CHAPTER IV
RESULTS

The results of this study will be presented as follows:

4.1 Characteristics of subjects

4.2 Examinations and measurements of facial and dental variables in both subjects wearing brass neck-coils and subjects not wearing brass neck-coils by age group

4.3 The associations between neck-coil wearing and the categorical variables

4.4 Two-way analysis of variance of continuous variables between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils accounting for age group

4.5 Comparison of the incisor inclination and the palatal height between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils in age group 2

4.1 Characteristics of subjects

The distributions of the subjects according to neck-coil wearing and age group are presented in Table 4, 5 and 6. The number of the subjects in age group 2 (over 15 years) was twice as much as age group 1 (5-15 years) (Table 4). The number of the subjects wearing brass neck-coils was approximately twice as much as the number of the subjects not wearing brass neck-coil in both age groups (Table 5 and 6).

In Table 7, the average height and weight of the sample were 146.3±12.9 cm. and 45.5±13.1 kg., respectively. The subjects wearing brass neck-coils had greater means of height and weight than the subjects not wearing brass neck-coils. The average length of neck-coils in the subjects wearing brass neck-coils was 11.7± 2.0 cm. The neck-coil length in age group 2 was longer than that in age group 1.

Table 4 Distribution of the subjects, by age group

Age group	Frequency (n)	Percent
Age group 1	31	33.3
Age group 2	62	66.7
Total	93	100.0

Table 5 Distribution of the subjects, by neck-coil wearing

Neck-coil wearing	Frequency (n)	Percent
Wearing	61	65.6
Not wearing	32	34.4
Total	93	100.0

Table 6 Distribution of the subjects, by neck-coil wearing and age group

| Neck-coil wearing | Age group | | Total |
| | Age group 1 | Age group 2 | |
	n (%)	n (%)	n (%)
Wearing	21 (67.7)	40 (64.5)	61 (65.6)
Not wearing	10 (32.3)	22 (35.5)	32 (34.4)
Total	31 (100.0)	62 (100.0)	93 (100.0)

Table 7 Means and standard deviations of height, weight and neck-coil length of the subjects by neck-coil wearing and age group

Neck-coil wearing	Age group	Height (cm) Means (SD)	Weight (kg) Means (SD)	Neck-coil length (cm) Means (SD)
Wearing	Age group 1	136.6 (10.6)	33.2 (9.0)	10.2 (2.2)
	Age group 2	155.4 (5.2)	53.8 (5.9)	12.5 (1.3)
	Total	148.9 (11.7)	46.7 (12.1)	11.7 (2.0)
Not wearing	Age group 1	124.2 (10.1)	24.8 (8.9)	-
	Age group 2	149.1 (6.1)	51.3 (7.5)	-
	Total	141.3 (13.9)	43.1 (14.7)	-
Total	Age group 1	132.6 (11.8)	30.5 (9.7)	-
	Age group 2	53.1 (6.3)	52.9 (6.6)	-
	Total	146.3 (12.9)	45.5 (13.1)	-

4.2 Examinations and measurements of facial and dental variables in both
subjects wearing brass neck-coils and subjects not wearing brass neck-coils
by age group

4.2.1   Categorical data

According to the examination of type of occlusion, most of the subjects not
wearing brass neck-coils had Class I malocclusion (65.0%) whereas the subjects
wearing brass neck-coils had Class II malocclusion (65.1%) (Table 8).   However, in age
group 1, most of the subjects not wearing brass neck-coils had Class II malocclusion
(66.7%) and the subjects wearing brass neck-coils had Class I malocclusion (53.8%).

Table 8   Distribution of type of occlusion between the subjects wearing brass neck-coils
and the subjects not wearing brass neck-coils, by age group

Age group	Type of occlusion	Neck-coil wearing	
		Wearing	Not wearing
		n (%)	n (%)
Age group 1	Class I	7 (53.8)	2 (33.3)
	Class II	6 (46.2)	4 (66.7)
	ClassIII	0 (0.0)	0 (0.0)
	Total	13 (100.0)	6 (100.0)
Age group 2	Class I	7 (23.3)	11 (78.6)
	Class II	22 (73.3)	3 (21.4)
	ClassIII	1 (3.3)	0 (0.0)
	Total	30 (100.0)	14 (100.0)
Total	Class I	14 (32.6)	13 (65.0)
	Class II	28 (65.1)	7 (35.0)
	ClassIII	1 (2.3)	0 (0.0)
	Total	43 (100.0)	20 (100.0)

There are three types of arch forms, parabolic, V-shaped and U-shaped. According to the examination of dental arch form, the most type of upper arch form was parabolic in both subjects wearing brass neck-coils (88.4%) and subjects not wearing brass neck-coils (85.0%). These results were consistent in both age groups (Table 9).

In lower arch, there were only parabolic and U-shaped forms among the subjects not wearing brass neck-coils. The parabolic form (60.0%) was found most frequently than the U-shaped form (40.0%). However, all types of arch forms were found among the subjects wearing brass neck-coils. The majority of arch forms among subjects wearing brass neck-coils were parabolic (46.5%) and V-shaped (44.2%) and only 9.3 % was U-shaped arch form (Table 10).

Table 9 Distribution of upper arch form between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils, by age group

Age group	Upper arch form	Neck-coil wearing	
		Wearing	Not wearing
		n (%)	n (%)
Age group 1	Parabolic	12 (92.3)	6 (100.0)
	V-shaped	1 (7.7)	0 (0.0)
	U-shaped	0 (0.0)	0 (0.0)
	Total	13 (100.0)	6 (100.0)
Age group 2	Parabolic	26 (86.7)	11 (78.6)
	V-shaped	3 (1.0)	0 (0.0)
	U-shaped	1 (3.3)	3 (21.4)
	Total	30 (100.0)	14 (100.0)
Total	Parabolic	38 (88.4)	17 (85.0)
	V-shaped	4 (9.3)	0 (0.0)
	U-shaped	1 (2.3)	3 (15.0)
	Total	43 (100.0)	20 (100.0)

Table 10 Distribution of lower arch form between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils, by age group

Age group	Lower arch form	Neck-coil wearing	
		Wearing n (%)	Not wearing n (%)
Age group 1	Parabolic	9 (69.2)	4 (66.7)
	V-shaped	4 (30.8)	0 (0.0)
	U-shaped	0 (0.0)	2 (33.3)
	Total	13 (100.0)	6 (100.0)
Age group 2	Parabolic	11 (36.7)	8 (57.1)
	V-shaped	15 (50.0)	0 (0.0)
	U-shaped	4 (13.3)	6 (42.9)
	Total	30 (100.0)	14 (100.0)
Total	Parabolic	20 (46.5)	12 (60.0)
	V-shaped	19 (44.2)	0 (0.0)
	U-shaped	4 (9.3)	8 (40.0)
	Total	43 (100.0)	20 (100.0)

4.2.2   Continuous data

The means, standard deviations of facial and dental variables of the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils are showed in Table 11 and 12.

For facial variables, the total face height and the lower face height of the subjects wearing brass neck-coils (176.62 mm., 56.14 mm.) were shorter than the subjects not wearing brass neck-coils (181.82 mm., 62.12 mm.). The subjects wearing brass neck-coils had shorter upper and lower lips lengths (19.69 mm., 36.61 mm.) than the subjects not wearing brass neck-coils (21.11 mm., 40.96 mm.). The subjects wearing brass neck-coils had larger of Sn-Pg' (6.57 mm.) than the subjects not wearing brass neck-coils (3.97 mm.). The subjects wearing brass neck-coils had less maximum mouth opening (36.55 mm.) than the subjects not wearing brass neck-coils (40.44 mm.).

For dental variables, the subjects wearing brass neck-coils had larger overjet (3.68 mm.) than the subjects not wearing brass neck-coils (2.01 mm.). The upper and lower anterior arch lengths of the subjects wearing brass neck-coils (18.39 mm., 16.80 mm.) were larger than the subjects not wearing brass neck-coils (17.01 mm., 14.72 mm.). The lower intercanine width of the subjects wearing brass neck-coils (27.03 mm.) was narrower than the subjects not wearing brass neck-coils (28.61 mm.). The subjects wearing brass neck-coils had flatter palatal height (11.41 mm.) than the subjects not wearing brass neck-coils (14.95 mm.). The subjects wearing brass neck-coils had more proclined of upper and lower incisor inclinations (13.32 degrees, 13.71 degrees) than the subjects not wearing brass neck-coils (9.07 degree, 6.33 degrees).

Table 11 Means and standard deviations of facial variables in the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils, by age group

| Facial variables | Age group | Neck-coil wearing | | | |
| | | Wearing | | Not wearing | |
		n	Means (SD)	n	Means (SD)
Photograph measurement					
Right eye width	Age group 1	21	26.59 (1.47)	10	25.13 (1.50)
(mm.)	Age group 2	40	26.83 (2.24)	22	27.25 (1.99)
	total	61	26.75 (2.00)	32	26.58 (2.09)
Left eye width	Age group 1	21	26.45 (1.54)	10	25.08 (1.50)
(mm.)	Age group 2	40	27.10 (1.68)	22	27.28 (1.94)
	total	61	26.88 (1.65)	32	26.59 (2.07)
Nose width	Age group 1	21	38.77 (2.79)	10	36.58 (1.98)
(mm.)	Age group 2	40	42.85 (2.63)	22	41.73 (3.09)
	total	61	41.45 (3.30)	32	40.12 (3.67)
Mouth width	Age group 1	21	44.48 (4.23)	10	41.12 (4.38)
(mm.)	Age group 2	40	49.52 (3.76)	22	49.60 (3.61)
	total	61	47.79 (4.58)	32	46.95 (5.51)
Upper face	Age group 1	21	134.56 (8.18)	10	134.40 (5.14)
Width	Age group 2	40	143.42 (5.88)	22	145.88 (5.83)
(mm.)	total	61	140.37 (7.92)	32	142.29 (7.74)
Lower face width	Age group 1	21	118.01 (8.65)	10	118.84 (7.66)
(mm.)	Age group 2	40	125.55 (6.88)	22	130.70 (7.73)
	total	61	122.95 (8.29)	32	126.99 (9.42)
Total face height	Age group 1	21	171.55 (6.26)	10	172.97 (7.76)
(mm.)	Age group 2	40	179.62 (8.20)	22	185.84 (10.37)
	total	61	176.62 (8.20)	32	181.82 (11.27)

Table 11 (continued)

Facial variables	Age group	Neck-coil wearing				
		Wearing			Not wearing	
		n	Means (SD)		n	Means (SD)
Facial index	Age group 1	21	1.28	(0.07)	10	1.29	(0.06)
	Age group 2	40	1.25	(0.07)	22	1.28	(0.10)
	total	61	1.26	(0.07)	32	1.28	(0.09)
Upper face	Age group 1	21	58.60	(3.93)	10	56.42	(7.64)
height	Age group 2	40	60.40	(4.64)	22	60.22	(5.51)
(mm.)	total	61	59.78	(4.46)	32	59.03	(6.38)
Middle face	Age group 1	21	59.00	(3.80)	10	58.70	(2.77)
height	Age group 2	40	61.59	(4.08)	22	61.55	(4.76)
(mm.)	total	61	60.70	(4.15)	32	60.66	(4.40)
Lower face	Age group 1	21	53.94	(3.82)	10	57.85	(2.33)
height	Age group 2	40	57.29	(4.64)	22	64.07	(3.40)
(mm.)	total	61	56.14	(4.63)	32	62.12	(4.24)
Upper face	Age group 1	21	0.34	(0.02)	10	0.33	(0.03)
proportion	Age group 2	40	0.34	(0.02)	22	0.32	(0.02)
	total	61	0.34	(0.02)	32	0.32	(0.02)
Middle face	Age group 1	21	0.34	(0.02)	10	0.34	(0.01)
proportion	Age group 2	40	0.34	(0.02)	22	0.33	(0.02)
	total	61	0.34	(0.02)	32	0.33	(0.02)
Lower face	Age group 1	21	0.32	(0.02)	10	0.33	(0.02)
proportion	Age group 2	40	0.32	(0.02)	22	0.35	(0.02)
	total	61	0.32	(0.02)	32	0.34	(0.02)
Upper lip length	Age group 1	21	18.70	(3.24)	10	20.19	(1.32)
(mm.)	Age group 2	40	20.20	(2.00)	22	21.53	(2.03)
	total	61	19.69	(2.57)	32	21.11	(1.92)

Table 11 (continued)

Facial variables	Age group	Neck-coil wearing				
		Wearing			Not wearing	
		n	Means (SD)		n	Means (SD)
Lower lip length	Age group 1	21	35.56	(2.31)	10	37.62 (2.55)
(mm.)	Age group 2	40	37.16	(3.73)	22	42.48 (2.50)
	total	61	36.61	(3.38)	32	40.96 (3.37)
Upper lip	Age group 1	21	0.34	(0.04)	10	0.35 (0.03)
proportion	Age group 2	40	0.35	(0.03)	22	0.34 (0.02)
	total	61	0.35	(0.03)	32	0.34 (0.03)
Lower lip	Age group 1	21	0.66	(0.04)	10	0.65 (0.03)
proportion	Age group 2	40	0.65	(0.03)	22	0.66 (0.02)
	total	61	0.65	(0.03)	32	0.66 (0.03)
Profile angle	Age group 1	21	168.52	(4.88)	10	169.70 (5.89)
(degree)	Age group 2	40	169.68	(15.55)	22	175.32 (5.75)
	total	61	169.28	(12.86)	32	173.56 (6.28)
Sn-Pg'	Age group 1	21	7.20	(2.68)	10	5.96 (3.81)
(mm.)	Age group 2	40	6.24	(5.24)	22	3.06 (3.57)
	total	61	6.57	(4.52)	32	3.97 (3.84)
UL-E-line	Age group 1	21	2.58	(2.49)	10	3.09 (1.56)
(mm.)	Age group 2	40	1.76	(1.94)	22	-0.83 (2.87)
	total	61	2.04	(2.16)	32	0.39 (3.11)
LL-E-line	Age group 1	21	2.55	(2.17)	10	2.28 (2.21)
(mm.)	Age group 2	40	2.41	(2.04)	22	1.58 (2.76)
	total	61	2.46	(2.07)	32	1.80 (2.58)
Direct measurement						
Maximum mouth	Age group 1	21	36.32	(5.21)	10	37.02 (5.13)
opening	Age group 2	40	36.66	(6.15)	22	41.99 (4.47)
(mm.)	total	61	36.55	(5.80)	32	40.44 (5.16)

Table 12 Means and stardard deviations of dental variables in the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils, by age group

Dental variables	Age group	Neck-coil wearing			
		Wearing		Not wearing	
		n	Means (SD)	n	Means (SD)
Overjet	Age group 1	13	3.32 (1.54)	6	2.33 (1.58)
(mm.)	Age group 2	30	3.84 (2.25)	14	1.88 (1.86)
	total	43	3.68 (2.05)	20	2.01 (1.75)
Overbite	Age group 1	13	2.40 (1.04)	6	2.45 (1.33)
(mm.)	Age group 2	30	3.46 (2.92)	14	1.72 (0.94)
	total	43	3.14 (2.54)	20	1.94 (1.09)
Curve of Spee	Age group 1	13	2.20 (1.27)	6	1.68 (0.50)
(mm.)	Age group 2	30	2.29 (1.12)	14	1.51 (0.65)
	total	43	2.26 (1.15)	20	1.56 (0.60)
Upper intercanine	Age group 1	13	35.42 (1.74)	6	36.27 (3.15)
width	Age group 2	30	35.83 (2.80)	14	35.92 (2.42)
(mm.)	total	43	35.70 (2.51)	20	36.03 (2.58)
Upper anterior	Age group 1	13	39.27 (2.04)	6	40.27 (1.50)
arch width	Age group 2	30	38.25 (2.33)	14	39.50 (2.65)
(mm.)	total	43	38.56 (2.27)	20	39.73 (2.35)
Upper posterior	Age group 1	13	49.32 (3.02)	6	49.45 (3.42)
arch width	Age group 2	30	49.54 (2.93)	14	51.95 (2.03)
(mm.)	total	43	49.48 (2.92)	20	51.20 (2.70)
Upper anterior	Age group 1	13	18.45 (1.37)	6	17.47 (1.51)
arch length	Age group 2	30	18.37 (2.21)	14	16.82 (1.88)
(mm.)	total	43	18.39 (1.98)	20	17.01 (1.76)
Lower intercanine	Age group 1	13	27.17 (1.91)	6	29.15 (2.12)
width	Age group 2	30	26.96 (3.40)	14	28.38 (1.99)
(mm.)	total	43	27.03 (3.00)	20	28.61 (2.01)

Table 12 (continued)

Dental variables	Age group	Neck-coil wearing				
		Wearing			Not wearing	
		n	Means (SD)	n	Means (SD)	
Lower anterior	Age group 1	13	38.05 (2.15)	6	38.34 (2.88)	
arch width	Age group 2	30	38.40 (2.30)	14	39.62 (1.95)	
(mm.)	total	43	38.30 (2.24)	20	39.24 (2.27)	
Lower posterior	Age group 1	13	49.07 (3.38)	6	49.43 (3.14)	
arch width	Age group 2	30	49.46 (2.98)	14	51.32 (1.75)	
(mm.)	total	43	49.34 (3.07)	20	50.75 (2.34)	
Lower anterior	Age group 1	13	16.50 (1.67)	6	14.72 (2.07)	
arch length	Age group 2	30	16.93 (2.32)	14	14.72 (1.52)	
(mm.)	total	43	16.80 (2.13)	20	14.72 (1.65)	
Lower posterior	Age group 1	13	31.81 (1.58)	6	32.42 (1.31)	
arch length	Age group 2	30	30.57 (2.61)	14	27.76 (2.14)	
(mm.)	total	43	30.95 (2.40)	20	29.16 (2.90)	
Palatal height	Age group 1	6	10.58 (1.99)	0	-	
(mm.)	Age group 2	28	11.59 (2.13)	13	14.95 (1.61)	
	total	34	11.41 (2.1)	13	14.95 (1.61)	
Upper incisor	Age group 1	6	12.72 (6.24)	0	-	
inclination	Age group 2	28	13.44 (8.05)	13	9.07 (5.52)	
(degree)	total	34	13.32 (7.68)	13	9.07 (5.52)	
Lower incisor	Age group 1	6	13.18 (6.27)	0	-	
inclination	Age group 2	28	13.82 (10.54)	13	6.33 (7.61)	
(degree)	total	34	13.71 (9.84)	13	6.33 (7.61)	

4.3 The associations between neck-coil wearing and the categorical variables

There were three categorical variables, type of occlusion, upper arch form and lower arch form. Chi-square test was performed to test the associations between neck-coil wearing and these variables.

For type of occlusion, Class I and Class III malocclusions were combined as non-Class II malocclusion in order to compare with Class II malocclusion. In both upper and lower arch form, the parabolic and U-shaped arch forms were combined as non - V-shaped arch form in order to compare with V-shaped arch form.

There was a statistically significant associations between Class II malocclusion and neck-coil wearing (P=0.03). The subjects wearing brass neck-coils had Class II malocclusion (65.1%) more than the subjects not wearing brass neck-coils (35.0%) (Table 13).

In upper arch, there was no statistically significant associations between V-shaped arch form and neck-coil wearing (Table 14).

In lower arch, there was a statistically significant associations between V-shaped arch form and neck-coil wearing (P<0.001). The subjects wearing brass neck-coils had V-shaped arch form (44.2%) more than the subjects not wearing brass neck-coils (0.0%) (Table 15).

Table 13 The associations between neck-coil wearing and type of occlusion

Type of occlusion	Neck-coil wearing		P-value^
	Wearing	Not wearing	
	n (%)	n (%)	
Class II	28 (65.1)	7 (35.0)	
Non-Class II	15 (34.9)	13 (65.0)	
Total	43 (100.0)	20 (100.0)	0.03*

^ Pearson's Chi-square

* P<0.05

Table 14 The associations between neck-coil wearing and upper arch form

Upper arch form	Neck-coil wearing		P-value^
	Wearing	Not wearing	
	n (%)	n (%)	
V-shaped	4 (9.3)	0 (0.0)	
Non – V-shaped	39 (90.7)	20 (100.0)	
Total	43 (100.0)	20 (100.0)	0.21

^ Fisher's exact test

Table 15 The associations between neck-coil wearing and lower arch form

Lower arch form	Neck-coil wearing		P-value^
	Wearing	Not wearing	
	n (%)	n (%)	
V-shaped	19 (44.2)	0 (0.0)	
Non – V-shaped	24 (55.8)	20 (100.0)	
Total	43 (100.0)	20 (100.0)	P<0.001***

^ Pearson's Chi-square

*** P<0.001

4.4 Two-way analysis of variance of continuous variables between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils accounting for age group

The two-way analysis of variance (two-way ANOVA) were performed to compare those means of facial and dental variables between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils accounting for age group as showed in Table 16, 17 and 18. The multiple comparisons (Post Hoc) were use to compare the means of facial and dental variables among groups.

4.4.1 Facial variables

4.4.1.1 Transverse relationship

There were statistically significant differences in the right eye width (REW) (P=0.03), left eye width (LEW) (P=0.001), mouth width (MW) (P<0.001) between age groups but not between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils. In addition, there were no significant interactions between neck-coil wearing and age group.

For nose width (NW), there were statistically significant differences between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils (P=0.01) and between age groups (P<0.001). However, there was no significant interaction.

There were statistically significant differences in the upper face width (UFW) and the lower face width (LFW) between age groups (P<0.001) but not between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils. However there were no significant interactions.

4.4.1.2 Sagittal relationship

The sagittal relationship of maxilla and mandible was described by the Sn-Pg' value. There was statistically significant difference in the Sn-Pg' between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils after controlling the effect of age group (P=0.03). However there was no significant effect of age group

after controlling the effect of neck-coil wearing. Furthermore, there was no significant interaction (P=0.005).

There was a statistically significant difference in the upper lip to E-line (UL-E-line) between age groups (P<0.001) but not between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils. However, there was a significant interaction (P=0.005).

The lower lip to E-line (LL-E-line) were no significant differences between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils and between age groups. Furthermore, there was no significant interaction neither.

There were no significant differences in the profile angle (G'-Sn-Pg') between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils and between age groups and no interaction as well.

4.4.1.3 Vertical relationship

There were statistically significant differences in the total face height (TFH) between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils (P=0.04) and between age groups (P<0.001). For the facial index, there were no statistically significant differences between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils and between age groups. Both variables were no interactions.

There were statistically significant differences in the upper face height (UFH) and the middle face height (MFH) between age groups (P=0.02, P=0.005), but not between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils. There were statistically significant differences in the lower face height (LFH) between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils (P <0.001) and between age groups (P<0.001). However, all of those variables were no significant interactions.

For the proportion of face, there was a statistically significant difference in the upper face proportion (UFP) between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils (P=0.005) but not between age groups. There

were no significant differences in the middle face proportion (MFP) between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils and between age groups. The lower face proportion (LFP) was statistically significant difference between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils (P<0.001) but not between age groups. However, all of those variables were no significant interactions.

For the length of the lips, there were statistically significant differences in both upper lip length (ULL) and lower lip length (LLL) between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils (P=0.01, P<0.001) and between age groups (P=0.009, P<0.001). However, there was no significant interaction in ULL but there was significant interaction in LLL (P=0.03). There were no significant differences in the upper lip proportion (ULP) and the lower lip proportion (LLP) between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils and between age groups. There were no interactions either.

There were statistically significant differences in the maximum mouth opening (MMO) between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils (P=0.02) and between age groups (P=0.04), However, there was no interaction.

In summary, the facial variables which showed the significant differences between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils were the NW, TFH, LFH, UPP, LFP, ULL, LLL, Sn-Pg' and MMO while the facial variables which showed the significant differences between age groups were REW, LEW, NW, MW, UFW, LFW, TFH, UFH, MFH, LFH, UUL, LLL, UL-E-line and MMO. The results indicated that both neck-coil wearing and age group had the effects to the facial variables.

4.4.2 Dental variables

4.4.2.1 Transverse relationship

There were no significant differences in the upper intercanine width (UCW) between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils and between age groups. However, there was a statistically significant difference in the lower intercanine width (LCW) between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils (P=0.04) but not between age groups. However, both of those variables were no significant interactions.

There were no significant differences in the upper anterior arch width (UAAW), upper posterior arch width (UPAW), lower anterior arch width (LAAW) and lower posterior arch width (LPAW) between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils and between age groups. Furthermore, all of those variables were no significant interactions.

4.4.2.2 Sagittal relationship

The significant difference in overjet (OJ) was observed between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils (P=0.01), but not between age groups. Furthermore, there was no significant interaction.

There were statistically significant differences in upper anterior arch length (UAAL) and lower anterior arch length (LAAL) between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils (P=0.03, P<0.001) but not between age groups. In addition there were no significant interactions.

For the posterior arch length, there were statistically significant differences in both upper posterior arch length (UPAL) and lower posterior arch length (LPAL) between age groups (P=0.01, P<0.001) but not between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils. However, there was no significant interaction in UPAL but there was significant interaction in LPAL (P=0.01).

4.4.2.3 Vertical relationship

The significant difference in curve of Spee (CS) was observed between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils (P=0.04), but not between age groups. Furthermore, there was no significant interaction,

There were no significant differences in overbite (OB) between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils and between age groups and no interaction as well.

In summary, the dental variables which showed the significant differences between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils were OJ, CS, UAAL, LCW, LAAL, while the dental variables which showed the significant differences between age groups were UPAL and LPAL. The results indicated that both neck-coil wearing and age group had the effects to the dental variables.

From the two way analysis of varience (Table 16 and 17), there were significant interactions between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils and between age groups on the LLL (P=0.03), UL-E-line (P=0.005), LPAL (P=0.01). The result of Scheffe test compared the mean differences in four groups: the subjects wearing brass neck-coils with age group 1 (nc1a1), the subjects wearing brass neck-coils with age group 2 (nc1a2), the subjects not wearing brass neck-coils with age group 1 (nc0a1) and the subjects not wearing brass neck-coils with age group 2 (nc0a2) was showed on Table 18.

There were statistically significant differences of the lower lip length (LLL) between nc1a1 and nc1a2 (P=0.001), nc1a2 and nc0a1 (P<0.001), nc1a2 and nc0a2 (P<0.001). There were statistically significant differences of the upper lip to E-line (UL-E-line) between nc1a1 and nc1a2 (P<0.001), nc1a2 and nc0a1 (P<0.001), nc1a2 and nc0a2 (P=0.001). There were statistically significant differences of the lower posterior arch length (LPAL) between nc1a1 and nc1a2 (P<0.001), nc1a2 and nc0a1 (P<0.001), nc1a2 and nc0a2 (P=0.004).

Table 16 Two-way ANOVA of the facial variables and their means and standard deviations by neck-coil wearing and age group

Facial variables		Neck-coil wearing			Age group			Interaction between neck-coil wearing and age group
		Wearing	Not wearing		Age group 1	Age group 2		
		Mean (SD)	Mean (SD)	P-value^	Mean (SD)	Mean (SD)	P-value^	P-value^
Photograph measurements								
Right eye width	(mm)	26.75 (2.00)	26.58 (2.09)	0.26	26.12 (1.61)	26.98 (2.15)	0.03*	0.06
Left eye width	(mm)	26.88 (1.65)	26.59 (2.07)	0.14	26.01 (1.64)	27.17 (1.76)	0.001**	0.06
Nose width	(mm)	41.45 (3.30)	40.12 (3.67)	0.01*	38.06 (2.73)	42.45 (2.83)	<0.001***	0.41
Mouth width	(mm)	47.49 (4.58)	46.95 (5.51)	0.08	43.40 (4.50)	49.55 (3.68)	<0.001***	0.06
Upper face width	(mm)	140.37 (7.92)	142.29 (7.74)	0.44	134.51 (7.25)	144.29 (5.93)	<0.001***	0.38
Lower face width	(mm)	122.95 (8.29)	126.99 (9.42)	0.10	118.27 (8.22)	127.38 (7.55)	<0.001***	0.23
Total face height	(mm)	176.62 (8.20)	181.82 (11.27)	0.04*	172.01 (6.68)	181.61 (9.32)	<0.001***	0.18
Facial index		1.26 (0.07)	1.28 (0.09)	0.31	1.28 (0.06)	1.26 (0.08)	0.28	0.64
Upper face height	(mm)	59.78 (4.46)	59.03 (6.38)	0.32	57.90 (5.38)	60.34 (4.92)	0.02*	0.40
Middle face height	(mm)	60.70 (4.15)	60.66 (4.40)	0.86	58.90 (3.46)	61.58 (4.30)	0.005**	0.89
Lower face height	(mm)	56.14 (4.63)	62.12 (4.24)	<0.001***	55.20 (3.84)	59.69 (5.34)	<0.001***	0.13
Upper face proportion		0.34 (0.02)	0.32 (0.02)	0.005**	0.34 (0.02)	0.33 (0.02)	0.46	0.95
Middle face proportion		0.34 (0.02)	0.03 (0.02)	0.06	0.34 (0.02)	0.34 (0.02)	0.24	0.20
Lower face proportion		0.32 (0.02)	0.34 (0.02)	<0.001***	0.32 (0.02)	0.33 (0.02)	0.09	0.35

^ F-test (Two-way ANOVA)

* P<0.05, ** P <0.01, ***P<0.001

Table 16 (continued)

Facial variables		Neck-coil wearing			Age group			Interaction between neck-coil wearing and age group
		Wearing	Not wearing		Age group 1	Age group 2		
		Mean (SD)	Mean (SD)	p-value^	Mean (SD)	Mean (SD)	P-value^	P-value^
Upper lip length	(mm)	19.69 (2.57)	21.11 (1.92)	0.01*	19.18 (2.83)	20.67 (2.09)	0.009***	0.88
Lower lip length	(mm)	36.61 (3.38)	40.96 (3.37)	<0.001***	36.22 (2.55)	39.05 (4.19)	<0.001***	0.03*
Upper lip proportion		0.35 (0.03)	0.34 (0.03)	0.49	0.35 (0.03)	0.35 (0.03)	0.76	0.09
Lower lip proportion		0.65 (0.03)	0.66 (0.03)	0.50	0.65 (0.03)	0.65 (0.03)	0.75	0.09
Sn-Pg'	(mm)	6.57 (4.52)	3.97 (3.84)	0.03*	6.80 (3.08)	5.11 (4.93)	0.06	0.33
UL-E-line	(mm)	2.04 (2.16)	0.39 (3.11)	0.06	2.74 (2.21)	0.84 (2.61)	<0.001***	0.005***
LL-E-line	(mm)	2.46 (2.07)	1.80 (2.58)	0.30	2.46 (2.15)	2.12 (2.33)	0.43	0.60
Profile angle	(deg)	169.28 (12.86)	173.56 (6.28)	0.19	168.90 (5.16)	171.68 (13.17)	0.19	0.39
Direct measurement								
Maximum mouth opening	(mm)	36.55 (5.80)	40.44 (5.16)	0.02*	36.55 (5.11)	26.12 (1.61)	0.04*	0.07

^ F-test (Two-way ANOVA)

*P<0.05, ** P<0.01, ***P<0.001

Table 17 Two-way ANOVA of the dental variables and their means and standard deviations by neck-coil wearing and age group

| Dental variables		Neck-coil wearing			Age group			Interaction between neck-coil wearing and age group
		Wearing	Not wearing		Age group 1	Age group 2		
		Mean (SD)	Mean (SD)	p-value^	Mean (SD)	Mean (SD)	P-value^	P-value^
Overjet	(mm)	3.68 (2.05)	2.01 (1.75)	0.01*	3.00 (1.58)	3.22 (2.30)	0.95	0.41
Overbite	(mm)	3.14 (2.54)	1.94 (1.09)	0.20	2.42 (1.10)	2.90 (2.59)	0.81	0.17
Curve of Spee	(mm)	2.26 (1.15)	1.56 (0.60)	0.04*	2.03 (1.10)	2.04 (1.05)	0.90	0.67
Upper intercanine width	(mm)	35.70 (2.51)	36.03 (2.58)	0.54	35.69 (2.22)	35.86 (2.66)	0.97	0.62
Upper anterior arch width	(mm)	38.56 (2.27)	39.73 (2.35)	0.10	39.58 (1.90)	38.65 (2.48)	0.19	0.86
Upper posterior arch width	(mm)	49.48 (2.92)	51.20 (2.70)	0.13	49.36 (3.05)	50.31 (2.88)	0.11	0.18
Upper anterior arch length	(mm)	18.39 (1.98)	17.01 (1.76)	0.03*	18.14 (1.45)	17.87 (2.21)	0.53	0.63
Upper posterior arch length	(mm)	32.41 (2.63)	30.75 (2.85)	0.13	32.98 (1.55)	31.41 (3.07)	0.01*	0.11
Lower intercanine width	(mm)	27.03 (3.00)	28.61 (2.01)	0.04*	27.79 (2.14)	27.41 (3.07)	0.55	0.73
Lower anterior arch width	(mm)	38.30 (2.24)	39.24 (2.27)	0.26	38.14 (2.32)	38.79 (2.25)	0.23	0.49
Lower posterior arch width	(mm)	49.34 (3.07)	50.75 (2.34)	0.20	49.78 (3.22)	50.05 (2.77)	0.18	0.38
Lower anterior arch length	(mm)	16.80 (2.13)	14.72 (1.65)	<0.001***	15.94 (1.94)	16.23 (2.33)	0.72	0.72
Lower posterior arch length	(mm)	30.95 (2.39)	29.16 (2.90)	0.10	32.00 (1.49)	29.68 (2.78)	<0.001***	0.01*

^ F-test (Two-way ANOVA)

* P <0.05, ***P<0.001

Table 18 One-way ANOVA and multiple comparisons for means of facial and dental variables among the groups categorized by neck-coil wearing and age group

Variables		Subjects wearing brass neck-coils				Subjects not wearing brass neck-coils				P-value^	Multiple comparison for means (Scheffe test) P-value^				
		Age group 1		Age group 2		Age group 1		Age group 2			$\bar{X}_{nc1a1}$-$\bar{X}_{nc1a2}$	$\bar{X}_{nc1a1}$-$\bar{X}_{nc0a1}$	$\bar{X}_{nc1a2}$-$\bar{X}_{nc0a2}$	$\bar{X}_{nc1a2}$-$\bar{X}_{nc0a1}$	$\bar{X}_{nc0a1}$-$\bar{X}_{nc0a2}$
		$\bar{X}_{nc1a1}$	SD	$\bar{X}_{nc1a2}$	SD	$\bar{X}_{nc0a1}$	SD	$\bar{X}_{nc0a2}$	SD						
Lower lip length	mm.	35.56	2.31	37.16	3.73	37.62	2.55	42.48	2.50	0.03*	0.001**	0.39	0.98	<0.001***	0.30
UL-E-line	mm.	2.58	2.49	1.76	1.94	3.09	1.56	-0.83	2.87	0.005**	<0.001***	0.95	0.45	0.001**	0.63
Lower posterior arch length	mm.	31.81	1.58	30.57	2.61	32.42	1.31	27.76	2.14	0.01*	<0.001***	0.96	0.34	<0.001***	0.44

^ F-test (One-way ANOVA)

* P <0.05, ** P <0.01, ***P<0.001
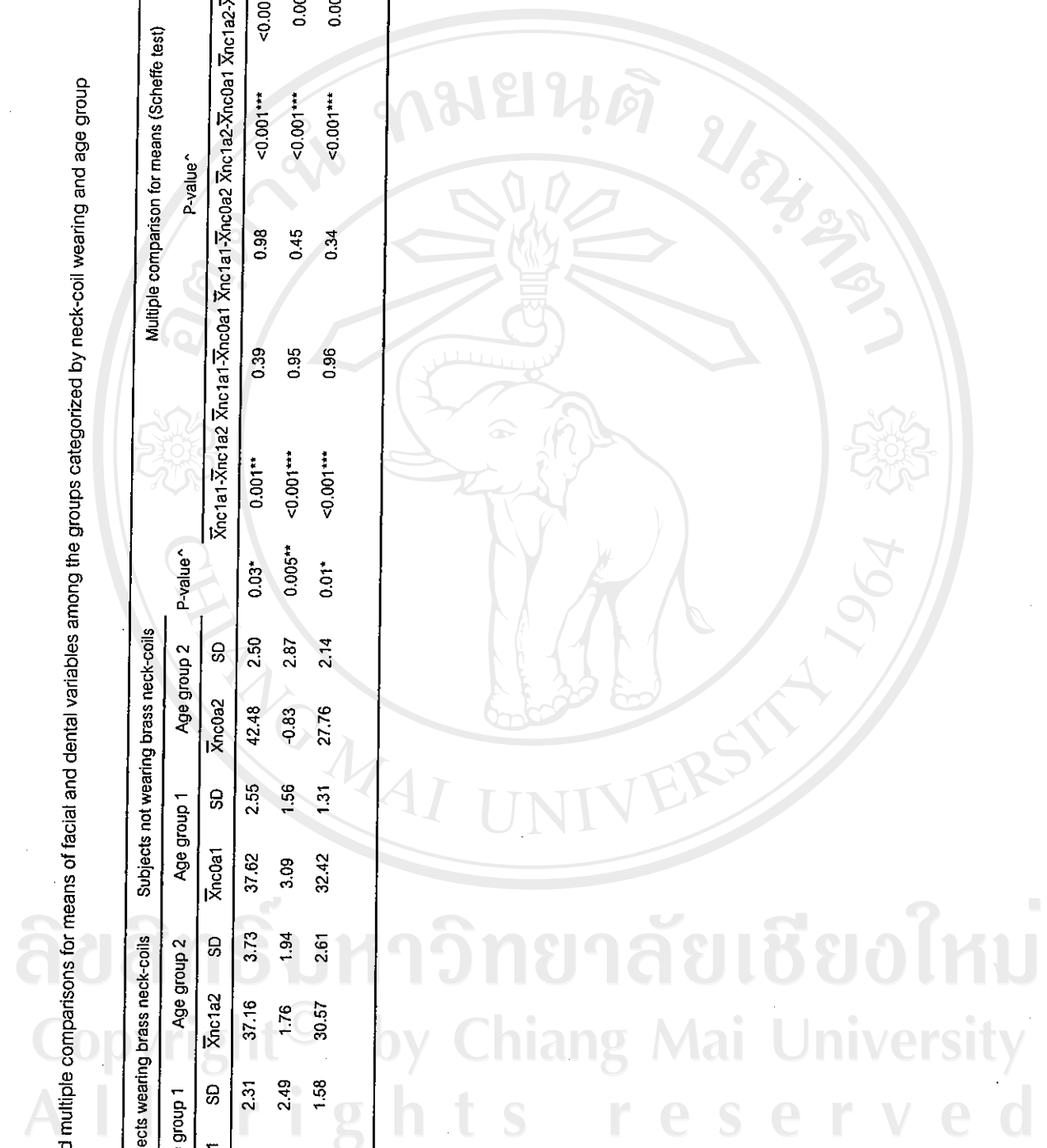
4.5 Comparisons of the incisor inclination and the palatal height between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils in age group 2

Since there was no measurements of the incisor inclination and palatal height in the subjects not wearing brass neck-coils in age group 1, comparisons of these variables between subjects wearing brass neck-coils and subjects not wearing brass neck-coils in age group 2 were performed (Table 19).

The palatal height (PH) in the subjects wearing brass neck-coils (11.59 mm.) was significantly flatter than that in the subjects not wearing brass neck-coils (14.95 mm.)(P <0.001).

The upper incisor inclination (UI) (13.44 degrees) and the lower incisor inclination (LI) (13.82 degrees) in the subjects wearing brass neck-coils were significantly more proclined than those in the subjects not wearing brass neck-coils (P=0.04, P=0.03).

Table 19 The comparisons of the incisor inclination and the palatal height between the subjects wearing brass neck-coils and the subjects not wearing brass neck-coils in age group 2

Dental variables	Neck-coil wearing				P-value^
	Wearing		Not wearing		
	n	Means (SD)	n	Means (SD)	
UI (degree)	28	13.44 (8.05)	13	9.07 (5.52)	0.04*
LI (degree)	28	13.82 (10.54)	13	6.33 (7.61)	0.03*
PH (mm.)	28	11.59 (2.13)	13	14.95 (1.61)	P<0.001***

^student T test

*P<0.05, ***P<0.001