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Original

Age-related changes in crown and root length in Sri Lankan Sinhalese

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Abstract: Exploration of the relationship between tooth dimensions, body size, and age is important in paleontology, forensic odontology and aesthetic dentistry. It is reasonable to speculate that tooth length is associated with stature since teeth contribute to facial height. This study aimed to determine whether there was an association between tooth length and stature and age in a sample of Sri Lankan Sinhalese. Extracted teeth of adults, whose age, sex and standing height were known, were used for measurements. The total tooth length (TTL), crown length (CL) and root length (RL) of permanent maxillary central (68) and lateral (67) incisors were measured using a caliper. Statistical analyses were performed with the software MINITAB version 14.0 (Minitab Inc, USA). Mean age and standing height were 47.81 yr and 152.15 cm, respectively. There was no significant correlation between stature and tooth lengths of incisors. However, age was found to have a significant correlation with RL, ($r = 0.26$, $P < 0.05$) and CL ($r = -0.28$, $P < 0.05$). Absence of an association between tooth length and stature indicated that the genetic linkage between tooth size and stature was weak, suggesting that determination of stature from tooth lengths is unwarranted. The association between tooth length and age indicates the importance of root length in age determination. (J Oral Sci 51, 587-592, 2009)

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Introduction

Tooth dimensions have often been used in the investigation of hominid evolution and pattern of variation among different population groups. Numerous studies have indicated a strong genetic influence in the determination of tooth dimensions (1,2). It has also been reported that tooth morphology and dimensions change with human evolution due to technological, environmental and dietary changes (3). Now it is widely accepted that both genetic and environmental factors affect tooth dimensions (4). Teeth are important in victim identification in forensic odontology and in aesthetic dentistry.

Does stature correlate with tooth dimensions? The answer to this question is still controversial. However, one might expect taller people to possess longer teeth since they contribute to the height of the face (5). Although numerous studies have compared tooth width with stature (6-9), few reports are available on the relationship between stature and tooth length. Sterrett et al. (1999) reported that no significant correlation existed between stature and clinical crown length and width in a study which used dental casts (10). However, information on the relationship between stature and anatomical tooth length is scarce. To our knowledge, there are few published data comparing tooth length with stature among Sri Lankans or any other populations in South Asia. The aim of the present study was to determine the relationship between stature and anatomical tooth length of permanent maxillary incisors in a sample of Sri Lankan Sinhalese to provide further information regarding the association between stature and

tooth dimensions.

Materials and Methods

The protocol of this study was approved by the Research, Ethical and Higher Degrees Committee of the Faculty of Dental Sciences, University of Peradeniya, Sri Lanka. A total of 200 maxillary incisor teeth were collected from adult patients attending the dental clinics of Peradeniya and Kandy hospitals for teeth extractions. Age, sex, race and standing height of the patient were recorded before extraction. Standing height was measured with a calibrated tape pasted to the wall. Teeth were fixed in 10% formol-saline and cleaned. Obvious abnormalities such as caries, attrition, abrasion and the presence of curved roots were recorded. Out of 200 incisors, 135 maxillary incisors with no or mild attrition were selected for measurements. The total tooth, crown and root lengths were measured on the labial side using a vernier caliper (Dentaurum, Pforaheim, Germany) to the nearest 0.1 mm. The total tooth length (TTL) was measured between the highest points of the crown and root along the center of the cervical margin. The crown length (CL) and the root length (RL) were recorded from the center of the cervical margin to the highest points of the crown and the root, respectively (Fig. 1). All measurements were done thrice and the mean value was taken. Measurements were repeated on a random sample (15) at two different time periods to exclude intra-examiner error.

Analysis of data

Statistical analyses were performed with software MINITAB version 14.0 (Minitab Inc, USA). Analysis was conducted by first testing for normal distribution of the variables. Means, standard deviations and coefficients of variation for all the variables were determined by gender for both teeth. Difference between means was analyzed using two-tailed Student's *t*-test. Pearson correlation coefficient was used (H_0: r = 0) to determine the correlation between tooth lengths (TTL, CL, RL, CL/RL) and stature and age.

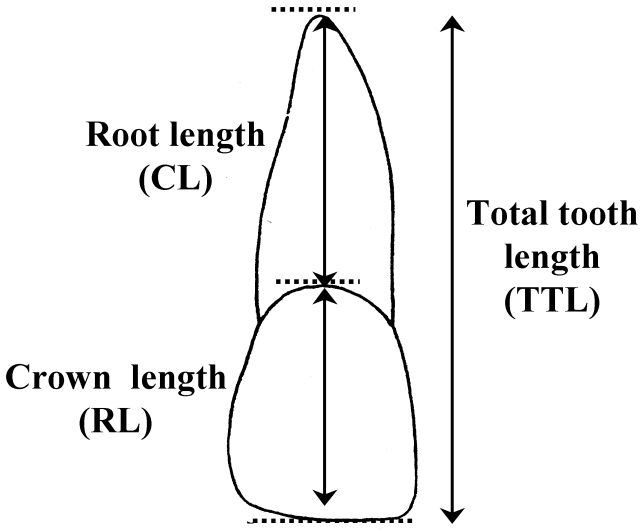

Fig. 1 Lengths were measured between the highest points of the crown and root along the center of the cervical margin.

Results

After exclusion, the study sample included 68 maxillary central and 67 lateral incisors from Sri Lankan Sinhalese males (33) and females (102). Basic statistics of all variables showed that data were in normal distribution. The age range of the study sample was 20-76 yr and the standing body height varied from 134-175.1 cm. The mean values of age and height of males were 56 yr and 162.11 cm, respectively, and those of females were 45.12 yr and 148.91 cm, respectively. A significant difference was observed in standing body height between males and females (Table 1).

The mean values of TTL and RL of both incisors and the CL of lateral incisors were higher in males than those of the females, although the differences were statistically not significant (Table 1). Therefore, the correlation between stature and each tooth length was calculated from the combined data of both sexes. Pearson correlation indicated that there was no statistically significant correlation between the standing body height and any of the tooth lengths of all maxillary incisors (Table 2). In contrast, a low but statistically significant correlation was observed between age and some of the tooth lengths (Fig. 2). Although the magnitude was small, positive correlations were observed between age and RL (r = 0.26, $P < 0.05$) and age and RL/CL ratio (r = 0.25, $P < 0.05$) for maxillary incisors. A negative weak correlation was depicted between age and CL (r = -0.28, $P < 0.05$). However, a significant correlation was not observed between age and the TTL (r = 0.04, $P = 0.66$).

Since the difference in tooth lengths between males and females was not statistically significant (Table 1), measurements of both sexes were combined to obtain average incisor lengths. Pooled data of both sexes revealed that the TTL and CL of the maxillary central incisor were longer than those of the adjacent lateral incisor (Table 3). However, the root of the lateral incisor was longer than that of the central incisor. The same result was observed when root length was calculated for each sex separately (Table 1). The ratios between root and crown lengths (RL/CL) of the maxillary central and lateral incisors were 1.2 ± 0.17 and 1.42 ± 0.21, respectively. The coefficient

Table 1 Body height and tooth length of maxillary incisors of males and females

	Male			Female				
	n	Mean	SD	*n*	Mean	SD	*t*-value	*P*
Central incisor								
Height	13	163.12	1.41	55	148.64	4.7	6.05	0.000
TTL	13	23.78	2.04	55	23.02	1.58	1.26	0.226
CL	12	10.67	1.22	55	10.79	0.81	0.35	0.732
RL	12	13.39	1.13	55	12.72	1.45	1.75	0.096
RL/CL	12	1.27	0.13	55	1.19	0.18	1.74	0.097
Lateral incisor								
Height	20	161.45	5.88	47	149.22	5.53	7.92	0.000
TTL	20	22.27	1.54	47	21.96	1.44	0.79	0.437
CL	20	9.5	0.8	47	9.42	0.86	0.4	0.694
RL	20	13.59	1.26	47	13.14	1.39	1.31	0.2
RL/CL	20	1.44	0.18	47	1.41	0.22	0.56	0.577

Height in cm and tooth lengths in mm.

Table 2 Pearson correlation (r) between length of maxillary incisors and stature

Tooth length	Central incisors			Lateral incisors			All incisors		
	n	r	*P*	*n*	r	*P*	*n*	r	*P*
Total tooth length (TTL)	68	0.236	NS	67	0.157	0.206	135	0.15	NS
Crown length (CL)	65	0.122	NS	67	0.207	0.093	132	0.07	NS
Root length (RL)	65	0.165	NS	67	0.134	0.279	132	0.16	NS
RL / CL	65	0.044	NS	67	0.64	0.058	132	0.038	NS

NS; Not significant ($P > 0.05$)

of variation of RL was greater than that of CL in both maxillary incisors. Coefficients of variations of RL and CL of the central incisor were 10.98% and 8.23%, while those of the lateral incisor were 10.23% and 8.9%, respectively.

Discussion

A statistically significant sexual dimorphism of stature was noticed in our study sample as reported in other populations. One can postulate that the stature might reflect tooth length since tooth height contributes to the facial height (5). Our study revealed that there was no association between tooth length and stature. This finding is in accord with previous results which indicated no association between stature and tooth width in Caucasians (6,10). Sterrett et al. reported that no significant correlation existed between stature and clinical crown length and

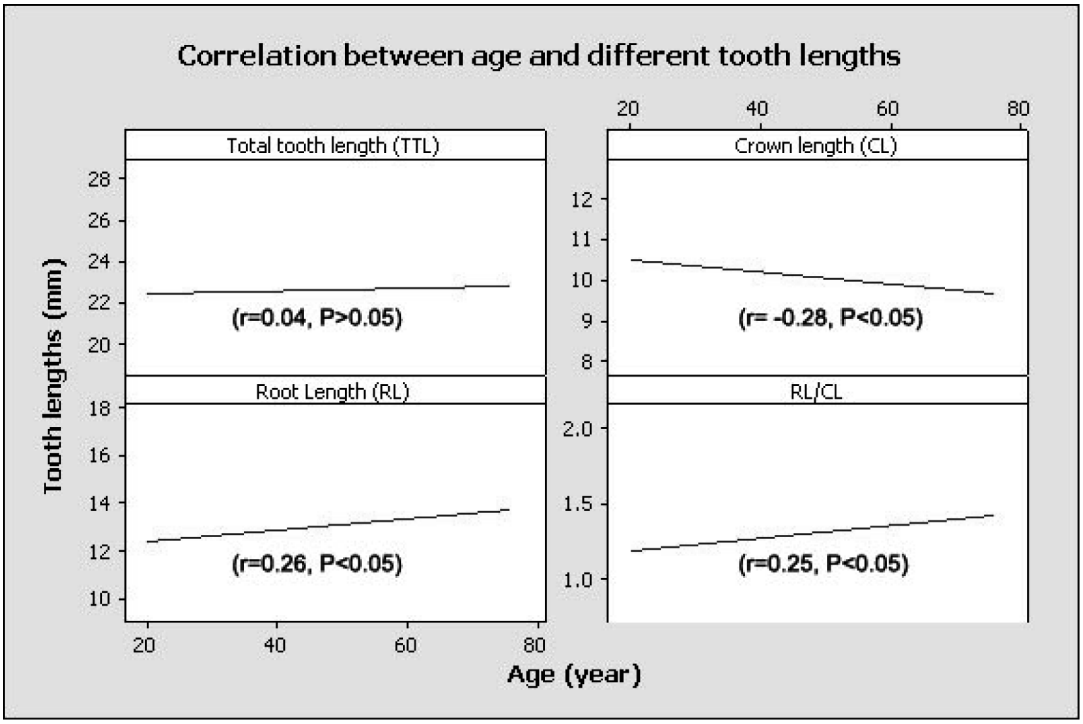

Fig. 2 Tooth length of maxillary incisors plotted against age showing correlation between tooth length and age.

Table 3 Mean length (mm) of human permanent maxillary incisors

	Central incisor			Lateral incisor		
	n	Mean	SD	*n*	Mean	SD
TTL	68	23.12	1.69	67	22.05	1.47
CL	65	10.77	0.89	67	9.44	0.84
RL	65	12.84	1.41	67	13.28	1.36
RL/CL	65	1.2	0.17	67	1.42	0.21

width of three tooth groups of the maxillary anterior sextant in a study which used dental casts of healthy subjects (10). Filipson and Goldson found a low correlation between incisor width and head width but no relationship between stature and size of anterior teeth (incisors and canines) in Swedish conscripts (6).

However, a few studies suggested a correlation between stature and tooth dimensions with a great variability. Ozaki et al. recounted that Ozaki and Ozawa reported a possible correlation between tooth length and stature (7). Further, Ozaki and Ozawa indicated that the tooth length was roughly the sum of the heights of crown and roots, and since root lengths are highly correlated with total lengths, there would be a correlation between root length and stature (7). However, a correlation between root length and stature was not found in the present study, although a greater variation among individuals was observed in the root length than in the crown length. Garn et al. found a significant correlation between stature and mesiodistal and buccolingual diameters of maxillary lateral incisors of males, while such a relationship was absent in the maxillary central incisor of both sexes (8). Henderson and Corruccini reported a positive correlation between stature and mesiodistal and buccolingual tooth width at different

magnitudes in some teeth of African Americans (9). In the same study, permanent maxillary central incisor showed a correlation (r = 0.32) between stature and tooth width in males, while the lateral incisor of males and all the incisors of females failed to show such a correlation (9). It seems that the association between stature and tooth dimension is inconsistent depending on the tooth, sex and race. Therefore, from the findings of previous studies and ours, it is reasonable to state that inferring stature from the length of tooth is unwarranted. This also reflects that the genetic linkage between tooth length and stature is not strong.

It is well known that a number of changes such as discoloration and attrition of teeth occur with aging. A negative correlation between age and CL observed in the present study indicates the occurrence of tooth attrition with aging. This correlation was very low in the present study ($r = -0.28$, $P < 0.05$) since our sample included teeth with no or mild attrition.

Unlike enamel, cementum keeps forming throughout life. The continuous apposition of cementum is influenced by the functional state and occlusion of teeth and dental changes like attrition and abrasion (11,12). One of the most common dental changes is occlusal attrition, which brings about cementum formation at the root apex as a continual adaptive and compensatory mechanism for the preservation of healthy masticatory function (12,13). The present finding of a positive correlation between age and RL infers the formation of cementum at the root apex with aging. Observation of a low degree of correlation between RL and age ($r = 0.26$, $P < 0.05$) in the present study may be due to the fact that teeth used in the study showed no or mild attrition. The finding of statistically significant correlation between age and RL/CL ratio ($r = 0.25$, $P < 0.05$) infers that CL decreases with aging due to attrition, which in turn increases the RL by compensatory cementum formation. Absence of any association between TTL and age may also infer that cementum formation at the root apex mainly takes place for adjustment of the tooth height for maintenance of occlusion. This is in line with the observation of ongoing tooth eruption in adult life (11,14). A close correlation between rate of tooth wear and rate of tooth eruption has also been reported (12). Since the study sample included teeth with no or mild attrition, the degree of correlation between age and RL/CL was low in the present study.

Among the few odontometric studies done in Sri Lanka, two studies were published on the quantitative assessment of mesiodistal and buccolingual crown diameters in permanent dentition using samples from Sri Lankan university students (15,16). Published data on the quantitative assessment of length dimension of permanent dentition of Sri Lankans are scarce. Therefore, the mean values of length dimension of permanent maxillary incisors reported in this study are valuable, although the sample size is not sufficient to establish norms for the Sri Lankans. In agreement with previous reports, the present study showed that the TTL and CL of the central incisor were longer than those of the lateral incisor (17-19). However, the root of the maxillary lateral incisor was longer than that of the adjacent central incisor in the present study. A similar finding has been reported in other populations in previous studies (20). A similar root length for both maxillary incisors has also been reported (18,19).

In conclusion, this study revealed that there is no association between vertical lengths of permanent maxillary incisors and stature. Although teeth are important for the vertical dimension of the face, it seems that tooth length has no contribution to stature. This indicates that the genetic linkage between tooth size and stature is not strong, suggesting that determination of stature from tooth lengths is unwarranted. However, the root length seems to be important in age determination.

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