matrix theory rankled more than a few colleagues, commonly generating heated, dynamic discussions at meetings. With his imposing stature, powerful voice, and considerable erudition, arguments with Moss often became lively theater for the audience. Since Moss was such an excellent speaker, he frequently was called on as the scientific expert to open sessions at clinical meetings of dentists (and, especially, orthodontists, who were broadly influenced by the functional matrix theory), so expectations of verbal fireworks between Mel and the antagonist-of-the-day often were fulfilled. Most researchers of his era have "Mel stories." Indeed, he clearly had a Socratic streak in him that enjoyed teaching by raising his opponent's blood pressure.

Development and elaboration of the functional matrix theory held much of Moss' attention during the latter part of the century, so younger scholars can be excused if they

Fig. 1. Mel Moss, 1993, following his final anatomy lecture, and preceding his emeritate.

perceive Moss as a craniofacial biologist. He published widely (with 16 papers in the *American Journal of Physical Anthropology*), and he did considerable early work on the histology of dental tissues. His work on the phylogeny of mineralized tissues (1964) and the evolution of mammalian dental enamel (1969) are representative of the breadth and scope of his considerable knowledge. Moss participated in several of the International Symposia on Dental Morphology (Moss, 1978, 1982), but he may be best known in dental anthropology circles for his study of tooth sizes of Liberian Negroes (1966, 1967), which is an area of the world that still merits anthropological investigation (Edgar, 2002). Of note, some of Moss' final studies were of teeth (Moss-Salentijn et al., 1997; Moss *et al*., 2005).

At the risk of being an absurd reductionist, Moss' professional career spanning a half-century offers a special opportunity to reflect on the productivity of an enthusiastic scientist, especially one working before the now-popular multi-author laboratories, where authorship comes more easily, but sole authorship only occurs rarely. Moss' publication record involved several close collaborators over the years, but the work generally reflects the vision of one person. My collation of his references from 1948 through 2005—which is almost guaranteed to be incomplete—comes up with 247 citations (mean = 4.3/year; sd = 3.2). Moss' productivity picked up in 1954 coincident with award of his Ph.D. (Fig. 4), and it seldom dropped below 4 peer-reviewed papers per year for the next 35 years. This sustained output likewise is shown in Fig. 5, where the cumulative curve has a characteristic sigmoid shape due to a hesitant start at the beginning and a decelerating denouement at the end, but I doubt if there are many of Moss' era who match the long, linear, high rate of publication in between. It devalues a scientist's career to merely count the lines on a CV, but these numbers provide an interesting benchmark of one person's research productivity. Unfortunately, they also cloud the powerful and lasting influence Mel had on his students and colleagues.

Edward F. Harris
Editor

ACKNOWLEDGEMENT

Melvin Moss' wife and colleague, Dr. Letty Moss-Salentijn, kindly provided a CV as well as the three photographs of Mel for this article.

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Fig. 3. Mel Moss, mid-1990s.

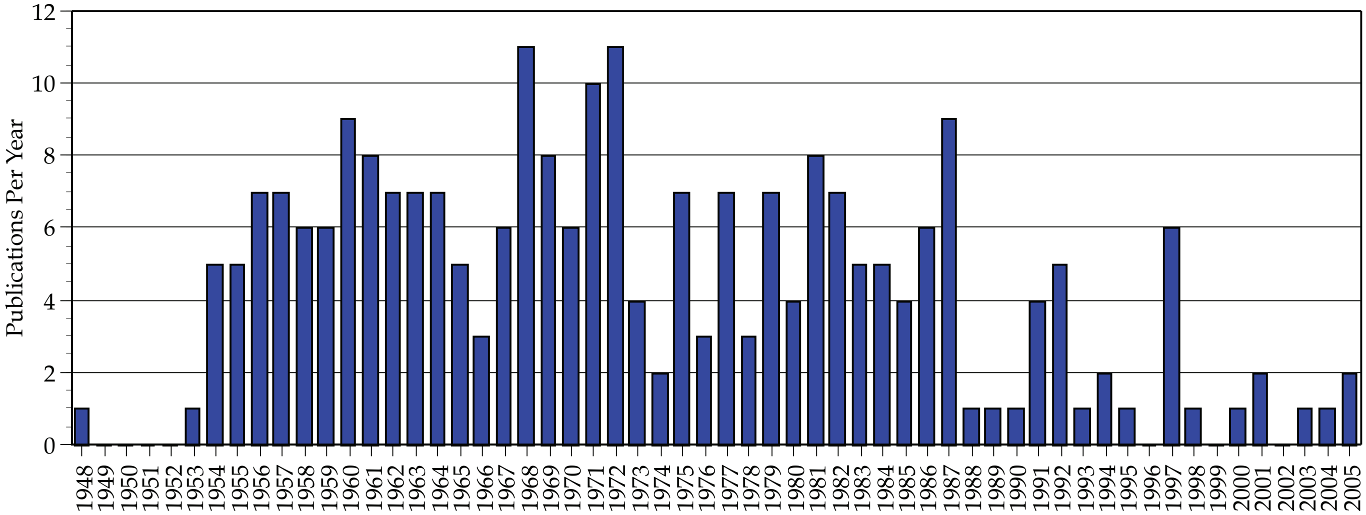

Fig. 5. Publications per year.

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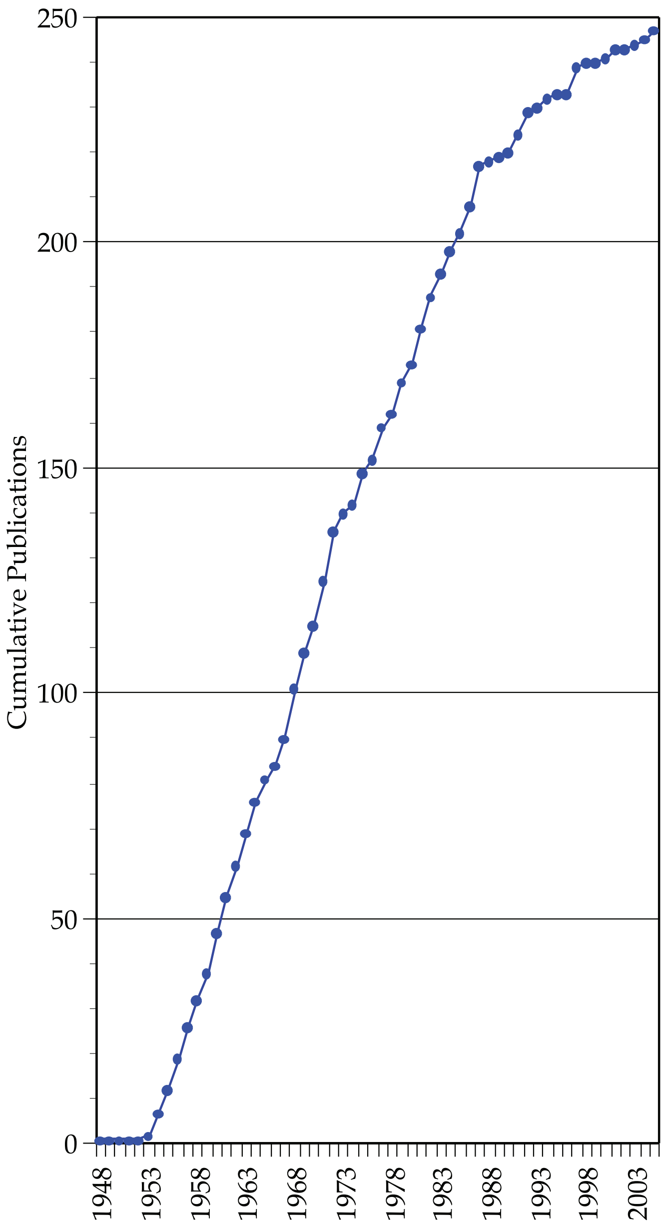

Fig. 5. Cumulative graph of publications.

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DAA Subscription

The secretary-treasurer of the **Dental Anthropology Association** is Dr. Loren R. Lease of Youngstown State University.

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Minutes of the 22nd Annual Dental Anthropology Association Business Meeting March 29th, 2006, Philadelphia, Pennsylvania

Call to Order
President Simon Hillson called the meeting to order at 7:45 pm. There were 35 members in attendance.

Old Business
None.

New Business

1. Secretary-Treasurer's Report: Heather Edgar reported that as of March 15th, 2007, the DAA has $3066.92 in operation funds and $1439.79 in the AA Dahlberg prize funds. Due to the journal being distributed electronically to most members, the operation funds are now in good shape. However, the Dahlberg prize fund is getting low, and donations would be welcome. There are 139 members in the association who are current with their dues or one year past current. Members who are more than one year in arrears on their dues will receive email reminders over the summer.
2. A. A. Dahlberg Student Prize: The winner of the 2007 was Matthew Skinner, for his paper entitled "Non-metric dental trait expression at the enamel-dentine junction of lower molars in extant and fossil hominoids." He received $200, a certificate of award, a year's free membership in the DAA (Fig. 1).
3. Simon Hillson nominated Edward Harris to continue in his position as Editor of *Dental Anthropology*. The motion was unanimously passed.
4. Loren Lease was elected Secretary-Treasurer for 2007-2008.
5. Simon Hillson discussed the continuing relevance of dental anthropology, as evidenced by the recent spate of related articles in the popular press. These articles reported on research ranging from health correlations of *Streptococcus mutans* to laboratories creating teeth from germs cells. He ended his term as DAA President by handing the presidential gavel to Brian Hemphill, President-Elect, who discussed present and future trends in dental anthropology, including the use of sophisticated statistical and technological methods (Fig. 2).

Adjournment
Simon Hillson adjourned the meeting at 8:45 pm. The meeting was followed by a period of socializing around the DAA bar.

Submitted by:
Heather J.H. Edgar
DAA Secretary-Treasurer

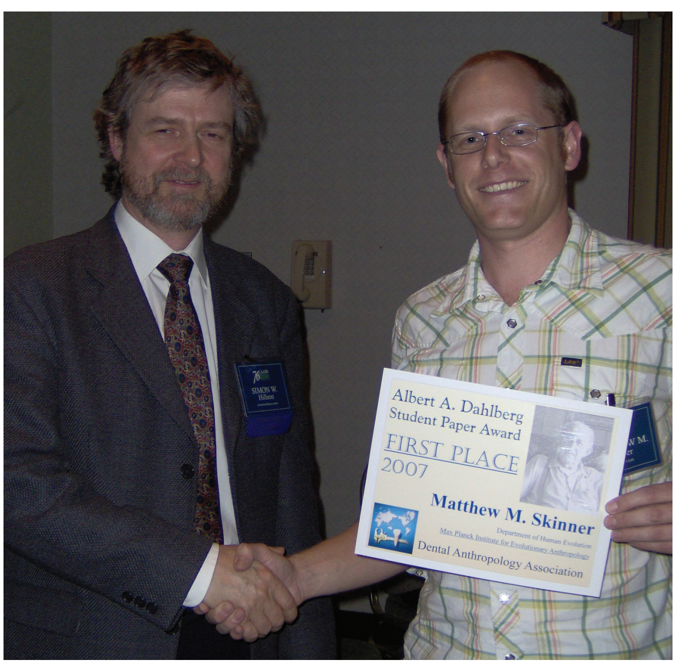

Fig. 1. President Hillson congratulates Matthew Skinner for winning the Dahlberg Award for 2007.

Fig. 2. Simon Hillson ceremoniously relinquishes the gavel to incoming President-Elect Brian Hemphill.

NOTICE TO CONTRIBUTORS

Dental Anthropology publishes research articles, book reviews, announcements and notes and comments relevant to the membership of the *Dental Anthropology Association*. Editorials, opinion articles, and research questions are invited for the purpose of stimulating discussion and the transfer of information. Address correspondence to the Editor, Dr. Edward F. Harris, Department of Orthodontics, University of Tennessee, Memphis, TN 38163 USA (E-mail: eharris@utmem.edu).

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Dental Anthropology

Volume 20, Number 2-3, 2007

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