CHAPTER IV

RESULTS

The results of this study are presented as follows:

Part 1: Means, standard deviations and two-way analysis of variance of the lateral cephalometric and the model measurements for both class III malocclusion and normal occlusion groups

Part 2: One way analysis of variance of the lateral cephalometric and the model measurements among groups categorized by type of occlusion and gender, following with the Scheffe' s multiple comparisons.

Part 3: One way analysis of variance of the lateral cephalometric and the model measurements among the skeletal normal overbite, skeletal deepbite and skeletal openbite in class III malocclusion group, following with the Scheffe' s multiple comparisons.

Part 4: The associations between type of occlusion and craniofacial measurements

Part 1: Means, standard deviations and two-way analysis of variance of the lateral cephalometric and the model measurements for both class III malocclusion and normal occlusion groups

The means and standard deviations of the lateral cephalometric and the model measurements for the class III malocclusion and normal occlusion groups (combined genders) were shown in Table 4.1 and 4.2. Since there were two factors in this study (type of occlusion and gender), each factor was categorized into two categories (class III malocclusion vs normal occlusion and male vs female). Therefore, two-way analysis of variances (two-way ANOVA) were performed to compare means of the lateral cephalometric and the model measurements between class III malocclusion group and normal occlusion group by gender, and followed by their interactions between type of occlusion and gender. The results of the two-way ANOVA were displayed in Table 4.1 and 4.2.

1.1 The lateral cephalometric measurements (Table 4.1)

1.1.1 Skeletal pattern

1.1.1.1 Anteroposterior relationship

There were no significant differences in the anteroposterior position of maxilla (SNA) between class III malocclusion group and normal occlusion group, and between male subject and female subject. Furthermore, there was no significant interaction between type of occlusion and gender.

For the anteroposterior position of mandible (SNB), there was a statistically significant difference between class III malocclusion group and normal occlusion group ($P<0.001$) but no obvious difference between male subject and female subject. In addition, there was no interaction as well.

The ANB angle and the Wits appraisal described the anteroposterior relationship of the maxilla and mandible. There were significant differences between class III malocclusion group and normal occlusion group ($P<0.001$) but there was no apparent difference between male subject and female subject. Furthermore, there was no

interaction, which meaned that the differences in ANB angle and the Wits appraisal between class III malocclusion group and normal occlusion group were consistence for both male subject and female subject.

The SNB angle, ANB angle and the Wits appraisal indicated that the mandible was in a more anterior position to the mandible in class III malocclusion group than that in normal occlusion group.

For the cranial base angle (NSBa), anterior cranial base length (SN) and posterior cranial base length (SBa), there were significant differences between class III malocclusion group and normal occlusion group and between male subject and female subject ($P<0.001$).

1.1.1.2 Vertical relationship

There were significant differences between male subject and female subject in the vertical position of maxilla (SN-PP) ($P=0.002$) and the vertical position of functional occlusal plane (SN-OP) ($P=0.02$) but there was no apparent difference between class III malocclusion group and normal occlusion group. Furthermore, there was no significant interaction, which implied the differences in SN-PP angle and SN-OP angle were consistence for class III malocclusion and normal occlusion groups.

For the vertical relationship of mandible, there was significant difference in the Y-axis angle (NSGn) between class III malocclusion group and normal occlusion group ($P=0.002$) but there was no significant difference between male subject and female subject. In addition, there was no significant interaction, which meaned that the difference in this angle between class III malocclusion group and normal occlusion group was consistence for both male and female subjects. The gonial angle (ArGoGn) had strongly significant difference between class III malocclusion group and normal occlusion group ($P<0.001$), irrespective of gender, indicated that in the class III malocclusion group had more obtuse gonial angle than that in normal occlusion group. The difference in ramus height (Ar-Go) was significant difference for the class III malocclusion and normal occlusion groups ($P<0.01$) and for either gender ($P<0.001$).

The ramus height was significantly longer in the normal occlusion and male groups than in the class III malocclusion and female groups sequentially. Interestingly, the symphysial width (SW) and the symphysial height (SH) of mandible had clearly significant differences between class III malocclusion group and normal occlusion group and between male subject and female subject. The symphysial width (SW) and the symphysial height (SH) were significantly wider and longer in the normal occlusion group and male subject than in the class III malocclusion group and female subject respectively. There were significant effects of gender on the mandibular length (Go-Gn) and the effective mandibular length (Ar-Me) after controlling the effect of type of occlusion ($P<0.001$) but there was no significant effect of type of occlusion after controlling the effect of gender. Furthermore, there were no significant interactions, which implied that the differences in the mandibular length and the effective mandibular length between male subject and female subject were consistence for both class III malocclusion and normal occlusion group. The mandibular length and the effective mandibular length were longer in male subject than that in female subject.

1.1.1.3 Facial height and vertical facial proportion

There were significant differences in the upper anterior facial height (UAFH), the lower posterior facial height (LPFH) and the total posterior facial height (TPFH) between class III malocclusion group and normal occlusion group ($P<0.001$) and between male subject and female subject ($P<0.001$) but there were no significant interactions. The UAFH, LPFH and TPFH were significantly greater in the normal occlusion group and male subject than in the class III malocclusion group and female subject.

There was significant difference in the total anterior facial height (TAFH) between class III malocclusion group and normal occlusion group ($P=0.02$) and between male subject and female subject ($P<0.001$) but there was no significant interaction.

There were significant differences in the lower anterior facial height (LAFH) and the upper posterior facial height (UPFH) between male subject and female subject ($P <0.001$) but there were no obvious differences between class III malocclusion group and

normal occlusion group. Furthermore, there were no significant interactions, which implied that the differences in the LAFH and the UPFH by gender were consistence for the class III malocclusion group and the normal occlusion group.

There were significant differences in the UAFH/LAFH ratio between class III malocclusion group and normal occlusion group and between male subject and female subject (P=0.04) but there was no significant interaction between type of occlusion and gender. Similarly, there was obvious difference in the TPFH/TAFH ratio between class III malocclusion group and normal occlusion group (P=0.01) and between male subject and female subject (P<0.001) but there was no significant interaction between type of occlusion and gender. These results implied that the effects of gender on the UAFH/LAFH ratio and the TPFH/TAFH ratio were the same for both class III malocclusion group and normal occlusion group. The UAFH/LAFH ratio was significantly greater in female subject than in male subject, while the TPFH/TAFH ratio was apparently greater in male subject than in female subject.

1.1.2 Dental pattern

1.1.2.1 Dental relationship

There were significant differences in the inclination of maxillary incisors in relation to NA line (U1-NA) and those with in relation to SN line (U1-SN), the inclination of mandibular incisors in relation to NB line (L1-NB) and those with in relation to GoGn line (L1-GoGn), the overbite and the inclination of mandibular incisors in relation to APg line (L1-APg) between class III malocclusion group and normal occlusion group (all significance at P<0.001; with the exception of the overbite which was significance at P=0.004) but there were no obvious differences between male subject and female subject. Furthermore, there were no significant interactions, which implied that the differences in all those dental variables between class III malocclusion group and normal occlusion group were consistence for both male subject and female subject. The U1-NA angle, U1-SN angle and L1-APg were considerably greater in class III malocclusion group than in normal occlusion group. While the L1-NB angle, L1-GoGn angle and the overbite were apparently smaller in class III malocclusion group than in

normal occlusion group. There were no significant differences between class III malocclusion group and normal occlusion group and between male subject and female subject in the interincisal angle (U1-L1) and there was no significant interaction as well. Interestingly, the overjet had significant difference between class III malocclusion group and normal occlusion group (P<0.001) and between male subject and female subject (P=0.02). In addition, there was significant interaction between type of occlusion and gender at P=0.02.

1.1.2.2 Dentoalveolar height

There were statistically significant differences in the upper anterior dental height (UADH), the lower anterior dental height (LADH) and the lower posterior dental height (LPDH) between male subject and female subject (P<0.001) and between class III malocclusion group and normal occlusion group (P<0.001, with the exception of the UADH which was significance at P=0.01). However, there were no significant interactions between type of occlusion and gender. The UADH, LADH and LPDH were significantly less in class III malocclusion group than in normal occlusion group. There was significant difference between male subject and female subject in the UPDH (P <0.001) but there was no significant difference between class III malocclusion group and normal occlusion group. Furthermore the UPDH had no significant interaction, which implied that the differences in the UPDH between male subject and female subject were consistence in class III malocclusion and normal occlusion groups.

The significant difference in the LPDH/LADH ratio was observed between class III malocclusion group and normal occlusion group (P<0.001) and between male subject and female subject (P=0.001) but there was no significant interaction as well. In stead of the UPDH/UADH ratio had significant difference between class III malocclusion group and normal occlusion group only (P=0.04). The UPDH/UADH ratio was significantly greater in class III malocclusion group than in normal occlusion group. While the LPDH/LADH ratio was apparently less in class III malocclusion group than in normal occlusion group.

1.1.3 Facial soft tissue pattern

There were significant differences in the soft tissue facial angle, the nasolabial angle, the superior sulcus depth, the relation of upper lip to Esthetic line and the relation of lower lip to esthetic line between class III malocclusion group and normal occlusion group ($P<0.001$; with the exception of the superior sulcus depth which was significance at $P=0.02$ and the relation of lower lip to esthetic line was significance at $P=0.004$) but there were no significant differences between male subject and female subject. In addition, all of these variables had no significant interaction between type of occlusion and gender, exception with the nasolabial angle that was significance at $P=0.01$. The soft tissue facial angle, the superior sulcus depth and the relation of lower lip to esthetic line were significantly greater in class III malocclusion group than in normal occlusion group. While the nasolabial angle and the relation of upper lip to esthetic line were apparently greater in normal occlusion group than in class III malocclusion group.

The significant differences in the mentolabial angle, the Holdaway angle (H angle), the inferior sulcus depth, the relation of subnasale to Holdaway line (Sn to H-line), the upper lip thickness and the lower lip thickness were observed between class III malocclusion group and normal occlusion group (all significance at $P<0.001$; with the exception of the upper lip thickness which was significance at $P=0.02$) and between male subject and female subject (mentolabial angle was significance at $P=0.04$; H angle, inferior sulcus depth and Sn to H-line were significance at $P=0.002$; upper lip thickness and lower lip thickness were significance at $P<0.001$). However, there were no significant interactions between type of occlusion and gender. The mentolabial angle and the upper lip thickness were significantly greater in class III malocclusion group than in normal occlusion group. While the Holdaway angle (H angle), the inferior sulcus depth, the relation of subnasale to Holdaway line (Sn to H-line) and the lower lip thickness were significantly less in class III malocclusion group than in normal occlusion group.

For the nose prominence and the soft tissue chin thickness had significant differences between male subject and female subject ($P=0.005$ and $P=0.01$

respectively) but there were no significant differences between class III malocclusion group and normal occlusion group. Furthermore, there were no significant interactions which meaned the differences in the nose prominence and the soft tissue chin thickness between male subject and female subject were consistence for both class III malocclusion group and normal occlusion group. The nose prominence and the soft tissue chin thickness were apparently greater in male subject than in female subject.

1.2 The model measurements (Table 4.2)

There were significant differences in the upper intercanine width (CWu), the lower intercanine width (CW_L) and the lower intermolar width (MW_L) between male subject and female subject ($P=0.004$, $P=0.04$ and $P<0.001$ respectively) but there were no significant differences between class III malocclusion group and normal occlusion group. Furthermore there were no significant interactions, which implied that the differences in the CWu, CW_L and MW_L between male subject and female subject were consistence in class III malocclusion and normal occlusion groups. The significant differences in the upper interpremolar width (PWu) and the upper intermolar width (MWu) were observed between male subject and female subject only ($P<0.001$) and they had significant interactions.

Interestingly, there was significant difference in the upper canine depth (CDu), between class III malocclusion group and normal occlusion group ($P<0.001$) but there was no significant difference between male subject and female subject. Furthermore there was no significant interaction, which indicated the differences in the CDu between class III malocclusion group and normal occlusion group were consistence for both male subject and female subject. The CDu was apparently less in class III malocclusion group than in normal occlusion group. For the lower interpremolar width (PW_L) had significant difference between class III malocclusion group and normal occlusion group ($P=0.03$) and between male subject and female subject ($P<0.001$). Furthermore there was significant interaction between type of occlusion and gender ($P=0.02$). The PW_L was significantly less in class III malocclusion group than in normal occlusion group.

There were no significant differences in the upper molar depth (MDu) and the lower molar depth (MDL) between class III malocclusion group and normal occlusion group, and between male subject and female subject. In addition, there were no significant interactions as well.

There were no significant differences in the CWu/CDu ratio and the CWL/CDL ratio . Furthermore there were no significant interactions. For the MWu/MDu ratio and the MWL/MDL ratio had significant differences between male subject and female subject ($P < 0.001$ and $P = 0.04$ respectively) but there were no significant differences between class III malocclusion group and normal occlusion group.

In summary, the lateral cephalometric measurements and the model measurements which showed the differences between class III malocclusion group and normal occlusion group were the SNB angle, ANB angle, NSBa angle, SArGo angle, ArGoGn angle, NSGn angle, SN-GoGn angle, PP-GoGn angle, anterior and posterior cranial base length, maxillary length, ramus height, Wits appraisal, symphysial width, symphysial height, UAFH, TAFH, LPFH, TPFH, UAFH/LAFH ratio, UPFH/LPFH ratio, TPFH/TAFH ratio, U1-Na angle, U1-SN angle, L1-NB angle, L1-GoGn angle, overjet, overbite, L1-APg, UADH, LADH, LPDH, UPDH/UADH ratio, LPDH/LADH ratio, soft tissue facial angle, nasolabial angle, mentolabial angle, H angle, superior sulcus depth, inferior sulcus depth, Sn to H-line, upper lip thickness, lower lip thickness, upper lip to E-line, lower lip to E-line, CDu and PWL. While the lateral cephalometric measurements and the model measurements which showed the differences between male subject and female subject were the NSBa angle, NSGn angle, SN-GoGn angle, SN-PP angle, SN-OP angle, anterior and posterior cranial base length, maxillary length (ANS-PNS), ramus height, mandibular length, effective mandibular length, symphysial width, symphysial height, UAFH, LAFH, TAFH, UPFH, LPFH, TPFH, UAFH/LAFH ratio, TPFH/TAFH ratio, overjet, UADH, UPDH, LADH, LPDH, LPDH/LADH ratio, mentolabial angle, H angle, nose prominence, inferior sulcus depth, Sn to H-line, upper lip thickness, lower lip thickness, soft tissue chin thickness, CWu, PWu, MWu, CWL, PWL, MWL, MWu/MDu ratio and

MWL/MDL ratio. These results indicated that both type of occlusion and gender factors had the effects to the craniofacial cephalometric measurements.

From the two-way analysis of variances (Table 4.1 and 4.2), there were statistically significant interactions between type of occlusion and gender on the SArGo angle, PWu (P=0.003 and P=0.005 respectively), ArGoGn angle, maxillary length (ANS-PNS), overjet, nasolabial angle, MWu and PWL (P=0.01 to P=0.004). The results of Scheffe test on the SArGo angle, ArGoGn angle, maxillary length (ANS-PNS), overjet, nasolabial angle, PWu, MWu and PWL, which compared the mean differences among four groups: Normal males (NM), Normal females (NF), Class III males (3M) and Class III females (3F) were shown on Table 4.3 and 4.4 respectively.

There was significant difference of the SArGo angle between the normal females and the class III females (P=0.003). The ArGoGn angle had significant differences between the normal females and the class III males (P=0.04), the normal males and the class III females (P=0.009) and between the normal males and the class III males (P<0.001). For the maxillary length, there were significant differences between the normal males and class III females, the class III males and the class III females (P<0.001) and the normal females and the class III females (P=0.006). There were significant differences of the overjet between the normal males and the class III males, the normal males and the class III females, the normal females and the class III males, the normal females and the class III females (P<0.001) and the class III males and the class III females (P=0.02). Furthermore, overjet was not found the gender difference in normal occlusion group. The nasolabial angle had significant differences between the normal males and the class III females (P=0.005), the normal females and the class III males, the normal females and the class III females (P<0.001) (Table 4.3).

The significant differences of the PWu were found between the normal males and the class III females, the class III males and the class III females (P<0.001). There were significant differences of the MWu between the normal males and the class III females, the class III males and the class III females (P<0.001) and the normal females and the

class III males (P=0.02). For the PW_L, there were significant differences between the normal males and the class III females, the class III males and the class III females (P<0.001) and the normal females and the class III females (P=0.02) (Table 4.4).

Table 4.1 Two-way ANOVA of the lateral cephalometric measurements and their means and standard deviations by type of occlusion and gender

Lateral cephalometric measurements		Occlusion					Gender					Interaction between occlusion and gender
		Normal occlusion		Class III malocclusion			Male		Female			
		$\bar{X}$	(SD)	$\bar{X}$	(SD)	P-value^	$\bar{X}$	(SD)	$\bar{X}$	(SD)	P-value^	P-value^
SKELETAL												
SNA	(deg)	83.09	3.28	82.06	3.09	0.11	82.89	3.69	82.29	3.57	0.37	0.94
SNB	(deg)	81.43	2.93	84.99	4.18	<0.001***	83.54	3.98	82.91	4.06	0.20	0.95
ANB	(deg)	1.66	1.61	-2.93	2.12	<0.001***	-0.65	2.98	-0.62	2.98	0.49	0.99
NSBa	(deg)	131.13	4.68	128.07	5.06	<0.001***	128.26	4.62	130.83	5.23	0.001**	0.79
SArGo	(deg)	144.29	5.10	146.81	7.38	0.03*	145.01	7.25	146.05	5.61	0.37	0.003**
ArGoGn	(deg)	120.01	5.07	124.14	5.93	<0.001***	121.85	6.47	122.27	5.31	0.80	0.04*
NSGn	(deg)	68.03	2.66	66.19	4.16	0.002**	66.89	3.48	67.31	3.72	0.40	0.65
SN-GoGn	(deg)	29.22	4.44	31.34	6.01	0.02*	29.03	5.34	31.43	5.17	0.009**	0.43
SN-PP	(deg)	9.02	2.91	8.84	3.23	0.62	8.09	3.03	9.71	2.90	0.002**	0.85
SN-OP	(deg)	14.74	4.12	14.21	5.46	0.45	13.52	4.53	15.35	4.95	0.02*	0.88
PP-GoGn	(deg)	20.20	4.28	22.50	5.76	0.008**	20.94	5.56	21.73	4.82	0.43	0.35
SN	(mm)	71.95	3.44	67.65	7.76	<0.001***	72.63	6.23	67.20	5.31	<0.001***	0.19
SBa	(mm)	50.36	3.98	47.37	7.29	0.003**	51.04	7.11	46.88	3.97	<0.001***	0.33
ANS-PNS	(mm)	51.88	2.80	49.39	6.27	0.003**	52.56	5.19	48.87	4.11	<0.001***	0.04*

^ F-test (Two-way ANOVA)

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

Table 4.1 (continued)

Lateral cephalometric measurements		Occlusion					Gender					Interaction between occlusion and gender
		Normal occlusion		Class III malocclusion			Male		Female			
		$\bar{X}$	(SD)	$\bar{X}$	(SD)	P-value^	$\bar{X}$	(SD)	$\bar{X}$	(SD)	P-value^	P-value^
SKELETAL												
Ar-Go	(mm)	52.19	4.91	48.99	7.91	0.004**	53.96	6.35	47.49	5.55	<0.001***	0.42
Ar-Me	(mm)	116.65	5.33	115.84	14.50	0.86	121.12	11.00	111.77	8.69	<0.001***	0.14
Go-Gn	(mm)	83.80	4.25	82.81	9.79	0.54	85.80	8.09	81.02	6.21	<0.001***	0.38
Wits	(mm)	-2.49	2.40	-9.74	3.56	<0.001***	-5.94	4.80	-6.28	4.69	0.96	0.34
SW	(mm)	15.68	1.41	13.93	2.37	<0.001***	15.39	2.11	14.27	2.03	<0.001***	0.33
SH	(mm)	23.61	2.01	21.68	3.30	<0.001***	24.08	2.66	21.33	2.45	<0.001***	0.89
UAFH	(mm)	58.41	2.97	55.02	6.22	<0.001***	58.49	5.30	55.09	4.44	<0.001***	0.85
LAFH	(mm)	70.72	4.54	69.36	10.24	0.41	73.53	7.41	66.84	7.00	<0.001***	0.23
TAFH	(mm)	129.14	6.19	124.38	15.41	0.02*	132.02	11.08	121.92	10.63	<0.001***	0.37
UPFH	(mm)	47.62	3.53	46.38	5.78	0.15	50.00	4.24	44.24	3.49	<0.001***	0.07
LPFH	(mm)	39.61	5.29	34.88	7.39	<0.001***	40.55	6.76	34.21	5.36	<0.001***	0.97
TPFH	(mm)	87.23	7.05	81.26	12.00	<0.001***	90.55	8.88	78.45	7.72	<0.001***	0.39
UAFH/LAFH		0.82	0.07	0.80	0.08	0.04*	0.80	0.08	0.82	0.07	0.04*	0.13
UPFH/LPFH		1.21	0.20	1.36	0.22	<0.001***	1.26	0.23	1.31	0.22	0.27	0.58
TPFH/TAFH		0.68	0.04	0.65	0.06	0.01*	0.69	0.04	0.64	0.05	<0.001***	0.88

^ F-test (Two-way ANOVA)

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

Table 4.1 (continued)

Lateral cephalometric measurements		Occlusion					Gender					Interaction between occlusion and gender
		Normal occlusion		Class III malocclusion			Male		Female			
		$\bar{X}$	(SD)	$\bar{X}$	(SD)	P-value^	$\bar{X}$	(SD)	$\bar{X}$	(SD)	P-value^	P-value^
DENTAL												
U1-NA	(deg)	25.56	5.42	31.98	6.40	<0.001***	28.97	6.66	28.58	6.84	0.51	0.92
U1-SN	(deg)	108.99	5.87	114.38	7.09	<0.001***	112.23	7.21	111.18	6.86	0.25	0.88
L1-NB	(deg)	29.58	4.52	25.66	6.53	<0.001***	27.47	5.75	27.76	6.12	0.63	0.50
L1-GoGn	(deg)	99.32	7.53	89.26	7.08	<0.001***	94.78	8.00	93.85	9.61	0.69	0.82
U1-L1	(deg)	122.94	6.77	125.74	10.76	0.06	124.47	9.63	124.23	8.58	0.81	0.45
Overjet	(mm)	3.09	0.81	-1.97	2.16	<0.001***	0.35	3.30	0.75	2.73	0.02*	0.02*
Overbite	(mm)	2.33	0.93	1.54	2.03	0.004**	2.01	1.72	1.87	1.54	0.68	0.99
L1-APg	(mm)	5.01	2.10	8.17	2.77	<0.001***	6.69	3.14	6.49	2.71	0.42	0.48
UADH	(mm)	30.14	2.54	28.38	4.90	0.01*	30.46	3.79	28.15	3.86	0.001**	0.50
UPDH	(mm)	26.18	2.00	25.28	4.05	0.12	26.78	3.01	24.76	3.11	<0.001***	0.62
LADH	(mm)	42.10	3.00	39.34	5.43	<0.001***	42.93	4.02	38.70	4.14	<0.001***	0.21
LPDH	(mm)	34.39	2.96	30.52	4.96	<0.001***	34.77	3.87	30.33	4.00	<0.001***	0.48
UPDH/UADH		0.87	0.06	0.90	0.07	0.04*	0.88	0.07	0.88	0.07	0.98	0.67
LPDH/LADH		0.82	0.04	0.78	0.05	<0.001***	0.81	0.05	0.78	0.05	0.001**	0.65

^ F-test (Two-way ANOVA)

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

Table 4.1 (continued)

Lateral cephalometric measurements		Occlusion					Gender					Interaction between occlusion and gender
		Normal occlusion		Class III malocclusion			Male		Female			
		$\bar{X}$	(SD)	$\bar{X}$	(SD)	P-value^	$\bar{X}$	(SD)	$\bar{X}$	(SD)	P-value^	P-value^
FACIAL SOFT TISSUE												
ST facial angle	(deg)	92.77	3.17	96.74	4.46	<0.001***	94.84	4.24	94.68	4.46	0.61	0.43
Nasolabial angle	(deg)	98.22	8.69	88.44	10.90	<0.001***	92.81	10.22	93.81	11.69	0.39	0.01*
Mentolabial angle	(deg)	138.76	9.04	144.74	11.26	0.001**	139.75	11.67	143.59	9.24	0.04*	0.36
H angle	(deg)	17.79	3.16	13.79	4.19	<0.001***	16.90	4.27	14.78	3.92	0.002**	0.44
Nose prominence	(mm)	13.51	1.83	13.07	2.23	0.21	13.80	1.86	12.83	2.10	0.005**	0.25
Sup sulcus depth	(mm)	6.23	2.10	7.16	2.50	0.02*	7.04	2.53	6.37	2.13	0.07	0.18
Inf sulcus depth	(mm)	4.10	1.58	1.58	1.69	<0.001***	3.30	2.14	2.42	1.91	0.005**	0.21
Sn to H-line	(mm)	10.32	2.51	8.78	2.91	0.001**	10.26	2.96	8.90	2.51	0.004**	0.07
Upp lip thickness	(mm)	14.26	2.15	15.05	0.45	0.02*	16.46	2.84	13.00	1.73	<0.001***	0.21
Low lip thickness	(mm)	15.93	1.90	14.29	2.66	<0.001***	16.30	2.32	14.01	2.01	<0.001***	0.45
ST chin thickness	(mm)	12.98	1.51	12.42	2.60	0.15	13.17	2.27	12.26	1.93	0.01*	0.49
Upp lip to E-line	(mm)	0.26	1.83	-1.68	2.31	<0.001***	-0.51	2.29	-0.89	2.30	0.40	0.74
Low lip to E-line	(mm)	1.63	2.05	2.78	2.58	0.004**	2.19	2.44	2.22	2.36	0.96	0.79

^ F-test (Two-way ANOVA)

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

Table 4.2 Two-way ANOVA of the model measurements and their means and standard deviations by type of occlusion and gender

Model measurements		Occlusion					Gender					Interaction between occlusion and gender
		Normal occlusion		Class III malocclusion			Male		Female			
		$\bar{X}$	(SD)	$\bar{X}$	(SD)	P-value^	$\bar{X}$	(SD)	$\bar{X}$	(SD)	P-value^	P-value^
CWu	(mm)	35.22	1.58	35.96	3.56	0.08	36.31	3.42	34.93	1.89	0.004**	0.18
PWu	(mm)	38.15	1.54	37.66	2.80	0.36	38.81	2.08	36.98	2.17	<0.001***	0.005**
MWu	(mm)	49.88	2.29	49.15	2.95	0.20	50.79	2.17	48.21	2.52	<0.001***	0.03*
CDu	(mm)	8.14	0.83	6.99	2.16	<0.001***	7.58	2.06	7.48	1.43	0.96	0.70
MDu	(mm)	30.22	1.75	29.89	2.25	0.36	30.04	2.16	30.05	1.90	0.94	0.61
CW_L	(mm)	26.72	1.53	27.23	2.11	0.08	27.30	1.95	26.68	1.75	0.04*	0.43
PW_L	(mm)	31.20	1.53	30.27	2.69	0.03*	31.71	1.93	29.71	2.14	<0.001***	0.02*
MW_L	(mm)	49.91	2.40	49.35	3.44	0.46	50.94	2.82	48.30	2.59	<0.001***	0.07
CD_L	(mm)	4.95	0.79	4.82	1.44	0.61	5.06	1.27	4.70	1.07	0.10	0.90
MD_L	(mm)	27.23	1.70	27.35	2.58	0.70	27.50	2.07	27.09	2.33	0.28	0.97
CWu / CDu		4.36	0.43	5.32	5.63	0.19	4.86	5.77	4.89	1.22	0.94	0.98
CW_L / CD_L		5.54	1.03	5.36	6.93	0.74	4.78	6.84	6.10	2.25	0.16	0.29
MWu / MDu		1.66	0.12	1.65	0.15	0.85	1.70	0.13	1.61	0.13	<0.001***	0.08
MW_L / MD_L		1.84	0.15	1.82	0.22	0.65	1.86	0.19	1.80	0.18	0.04*	0.38

^ F-test (Two-way ANOVA)

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

Table 4.3 One-way ANOVA and multiple comparisons for means of the lateral cephalometric measurements among the groups categorized by type of occlusion and gender

Lateral cephalometric measurements		Normal occlusion				Class III malocclusion				P-value^	Multiple comparison for means (Scheffe test) P-value					
		Male		Female		Male		Female								
		$\bar{X}_{NM}$	(SD)	$\bar{X}_{NF}$	(SD)	$\bar{X}_{3M}$	(SD)	$\bar{X}_{3F}$	(SD)		$\bar{X}_{NM} - \bar{X}_{NF}$	$\bar{X}_{NM} - \bar{X}_{3M}$	$\bar{X}_{NM} - \bar{X}_{3F}$	$\bar{X}_{NF} - \bar{X}_{3M}$	$\bar{X}_{NF} - \bar{X}_{3F}$	$\bar{X}_{3M} - \bar{X}_{3F}$
SKELETAL																
SNA	(deg)	83.34	3.29	82.83	3.30	82.39	4.08	81.79	3.79	0.31	0.95	0.76	0.34	0.97	0.68	0.92
SNB	(deg)	81.80	3.09	81.06	2.76	85.44	4.01	84.61	4.33	<0.001***	0.86	0.001**	0.01*	<0.001***	0.001**	0.83
ANB	(deg)	1.54	1.63	1.77	1.61	-3.05	2.15	-2.83	2.11	<0.001***	0.97	<0.001***	<0.001***	<0.001***	<0.001***	0.97
NSBa	(deg)	129.67	4.46	132.59	4.50	126.72	4.35	129.21	5.38	<0.001***	0.09	0.09	0.98	<0.001***	0.03*	0.19
SArGo	(deg)	145.39	4.96	143.19	5.07	144.59	9.20	148.68	4.77	0.002**	0.53	0.96	0.16	0.83	0.003**	0.06
ArGoGn	(deg)	118.96	5.09	121.06	4.90	125.02	6.40	123.39	5.48	<0.001***	0.47	<0.001***	0.009**	0.04*	0.35	0.68
NSGn	(deg)	27.64	2.58	68.41	2.72	66.06	4.14	66.29	4.24	0.02*	0.84	0.34	0.44	0.06	0.09	1.00
SN-GoGn	(deg)	27.71	4.27	30.73	4.15	30.47	6.06	32.08	5.95	0.005**	0.12	0.20	0.006**	1.00	0.74	0.64
SN-PP	(deg)	8.26	2.60	9.79	3.04	7.91	3.48	9.63	2.81	0.02*	0.21	0.97	0.28	0.09	1.00	0.13
SN-OP	(deg)	13.76	3.66	15.73	4.36	13.27	5.37	15.00	5.47	0.13	0.40	0.98	0.75	0.22	0.94	0.52
PP-GoGn	(deg)	19.46	4.26	20.94	4.24	22.56	6.38	22.45	5.26	0.04*	0.68	0.11	0.10	0.64	0.66	1.00
SN	(mm)	73.97	2.79	69.93	2.79	71.17	8.35	64.69	5.85	<0.001***	0.02*	0.22	<0.001***	0.83	0.001**	<0.001***
SBa	(mm)	52.84	3.70	47.89	2.41	49.06	9.21	45.95	4.85	<0.001***	0.004**	0.05	<0.001***	0.86	0.53	0.15
ANS-PNS	(mm)	52.91	2.57	50.84	2.67	52.18	7.06	47.04	4.39	<0.001***	0.29	0.93	<0.001***	0.69	0.006**	<0.001***

^ F-test (One-way ANOVA)

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

Table 4.3 (continued)

Lateral cephalometric measurements		Normal occlusion				Class III malocclusion				P-value^	Multiple comparison for means (Scheffe test) P-value					
		Male		Female		Male		Female								
		$\bar{X}_{NM}$	(SD)	$\bar{X}_{NF}$	(SD)	$\bar{X}_{3M}$	(SD)	$\bar{X}_{3F}$	(SD)		$\bar{X}_{NM}$ - $\bar{X}_{NF}$	$\bar{X}_{NM}$ - $\bar{X}_{3M}$	$\bar{X}_{NM}$ - $\bar{X}_{3F}$	$\bar{X}_{NF}$ - $\bar{X}_{3M}$	$\bar{X}_{NF}$ - $\bar{X}_{3F}$	$\bar{X}_{3M}$ - $\bar{X}_{3F}$
SKELETAL																
Ar-Go	(mm)	54.96	3.86	49.41	4.27	52.87	8.19	45.72	6.04	<0.001***	0.002**	0.54	<0.001***	0.12	0.07	<0.001***
Ar-Me	(mm)	120.09	3.81	113.21	4.34	122.25	15.46	110.44	11.22	<0.001***	0.04*	0.85	0.001**	0.004**	0.70	<0.001***
Go-Gn	(mm)	85.64	3.82	81.96	3.89	85.97	11.10	80.15	7.72	0.001**	0.21	1.00	0.02*	0.16	0.77	0.01*
Wits	(mm)	-2.23	2.33	-2.76	2.48	-10.00	3.27	-9.52	3.83	<0.001***	0.91	<0.001***	<0.001***	<0.001***	<0.001***	0.94
SW	(mm)	16.04	1.37	15.31	1.37	14.67	2.53	13.31	2.07	<0.001***	0.46	0.03*	<0.001***	0.58	<0.001***	0.03*
SH	(mm)	24.97	1.45	22.24	1.51	23.10	3.29	20.48	2.84	<0.001***	<0.001***	0.02*	<0.001***	0.54	0.02	<0.001***
UAFH	(mm)	59.97	2.68	56.86	2.38	56.88	6.84	53.46	5.24	<0.001***	0.05	0.06	<0.001***	1.00	0.02*	0.03*
LAFH	(mm)	73.31	3.54	68.13	3.93	73.76	10.15	65.65	8.85	<0.001***	0.03*	1.00	<0.001***	0.02*	0.54	<0.001***
TAFH	(mm)	133.29	4.29	124.99	4.87	130.64	15.41	119.11	13.46	<0.001***	0.02*	0.80	<0.001***	0.20	0.14	<0.001***
UPFH	(mm)	49.89	2.86	45.36	2.56	50.13	5.40	43.22	3.92	<0.001***	<0.001***	1.00	<0.001***	<0.001***	<0.001***	<0.001***
LPFH	(mm)	42.70	4.50	36.51	4.12	38.20	8.00	32.08	5.54	<0.001***	<0.001***	0.02*	<0.001***	0.69	0.01*	<0.001***
TPFH	(mm)	92.59	4.42	81.87	4.72	88.33	11.70	75.30	8.61	<0.001***	<0.001***	0.19	<0.001***	0.01*	0.007**	<0.001***
UAFH/LAFH		0.82	0.06	0.83	0.08	0.78	0.09	0.82	0.06	0.02*	0.99	0.10	1.00	0.05	0.98	0.11
UPFH/LPFH		1.18	0.17	1.24	0.22	1.35	0.25	1.37	0.20	<0.001***	0.71	0.01*	0.003**	0.20	0.07	0.99
TPFH/TAFH		0.69	0.04	0.66	0.04	0.68	0.05	0.63	0.06	<0.001***	0.006**	0.45	<0.001***	0.33	0.30	0.003**

^ F-test (One-way ANOVA)

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

Table 4.3 (continued)

Lateral cephalometric measurements		Normal occlusion				Class III malocclusion				P-value^	Multiple comparison for means (Scheffe test) P-value					
		Male		Female		Male		Female								
		$\bar{X}_{NM}$	(SD)	$\bar{X}_{NF}$	(SD)	$\bar{X}_{3M}$	(SD)	$\bar{X}_{3F}$	(SD)		$\bar{X}_{NM} - \bar{X}_{NF}$	$\bar{X}_{NM} - \bar{X}_{3M}$	$\bar{X}_{NM} - \bar{X}_{3F}$	$\bar{X}_{NF} - \bar{X}_{3M}$	$\bar{X}_{NF} - \bar{X}_{3F}$	$\bar{X}_{3M} - \bar{X}_{3F}$
DENTAL																
U1-NA	(deg)	25.94	5.38	25.17	5.51	32.28	6.40	31.72	6.48	<0.001***	0.96	<0.001***	0.001**	<0.001***	<0.001***	0.99
U1-SN	(deg)	109.71	6.37	108.27	5.31	114.98	7.15	113.87	7.09	<0.001***	0.84	0.01*	0.07	<0.001***	0.005**	0.92
L1-NB	(deg)	29.67	3.71	29.49	5.25	25.06	6.62	26.17	6.50	0.001**	1.00	0.01*	0.08	0.02*	0.10	0.88
L1-GoGn	(deg)	99.71	5.07	98.93	9.43	89.38	7.11	89.17	7.15	<0.001***	0.98	<0.001***	<0.001***	<0.001***	<0.001***	1.00
U1-L1	(deg)	122.54	6.26	123.34	7.32	126.58	12.07	125.04	9.62	0.27	0.99	0.35	0.71	0.55	0.89	0.92
Overjet	(mm)	3.09	0.79	3.09	0.84	-2.64	2.21	-1.41	1.97	<0.001***	1.00	<0.001***	<0.001***	<0.001***	<0.001***	0.02*
Overbite	(mm)	2.39	0.91	2.27	0.96	1.60	2.24	1.49	1.86	0.04*	0.99	0.26	0.13	0.40	0.23	0.99
L1-APg	(mm)	5.03	2.14	4.99	2.08	8.52	3.07	7.88	2.50	<0.001***	1.00	<0.001***	<0.001***	<0.001***	<0.001***	0.76
UADH	(mm)	31.04	2.15	29.23	2.59	29.83	4.96	27.15	4.55	<0.001***	0.26	0.63	<0.001***	0.93	0.14	0.04*
UPDH	(mm)	27.04	1.70	25.31	1.91	26.49	3.99	24.25	3.86	0.001**	0.14	0.91	0.002**	0.48	0.53	0.03*
LADH	(mm)	43.74	2.49	40.46	2.55	42.03	5.10	37.08	4.66	<0.001***	0.007**	0.36	<0.001***	0.43	0.004**	<0.001***
LPDH	(mm)	36.31	2.19	32.46	2.31	37.08	4.58	28.37	4.24	<0.001***	<0.001***	0.003**	<0.001***	0.91	<0.001***	<0.001***
UPDH/UADH		0.87	0.06	0.87	0.07	0.89	0.07	0.90	0.08	0.21	0.99	0.73	0.51	0.58	0.36	0.99
LPDH/LADH		0.83	0.04	0.80	0.04	0.79	0.04	0.77	0.05	<0.001***	0.08	0.001**	<0.001***	0.51	0.006**	0.27

^ F-test (One-way ANOVA)

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

Table 4.3 (continued)

Lateral cephalometric measurements		Normal occlusion				Class III malocclusion				P-value^	Multiple comparison for means (Scheffe test) P-value					
		Male		Female		Male		Female								
		$\bar{X}_{NM}$	(SD)	$\bar{X}_{NF}$	(SD)	$\bar{X}_{3M}$	(SD)	$\bar{X}_{3F}$	(SD)		$\bar{X}_{NM} - \bar{X}_{NF}$	$\bar{X}_{NM} - \bar{X}_{3M}$	$\bar{X}_{NM} - \bar{X}_{3F}$	$\bar{X}_{NF} - \bar{X}_{3M}$	$\bar{X}_{NF} - \bar{X}_{3F}$	$\bar{X}_{3M} - \bar{X}_{3F}$
FACIAL SOFT TISSUE																
ST facial angle	(deg)	93.20	3.43	92.34	2.86	96.64	4.35	96.83	4.61	<0.001***	0.84	0.006**	0.002**	<0.001***	<0.001***	1.00
Nasolabial angle	(deg)	95.40	8.46	101.04	8.09	89.98	11.32	87.14	10.52	<0.001***	0.12	0.16	0.005**	<0.001***	<0.001***	0.68
Mentolabial angle	(deg)	136.19	9.13	141.34	8.30	143.66	12.97	145.66	9.68	0.001**	0.21	0.03*	0.002**	0.83	0.35	0.88
H angle	(deg)	19.00	2.74	16.59	3.13	14.59	4.48	13.12	3.87	<0.001***	0.05	<0.001***	<0.001***	0.17	0.001**	0.41
Nose prominence	(mm)	14.19	1.75	12.84	1.67	13.37	1.92	12.81	2.45	0.01*	0.04*	0.43	0.04*	0.75	1.00	0.71
Sup sulcus depth	(mm)	6.84	1.98	5.61	2.06	7.26	3.04	7.07	1.97	0.01*	0.17	0.90	0.98	0.04*	0.06	0.99
Inf sulcus depth	(mm)	4.66	1.38	3.54	1.59	1.81	1.81	1.38	1.58	<0.001***	0.04*	<0.001***	<0.001***	<0.001***	<0.001***	0.73
Sn to H-line	(mm)	11.37	2.04	9.27	2.51	9.04	3.35	8.56	2.50	<0.001***	0.01*	0.006**	<0.001***	0.99	0.72	0.90
Upp lip thickness	(mm)	15.77	1.50	12.76	1.56	17.21	3.68	13.22	1.86	<0.001***	<0.001***	0.09	<0.001***	<0.001***	0.86	<0.001***
Low lip thickness	(mm)	16.91	1.55	14.94	1.70	15.64	2.82	13.15	1.90	<0.001***	0.001**	0.09	<0.001***	0.58	0.003**	<0.001***
ST chin thickness	(mm)	13.30	1.45	12.66	1.53	13.03	2.93	11.90	2.20	0.03*	0.65	0.97	0.04*	0.91	0.50	0.17
Upp lip to E-line	(mm)	0.47	1.55	0.06	2.07	-1.58	2.50	-1.76	2.17	<0.001***	0.88	0.002**	<0.001***	0.02*	0.004**	0.99
Low lip to E-line	(mm)	1.59	1.95	1.67	2.17	2.85	2.77	2.72	2.44	0.04*	1.00	0.19	0.24	0.25	0.31	1.00

^ F-test (One-way ANOVA)

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

Table 4.4 One-way ANOVA and multiple comparisons for means of the model measurements among the groups categorized by type of occlusion and gender

Model measurements		Normal occlusion				Class III malocclusion				P-value^	Multiple comparison for means (Scheffe test) P-value					
		Male		Female		Male		Female								
		$\bar{X}_{NM}$	(SD)	$\bar{X}_{NF}$	(SD)	$\bar{X}_{3M}$	(SD)	$\bar{X}_{3F}$	(SD)		$\bar{X}_{NM}$ - $\bar{X}_{NF}$	$\bar{X}_{NM}$ - $\bar{X}_{3M}$	$\bar{X}_{NM}$ - $\bar{X}_{3F}$	$\bar{X}_{NF}$ - $\bar{X}_{3M}$	$\bar{X}_{NF}$ - $\bar{X}_{3F}$	$\bar{X}_{3M}$ - $\bar{X}_{3F}$
CWu	(mm)	35.57	1.77	34.81	1.24	37.07	4.44	35.02	2.27	0.005**	0.76	0.18	0.87	0.02*	0.99	0.02*
PWu	(mm)	38.46	1.61	37.78	1.38	39.16	2.44	36.40	2.45	<0.001***	0.65	0.60	0.001**	0.09	0.07	<0.001***
MWu	(mm)	50.60	1.97	49.03	2.39	50.98	2.37	47.61	2.47	<0.001***	0.08	0.93	<0.001***	0.02*	0.12	<0.001***
CDu	(mm)	8.20	0.90	8.07	0.75	6.94	2.67	7.04	1.66	0.002**	0.99	0.03*	0.04*	0.08	0.11	1.00
MDu	(mm)	30.29	1.97	30.13	1.46	29.78	2.34	29.99	2.19	0.78	0.99	0.80	0.94	0.93	0.99	0.98
CWL	(mm)	26.90	1.81	26.51	1.11	27.72	2.03	26.81	2.11	0.07	0.88	0.36	1.00	0.10	0.93	0.25
PWL	(mm)	31.68	1.54	30.63	1.34	31.74	2.30	29.04	2.37	<0.001***	0.24	1.00	<0.001***	0.20	0.02*	<0.001***
MWL	(mm)	50.69	2.16	49.00	2.38	51.20	3.38	47.79	2.65	<0.001***	0.12	0.90	<0.001***	0.02*	<0.001***	<0.001***
CDL	(mm)	5.10	0.77	4.78	0.81	5.02	1.65	4.65	1.23	0.35	0.77	1.00	0.46	0.89	0.98	0.63
MDL	(mm)	27.41	1.78	27.01	1.62	27.58	2.36	27.15	2.76	0.74	0.92	0.99	0.97	0.80	1.00	0.88
CWu / CDu		4.38	0.45	4.35	0.42	5.36	8.25	5.29	1.45	0.63	1.00	0.83	0.84	0.83	0.84	1.00
CWL / CDL		5.39	0.92	5.72	1.15	4.15	9.74	6.37	2.78	0.34	1.00	0.81	0.88	0.70	0.97	0.35
MWu / MDu		1.68	0.12	1.63	0.12	1.72	0.15	1.59	0.13	0.001**	0.62	0.58	0.08	0.07	0.74	0.001**
MWL / MDL		1.86	0.15	1.82	0.16	1.87	0.23	1.78	0.20	0.15	0.91	0.99	0.36	0.78	0.82	0.22

^ F-test (One-way ANOVA)

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

Part 2: One way analysis of variance of the lateral cephalometric and the model measurements among groups categorized by type of occlusion and gender, following with the Scheffe' s multiple comparisons.

The means, standard deviations, one-way analysis of variance and Scheffe test of the lateral cephalometric and the model measurements for the class III malocclusion and normal occlusion groups according to gender were shown in Table 4.3 and 4.4.

2.1 The lateral cephalometric measurements (Table 4.3)

2.1.1 Skeletal pattern

2.1.1.1 Anteroposterior relationship

There were no significant differences of the SNA angle, SNB angle, ANB angle, NSBa angle in both male subject and female subject of class III malocclusion group and normal occlusion group.

The anterior cranial base length (SN) were significantly longer in male subject than in female subject for both normal occlusion and class III malocclusion groups ($P=0.02$ and $P<0.001$ respectively). While the posterior cranial base length (SBa) was significant longer in normal male subject than in normal female subject ($P=0.004$) but there was no significantly different between class III male and female groups.

2.1.1.2 Vertical relationship

The SN-PP angle, as described by the vertical relationship of maxilla to the anterior cranial base, was not significantly different in both male subject and female subject of both class III malocclusion group and normal occlusion group.

For the vertical relationships of mandible, SArGo angle, ArGoGn angle, NSGn angle, SN-GoGn angle and PP-GoGn angle were not significantly different in both male subject and female subject of normal occlusion group and class III malocclusion group. The ramus height (Ar-Go) was significantly longer in male and female subjects for either type of occlusion ($P=0.002$ and $P<0.001$ respectively). In class III malocclusion group, there were significantly longer for either the effective mandibular length (Ar-Me) (P

<0.001) and mandibular length (Go-Gn) (P<0.05) in male subject than in female subject. There were significantly longer of the symphysial height (SH) in male subject than in female subject (P<0.001) for both class III malocclusion group and normal occlusion group. Furthermore, the symphysial width (SW) was significantly wider in class III male group than in class III female group (P=0.03). However, the symphysial width was not obviously different in either gender of normal occlusion group.

2.1.1.3 Facial height and vertical facial proportion

There was significantly greater of the UAFH in class III male group than in class III female group (P=0.03). For the LAFH and TAFH, there were significantly greater in male subject than in female subject for both normal occlusion and class III malocclusion groups (P<0.001 to P=0.02).

The UPFH, LPFH and TPFH were significantly greater in male subject than in female subject for both normal occlusion and class III malocclusion groups (P<0.001).

There were no significant differences of the UAFH/LAFH ratio and UPFH/LPFH ratio between male and female subjects for both normal occlusion and class III malocclusion groups.

The significantly greater of the TPFH/TAFH ratio, was found in male subject than in female subject for both normal occlusion group and class III malocclusion group (P=0.006 and P=0.003 respectively).

2.1.2 Dental pattern

2.1.2.1 Dental relationship

The inclination of maxillary and mandibular incisors related to their bases (U1-NA, U1-SN, L1-NB, L1-GoGn, L1-APg), interincisal angle (U1-L1) and overbite for normal occlusion and class III malocclusion groups were not significantly different in either gender. There was significantly different of overjet between class III male and female groups (P=0.02).

2.1.2.2 Dentoalveolar height

In class III malocclusion group, there were significantly greater of the UADH, UPDH, LADH and LPDH in male subject than in female subject. For the normal occlusion group, there were significantly greater of the LADH and LPDH in male subject than in female subject. There were not significantly different of the UPDH/UADH ratio and LPDH/LADH ratio between male and female subjects in either type of occlusion.

2.1.3 Facial soft tissue pattern

There were significantly greater of the nose prominence, inferior sulcus depth, Sn to H-line in male than in female subjects in normal occlusion group (P=0.001 to P=0.04). In addition, there were significantly greater of the upper and lower lip thickness in male and female subjects for both normal occlusion and class III malocclusion groups (P<0.001).

The soft tissue facial angle, nasolabial angle, mentolabial angle, H angle, superior sulcus depth, soft tissue chin thickness, upper and lower lip to E-line did not show any significant differences in either gender for both normal occlusion and class III malocclusion groups.

2.2 The model measurements (Table 4.4)

In the normal occlusion group, all of the model measurements did not show any significant differences between male and female subjects.

There were apparently greater of the PWu, MWu, PWL, MWL and MWu/MDu ratio in class III male group than in class III female group (P<0.001; with the exception of the MWu/MDu ratio, which was significant difference at P=0.001). While the CWu was significantly less in class III female group than in class III male group (P=0.02).

Part 3: One way analysis of variance of the lateral cephalometric and the model measurements among the skeletal normal overbite, skeletal deepbite and skeletal openbite in class III malocclusion group, following with the Scheffe' s multiple comparisons.

The means, standard deviations and the comparison of the skeletal, dental and facial soft tissue patterns of the skeletal normal overbite (3N), skeletal deepbite (3D) and skeletal openbite (3O) in class III malocclusion group (combined genders) by one way analysis of variance (one-way ANOVA) were presented in Table 4.5 and 4.6. If the F-value was significant, the Scheffe test would be done to identify which of several possible differences between means of the lateral cephalometric measurements and the model measurements were significant.

3.1 The lateral cephalometric measurements (Table 4.5)

3.1.1 Skeletal pattern

The SNA and SNB angles were significantly less in the class III openbite group than in the class III normal overbite and deepbite groups. The SNA and SNB angles were similar for class III normal overbite and deepbite groups

The ArGoGn angle was similar for class III normal overbite and openbite groups, but it was apparently less in class III deepbite than in the class III normal overbite and openbite groups. The NSGn and SN-OP angles were significantly greater in the class III openbite group than in the class III normal overbite and deepbite groups. For the SN-GoGn and PP-GoGn angles had strongly significant differences in either group, the class III openbite had the widest angle in three groups and class III normal overbite group was significantly wider than class III deepbite group.

The maxillary length (ANS-PNS) and the ramus height (Ar-Go) showed the significantly greater in class III deepbite than in the class III openbite group. The symphysial width and the symphysial height had no significant differences among three groups of class III malocclusion group.

Table 4.5 One-way ANOVA and multiple comparisons for means of the lateral cephalometric measurements among the skeletal normal overbite, deepbite and openbite in the class III malocclusion group

Lateral cephalometric measurements		Cl.III norm.overbite (n=35)	Cl.III deepbite (n=10)	Cl.III openbite (n=25)	P-value^	Multiple comparison for means P-value (Scheffe test)		
		$\bar{X}_{3N}$ (SD)	$\bar{X}_{3D}$ (SD)	$\bar{X}_{3O}$ (SD)		$\bar{X}_{3N} - \bar{X}_{3D}$	$\bar{X}_{3N} - \bar{X}_{3O}$	$\bar{X}_{3D} - \bar{X}_{3O}$
SKELETAL								
SNA	(deg)	83.23 (3.24)	84.35 (3.89)	79.52 (3.52)	<0.001***	0.66	0.001**	0.002**
SNB	(deg)	86.63 (2.87)	87.70 (4.34)	81.62 (3.55)	<0.001***	0.67	<0.001***	<0.001***
ANB	(deg)	-3.40 (2.17)	-3.35 (2.45)	-2.10 (1.67)	0.04*	1.00	0.06	0.27
NSBa	(deg)	127.36 (4.16)	126.70 (4.76)	129.62 (6.05)	0.15	0.94	0.23	0.30
SArGo	(deg)	146.03 (5.16)	145.50 (3.88)	148.44 (10.43)	0.39	0.98	0.46	0.57
ArGoGn	(deg)	124.13 (5.04)	117.95 (5.43)	126.62 (5.64)	<0.001***	0.008**	0.21	<0.001***
NSGn	(deg)	64.20 (2.59)	62.90 (3.73)	70.28 (2.73)	<0.001***	0.44	<0.001***	<0.001***
SN-GoGn	(deg)	29.14 (2.59)	22.80 (1.44)	37.84 (3.48)	<0.001***	<0.001***	<0.001***	<0.001***
SN-PP	(deg)	8.39 (2.85)	7.35 (3.19)	10.08 (3.43)	0.04*	0.65	0.12	0.07
SN-OP	(deg)	12.77 (4.62)	10.95 (3.76)	17.52 (5.59)	<0.001***	0.59	0.002**	0.003**
PP-GoGn	(deg)	20.76 (3.53)	15.45 (3.56)	27.76 (4.34)	<0.001***	0.001**	<0.001***	<0.001***
SN	(mm)	67.54 (8.04)	70.98 (10.11)	66.47 (6.10)	0.30	0.47	0.87	0.30
SBa	(mm)	47.99 (6.21)	50.05 (10.08)	45.44 (7.25)	0.19	0.73	0.41	0.24
ANS-PNS	(mm)	49.49 (6.79)	53.52 (8.21)	47.59 (3.48)	0.04*	0.19	0.49	0.04*
Ar-Go	(mm)	49.50 (8.24)	54.20 (8.54)	46.19 (6.04)	0.02*	0.23	0.26	0.02*
Ar-Me	(mm)	115.06 (15.69)	122.15 (17.29)	114.40 (11.13)	0.33	0.40	0.99	0.36
Go-Gn	(mm)	81.96 (9.79)	87.58 (13.66)	82.09 (7.66)	0.25	0.28	1.00	0.33
Wits	(mm)	10.14 (3.45)	9.64 (3.23)	9.22 (3.90)	0.62	0.93	0.63	0.95
SW	(mm)	13.71 (2.60)	15.20 (2.68)	13.73 (1.77)	0.19	0.22	1.00	0.25
SH	(mm)	21.39 (3.09)	22.45 (5.14)	21.78 (2.75)	0.67	0.68	0.91	0.87
UAFH	(mm)	53.86 (5.45)	56.41 (9.50)	56.09 (5.58)	0.30	0.52	0.39	0.99
LAFH	(mm)	67.72 (9.28)	68.98 (15.47)	71.81 (8.91)	0.32	0.94	0.32	0.76
TAFH	(mm)	121.58 (13.97)	125.39 (22.67)	127.90 (13.71)	0.29	0.79	0.30	0.91
UPFH	(mm)	45.42 (5.11)	49.94 (7.33)	46.30 (5.70)	0.09	0.09	0.84	0.24
LPFH	(mm)	35.75 (7.22)	40.66 (8.58)	31.34 (5.26)	0.001**	0.14	0.05	0.002**
TPFH	(mm)	81.18 (11.84)	90.60 (14.44)	77.63 (9.33)	0.01*	0.08	0.50	0.01*
UAFH/LAFH		0.80 (0.06)	0.84 (0.14)	0.79 (0.07)	0.25	0.47	0.78	0.25
UPFH/LPFH		1.30 (0.16)	1.25 (0.18)	1.51 (0.24)	<0.001***	0.81	0.001**	0.004**
TPFH/TAFH		0.67 (0.04)	0.73 (0.04)	0.61 (0.04)	<0.001***	<0.001***	<0.001***	<0.001***

^ F-test (One-way ANOVA)

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

Table 4.5 (continued)

Lateral cephalometric measurements		Cl.III norm.overbite (n=35)	Cl.III deepbite (n=10)	Cl.III openbite (n=25)	P-value^	Multiple comparison for means P-value (Scheffe test)		
		$\bar{X}_{3N}$ (SD)	$\bar{X}_{3D}$ (SD)	$\bar{X}_{3O}$ (SD)		$\bar{X}_{3N} - \bar{X}_{3D}$	$\bar{X}_{3N} - \bar{X}_{3O}$	$\bar{X}_{3D} - \bar{X}_{3O}$
DENTAL								
U1-NA	(deg)	31.27 (6.97)	32.55 (6.39)	32.74 (5.68)	0.66	0.86	0.69	1.00
U1-SN	(deg)	114.89 (7.03)	116.70 (7.90)	112.74 (6.74)	0.28	0.77	0.51	0.33
L1-NB	(deg)	24.46 (7.31)	23.90 (4.50)	28.06 (5.46)	0.07	0.97	0.11	0.23
L1-GoGn	(deg)	88.59 (7.75)	92.60 (4.98)	88.88 (6.66)	0.27	0.29	0.99	0.38
U1-L1	(deg)	127.73 (10.80)	129.95 (11.60)	121.28 (9.11)	0.027*	0.84	0.07	0.09
Overjet	(mm)	2.18 (2.04)	3.13 (2.01)	1.22 (2.18)	0.041*	0.45	0.22	0.06
Overbite	(mm)	1.77 (1.90)	2.18 (2.24)	0.96 (2.06)	0.18	0.85	0.31	0.28
L1-APg	(mm)	7.62 (2.56)	7.88 (3.24)	9.05 (2.75)	0.14	0.97	0.15	0.53
UADH	(mm)	27.44 (4.34)	27.15 (7.31)	30.17 (4.11)	0.07	0.99	0.10	0.25
UPDH	(mm)	24.94 (4.06)	24.80 (5.57)	25.93 (3.39)	0.61	1.00	0.66	0.76
LADH	(mm)	38.33 (4.77)	40.18 (8.42)	40.43 (4.80)	0.30	0.64	0.34	0.99
LPDH	(mm)	29.70 (4.78)	32.13 (6.93)	31.04 (4.25)	0.32	0.40	0.59	0.84
UPDH/UADH		0.91 (0.08)	0.93 (0.08)	0.86 (0.05)	0.01*	0.88	0.03*	0.06
LPDH/LADH		0.77 (0.05)	0.80 (0.05)	0.77 (0.05)	0.20	0.29	0.94	0.22
FACIAL SOFT TISSUE								
ST facial angle	(deg)	98.44 (3.39)	99.60 (4.69)	93.22 (3.49)	<0.001***	0.68	<0.001***	<0.001***
Nasolabial angle	(deg)	88.39 (10.22)	89.55 (12.33)	88.08 (11.67)	0.94	0.96	0.99	0.94
Mentolabial angle	(deg)	144.67 (10.76)	140.10 (12.46)	146.70 (11.38)	0.30	0.53	0.79	0.30
H angle	(deg)	12.84 (4.83)	14.25 (4.07)	14.94 (2.91)	0.15	0.64	0.16	0.91
Nose prominence	(mm)	12.80 (2.22)	12.30 (2.23)	13.75 (2.14)	0.14	0.82	0.27	0.22
Sup sulcus depth	(mm)	7.42 (2.20)	7.77 (2.57)	6.55 (2.82)	0.30	0.93	0.42	0.43
Inf sulcus depth	(mm)	1.65 (1.57)	2.12 (1.90)	1.26 (1.76)	0.37	0.74	0.67	0.39
Sn to H-line	(mm)	8.32 (2.80)	8.97 (2.57)	9.35 (3.16)	0.40	0.83	0.41	0.94
Upp lip thickness	(mm)	14.96 (3.32)	17.44 (4.42)	14.22 (2.87)	0.04*	0.13	0.70	0.04*
Low lip thickness	(mm)	13.72 (2.38)	16.05 (2.78)	14.38 (2.76)	0.04*	0.04*	0.62	0.23
ST chin thickness	(mm)	12.08 (2.34)	13.19 (3.06)	12.58 (2.80)	0.47	0.50	0.77	0.83
Upp lip to E-line	(mm)	2.15 (2.30)	1.29 (1.98)	1.18 (2.41)	0.24	0.58	0.28	0.99
Low lip to E-line	(mm)	2.32 (2.40)	2.96 (2.02)	3.34 (2.96)	0.32	0.79	0.33	0.93

^ F-test (One-way ANOVA)

* P<0.05, *** P<0.001

Table 4.6 One-way ANOVA and multiple comparisons for means of the model measurements among the skeletal normal overbite, deepbite and openbite in the class III malocclusion group

Model measurements		Cl.III normal overbite (n=35)	Cl.III deepbite (n=10)	Cl.III openbite (n=25)	P-value^	Multiple comparison for means P-value (Scheffe test)		
		$\bar{X}_{3N}$ (SD)	$\bar{X}_{3D}$ (SD)	$\bar{X}_{3O}$ (SD)		$\bar{X}_{3N} - \bar{X}_{3D}$	$\bar{X}_{3N} - \bar{X}_{3O}$	$\bar{X}_{3D} - \bar{X}_{3O}$
CWu	(mm)	36.15 (2.55)	38.96 (6.82)	34.48 (1.93)	0.002**	0.07	0.16	0.002**
PWu	(mm)	37.55 (2.84)	39.24 (3.20)	37.19 (2.45)	0.14	0.24	0.88	0.15
MWu	(mm)	49.13 (3.06)	50.21 (3.04)	48.75 (2.75)	0.42	0.60	0.89	0.42
CDu	(mm)	6.67 (2.33)	7.11 (2.30)	7.39 (1.85)	0.44	0.85	0.45	0.94
MDu	(mm)	29.83 (2.30)	29.46 (2.37)	30.15 (2.27)	0.71	0.90	0.87	0.72
CWL	(mm)	27.14 (2.08)	27.83 (2.08)	27.12 (2.20)	0.63	0.67	1.00	0.68
PWL	(mm)	30.20 (1.93)	31.32 (3.48)	29.95 (3.23)	0.39	0.51	0.94	0.40
MWL	(mm)	49.22 (3.18)	51.08 (3.32)	48.84 (3.75)	0.21	0.32	0.91	0.22
CDL	(mm)	5.02 (1.46)	5.60 (1.03)	4.23 (1.38)	0.02*	0.50	0.10	0.04*
MDL	(mm)	27.41 (2.68)	27.73 (2.00)	27.11 (2.70)	0.80	0.94	0.91	0.82
CWu / CDu		5.12 (7.37)	6.69 (5.28)	5.05 (1.71)	0.71	0.74	1.00	0.74
CWL / CDL		6.10 (2.91)	5.18 (1.36)	4.39 (11.12)	0.65	0.93	0.65	0.96
MWu / MDu		1.65 (0.14)	1.71 (0.13)	1.63 (0.17)	0.36	0.60	0.80	0.36
MWL / MDL		1.81 (0.21)	1.85 (0.17)	1.82 (0.25)	0.90	0.90	0.99	0.94

^ F-test (One-way ANOVA)

* P<0.05, ** P<0.01

The LPFH and TPFH were significantly greater in class III deepbite group than in class III openbite group. In addition, the UPFH/LPFH ratio was significantly greater in class III openbite group than in class III normal overbite and deepbite groups. Interestingly, the TPFH/TAFH ratio was strongly significant difference among three groups of class III malocclusion ($P<0.001$). By the class III deepbite had the greatest value in three groups, while the class III normal overbite was significantly greater than in class III openbite group.

3.1.2 Dental pattern

For the inclination of maxillary and mandibular incisors in relation to their bases, the interincisal angle, the overjet, the overbite, the anterior and posterior dental height and the LPDH/LADH ratio, there were no significant differences among three groups of class III malocclusion. Only the UPDH/UADH ratio was significantly greater in class III normal overbite than in class III openbite group.

3.1.3 Facial soft tissue pattern

The soft tissue facial angle was similar in class III normal overbite and deepbite groups, while the class III openbite was significantly less than the others. There was significantly greater for the upper lip thickness in class III deepbite than in class III openbite group. Furthermore, the lower lip thickness was significantly greater in class III deepbite than in class III normal overbite group. So, in class III deepbite group had the most thickly of both the upper and lower lip in three groups of class III malocclusions.

3.2 The model measurements (Table 4.6)

The upper intercanine width (CWu) and the lower canine depth (CDL) were similar in class III normal overbite and deepbite, but they were significantly greater in class III deepbite than in class III openbite. For the others, there were no significant differences among three groups of class III malocclusions.

Part 4: The associations between type of occlusion and craniofacial measurements

Multilevel analyses were performed to investigate the associations between type of occlusion and the explanatory variables of craniofacial measurements (the lateral cephalometric measurements and the model measurements). The first section reports the unadjusted associations between type of occlusion and craniofacial measurements. After that, all these variables were possible confounding factors of the associations between type of occlusion and craniofacial measurements. Table B.1 - B.15 (Appendix B) show the associations between type of occlusion and craniofacial measurements controlling for each potential confounding factors. The second section presents the associations between type of occlusion and craniofacial measurements sequentially adjusted for confounding factors.

4.1 The unadjusted associations between type of occlusion and craniofacial measurements

The simple logistic regression analysis was used for analyzing of the associations between type of occlusion and craniofacial measurements of the normal occlusion or control group and class III malocclusion group. There were statistically significant association between type of occlusion and craniofacial measurements (Table 4.7). Those explanatory variables were the CDu, PWL, SNB, ANB, NSBa, SArGo, ArGoGn, NSGn, SN-GoGn, PP-GoGn, SN, SBa, ANS-PNS, Ar-Go, Wits appraisal, SW, SH, UAFH, TAFH, LPFH, TPFH, U1-NA, U1-SN, L1-NB, L1-GoGn, overjet, overbite, L1-APg, UADH, LADH, Soft tissue facial angle, nasolabial angle, mentolabial angle, H angle, superior sulcus depth, inferior sulcus depth, Sn to H line, lower lip thickness, upper lip thickness, upper lip to E-line and lower lip to E-line.

Table 4.7 The simple logistic regression analyses for the unadjusted associations between type of occlusion and craniofacial measurements

Factors		n	Crude Odds Ratio (95% CI)	P-value^
CDu	(mm)	131	0.60 (0.45, 0.80)	0.001**
PWL	(mm)	131	0.82 (0.70, 0.97)	0.02*
SNB	(deg)	140	1.32 (1.18, 1.48)	<0.001***
ANB	(deg)	140	0.12 (0.53, 0.29)	<0.001***
NSBa	(deg)	140	0.88 (0.82, 0.95)	0.001**
SArGo	(deg)	140	1.07 (1.01, 1.14)	0.02*
ArGoGn	(deg)	140	1.15 (1.07, 1.22)	<0.001***
NSGn	(deg)	140	0.86 (0.77, 0.95)	0.003**
SN-GoGn	(deg)	140	1.08 (1.01, 1.15)	0.02*
PP-GoGn	(deg)	140	1.10 (1.02, 1.18)	0.01*
SN	(mm)	140	0.86 (0.78, 0.95)	<0.001***
SBa	(mm)	140	0.91 (0.86, 0.97)	0.005**
ANS-PNS	(mm)	140	0.90 (0.83, 0.97)	0.004**
Ar-Go	(mm)	140	0.93 (0.88, 0.98)	0.006**
Wits	(mm)	140	0.49 (0.39, 0.61)	<0.001***
SW	(mm)	140	0.60 (0.47, 0.77)	<0.001***
SH	(mm)	140	0.78 (0.66, 0.92)	<0.001***
UAFH	(mm)	140	0.90 (0.82, 0.99)	<0.001***
TAFH	(mm)	140	0.97 (0.94, 0.99)	0.02*
LPFH	(mm)	140	0.89 (0.83, 0.95)	<0.001***
TPFH	(mm)	140	0.94 (0.91, 0.97)	0.001**
U1-NA	(deg)	140	1.20 (1.12, 1.29)	<0.001***
U1-SN	(deg)	140	1.14 (1.07, 1.20)	<0.001***
L1-NB	(deg)	140	0.88 (0.82, 0.94)	<0.001***
L1-GoGn	(deg)	140	0.79 (0.73, 0.86)	<0.001***

^ Wald's test (* P<0.05, ** P<0.01, *** P<0.001)

Table 4.7 (continued)

Factors		n	Crude Odds Ratio (95% CI)	P-value^
Overjet	(mm)	140	0.08 (0.02, 0.25)	<0.001***
Overbite	(mm)	140	0.72 (0.58, 0.91)	0.005**
L1-APg	(mm)	140	1.83 (1.49, 2.23)	<0.001***
UADH	(mm)	140	0.89 (0.81, 0.97)	0.01*
LADH	(mm)	140	0.87 (0.80, 0.94)	0.001**
LPDH	(mm)	140	0.80 (0.73, 0.88)	<0.001***
ST facial angle	(deg)	140	1.32 (1.18, 1.47)	<0.001***
Nasolabial angle	(deg)	140	0.90 (0.87, 0.94)	<0.001***
Mentolabial angle	(deg)	140	1.06 (1.02, 1.10)	0.001**
H Angle	(deg)	140	0.75 (0.67, 0.84)	<0.001***
Sup sulcus depth	(mm)	140	1.19 (1.03, 1.39)	0.02*
Inf sulcus depth	(mm)	140	0.38 (0.28, 0.53)	<0.001***
Sn to H line	(mm)	140	0.81 (0.71, 0.92)	0.002**
Low lip thickness	(mm)	140	0.73 (0.62, 0.86)	<0.001***
Upp lip to E-line	(mm)	140	0.63 (0.51, 0.77)	<0.001***
Low lip to E-line	(mm)	140	1.24 (1.06, 1.45)	0.006**

^ Wald's test (* P<0.05, ** P<0.01, *** P<0.001)

4.2 The associations between type of occlusion and craniofacial measurements sequentially adjusted for confounding factors.

According to the analyzing result from the simple logistic regression, founded 41 craniofacial measurements (independent variables) that might have influenced on type of occlusion. Then, the bivariate logistic regression and the forward stepwise multiple logistic regression analyses were used to find out the potential confounding factors for the associations between type of occlusion and craniofacial measurements. This section presents the associations between type of occlusion and craniofacial measurements sequentially adjusted for confounding factors. However, the associations between type of occlusion and other explanatory variables in the fully adjusted model

between type of occlusion and other explanatory variables in the fully adjusted model are presented in Table B.1- B.15 (Appendix B). The confounding factors, 15 craniofacial measurements, were the SNB, ArGoGn, SN, SW, SH, UAFH, LPFH, U1-NA, U1-SN, L1-NB, L1-GoGn, L1-APg, nasolabial angle, H angle and upper lip to E-line.

Table 4.8 The multiple logistic regression analyses for the association between type of occlusion and craniofacial measurements sequentially adjusted for confounding factors

Independent Variables		Crude Odd Ratio (95% CI)	P-value^	Adjusted Odd Ratio (95% CI)	P-value^
SNB	(deg)	1.32 (1.18, 1.48)	<0.001***	1.32 (1.05, 1.66)[1]	0.02*
ArGoGn	(deg)	1.15 (1.07, 1.23)	<0.001***	0.70 (0.45, 1.08)[2]	0.11
SN	(mm)	0.86 (0.78, 0.95)	<0.001***	0.85 (0.69, 1.03)[3]	0.10
SW	(mm)	0.60 (0.47, 0.77)	<0.001***	0.64 (0.17, 2.49)[4]	0.52
SH	(mm)	0.78 (0.66, 0.92)	<0.001***	0.46 (0.23, 0.94)[5]	0.03*
UAFH	(mm)	0.90 (0.82, 0.99)	<0.001***	2.03 (0.36, 11.40)[6]	0.42
LPFH	(mm)	0.89 (0.83, 0.95)	<0.001***	0.92 (0.63, 1.34)[7]	0.67
U1-NA	(deg)	1.20 (1.12, 1.29)	<0.001***	1.03 (0.76, 1.40)[8]	0.86
U1-SN	(deg)	1.14 (1.07, 1.20)	<0.001***	0.24 (0.10, 0.60)[9]	0.002**
L1-NB	(deg)	0.88 (0.82, 0.94)	<0.001***	1.35 (1.06, 1.71)[10]	0.01*
L1-GoGn	(deg)	0.79 (0.73, 0.86)	<0.001***	0.81 (0.50, 1.32)[11]	0.40
L1-APg	(mm)	1.83 (1.49, 2.23)	<0.001***	33.71 (3.60, 315.43)[12]	0.002**
Nasolabial angle	(deg)	0.90 (0.87, 0.94)	<0.001***	0.77 (0.63, 0.95)[13]	0.01*
H Angle	(deg)	0.75 (0.67, 0.84)	<0.001***	0.82 (0.43, 1.56)[14]	0.55
Upp lip to E-line	(mm)	0.63 (0.51, 0.77)	<0.001***	0.38 (0.15, 0.97)[15]	0.04*

^ Wald's test

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

[1] The final model; adjusted for LPFH, L1-GoGn, Nasolabial angle, H angle, L1-NB, Upp lip to E-line, U1-NA, SW

[2] The final model; adjusted for L1-GoGn, L1-APg, SW, SNB, SN, L1-NB, Upp lip to E-line, U1-SN

[3] The final model; adjusted for SW, U1-NA, SNB, L1-NB, ArGoGn, U1-SN, L1-GoGn, Nasolabial angle, Upp lip to E-line

[4] The final model; adjusted for L1-APg, L1-NB, Upp lip to E-line, SN, U1-NA, Nasolabial angle

[5] The final model; adjusted for SW, L1-GoGn, U1-NA, L1-APg, L1-NB, Nasolabial angle, Upp lip to E-line

[6] The final model; adjusted for SNB, SN, SH, Nasolabial angle, H angle, LPFH, U1-NA, L1-GoGn, L1-APg, Upp lip to E-line

[7] The final model; adjusted for SNB, L1-GoGN, SW, L1-APg, SN, L1-NB, Nasolabial angle

[8] The final model; adjusted for L1-APg, L1-GoGn, L1-NB, Nasolabial angle, SN

[9] The final model; adjusted for U1-NA, L1-APg, SNB, L1-GoGN, Nasolabial angle, SW

[10] The final model; adjusted for L1-GoGn, H angle, U1-NA, SNB, SN, U1-SN, Nasolabial angle, SN

[11] The final model; adjusted for L1-APg, L1-NB, Upp lip to E-line, SW, Nasolabial angle, SN

[12] The final model; adjusted for L1-NB, SW, Nasolabial angle, SN

[13] The final model; adjusted for SNB, SW, LPFH, U1-NA, U1-SN, L1-GoGN, L1-APg

[14] The final model; adjusted for L1-GoGn, L1-APg, Upp lip to E-line, SW, L1-NB, Nasolabial angle, SN

[15] The final model; adjusted for L1-APg, L1-GoGn, L1-NB, SW, Nasolabial angle, SH

The strength of the association between type of occlusion and SNB was the same (1.32) when controlling for LPFH, L1-GoGn, Nasolabial angle, H angle, L1-NB, Upp lip to E-line, U1-NA, SW. The final model for this association was statistically significant at P=0.02 (Table 4.8).

The strength of the association between type of occlusion and SH was significantly decreased from 0.78 to 0.46 (P=0.03) when controlling for SW, L1-GoGn, U1-NA, L1-APg, L1-NB, Nasolabial angle, Upp lip to E-line (Table 4.8).

The strength of the association between type of occlusion and U1-SN was significantly decreased from 1.14 to 0.24 (P=0.002) when controlling for U1-NA, L1-APg, SNB, L1-GoGN, Nasolabial angle, SW (Table 4.8).

The strength of the association between type of occlusion and L1-NB was significantly increased from 0.88 to 1.35 (P=0.01) when controlling for L1-GoGn, H angle, U1-NA, SNB, SN, U1-SN, Nasolabial angle, SN (Table 4.8).

The strength of the association between type of occlusion and L1-APg was highly increased from 1.83 to 33.71 (P=0.002) when controlling for L1-NB, SW, Nasolabial angle, SN (Table 4.8).

The strength of the association between type of occlusion and nasolabial angle was slightly decreased from 0.90 to 0.77 (P=0.01) when controlling for SNB, SW, LPFH, U1-NA, U1-SN, L1-GoGN, L1-APg (Table 4.8).

The strength of the association between type of occlusion and Upp lip to E-line was statistically decreased from 0.63 to 0.38 (P=0.04) when controlling for L1-APg, L1-GoGn, L1-NB, SW, Nasolabial angle, SH (Table 4.8).

Despite no statistically significantly association of the final models between type of occlusion and the other confounding factors (ArGoGn, SN, SW, UAFH, LPFH, U1-NA, L1-GoGn, H angle), it was considered worthwhile to investigate the associations between type of occlusion and craniofacial measurements (P=0.10 to P=0.86) (Table 4.8). Such as for the associations between type of occlusion and UAFH, was tended to increased the Odd ratio from 0.90 to 2.03 when controlling for SNB, SN, SH, Nasolabial angle, H angle, LPFH, U1-NA, L1-GoGn, L1-APg, Upp lip to E-line (Table 4.8).