영구치의 치아크기에 관한 연구

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── 국문초록 ──

전북대학교에 재학중인 학생 800명을 대상으로 구강 검사를 시행하여 정상교합자로 판단되는 86명(남자 43명, 여자 43명, 평균나이 22.2세)의 석고모형을 채득하여 분석한 결과 다음과 같은 결론을 얻었다.

1. 계측자내 오차는 순(협)설 치관 직경에서 상악 측절치가, 근원심 치관 직경에서는 상악 제1대구치, 상악 제2대구치에서 다소 큰 값을 나타내었다. 평균 계측 오차는 순(협)설 치관 직경 측정은 0.051mm, 근원심 치관 직경 측정은 0.083mm 였다.
2. 좌우측 계측치 간의 차이는 순(협)설 치관 직경에서 평균 0.030mm, 근원심 치관 직경에서 평균 0.037mm를 보였으며, 통계학적으로 좌우측 계측치간의 유의한 차이는 없었다.
3. 영구치의 순(협)설 및 근원심 치관 직경은 전체 영구치에서 남자가 여자보다 컸다. 통계학적으로 유의성이 있는 치아는 순(협)설 치관 직경에서 상악 측절치, 상악 견치, 상악 제2소구치, 상악 제1대구치, 상악 제2대구치, 하악 중절치, 하악 견치, 하악 제2소구치, 하악 제1대구치 등이었고, 근원심 치관 직경에서 상악 중절치, 상악견치, 하악 견치, 하악 제1대구치 등이었다.
4. 남녀의 성차가 가장 인정되는 치아는 순(협)설 치관 직경에서는 상악 측절치, 근원심 치관 직경에서는 하악 견치였다.
5. Crown index는 남녀간에 비슷한 값을 보였고, Crown module과 Crown area는 모든 값에서 남자의 계측치가 컸다. 순(설)측 치관 직경값과 근원심 치관 직경값의 곱으로 표현되는 Crown area는 상악 제1소구치, 하악 측절치, 하악 제1소구치, 하악 2제소구치, 하악 제2대구치를 제외한 모든 치아에서 남녀간 차이에 통계학적 유의성이 있었다. (p<0.05)

주요어 : 치아크기, 영구치, 치관협설직경, 치관근원심직경

I. Introduction

Measurement of tooth is a subdivision of human measurement science which have been studied a lot by many scholars of the world. Data from tooth measurement has important roles in manufacture of dental materials like preformed crown, orthodontic band and in diagnosis, treatment plan of prothodontic and orthodontic treatment. It also helps to classify sex and race in the filed of Forensic Dentistry as well as clinical dental field.

Within the country Seo[1], Lee[2], Shon et al.[3] had studied about tooth size. However few researches about buccolingual diameter were published. Hence buccolingual, mesiodistal diameter of tooth, fluctuating asymmetry and tooth size difference by gender was studied.

II. Materials and Methods

1. Materials

800 students of Chonbuk National University was investigated, 86 person of them (male : 43, female : 43, mean age : 22.2 years old), considered a group of normal occlusion were selected in this study. Alginate was used as impression material and white stone for cast. Normal occlusion should contain fol-

lowing criteria. They shouldn't have an experience of orthodontic treatment. There shouldn't be supernumerary tooth, oligodontia, microdontia, macrodontia and no attrition. Fully erupted teeth. Total sum of crowding and spacing shouldn't over 4mm.

2. Methods

According to measuring criteria of Seipel[4] & Moorrees et al.[5], crown diameter was measured by digital caliper (0.01mm accuracy). Mesiodistal crown diameter was parallel to occlusal surface and vestibular surface, it was the longest distance between proximal wall. If there was space between teeth, the point where would contact normally with proximal teeth was measured. To measure buccolingual crown diameter, placed sliding caliper perpendicular to mesiodistal crown diameter, it was the longest distance from buccal surface to lingual surface. Each teeth was measured three times and used mean value as the representative for analysis. Crown diameter was analysed separately by gender and got mean value, standard deviation.

The intra-observer measurement errors was checked before analysing gender difference. Single determination method was used for error calculating, same observer measured objects three times and calculated error. Mean error of each step was used. To show gender difference of teeth size, index was quantified.

Fluctuating asymmetry between left and right antimere was analysed by Harris & Nweeia's formula[6].
$$d = |L-R| \div [(L+R) \div 2]$$
d = Fluctuating asymmetry, L= left, R=right

Sexual dimorphism was checked from buccolingual

and mesiodistal diameter.
$$\text{Sexual dimorphism } (\%) = (M-F)/F \times 100$$
M: mean value of male
F: mean value of female

Three additional indices of crown size was computed to compare. These were crown index, crown module and crown area.
$$\text{Crown index}(\%) = (\text{buccolingual diameter} / \text{mesiodistal diameter}) \times 100$$
$$\text{Crown module} = (\text{buccolingual distance} + \text{mesiodistal diameter}) / 2$$
$$\text{Crown area} = \text{buccolingual diameter} \times \text{mesiodistal diameter}.$$

Statistical analysis was performed by SPSS(SPSS Ver 10.0 for windows). Permanent teeth size difference between gender was tested by Student's t-test.

Ⅲ. Results

1. Measurement errors

Maxillary lateral incisor had the biggest measurement errors of buccolingual diameter, and mandibular first premolar had the smallest error (Table 2). Overall errors in mandible were smaller than maxilla. Average error of buccolingual diameter was 0.051 mm.

As Table 3, maxillary second molar had the biggest measurement error of mesiodistal diameter, and mandibular lateral incisor had the smallest error. Like buccolingual diameter, error in mesiodistal diameter of mandibular teeth was smaller than maxillary teeth. Average error of mesiodistal diameter was 0.083mm.

Table 1. Mean age and standard deviation of samples.

	N	Mean age(yr)	S.D.
Total	86	22.2	2.66
Male	43	22.5	2.81
Female	43	22.0	2.49

Table 2. Intra-observer measurement errors in buccolingual diameter

Maxilla	Error(mm)	Rank	Mandible	Error(mm)	Rank
I1	0.069	2	I1	0.044	9
I2	0.083	1	I2	0.044	9
C	0.050	5	C	0.039	11
PM1	0.038	12	PM1	0.032	14
PM2	0.050	5	PM2	0.033	13
M1	0.066	3	M1	0.048	7
M2	0.065	4	M2	0.046	8

2. Fluctuating asymmetry

Fluctuating asymmetry between right and left antimere was calculated by Harris & Nweeia' s[6] formula which announced in 1980. Absolute number of difference between right and left antimere is divided by average of right and left antimere. As table 4, it was 0.030 average in buccolingual diameter and 0.037 average in mesiodistal diameter.(Table 5) There is no statistical difference between results of right and left.

$$d = L - R / \{(L + R) / 2\}$$

Table 3. Intra-observer measurement errors in mesiodistal diameter

Maxilla	Error(mm)	Rank	Mandible	Error(mm)	Rank
I1	0.084	7	I1	0.058	13
I2	0.083	8	I2	0.051	14
C	0.091	4	C	0.069	10
PM1	0.087	6	PM1	0.077	9
PM2	0.099	3	PM2	0.067	12
M1	0.112	2	M1	0.090	5
M2	0.138	1	M2	0.069	10

3. Size of tooth

Buccolingual diameter of permanent dentition is shown in table 6. Maxillary second molars has the longest buccolingual diameter in male. Maxillary first molar and maxillary second molar have long diameter in female. Male have longer measurement in every tooth than female. Maxillary lateral incisor, maxillary canine, maxillary second premolar, maxillary first molar, maxillary second molar, mandibular central incisor, mandibular canine, mandibular second premolar and mandibular first molar have statistical difference by gender.

Mesiodistal diameter is shown in table 7. Both male and female have the biggest value at mandibular first molar. Maxillary central incisor, maxillary canine, mandibular first molar have statistical difference by gender.

Table 4. Fluctuating asymmetry in buccolingual diameter

Maxilla	d	Rank	Mandible	d	Rank
I1	0.030	7	I1	0.037	2
I2	0.055	1	I2	0.035	3
C	0.031	6	C	0.033	4
PM1	0.017	14	PM1	0.028	9
PM2	0.020	13	PM2	0.023	12
M1	0.027	10	M1	0.024	11
M2	0.033	4	M2	0.029	8

Table 5. Fluctuating asymmetry in mesiodistal diameter

Maxilla	d	Rank	Mandible	d	Rank
I1	0.025	13	I1	0.037	7
I2	0.043	4	I2	0.042	5
C	0.028	12	C	0.035	9
PM1	0.033	10	PM1	0.032	11
PM2	0.050	2	PM2	0.044	3
M1	0.036	8	M1	0.028	12
M2	0.051	1	M2	0.038	6

Table 6. Buccolingual diameter in permanent dentition

Maxilla	Male Mean	Male S.D.	Female Mean	Female S.D.	Mandible	Male Mean	Male S.D.	Female Mean	Female S.D.
I1	7.08	0.53	6.80	0.56	I1*	6.05	0.43	5.77	0.38
I2*	6.43	0.58	6.01	0.62	I2	6.37	0.37	6.07	0.49
C**	8.22	0.48	7.83	0.52	C**	7.62	0.45	7.24	0.52
PM1	9.61	0.55	9.31	0.44	PM1	8.08	0.51	7.89	0.46
PM2*	9.48	0.52	9.15	0.46	PM2*	8.61	0.43	8.31	0.43
M1**	11.41	0.40	11.01	0.50	M1**	10.92	0.47	10.56	0.53
M2**	11.51	0.58	11.01	0.56	M2	10.66	0.54	10.45	0.52

* Difference between mean values for males & females significant at P<0.05
** Difference between mean values for males & females significant at P<0.01

4. Sexual dimorphism

Maxillary lateral incisor had the biggest sexual dimorphism in buccolingual diameter and mandibular second molar has the smallest. Generally anterior teeth were bigger than posterior teeth(Table 8).

At the same time mandibular canine had the biggest sexual dimorphism in mesiodistal diameter and maxillary first premolar had the smallest sexual dimorphis(Table 9).

Sexual dimorphism = (M - F) / F x 100 (%)

(M : mean value of male, F : mean value of female)

5. Crown index, crown module, crown area

Crown index calculated by this process which is mesiodistal crown diameter dividing by buccolingual crown diameter and then multiplying 100. If it is over 100, it means that buccolingual diameter is longer than mesiodistal diameter. If it is smaller than 100, mesiodistal diameter is longer. In table 10, maxillary premolars have the biggest value which means buccolingually long, maxillary incisors have the smallest value which indicate buccolingually flat. Generally male has bigger value.

Crown index = (Mesiodistal diameter $\div$ Buccolingual diameter) $\times$ 100

Table 7. Mesiodistal diameter in diameter

Maxilla	Male		Female		Mandible	Male		Female	
	Mean	S.D.	Mean	S.D.		Mean	S.D.	Mean	S.D.
I1**	8.62	0.30	8.28	0.43	I1	5.45	0.24	5.33	0.34
I2	7.11	0.48	6.81	0.68	I2	6.05	0.32	5.92	0.37
C**	8.11	0.33	7.79	0.41	C**	7.11	0.33	6.71	0.43
PM1	7.44	0.37	7.36	0.41	PM1	7.39	0.40	7.23	0.40
PM2	7.04	0.47	6.85	0.37	PM2	7.31	0.44	7.19	0.47
M1	10.43	0.64	10.14	0.62	M1**	11.58	0.45	11.13	0.69
M2	9.98	0.49	9.86	0.55	M2	10.87	0.60	10.59	0.72

* Difference between mean values for males & females significant at P<0.05
** Difference between mean values for males & females significant at P<0.01

Table 8. Sexual dimorphism in buccolingual diameter

Maxilla	Sexual Dimorphism(%)	Rank	Mandible	Sexual Dimorphism(%)	Rank
I1	4.05	7	I1	4.82	5
I2	7.00	1	I2	4.93	4
C	4.99	3	C	5.39	2
PM1	3.23	12	PM1	2.47	13
PM2	3.67	8	PM2	3.64	10
M1	3.65	9	M1	3.49	11
M2	4.53	6	M2	1.99	14

Table 9. Sexual dimorphism in mesiodistal diameter

Maxilla	Sexual Dimorphism(%)	Rank	Mandible	Sexual Dimorphism(%)	Rank
I1	4.13	3	I1	2.19	11
I2	4.50	2	I2	2.35	9
C	4.03	4	C	5.84	1
PM1	1.06	14	PM1	2.26	10
PM2	2.72	7	PM2	1.65	12
M1	2.95	6	M1	4.02	5
M2	1.20	13	M2	2.59	8

Table 10. Crown index

Maxilla	Male		Female		Mandible	Male		Female	
	Mean	S.D.	Mean	S.D.		Mean	S.D.	Mean	S.D.
I1	82.31	6.11	82.20	6.03	I1	111.16	8.60	108.37	6.11
I2	90.03	6.91	88.66	8.42	I2	105.36	6.98	102.73	7.79
C	101.48	6.56	100.53	6.06	C	108.31	9.18	107.87	6.17
PM1	128.29	9.26	126.66	6.07	PM1	109.46	6.06	109.34	7.46
PM2	135.02	8.58	133.64	7.02	PM2	117.99	6.72	115.76	6.82
M1	110.00	6.72	108.87	6.34	M1	93.97	4.81	94.99	4.43
M2	116.23	8.69	111.89	7.13	M2	98.27	5.33	98.85	4.67

Table 11. Crown module

Maxilla	Male		Female		Mandible	Male		Female	
	Mean	S.D.	Mean	S.D.		Mean	S.D.	Mean	S.D.
I1	7.86	0.34	7.54	0.43	I1	5.75	0.27	5.55	0.32
I2	6.75	0.46	6.41	0.57	I2	6.21	0.27	5.99	0.37
C	8.16	0.32	7.81	0.40	C	7.39	0.35	6.97	0.43
PM1	8.48	0.40	8.34	0.38	PM1	7.73	0.40	7.56	0.35
PM2	8.26	0.41	8.00	0.36	PM2	7.96	0.37	7.75	0.39
M1	10.91	0.45	10.57	0.48	M1	11.22	0.38	10.84	0.56
M2	10.72	0.46	10.43	0.45	M2	10.76	0.49	10.52	0.58

Table 12. Crown area

Maxilla	Male		Female		Mandible	Male		Female	
	Mean	S.D.	Mean	S.D.		Mean	S.D.	Mean	S.D.
I1**	61.22	5.57	56.47	6.69	I1*	32.95	2.95	30.82	3.53
I2*	45.63	6.31	41.12	7.30	I2	38.58	3.29	35.98	4.35
C**	66.63	5.19	61.08	6.26	C**	54.61	4.98	48.71	5.94
PM1	70.95	6.49	68.64	6.28	PM1	59.82	6.20	57.04	5.29
PM2*	66.85	6.79	62.78	5.65	PM2	63.06	5.99	59.88	6.01
M1**	118.85	9.88	111.71	10.15	M1**	125.89	8.43	117.72	11.75
M2*	114.39	10.06	108.65	9.41	M2	115.92	10.53	110.95	12.12

* Difference between mean values for males & females significant at P⟨0.05
** Difference between mean values for males & females significant at P⟨0.01

Crown module is the mean value of the sum of buccolingual diameter and mesiodistal diameter. Male has bigger value at every tooth(Table 11).

Crown module = (Mesiodistal diameter + Buccolingual diameter) / 2

Buccolingual diameter times mesiodistal diameter makes crown area. This could consider as an size of tooth from occlusal surface. Except on maxillary first premolar, mandibular lateral incisor, mandibular first premolar, and mandibular second premolar, other teeth had statistical difference by gender(Table 12).

Crown area = Mesiodistal diameter × Buccolingual diameter

Ⅳ. Discussion

Teeth are the hardest part of the human body and shape of crown is formed before teeth eruption. Size of tooth(buccolingual, mesiodistal diameter) is constant unless dental caries or tooth fracture and teeth are not easily to decay after death, its size had important role in Forensic Dentistry.

Study of tooth measurement is divided three field. First, study on tooth size itself, its mean value are used for manufacture of preformed crown, orthodontic band and bracket. Second, for Forensic Dentistry, sexual and racial differences are established from teeth size. Third, study on measuring methods of teeth[7,8], it is about measurement error as various measuring methods, for the more accurate measurement.

Mainly tooth size itself and difference of tooth size by gender are investigated.

For our country, Seo[1] investigated first, he said tooth size of male is bigger than that of female in all teeth after examination of gypsum cast in 103 Korean. Thereafter Lee[2], Shon et al.[3], Namh[9], and Son et al.[10] have published their researches of the tooth size, it has little difference among their results. But each research has shown various teeth of statistical difference by gender.

After examination of 41 children of ideal occlusion, Lee[2] said maxillary central incisor, maxillary lateral incisor, maxillary canine, maxillary first molar, mandibular canine and mandibular first molar have statistical difference by gender.

Shon et al.[3] said maxillary central incisor, maxillary second molar, mandibular canine and mandibular second molar have statistical difference by gender after examination of 736 Korean.

Namh[9] said maxillary central incisor, maxillary canine, maxillary first molar, mandibular canine, mandibular first molar and mandibular second molar have statistical difference by gender after examination of 120 Korean.

Hattab et al.[11] said no statistical difference was found on the size of right and left antimere teeth, maxillary lateral incisor had biggest size variation and maxillary first molar had smallest size variation. In all teeth, male's tooth size was bigger than female's, canine have shown the biggest statistical difference by gender after examination of 109 Jordanians.

Son et al.[10] said, in Korean, maxillary canine, maxillary first molar, mandibular second premolar, mandibular first molar and mandibular second molar in mesiodistal diameter, maxillary first molar, mandibular second molar in buccolingual diameter have statistical difference by gender. Crown size of Korean was bigger than Japanese and Taiwan in mesiodistal, but smaller than Japanese and Taiwan in buccolingual after examination of gypsum cast of Korean, Japanese and Taiwan. But Son et al. investigated buccolingual diameter only at posterior teeth.

Samir et al.[12] have studied buccolingual, mesiodistal crown diameter of Egyptian, Mexican, American and said no statistical difference between tooth size of right and left antimere. Maxillary canine, maxillary first molar, mandibular canine and mandibular first molar have statistical difference and buccolingual diameter have bigger variation than mesiodistal diameter in all countries.

After measuring of same gypsum cast in three times, Sim et al.[7] said no significant difference was found among the each results and measurement error was bigger from anterior teeth to posterior teeth, and first molar showed the biggest error in three measurements.

V. Conclusion

After 800 students of Chonbuk National University was examined, 86 persons (male : 43, female : 43, mean age : 22.2 years old) was selected as a group who had normal occlusion. From their gypsum cast, this conclusion was obtained.

There is no statistical significance between tooth size of right and left antimere. Mesiodistal diameter of tooth crown and teeth that showed sexual difference didn't have big difference compare to any results of other researches of Korean.

Tooth which has the biggest difference depending on gender is maxillary lateral incisor in buccolingual diameter and mandibular canine in mesiodistal diameter.

Crown area considered as size of tooth from occlusal surface was bigger in male than in female significantly except some teeth, maxillary first premolar, mandibular lateral incisor, first premolar and second premolar.

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Abstract

A STUDY ON THE SIZE OF THE PERMANENT TEETH

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After 800 students of Chonbuk National University was examined, 86 people (male : 43, female : 43, mean age : 22.2 years old) was selected as a group of normal occlusion. From their gypsum cast, this conclusion was obtained.

1. Intra-observer measurement errors in buccolingual diameter, maxillary lateral incisors have somewhat bigger errors. In mesiodistal diameter, maxillary first molars and maxillary second molar have bigger numerical value. Mean errors of measurement are 0.051mm at buccolingual diameter of crown and 0.083mm at mesiodistal diameter.

2. Fluctuating asymmetry is 0.030 average in buccolingual diameter, and 0.037 average in mesiodistal diameter. Statistically there are no big differences.

3. Male has longer buccolingual diameter than female in every permanent teeth. Teeth which have statistical difference in buccolingual diameter are maxillary lateral incisor, maxillary canine, maxillary second molar, mandibular central incisor, mandibular canine, mandibular second premolar, and mandibular first molar. In mesiodistal diameter maxillary central incisor, maxillary canine, and mandibular first molar have statistically difference.

4. Tooth which has the biggest difference depending on gender is maxillary lateral incisor in buccolingual diameter and mandibular canine in mesiodistal diameter.

5. Both sexes have similar crown index. Male has bigger value of crown module measurement and crown area measurement in every tooth. Crown area considered as size of tooth from occlusal surface was bigger in male than in female statistically except some teeth, maxillary first premolar, mandibular lateral incisor, first premolar and second premolar.

Key words : Tooth size, Permanent tooth, Buccolingual diameter of crown, Mesiodistal diameter of crown