JOURNAL OF COMPLEMENTARY MEDICINE RESEARCH, 2020
VOL 11, NO. 1
10.5455/jcmr.2020.11.01.22

RESEARCH ARTICLE

Open Access

MEASUREMENT CHARACTERISTICS OF THE CROWN DIAMETERS OF THE DECIDUOUS AND PERMANENT TEETH OF VIETNAMESE CHILDREN

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ABSTRACT

Objectives: This longitudinal study examined the relationship between the crown diameters of the deciduous and permanent teeth to establish prediction equations for the permanent tooth crown diameters.

Method: The mesiodistal and buccolingual diameters of 64 pairs of dental casts (32 boys, 32 girls, aged 3–5 and 12–14) were measured.

Results: Correlation coefficients between the deciduous and permanent teeth varied from low to high (0.45 to 0.73 for mesiodistal diameters; 0.52 to 0.71 for buccolingual). The correlation coefficients for the groups of teeth varied from medium (0.59) to high (0.85) ($p<0.001$). Prediction equations for the mesiodistal diameters of the permanent tooth groups were developed based on the deciduous tooth group ($y=0.88x + 7.73$).

Conclusions: Correlation coefficients were higher for the mesiodistal and buccolingual diameters between the deciduous second molars and the permanent first molars than between the deciduous second molars and the second premolars. The correlation coefficients were always higher between groups of teeth than between pairs of teeth. The crown diameters of the permanent tooth groups can be predicted from the crown diameters of the deciduous tooth groups.

ARTICLE HISTORY

Received January 21 2020,
Accepted February 11, 2020
Published July 2, 2020

KEYWORDS

Buccolingual, Correlation, Mesiodistal, Teeth, Vietnam.

INTRODUCTION

Tooth size has been shown to be closely related to both sex and ethnicity (Jaroontham and Godfrey, 2000; Smith et al., 2000). From an anthropological perspective, determining tooth size and form is a useful way of comparing the current population with previous civilizations. This is because differences in tooth size may correlate with differences in customs, living environments, and eating habits of different ethnic groups (Garn et al., 1967, 1969; Guagliardo, 1982; Hinton et al., 1980; Lavelle, 1973). Tooth size studies often focus on the size of the primary tooth in the permanent tooth dentition, although some studies are based on geographic and racial variables (Barberia et al, 2009; Margetts and Brown, 1978; Moorres and Chadha, 1962). Other studies have focused only on analysis of the mesiodistal diameter of permanent teeth, and few authors have examined double-sided diameters or all molars (Barberia et al., 2009).

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The mechanisms may be ambiguous, but genes that control tooth size may also be linked or inherited with other genes that control jawbone development. However, investigations of the size of the crowns in the front teeth and permanent teeth in the same study are scarce. Northcroft (1924) studied the correlation between the mesiodistal crown size (MCS) i_1 and the maxillary I_1 in 53 children and found a clear correlation between the MCS of the baby teeth with that of the permanent teeth; but no specific correlation coefficient. Lysell (1960) studied the total size of the i_1, i_2, and the I_1, I_2 functions and found a weak correlation. Moorrees et al. (1957) suggested that the highest correlation coefficient of the mesiodistal crown dimensions was in the i_1, I_1 upper functions. Lysell (1957) found a low r value for measurements of the mesiodistal crown dimensions of i_1, i_2 and I_1, I_2 and reported a higher r value for women than for men.

The MCS correlation between deciduous teeth and permanent teeth plays an important role in the development of occlusion of the permanent teeth (Hung, 1993). However, very little information is available regarding the tooth size correlation between deciduous teeth and permanent teeth in the same individual, because longitudinal research data is difficult to obtain. Therefore, this study was conducted to assess the correlation of the tooth size between the deciduous teeth and permanent teeth and to make predictions regarding the size of permanent teeth based on the size of the deciduous teeth.

METHODS

Study design and subjects

Sample selection: This was a longitudinal study. The measurement characteristics were analyzed on 64 pairs of dental samples taken at 3 to 5 years of age and again at 12 to 14 years of age in the same child. Thus, 128 pairs of teeth were taken from the collection of cast jaw samples at the Faculty of Odonto-Stomatology, University of Pharmacy and Medicine at Ho Chi Minh City obtained from children aged 3 to 18 years old, conducted in November 1996 by Prof. Dr. Hoang Tu Hung, who presides over the Faculty of Odonto-Stomatology at the University of Medicine and Pharmacy at Ho Chi Minh City(Hung, 1993).

Inclusion criteria: Pairs of dental casts were used when the teeth were fully formed, without abnormal crown shape; and without much wear on the top of the zone, central fossa, the chewing surface.

Exclusion criteria: Jaw samples with errors due to breakage, frothing, cavities, side fillings, or misalignment were excluded.

Study instrument

The mesiodistal crown size (MCS) and the buccolingual crown size (BCS) in deciduous and permanent teeth were measured by as described by Moorrees et al. (1957), using an electronic slide with an accuracy of 0.01mm connected to a computer. The MCS was the largest distance between the contact points on the side, using the slide to keep the chewing and outside surfaces parallel and measuring the maximum distance between the outer surface and the inner surface of the crown. The ruler was held perpendicular to the plane to measure the MCS. (**Figure 1**).

Size measurements were made of the MCS and BCS for the upper and lower jaws on the tooth model of a 3-year-old child and of the 5-year-old permanent teeth. The size of the pair of symmetrical teeth was averaged and used as the size of each tooth type for statistical analysis.

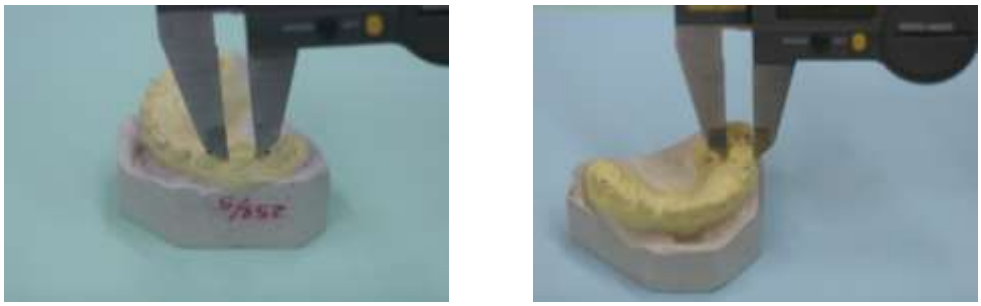

Figure 1. Mesiodistal crown size (MCS) and Buccolingual crown size (BCS) measurements

Data analysis

The study used Pearson correlation (r) to analyze the MCS and BCS correlation in the upper and lower jaws, including the following variables: (1) between the teeth of the same name in the deciduous and permanent teeth (For example: i_1 and I_1 ...); (2) between m_2 and M_1; (3) between the incisor groups (i_1, i_2 and I_1, I_2); (4) between the anterior tooth groups (including i_1, i_2, c and I_1, I_2, C); (5) between the posterior tooth groups (including m_1, m_2 and P_1, P_2), and (6) pairs of teeth (including i_1, i_2, c, m_1, m_2 and I_1, I_2, C, P_1, P_2).

The Pearson correlation coefficient was used to evaluate the stability of the measurement. The MCS and BCS were first measured, and then these measurements were repeated two weeks later on

all 128 samples. For each measurement feature, a correlation coefficient between the two measurements was calculated. The results for the correlation coefficient r were higher than 0.8.

Ethical considerations

The research protocol was reviewed by the ethics committee of the University of Medicine and Pharmacy at Ho Chi Minh City before the study was conducted.

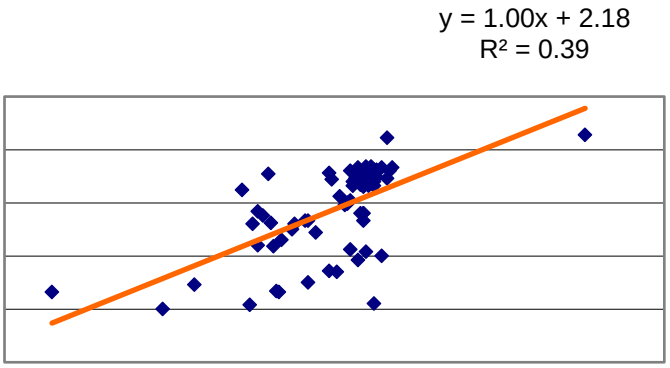

Figure 2. Predictive equations showing the MCS of the M1 teeth of the upper jaw

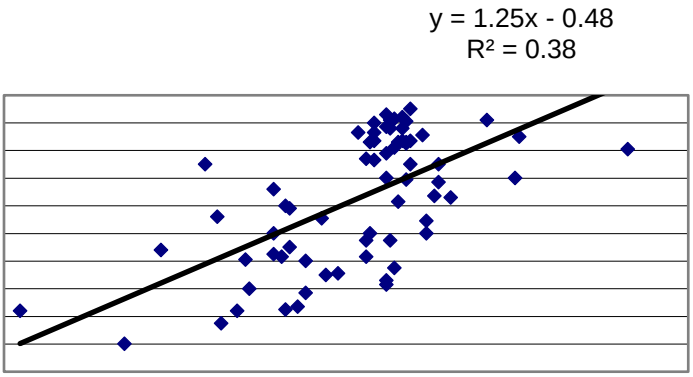

Figure 3. Predictive equations showing the MCS of the M1 teeth of the lower jaw

RESULTS AND DISCUSSION

A. Tooth size and gender difference

Gender differences in deciduous teeth

Table 1 shows that the size of the MCS in the deciduous teeth of men and women had the greatest difference in c and the smallest difference in m_2 in both upper and lower teeth. Similarly, the size distribution outside showed the largest difference in position c and the smallest in position m_2.

Gender differences in permanent teeth

In the permanent teeth, the sex distribution in the size of the MCS had the largest difference in C and the smallest in P_2 (Table 2). Garn et al. (1966) showed that sex had a clear influence on tooth size, with the most obvious gender difference seen in the canines. Several studies (Black, 1978; Garcia-Godoy et al., 1985; Moorrees and Chadha, 1962; Moorrees and Reid, 1964; Singh and Goyal, 2006) also showed the same results. As with the MCS, the difference in the size of the BCS was largest for C and smallest for P_2.

Table 1: Gender differences in deciduous teeth

	Mesiodistal Crown Size				Buccolingual Crown Size			
Deciduous	**Male (n=32) Mean ± SD**	**Female (n=32) Mean ± SD**	**% Difference**	**Rate**	**Male (n=32) Mean ± SD**	**Female (n=32) Mean ± SD**	**% Difference**	**Rate**
Upper jaw								
i_1	6.47 ± 0.29	6.45 ± 0.30	0.15	3	4.91 ± 0.26	4.89 ± 0.13	0.4	3
i_2	5.27 ± 0.23	5.25 ± 0.20	0.38	2	4.66 ± 0.23	4.63 ± 0.16	0.64	2
c	6.48 ± 0.31	6.44 ± 0.35	0.62	1	5.83 ± 0.32	5.78 ± 0.26	0.86	1
m_1	7.43 ± 0.37	7.42 ± 0.28	0.13	4	8.56 ± 0.35	8.54 ± 0.32	0.23	4
m_2	8.75 ± 0.30	8.74 ± 0.19	0.11	5	9.68 ± 0.28	9.67 ± 0.23	0.1	5
Lower jaw								
i_1	4.14 ± 0.17	4.12 ± 0.19	0.48	4	3.66 ± 0.24	3.64 ± 0.23	0.54	3
i_2	4.68 ± 0.25	4.65 ± 0.26	0.44	3	4.22 ± 0.18	4.18 ± 0.24	0.95	2
c	5.99 ± 0.27	5.89 ± 0.38	1.7	1	5.22 ± 0.19	5.15 ± 0.20	1.36	1
m_1	7.70 ± 0.39	7.62 ± 0.26	1.04	2	7.18 ± 0.33	7.16 ± 0.27	0.28	4
m_2	9.39 ± 0.21	9.36 ± 0.26	0.32	5	8.68 ± 0.28	8.67 ± 0.21	0.12	5

Table 2. Gender differences in permanent teeth

Permanent teeth	**Male (n=32) Mean ± SD**	**Female (n=32) Mean ± SD**	**% Difference**	**Rate**	**Male (n=32) Mean ± SD**	**Female (n=32) Mean ± SD**	**% Difference**	**Rate**
			Upper jaw					
I_1	8.63 ± 0.42	8.61 ± 0.31	0.25	5	7.35 ± 0.40	7.30 ± 0.52	0.77	3
I_2	6.82 ± 0.46	6.79 ± 0.32	0.44	3	6.49 ± 0.37	6.43 ± 0.27	0.93	2
C	8.21 ± 0.21	8.13 ± 0.31	0.98	1	8.44 ± 0.31	8.36 ± 0.40	0.96	1
P_1	7.34 ± 0.30	7.32 ± 0.23	0.27	4	9.55 ± 0.30	9.52 ± 0.26	0.31	5
P_2	7.06 ± 0.32	7.05 ± 0.23	0.14	6	9.38 ± 0.37	9.36 ± 0.15	0.21	6
M_1	10.97 ± 0.42	10.9 ± 0.41	0.64	2	11.38 ± 0.53	11.33 ± 0.35	0.44	4
			Lower jaw					
I_1	5.70 ± 0.37	5.69 ± 0.28	0.17	5	5.99 ± 0.36	5.97 ± 0.33	0.17	4
I_2	6.17 ± 0.33	6.14 ± 0.34	0.48	2	6.34 ± 0.30	6.29 ± 0.37	0.48	3
C	7.09 ± 0.30	7.04 ± 0.31	0.71	1	7.99 ± 0.33	7.82 ± 0.41	0.71	1
P_1	7.43 ± 0.42	7.41 ± 0.41	0.27	4	8.31 ± 0.36	8.29 ± 0.26	0.27	5
P_2	7.33 ± 0.41	7.32 ± 0.45	0.14	6	8.74 ± 0.38	8.73 ± 0.21	0.14	6
M_1	11.27 ± 0.43	11.23 ± 0.52	0.35	3	10.75 ± 0.32	10.58 ± 0.28	0.35	2

B. Relationship of tooth crown size between deciduous and permanent teeth

Relationship of the MCS between deciduous and permanent teeth

Table 3 shows that the MCS correlation between deciduous teeth and permanent teeth is the lowest, with an r value of 0.45 ($p < 0.01$) for the m_2 and P_2 pair of maxillary teeth. The highest correlation was observed between the m1 and P1 pair of the upper jaw, which had the highest r of 0.73 ($p < 0.001$).

Many studies have reported the MCS correlation between baby teeth and permanent teeth in different communities. The value of r varies greatly among these studies; the degree of change of r differs from zero and is positive (Table 4). Therefore, generally speaking, when deciduous teeth have a small crown size, the permanent replacement teeth are small, and vice versa.

Garn et al. (1977) showed that the value of r had the lowest value in the pair c and C of the lower jaw (Table 4). The r value between m_2 and M_1 was greater than the r value between m_2 and P_2 (0.62 vs. 0.45 for the MCS maxillary), which shows that although M_1 is not a replacement tooth for m_2, it is a tooth significantly similar in shape and size to m_2, in agreement with the results of the study by Clinch et al. (2007).

Table 3: The relationship of mesiodistal crown size (MCS) between deciduous teeth and permanent teeth

Variables	Upper jaw			Lower jaw		
	Male (n=32)	Female (n=32)	Total (n=64)	Male (n=32)	Female (n=32)	Total (n=64)
$i_1 - I_1$	0.76***	0.64***	0.7***	0.65***	0.53***	0.59***
$i_2 - I_2$	0.67***	0.6***	0.64***	0.56***	0.61***	0.58***
c – C	0.62***	0.61***	0.61***	0.63***	0.67***	0.64***
$m_1 - P_1$	0.72***	0.76***	0.73***	0.62***	0.7***	0.64***
$m_2 - P_2$	0.47**	0.41**	0.45**	0.6***	0.58***	0.59***
$m_2 - M_1$	0.69***	0.55***	0.62***	0.61***	0.62***	0.62***

***: $p < 0.001$; **: $p < 0.01$

Table 4: The global relationships of mesiodistal crown size (MCS) between deciduous teeth and permanent teeth

Studies	Subject	i_1 - I_1	$i_2 - I_2$	c - C	m_1- P_1	$m_2 - P_2$
The upper jaw						
Moorrees et al. (1957)	North Americans	0.6***	0.32*	0.3*	0.31*	0.4**
Yuen et al. (1996)	Hongkong	0.6***	0.4**	0.5**	0.6***	0.6***
Brown et al. (1980)	Australian	0.57**	0.54**	0.25*	0.36*	0.44**
Lysell et al. (1982)	Swedish	0.53**	0.27*	0.36*	0.42**	0.41**
Garn et al., (1977)	American	0.5**	0.23*	0.25*	0.61***	0.43**
Khang (2011)	Vietnamese	0.7***	0.64***	0.61***	0.73***	0.45**
The lower jaw						
Moorrees et al. (1957)	North Americans	0.4**	0.37*	0.3*	0.47**	0.4**
Yuen et al. (1996)	Hongkong	0.55**	0.5**	0.25*	0.4**	0.55**
Brown et al. (1980)	Australian	0.52**	0.38*	0.35*	0.45**	0.42**
Lysell et al. (1982)	Swedish	0.43**	0.42**	0.42**	0.34*	0.43**
Garn et al., (1977)	American	0.49**	0.47**	0.28*	0.32**	0.51**
Khang (2011)	Vietnamese	0.59***	0.58***	0.64***	0.64***	0.59**

***: $p < 0,001$; **: $p < 0,01$; *: $p < 0,05$

The proximate equation for the MCS of M_1 in the upper jaw is $y = 1.00 x + 2.18$, where y is the MCS of M1 in the upper jaw and x is the MCS of m_2 in the upper jaw.

The proximate equation for the MCS of M_1 lower jaw is $y = 1.25 x - 0.48$, where y is the MCS of M_1 in the lower jaw and x is the MCS of M_2 in the lower jaw.

Table 5: The relationship of buccolingual crown size (BCS) between deciduous teeth and permanent teeth

	Upper jaw			Lower jaw		
	Male (n=32)	Female (n=32)	Total (n=64)	Male (n=32)	Female (n=32)	Total (n=64)
$i_1 - I_1$	0.59***	0.53***	0.52***	0.67***	0.57***	0.62***
$i_2 - I_2$	0.55***	0.69***	0.6***	0.68***	0.74***	0.71***
c – C	0.64***	0.69***	0.65***	0.63***	0.77***	0.71***

$m_1 - P_1$	0.63***	0.62***	0.63***	0.57***	0.53***	0.55***
$m_2 - P_2$	0.64***	0.62**	0.61***	0.58***	0.49***	0.55***
$m_2 - M_1$	0.71***	0.65***	0.68***	0.6***	0.53***	0.57***

*** : p < 0,001; ** : p < 0,01

Table 6: The relation of buccolingual crown size (BCS) between deciduous teeth and permanent teeth in the world

Studies	Subject	i_1 - I_1	$i_2 - I_2$	c - C	m_1- P_1	$m_2 - P_2$
Upper jaw						
Brown et al. (1980)	Australian	0.56**	0.31*	0.41**	0.41**	0.58**
Garn et al. (1977)	American	0.42**	0.27*	0.11*	0.44**	0.34*
Khang (2011)	Vietnamese	0.52***	0.6***	0.65***	0.63***	0.61**
Lower jaw						
Brown et al. (1980)	Australian	0.53**	0.62***	0.42**	0.47**	0.6**
Garn et al. (1977)	American	0.18*	0.27*	0.27*	0.39*	0.44**
Khang (2011)	Vietnamese	0.62***	0.71***	0.71***	0.55***	0.57**

*** : p < 0,001; ** : p < 0,01; * : p < 0,05

Table 7: The relationship of tooth size between deciduous teeth and permanent teeth in group and series teeth

	Mesiodistal Crown Size (MCS)					
	Upper jaw			Lower jaw		
Group	Male	Female	Total	Male	Female	Total
	(n=32)	(n=32)	(n=64)	(n=32)	(n=32)	(n=64)
$i_1,i_2 - I_1,I_2$	0.81***	0.71***	0.77***	0.77***	0.69***	0.74***
$i_1,i_2,c - I_1,I_2,C$	0.8***	0.72***	0.75***	0.8***	0.77***	0.77***
m_1,m_2-P_1,P_2	0.73***	0.74***	0.73***	0.69***	0.75***	0.7***
i_1,i_2,c,m_1,m_2-I_1,I_2,C,P_1,P_2	0.83***	0.79***	0.81***	0.8***	0.8***	0.8***
	Buccolingual Crown Size (BCS)					
$i_1,i_2 - I_1,I_2$	0.71***	0.75***	0.69***	0.71***	0.8***	0.76***
$i_1,i_2,c - I_1,I_2,C$	0.73***	0.82***	0.73***	0.74***	0.85***	0.81***
m_1,m_2-P_1,P_2	0.7***	0.72***	0.7***	0.6***	0.58***	0.59***
i_1,i_2,c,m_1,m_2-I_1,I_2,C,P_1,P_2	0.85***	0.84***	0.85***	0.76***	0.86***	0.81***

*** : p < 0,001

Relationship of the BCS between deciduous and permanent teeth

The lowest r value in the pair of i_1 and I_1 in the upper jaw is 0.52, similar to the highest r value in the pair i_2, c and I_2, C of 0.71. The correlations are statistically significant (p <0.001) (Table 5).

The r value indicates the relationship of the BCS between roasting and permanent roasting, which varies greatly between groups. Garn et al. (1977) reported that the relationship of the BCS in the pair c and C of the upper jaw was the lowest, with r = 0.11 (Table 8). Brown et al. (1980) showed that the relationship of the maxillary functions between the pair of i_2 and I_2 was the largest, with r reaching a value of 0.62 (Table 6). The relationship between the size of m2 and M1 is larger than that of m_2 and the tooth replacing it (P_2) (upper jaw: r = 0.68, p <0.001; r = 0.61, p <0.001; lower jaw: r = 0.57, p <0.001; r = 0.55, p <0.001) (Table 6).

A strong correlation was noted for the size of the tooth group between deciduous teeth and permanent teeth. For MCS: in the lower maxillary teeth, the lowest value of r was 0.73 (p <0.001); the highest was 0.81 (p <0.001), while in the lower jaw, the lowest r value was 0.7 (p <0.001) and the highest was 0.8 (p <0.001) (Table 7). For the BCS, in the upper jaw, the lowest r value was 0.69 (p <0.001) and the highest was 0.85 (p <0.001), while in the lower jaw, the lowest r value was 0.59 (p <0.001) and the highest was 0.81 (p <0.001). In general, the correlation of the size of the tooth group between deciduous teeth and permanent

teeth was always larger than the correlation for each individual tooth.

Figure 4 shows that the BCS estimation equation for the permanent teeth I_1, I_2, C, P_1, and P_2 in the upper jaw is y = 0.88x + 7.73, where y is the MCS of the roasters I_1, I_2, C, P_1, and P_2 in the upper jaw and x is the MCS of the i_1, i_2, c, m_1, and m_2 maxillary teeth.

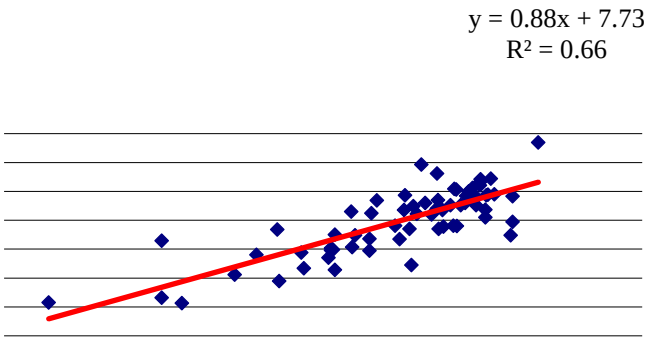

Figure 4. Predictive equations showing the MCS of the I_1, I_2, C, P_1, and P_2 teeth of the upper jaw

CONCLUSION

The degree of correlation of the MCS and BCS between the deciduous teeth and permanent teeth changes in the same teeth. The correlation coefficient was larger for the MCS and BCS between m_2 and M_1 than between m_2 and its replacement tooth (P_2). The correlation coefficient for the tooth group is always greater for the series of teeth between the permanent teeth and deciduous teeth than the correlation coefficient for each tooth. Predicting the size of each permanent tooth is less valuable than predicting the size of all permanent teeth based on the sizes of the known baby teeth. The MCS, BCS, and gender differences in tooth height are highest for the canines in both sets of teeth.

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