The prediction of the tooth size in the mixed dentition for Korean

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Abstract

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The purpose of this study is to produce estimated equations for the prediction of the size of unerupted canines and premolars in the Korean population.

Estimating the size of unerupted teeth is an essential aspect of orthodontic diagnosis and treatment planning in the mixed dentition.

Several methods were introduced and used for the prediction. The most common methods among these would be Moyer's probability chart and Tanaka and Johnston equations. These are widely used currently, but they were developed for white people.

Because there are clear racial differences in teeth size, the objectives of this study were to produce odontometric data, correlation coefficients between the combined mesiodistal widths of the permanent mandibular incisors and those of the canine and premolars for each quadrant, and prediction tables with the regression equations, specifically for Korean children. 178 Korean young adults (70 women, 108 men, mean age 21.63 years) were selected from the College of Dentistry, Yonsei University, Seoul, Korea. The mesiodistal crown diameters of the permanent teeth were measured with calipers. Significant sexual dimorphism was found in tooth sizes. The correlation coefficients between the total mesiodistal

width of the mandibular permanent incisors and that of the maxillary and mandibular canines and premolars were found to be between 0.52 and 0.64. The standard error of the estimate was better (0.60) for women and the r^2values ranged from 0.27 to 0.41 for both sexes. Prediction tables were prepared for Korean.

This study showed larger canine and premolar diameters than Tanaka and Johnston's and Moyer's studies which might be due to the fact that recently the tooth size has been increasing.

Further investigations with a larger sample size will be needed for more representative data on the Korean population.

Key Words : mixed dentition analysis, tooth size, prediction tables

The prediction of the tooth size in the mixed dentition for Korean

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Ⅰ. Introduction

Space analysis in the mixed dentition is very important in orthodontic diagnosis and predicting the mesiodistal crown diameters of the permanent canines and premolars is an essential diagnostic procedures.

The purpose of space analysis is to allow for the eruption of the permanent successors and to evaluate the requirement space for an occlusal adjustment. In order to perform this procedure, a prediction of the unerupted tooth size is needed. The mixed dentition requires an accurate prediction of the mesiodistal width of the unerupted permanent canines and premolars.

Three methods of prediction have been used: direct measurements of the unerupted tooth sizes on radiographs, as recommended by Staley et al. (1984) and Paula et al. (1995); calculations from the prediction equations

and tables, as reported by Moyers (1988), Tanaka and Johnston (1974) and Fergusson et al. (1978); and a combination of radiographic measurements and prediction tables, as recommended by Hixon and Old father (1958), Staley et al. (1984), Bishara et al. (1989)

The Hixon and Oldfather (1958) approach is believed to be the most accurate (Gardner, 1979, Irwin et al., 1995). However it is complex, and sometimes difficult to use. One method used widely is the use of the mesiodistal crown diameters of the unerupted mandibular permanent incisors as the predictor for the size of the unerupted canines and premolars. The Tanaka and Johnston prediction equations and the Moyer's probability table are widely used (Al-Khadra, 1993) but they were developed for North American Caucasian children, and it is reasonable to question their use in other populations because the tooth sizes vary significantly between ethnic groups (Schirmer et al., 1997). There is little odontometric data on Korean children available in the literature. Song et al. (1985) made a prediction table but did not consider the differences between genders.

Because there are definite racial differences with respect to the tooth sizes, the application of the Moyer's probability table and the Tanaka and Johnston equation to the local Korean population may have undermined the accuracy of these predictions.

The aims of this study were (1) to produce odontometric data for the Korean population (2) to obtain the correlation coefficients between the

combined mesiodistal widths of the permanent mandibular incisors and those of the canines and the first and second premolars of a maxillary or mandibular quadrant, (3) to test the reliability of both the Moyers (1988) and the Tanaka and Johnston (1974) methods in a Korean group, and (4) to construct probability tables for Korean children.

II. Material and methods

420 students from the College of Dentistry, Yonsei University, Seoul, Korea were examined and 178 young adults (108 males, 70 females, mean age 21.63 years) were selected. In this study the dental casts from 178 Korean young adults with a normal occlusion were used.

The selection criteria were (1) native Korean, (2) no congenital craniofacial anomalies or previous history of orthodontic treatment, (3) all permanent teeth present in each arch (with the exception of the third molars), (4) an intact dentition with no proximal caries, restorations, or significant attritions, (5) Angle Class I molar relationship, (6) no supernumerary tooth and (7) mild crowding or spacing.(Baek et al, 2003)

The data were obtained from the measurement of dental casts. The mesiodistal diameter of all the mandibular and maxillary canines, premolars and mandibular incisors were measured by a single investigator.

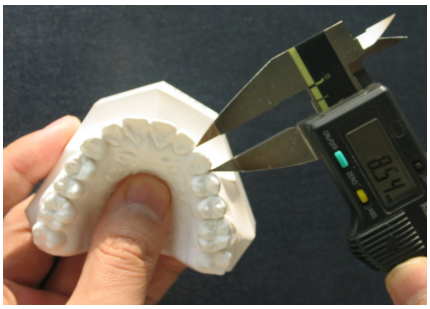
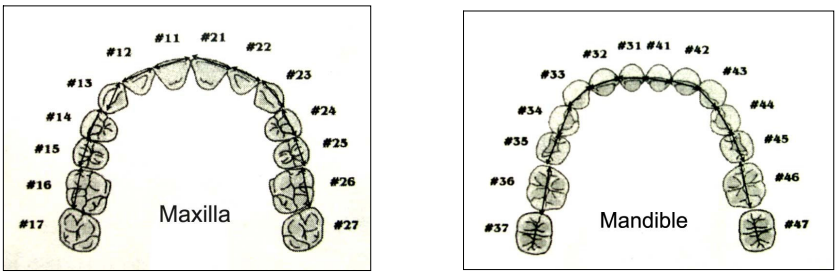


Fig. 1. Measuring the tooth size using a digital caliper.



(a) (b)

Fig. 2. Tooth size measurement represented by Bolton.

Each tooth was measured twice. According to the measurement criteria reported by Seipel (1946), Moorrees et al. (1957), Hunter et al. (1960) and Bolton (1962)(Fig. 2), the crown diameter was measured using a digital caliper (0.1mm accuracy)(Fig. 1). The mesiodistal crown diameter was parallel to the occlusal surface and the vestibular surface. It was the longest distance between the proximal walls. The caliper beaks were inserted from the buccal(labial), and were held occlusally. The beaks were then closed until gentle contact with the tooth was made. The inter-examiner reliability was tested(Cronbach, alpha=0.83). The intra-examiner reliability was predetermined at 0.2 mm, as suggested by Bishara et al. (1989). The 2 sets of measurements were compared. The measurements were averaged when they varied by 0.2 mm or less.

Descriptive statistics, including the means, standard deviations, and minimum and maximum values, were calculated. Student *t* tests were used to compare the tooth sizes between genders. The correlation coefficients (*r*) and regression equations ($y = a + bx$) were formulated in

order to evaluate the relationships between the combined widths of the 4 mandibular incisors (y) and those of the canine and premolars (x) on each dental arch.

The constants **a** and **b** in the standard linear regression equation (y = **a** + **b**x), the coefficients of determination (r^2), and the standard errors of the estimates (SEE) were calculated for the genders combined and for men and women separately. The r^2 value is an indicator of the predictive accuracy of the regression equation. The SEE indicates the error involved in the use of the prediction equations.

These equations were also used to assess the differences using the Tanaka and Johnston (1974) method and Moyer's probability charts (75%)(1988).

Probability tables for the Korean children were constructed. Statistical analysis was performed using statistical software (SAS, ver 8.1).

III. Results

The descriptive statistics for the summation of the upper canine and premolar diameters (UCPM), the summation of the lower canine and premolar diameters (LCPM), and the summation of the lower incisor mesiodistal diameters (LI) are presented in Table 1. for men and women separately. The canine-premolar segments in both arches were statistically larger in men than in women ($p < 0.05$, *t* test).

Table 1. Descriptive statistics for the UCPM, LCPM, and LI

Tooth group	Sex	n	Mean (mm)	Range (mm)	SD (mm)
LI	M	108	23.29	21.28-26.24	1.16
UCPM	M	108	23.20	20.06-26.66	1.02
LCPM	M	108	22.28	20.26-25.50	0.94
LI	F	70	22.88	19.69-27.17	1.29
UCPM	F	70	22.47	19.71-25.23	1.02
LCPM	F	70	21.54	19.08-24.10	1.02

SD, standard deviation; *M,* male; *F,* female;

UCPM, summation of the upper canine and premolar diameters;

LCPM, summation of the lower canine and premolar diameters;

LI, summation of the lower incisor mesiodistal diameters.

The correlation coefficients and prediction equations were derived from the data collected. Table 2. shows the correlation coefficients (r) between the LI and buccal segments for men and women, the regression values of

a and **b** in the standard linear regression equation (y = **a** + **b**x), SEE, and r^2 of the maxillary and mandibular regression equations.

Table 2. Regression parameters for predicting the buccal segment widths

Tooth group	sex	*r*	a	b	SEE(mm)	r^2
UCPM	M	0.57	11.20	0.51	0.80	0.33
LCPM	M	0.64	10.01	0.53	0.70	0.41
UCPM	F	0.52	12.90	0.42	0.60	0.27
LCPM	F	0.58	10.89	0.47	0.60	0.34

M, Male; *F,* female; r, correlation coefficient;

SEE, standard errors of the estimates;

UCPM, summation of the upper canine and premolar diameters;

LCPM, summation of the lower canine and premolar diameters.

The correlation coefficients were from 0.52 to 0.64 with the coefficients being higher in men. The r^2 values ranged from 27% in women to 41% in men, and the SEE was better (0.60 mm) for women.

Fig. 1., Fig. 2., Fig. 3. and Fig. 4. represent the relative comparisons between the predicted values at the 75th percentile level by the proposed equations in Korean , Tanaka and Johnston(1974) equations and Moyer's(1988) probability charts at the 75th percentile level for the maxillary and mandibular buccal segments.

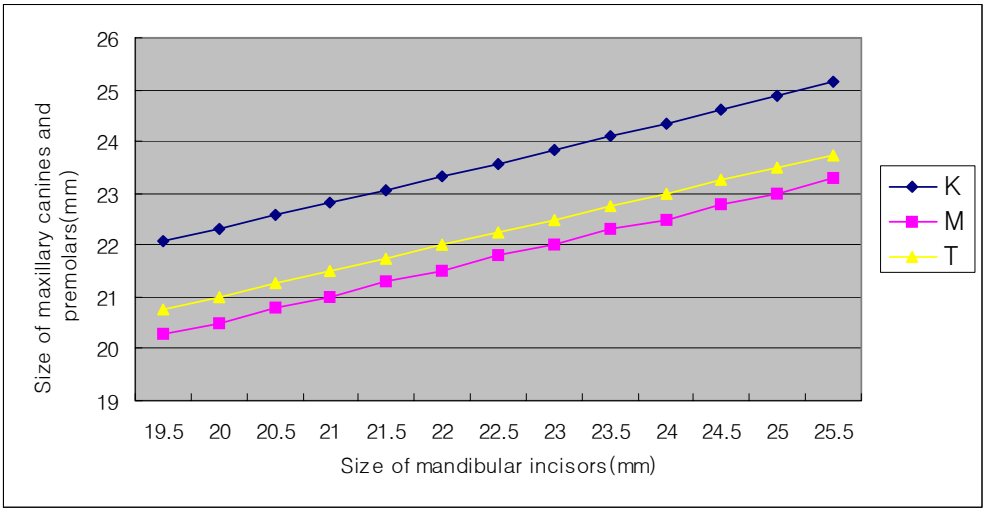


Fig. 3. Comparison of the predicted values of the unerupted maxillary canines and premolars(male) (K : new Korean prediction equations, M : Moyer's probability charts (75%), T : Tanaka and Johnston equations)

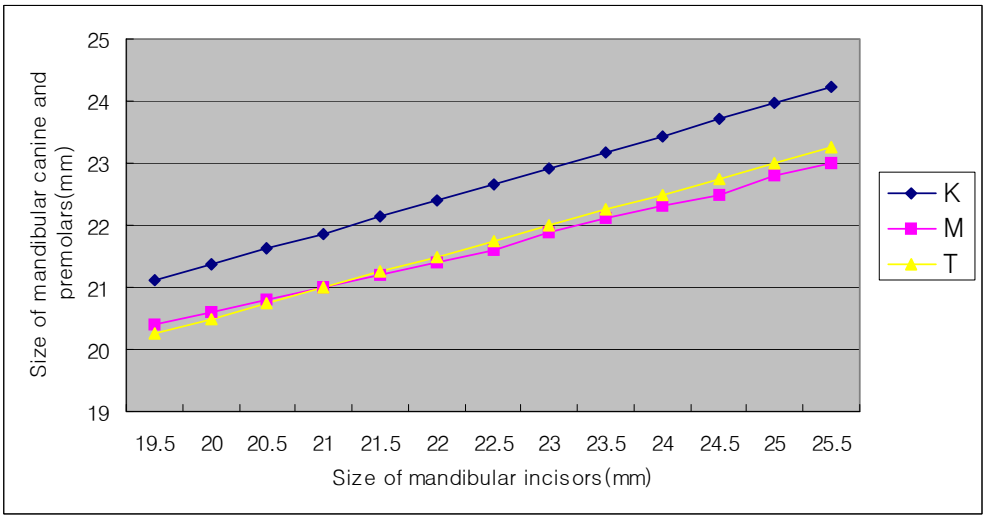


Fig. 4. Comparison of predicted values of unerupted mandibular canines and premolars(male) (K : new Korean prediction equations, M : Moyer's probability charts (75%), T : Tanaka and Johnston equations)

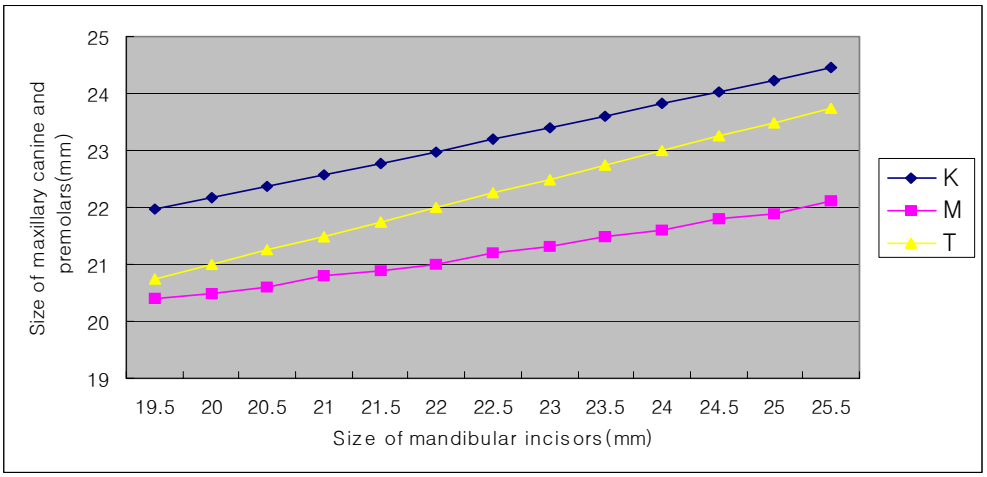


Fig. 5. Comparison of the predicted values of the unerupted maxillary canines and premolars(female) (K : new Korean prediction equations, M : Moyer's probability charts (75%), T : Tanaka and Johnston equations)

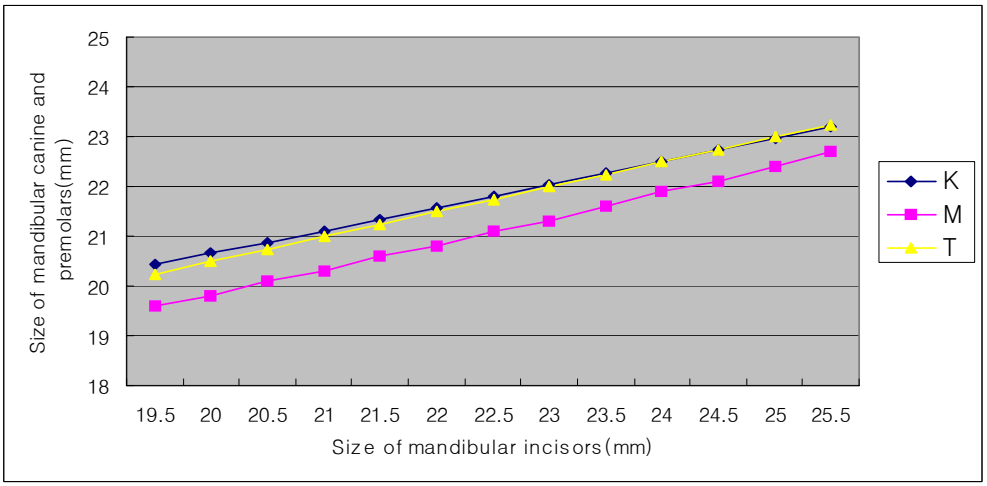


Fig. 6. Comparison of the predicted values of the unerupted mandibular canines and premolars(female) (K : new Korean prediction equations, M : Moyer's probability charts (75%), T : Tanaka and Johnston equations)

Graphically, the Tanaka and Johnston equations underestimated the size of the canines and premolars in the maxilla for males (Fig. 3), and the Moyer's chart (75%) also underestimated the posterior mandibular teeth for Korean. The mandible and the maxilla showed almost the same result in males (Fig. 4). The data for females shows somewhat different results. For the maxilla, it is similar to the result for males (Fig. 5). However, in the mandible, the Tanaka and Johnston equation was similar to our data (Fig. 6).

Table 3. and Table 4. show the newly proposed prediction tables determined from the regression equations of this study.

Table 3. Prediction table for Korean males (mm)

LI	75%		50%		25%	
	UCPM	LCPM	UCPM	LCPM	UCPM	LCPM
19.5	22.08	21.11	21.24	20.28	20.41	19.44
20.0	22.32	21.36	21.50	20.54	20.68	19.72
20.5	22.57	21.62	21.76	20.80	20.94	19.99
21.0	22.82	21.87	22.02	21.07	21.21	20.26
21.5	23.07	22.13	22.27	21.33	21.47	20.53
22.0	23.32	22.39	22.53	21.59	21.74	20.80
22.5	23.58	22.65	22.79	21.86	22.00	21.07
23.0	23.83	22.91	23.05	22.12	22.26	21.33
23.5	24.09	23.17	23.30	22.39	22.52	21.60
24.0	24.35	23.44	23.56	22.65	22.77	21.86
24.5	24.61	23.71	23.82	22.91	23.03	22.12
25.0	24.87	23.97	24.08	23.18	23.28	22.38
25.5	24.87	24.24	24.33	23.44	23.53	22.64
26.0	25.14	24.52	24.59	23.70	23.78	22.89
26.5	25.40	24.79	24.85	23.97	24.03	23.14
27.0	25.67	25.07	25.11	24.23	24.27	23.40

Table 4. Prediction table for Korean females (mm)

LI	75%		50%		25%	
	UCPM	LCPM	UCPM	LCPM	UCPM	LCPM
19.5	21.96	20.43	21.06	19.53	20.15	18.63
20.0	22.16	20.66	21.26	19.76	20.37	18.87
20.5	22.36	20.88	21.47	19.99	20.59	19.11
21.0	22.57	21.11	21.68	20.23	20.80	19.34
21.5	22.77	21.34	21.89	20.46	21.01	19.58
22.0	22.98	21.57	22.10	20.69	21.22	19.81
22.5	23.19	21.80	22.31	20.92	21.43	20.05
23.0	23.40	22.03	22.52	21.16	21.64	20.28
23.5	23.61	22.27	22.73	21.39	21.85	20.51
24.0	23.82	22.50	22.94	21.62	22.06	20.74
24.5	24.03	22.74	23.15	21.85	22.27	20.97
25.0	24.24	22.97	23.36	22.09	22.47	21.20
25.5	24.46	23.21	23.57	22.32	22.68	21.43
26.0	24.67	23.45	23.78	22.56	22.88	21.65
26.5	24.89	23.69	23.98	22.78	23.08	21.88
27.0	25.11	23.93	24.19	23.02	23.28	22.10

IV. Discussion

Although there are many methods in the diagnostic phase of orthodontic treatment, dental casts are still believed to be a vital diagnostic tool (Saatci, 1997). From the dental cast, one can analyze the tooth size and the shape of the tooth, evaluating the alignment and rotations of the teeth, the presence or absence of teeth, the arch form and symmetry, the arch width and the occlusal relationship.

As other biological forms, the teeth are present in different sizes and shapes. Variations in the size and shape of the teeth are mostly genetically determined (Garn, 1965, Towsend, 1978). The genetic basis for this variation is best explained by the polygenic model of inheritance. Lundstrőm (1964) compared 97 pairs of monozygotic and dizygotic twins, and found a strong correlation in the mesiodistal tooth size between the monozygotic twins. He concluded that the tooth size is to a large extent determined by genetic factors.

Several methods were introduced and used to predict the sizes of unerupted teeth. The most common method among these is Moyer's analysis (1988). Moyer established probability tables suggesting the predicted space required to align the permanent upper and lower canines, as well as the first and second premolars by using the sum of the four lower permanent incisors.

Tanaka and Johnston (1974) presented prediction equations which

provided similar values to Moyer's prediction probability table. These equations are widely used.

The most important factors in the reliability of the data are the characteristics of the sample. The suitability of this study sample could be questionable owing to its small size (70 women, 108 men). However, odontometric data collected from an adult sample can be used for children if the extent of dental attrition is minimal.

Definite racial and ethnic differences in tooth size have been emphasized in several studies (Schirmer et al, 1997, Frankel, 1986). Descriptive statistics also showed that the mesiodistal diameters of the mandibular incisors and the maxillary and mandibular canine and premolar segments were greater in men than those in women ($p < 0.05$). Significant sexual dimorphism has also been noted in other studies (Jaroontham et al, 2000, Yuen et al, 1998).

Table 5. shows the r values for the buccal segments of each arch, the constants a and b, the SEE, and the r^2 of the maxillary and mandibular regression equations from different investigations. The correlation coefficients for the Korean population between the buccal segment of each arch and the mandibular incisors were found to be smaller than for Hong Kong Chinese (Yuen et al, 1998) in both genders but higher than those for Thai boys (Jaroontham et al, 2000).

Table 5. Regression parameters for the buccal segment widths from various investigations

Study	sex	Arch(y)	r	Constants		SEE(mm)	r^2
				a	b		
Jaroontham et al(2000) (Thai)	M	Mx	0.54	13.36	0.41	0.88	0.29
		Mn	0.58	11.92	0.43	0.85	0.34
	F	Mx	0.62	11.16	0.49	0.78	0.39
		Mn	0.65	9.49	0.53	0.78	0.42
Yuen et al(1998) (Hong Kong Chinese)	M	Mx	0.79	7.97	0.66	0.68	0.62
		Mn	0.77	8.82	0.58	0.61	0.60
	F	Mx	0.65	8.30	0.61	0.81	0.42
		Mn	0.69	6.66	0.64	0.82	0.47
Present study	M	Mx	0.57	11.20	0.51	0.80	0.33
		Mn	0.64	10.01	0.53	0.70	0.41
	F	Mx	0.52	12.90	0.42	060	0.27
		Mn	0.58	10.89	0.47	0.60	0.34

M, Male; *F,* female; Mx, Maxilla; Mn, Mandible.

The relative comparison of regression parameters from Thai studies (Jaroontham et al, 2000) showed a **b** value of 0.41 and 0.43 respectively for men which is a great deal smaller than our data. However the **b** value in this study is smaller than for Hong Kong Chinese(0.66, 0.58). This study also showed larger constant **a** values for both genders in both arches than in Hong Kong Chinese.

The r^2 values are indicators of the predictive accuracy of the regression equations. This study showed greater r^2 values in both arches for men than in Thai boys but smaller values than those in Thai girls. For Hong Kong Chinese, the r^2 values in this study were smaller in both arches for both genders.

SEE indicates the error in the use of the prediction equations. In this study, the SEE of men in the maxilla was the largest compared with that in other genders and other arches.

This study showed larger canine and premolar diameters than Tanaka and Johnston's and Moyer's studies which might be due to the fact that recently the tooth size has been increasing. Our data is somewhat similar to recent study of Kim et al (2000) for b value.

The prediction tables could be applied to Korean children which are convenient to use and do not require complex equations.

Further investigations with a larger sample size would be needed to collect more representative odontometric data on the Korean population.

V. Conclusions

In order to construct probability prediction tables of mixed dentition for Korean children, 178 dental casts with a normal occlusion obtained from Yonsei University students were used. The mesiodistal diameter of all mandibular and maxillary canines and premolars and mandibular incisors were measured. Linear regression equations were established to predict the tooth width of the unerupted permanent canines and premolars. The prediction tables were then constructed . The results are summarized below;

1. There was a statistically significant sexual dimorphism in the tooth sizes($p<0.05$, t test).

2. The Tanaka and Johnston prediction equations and the Moyer'scharts (75%) underestimated the mesiodistal diameters of the unerupted canines and premolars in Korean children except for the female mandibular data.

3. The observed differences are considered to be the result of the unique racial charicteristics of Korean.

4. The following regression equations were made:

y = 11.20 + 0.51 x (male, maxilla)

y = 10.01 + 0.53 x (male, mandible)

y = 12.90 + 0.42 x (female, maxilla)

y = 10.89 + 0.47 x (female, mandible)

References

Al-Khadra BH: Prediction of the size of unerupted canines and premolars in a Saudi Arab population. Am J Orthod Dentofacial Orthop 104: 369-372, 1993.

Baek BJ, Park JR, Kim JK, Lee DC: Study of the size of permanent teeth. J Korea Pediatr Dent 31: 502-508, 2003.

Bishara SE, Jakobsen JR, Abdallah EM, Garcia AF: Comparisons of mesiodistal and buccolingual crown dimensions of the permanent teeth in three populations from Egypt, Mexico, and the United States. Am J Orthod Dentofacial Orthop 96: 416-422, 1989.

Bolton WA: The clinical application of a tooth size analysis. Am J Orthod 48:504-529, 1962.

Frankel HH, Benz EM: Mixed dentition analysis for black Americans. Pediatr Dent 8: 226-230, 1986.

Ferguson FS, Macko DJ, Sonnenberg EM, Shakun ML: The use of regression constants in estimating tooth size in a Negro population. Am J Orthod 73: 68-72, 1978.

Garn SM, Lewis AB, Kerewsky RS: X-Linked inheritance of tooth size. J Dent Res 44: 439 - 441, 1965 a.

Gardner RB: A comparison of four methods of predicting arch length. Am J Orthod 75: 387-398, 1979.

Hixon EH and Oldfather RE: Estimation of the sizes of unerupted cuspid and bicuspid teeth. Angle Orthod 28:236-240, 1958.

Hunter WS, Priest WR: Errors and discrepancies in measurement. J Dent Res 39: 405- 414, 1960.

Irwin RD, Herold JS: A. Richardson, Mixed dentition analysis: a review of methods and their accuracy. Int J Pediatr Dent 5: 137-142, 1995.

Jaroontham J, Godfrey K: Mixed dentition space analysis in a Thai population. Eur J Orthod 22: 127-134, 2000.

Kim DS, Kim YJ, Baek HS, Yu HS: A study of Korean Norm about tooth size and ratio in Korean adults with normal occlusion. Yonsei university, Seoul, Korea, 2000.

Lundstrőm A: Size of the teeth and jaw in the twins. Br Dent J 117: 321-326, 1964.

Moorrees CF, Thomsen SO, Jensen E: Mesiodistal crown diameters of the deciduous and permanent teeth in individuals, J Dent Res,35:39-47, 1957.

Moyers RE: Handbook of orthodontics (4th ed ed.), Year Book Medical Publishers, Chicago p. 577, 1988.

Paula SD, Almeida AO, Lee PC: Prediction of mesiodistal diameter of unerupted lower canines and premolar using 45 cephalometric radiography. Am J Orthod Dentofacial Orthop 107: 309-313, 1995.

Saatci P, Yukay F: The effect of premolar extraction on tooth-size discrepancy. Am J Orthod 111: 428-34, 1997.

Schirmer UR, Wiltshire WA: Orthodontic probability tables for black patients of African descent: mixed dentition analysis. Am J Orthod Dentofacial Orthop 112: 545-551, 1997.

Seipel CM : Variation ot tooth position: Sven Tandlak Tidskr 39:Suppl, 1946.

Song HS, Jung KL, Lee KS: Study of the measurement of the size of unerupted permanent canine and premolars. Korea J Orthod 15:67-73, 1985.

Staley RN, O'Gorman TW, Hoag JF, Shelly TH: Prediction of the widths of unerupted canines and premolars. J Am Dent Assoc 108:185-190, 1984.

Tanaka MM, Johnston LE: The prediction of the size of unerupted canines and premolars in a contemporary orthodontic population. J Am Dent Assoc 88: 798-801, 1974.

Towsend GC, Brown T: Inheritance of tooth size in Australian aborigines. Am J Phys Anthropol 48: 305- 331, 1978 b.

Yuen KK, Tang EL, Lai L: Mixed dentition analysis for Hong Kong Chinese. Angle Orthod 68: 21-27, 1998.

국문요약

한국인의 혼합치열기 치아 크기 예측에 관한 연구

연세대학교 대학원 치의학과

문 성 환

(지도교수 : 이 제 호)

이번 연구의 목적은 혼합치열기 아동에서 미맹출된 견치와 소구치의 크기를 예측하는데 있어서 한국인에 맞는 방정식과 예측표를 만들기 위함이다.

미맹출 치아의 크기를 예측하는 것은 혼합치열기 교정 진단과 치료계획 수립에 있어서 매우 중요하다.

미맹출된 견치와 소구치 크기를 예측하는 방법은 몇가지가 있지만 그중에서도 가장 흔하게 쓰이는 것이 Tanaka and Johnston equations과 Moyer's probability charts가 있다. 하지만 그것들은 백인을 위해서 제작된 것이고 치아 크기는 인종에 따라서 다르다고 알려져 있다.

이번 연구에서는 치아크기를 측정하여 하악 영구 절치의 크기 합과 견치 및 소구치의 크기 합 사이의 상관계수를 구하고 회귀방정식을 이용해서 한국인에 맞는 예측표를 만들었다.

연세대학교 치과대학에 재학중인 178명의 정상 교합자(남 108명, 여 70명, 평균 연령 21.63)을 대상으로 실험하였다. 영구치의 근원심 폭경을 석고모형상에서 calipers를 이용해서 측정하였다. 치아 크기에는 남녀간의 차이가 있었다.($p<0.05$) correlation coefficient는 0.57에서 0.64의 범위였고, standard errors of the

estimates는 여성에서 0.6으로써 남성보다 우수하였다. r^2값은 0.27에서 0.41의 범위를 나타내었다.

Moyer의 예측표나 Tanaka와 Johnston의 예측방정식과 이번 연구에서의 예측값들을 비교해 보았을 때 이번 연구는 미맹출된 견치와 소구치의 크기를 다소 크게 예측하는 경향이 있었다. 이는 인종간, 시대간의 차이일 것으로 보이며 한국 청소년에서 혼합치열기 분석을 하는데 있어서 이번 연구의 데이터를 사용하는 것이 도움되리라 생각된다.

Key words: 혼합치열기분석, 치아크기, 예측표