

CHAPTER 4

RESULTS

Error of the method

The method errors for linear, angular and area measurements were not statistically significant. Intra-examiner error in recording presence or absence of the third molar was also not significant (Table 4.1)

Table 4.1 Error of the method in the present study

Variable	<i>P-value</i>
SNA	0.70
SNB	0.48
ANB	0.52
FH – MP	0.58
UAFH	0.88
LAFH	0.41
LAFH ratio	0.72
U1PP	0.45
U3PP	0.36
U4PP	0.18
U5PP	0.15
U6PP	0.20
U7PP	0.24
L1MP	0.16
L3MP	0.37
L4MP	0.35
L5MP	0.28
L6MP	0.27
L7MP	0.18
Angle formed the tooth axes	0.65
Interradicular distance	0.72
Interradicular area	0.69
Arch length discrepancy	0.87
Presence or absence of the third molar	2.00

4.1 Dento-skeletal pattern

Comparisons between lateral cephalometric measurements of the control group and the different skeletal patterns are presented in Table 4.2.

Table 4.2 Results of cephalometric and mesiodistal tooth angulation measurements

Variable	Control		Skeletal I		Skeletal II		Skeletal III		Turkey's Test, significance of <i>P</i>					
	M	SD	M	SD	M	SD	M	SD	Control - I	Control - II	Control - III	I- II	II- III	I- III
SNA	84.4	3.4	83.5	2.4	85.3	4.0	82.7	3.8						
SNB	81.5	3.2	80.5	2.4	78.1	4.0	85.3	3.8		**	**		**	**
ANB	2.9	1.6	3.0	0.9	7.2	1.3	-2.6	2.4		**	**	**	**	**
FH-MP	20.8	5.0	25.9	4.9	27.0	5.9	24.3	7.0	**	**				
UAFH	57.7	3.0	57.3	4.0	59.4	3.4	55.2	2.1			*		**	
LAFH	66.9	4.6	68.8	6.2	69.1	6.4	68.5	5.6						
LAFH ratio	53.7	1.7	54.5	2.4	53.7	2.4	55.3	2.2			*			
U1-PP	114.5	7.0	119.6	7.7	117.3	11.5	124.2	7.9			**		*	
U3-PP	100.9	6.7	103.5	8.2	100.5	6.9	106.8	7.9			*		*	
U4-PP	91.7	7.1	92.6	6.6	88.0	6.5	95.2	7.6					**	
U5-PP	86.1	7.0	86.2	6.9	81.5	6.7	88.1	8.1					*	
U6-PP	83.1	5.9	84.8	6.3	80.9	6.8	87.6	7.1			*		**	
U7-PP	79.4	6.0	83.0	8.0	72.7	5.6	79.2	10.8		**		**	*	
L1-MP	96.7	4.8	93.6	4.5	98.3	4.0	88.4	5.3			**	*	**	**
L3-MP	89.5	5.0	89.0	5.8	92.4	7.7	84.2	6.7			**		**	
L4-MP	83.8	5.2	83.8	5.2	85.7	6.7	78.7	6.7			**		**	*
L5-MP	83.6	5.0	82.2	6.4	84.4	5.2	78.8	5.9			**		**	
L6-MP	86.0	5.0	84.2	5.2	85.4	4.3	84.1	7.9						
L7-MP	95.1	5.8	92.0	9.2	94.0	6.7	89.0	8.7			**			

* Significance of $P < 0.05$; ** $P < 0.01$. U, Maxillary teeth; L, Mandibular teeth; PP, palatal plane; MP, mandibular plane; I, Skeletal I; II, Skeletal II; III, Skeletal III relationships

No significant difference in the SNA angle between the control group and the different skeletal patterns was observed. Significant differences in the SNB angle were observed between the control group and the patients with skeletal Class II and III

relationships. The SNB angles showed the mandibles of the patients with skeletal Class III relationships were prognathic, whereas the mandibles of the patients with skeletal Class II relationships were retrognathic when compared with the controls. No significant difference in the SNB angle between the control group and the patients with skeletal Class I relationships was observed.

The ANB angles in the patients with skeletal Class I, II and III relationships were 3.0 ± 0.9 degrees, 7.2 ± 1.3 degree and -2.6 ± 2.4 degrees, respectively (control = 2.9 ± 1.6 degrees). The ANB angles were significantly different in all skeletal patterns of relationship ($P < 0.01$).

Characteristics of dento-alveolar compensation between different skeletal patterns were observed (Figure 4.1).



Figure 4.1 Schematics of characteristic dento-alveolar compensation in the patients with, A; skeletal Class I, B; skeletal Class II and C; skeletal Class III relationships

Mean mesiodistal tooth angulation values of each tooth in the maxilla and the mandible in different skeletal patterns are presented in Figures 4.2 and 4.3.

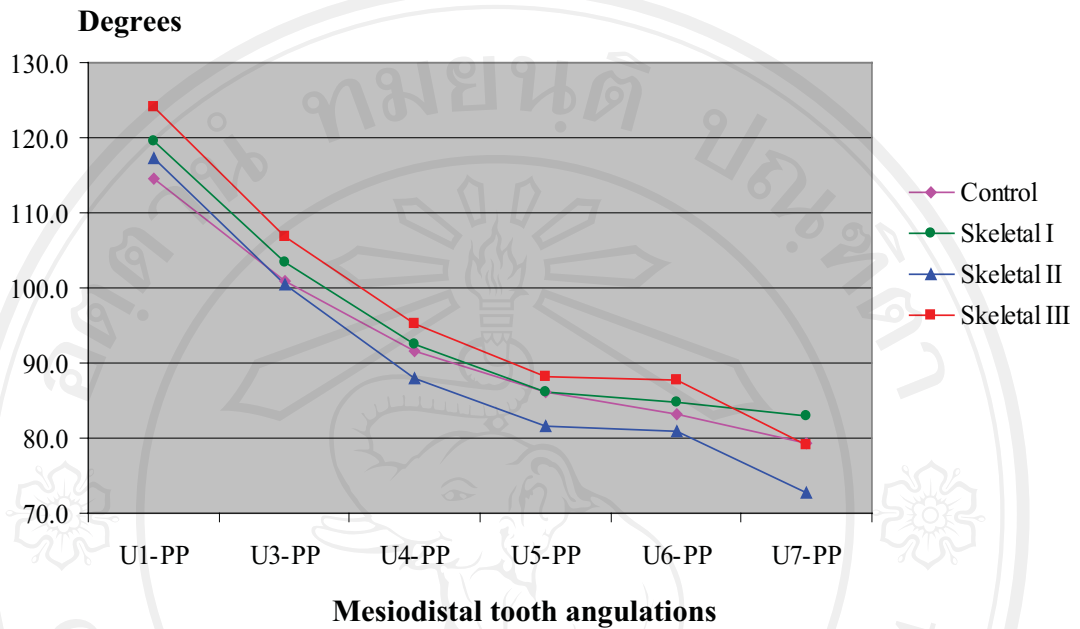


Figure 4.2 Mean mesiodistal tooth angulation values of the maxillary teeth in the control group, patients with skeletal Class I, II and III relationships

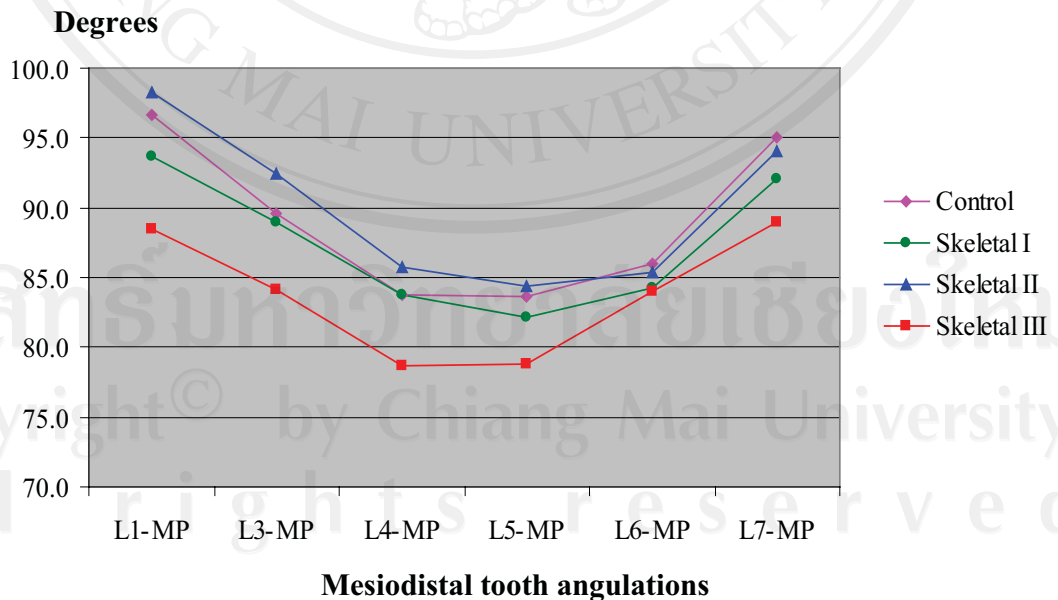


Figure 4.3 Mean mesiodistal tooth angulation values of the mandibular teeth in the control group, patients with skeletal Class I, II and III relationships

In general, the maxillary teeth of the patients with skeletal Class III relationships were significantly more proclined or mesially inclined than were those of the control group or of the patients with skeletal Class II relationships. In contrast, the mandibular teeth of the patients with skeletal Class III relationships were significantly retroclined or were upright when compared to those of the control group or of the patients with skeletal Class I or II relationships. No significant difference in the angulation of the maxillary and mandibular teeth between the control group and the patients with skeletal Class I relationships was observed.

4.2 Effects of dento-skeletal patterns on the interradicular space

4.2.1 Angle formed between tooth axes

The Pearson product-moment correlation coefficients between the angles formed between tooth axes, and the interradicular areas are presented in Table 4.3. Significantly positive correlations between the angles formed between tooth axes and interradicular areas ($P < 0.001$) were observed at all interradicular sites.

The angles formed between tooth axes were divided into two groups, convergent and divergent tooth root groups. Table 4.4 shows the number of teeth in each group and the differences between skeletal patterns. The number of divergent tooth roots between the first and second premolars, and between the second premolar and the first molar, in the patients with skeletal Class III relationships, were significantly greater than those in the patients with skeletal Class II relationships ($P < 0.05$ and $P < 0.01$, respectively)

Table 4.3 The Pearson product-moment correlation coefficients between the angles formed between tooth axes and the interradicular areas

Angle formed between tooth axes	Interradicular area
	Correlation Coefficient (r)
U 4-5	0.37***
U 5-6	0.47***
U 6-7	0.72***
L 4-5	0.65***
L 5-6	0.63***
L 6-7	0.50***

* Significance of $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$. U, Maxillary teeth; L, Mandibular teeth

Table 4.4 The number of teeth in convergent and divergent tooth root groups and the differences between skeletal patterns

Location	skeletal I		skeletal II		skeletal III		Turkey's Test		
	convergent	divergent	convergent	divergent	convergent	divergent	I-II	II-III	I-III
Maxillae									
4-5	35	5	39	1	34	6			
5-6	21	19	22	18	22	18			
6-7	33	7	32	8	35	5			
Mandibles									
4-5	12	28	17	23*	8	32*		*	
5-6	11	29	17	23**	6	34**		**	
6-7	5	35	3	37	7	33			

* Significance of $P < .05$; ** $P < .01$. I, Skeletal I; II, Skeletal II; III, Skeletal III relationships

4.2.2 Interradicular distance

Table 4.5 shows the measurements of interradicular distance at 3, 5, 7, 9, and 11-mm depths from the alveolar crest in the maxilla and mandible in the patients with skeletal Class I, II and III relationships and comparisons between different skeletal patterns.

Table 4.5 Means and standard deviations of the interradicular distance measurements including the right and left sides of the maxilla and mandible in the patients with skeletal Class I, II, and III relationships and comparisons between the different skeletal patterns

Location	Measurement level (depth)																		Turkey's Test, significance of P																																									
	3-mm						5-mm						7-mm						9-mm						11-mm						3-mm						5-mm						7-mm						9-mm						11-mm					
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III												
Maxillae	M	1.3	1.4	1.5	1.7	1.8	1.9	2.0	1.9	1.9	2.2	2.1	2.0	2.1	2.0	2.6	2.7	2.2	2.2	2.2	2.2	2.6	2.7	2.2	2.2	2.2	2.2	2.6	2.7	2.2	2.2	2.2	2.2	2.6	2.7	2.2	2.2	2.2	2.2	2.6	2.7	2.2	2.2	2.2	2.2	2.6	2.7	2.2	2.2	2.2	2.2	2.6	2.7	2.2						
	SD	0.6	0.5	0.7	0.7	0.5	0.8	0.8	0.6	0.9	0.9	0.7	1.0	1.1	1.0	1.1	1.1	1.0	1.0	1.1	1.0	1.1	1.1	1.0	1.0	1.1	1.0	1.1	1.1	1.0	1.0	1.1	1.0	1.1	1.1	1.0	1.0	1.1	1.0	1.1	1.1	1.0	1.0	1.1	1.0	1.1	1.1	1.0	1.0	1.1	1.0	1.1	1.1	1.0						
5-6	M	1.7	1.7	1.5	2.0	2.3	1.9	2.4	2.6	2.1	3.0	3.1	2.8	3.9	4.0	3.8	3.8	3.8	3.8	3.8	3.8	3.9	4.0	3.8	3.8	3.8	3.8	3.9	4.0	3.8	3.8	3.8	3.8	3.9	4.0	3.8	3.8	3.8	3.8	3.9	4.0	3.8	3.8	3.8	3.8	3.9	4.0	3.8												
	SD	0.6	0.5	0.7	0.8	0.8	0.9	0.9	1.0	1.1	1.3	1.4	1.4	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.7	1.8	1.8	1.8	1.8	1.8	1.7	1.8	1.8	1.8	1.8	1.8	1.7	1.8	1.8	1.8	1.8	1.8	1.7	1.8	1.8	1.8	1.8	1.8	1.7	1.8	1.8												
6-7	M	1.8	1.5	1.1	2.1	1.5	1.1	2.3	1.4	1.0	2.8	1.6	1.3	3.8	2.4	2.1	2.1	2.1	2.1	2.1	2.1	3.8	2.4	2.1	2.1	2.1	2.1	3.8	2.4	2.1	2.1	2.1	2.1	3.8	2.4	2.1	2.1	2.1	2.1	3.8	2.4	2.1	2.1	2.1	2.1	3.8	2.4	2.1												
	SD	0.8	0.7	0.6	0.9	0.7	0.7	1.2	0.9	0.8	1.6	1.0	0.9	2.0	1.2	1.2	1.2	1.2	1.2	1.2	1.2	2.0	1.2	1.2	1.2	1.2	1.2	2.0	1.2	1.2	1.2	1.2	1.2	2.0	1.2	1.2	1.2	1.2	1.2	2.0	1.2	1.2	1.2	1.2	1.2	2.0	1.2	1.2												
Mandibles																																																												
4-5	M	2.6	2.4	3.0	3.3	3.0	3.7	3.7	3.4	4.3	4.3	3.9	4.9	5.1	4.6	5.6	5.6	5.6	5.6	5.6	5.6	5.1	4.6	5.6	5.6	5.6	5.6	5.1	4.6	5.6	5.6	5.6	5.6	5.1	4.6	5.6	5.6	5.6	5.6	5.1	4.6	5.6																		
	SD	0.8	0.9	0.9	1.0	1.1	1.0	1.1	1.3	1.2	1.2	1.4	1.5	1.3	1.6	1.8	1.8	1.8	1.8	1.8	1.8	1.3	1.6	1.8	1.8	1.8	1.8	1.3	1.6	1.8	1.8	1.8	1.8	1.3	1.6	1.8	1.8	1.8	1.8	1.3	1.6	1.8																		
5-6	M	2.2	2.1	2.4	2.5	2.4	2.8	2.9	2.6	3.2	3.5	3.2	3.9	4.6	4.3	5.1	5.1	5.1	5.1	5.1	5.1	4.6	4.3	5.1	5.1	5.1	5.1	4.6	4.3	5.1	5.1	5.1	5.1	4.6	4.3	5.1	5.1	5.1	5.1	4.6	4.3	5.1																		
	SD	0.7	0.8	0.9	0.8	0.9	1.0	0.9	1.0	1.1	1.2	1.3	1.2	1.5	1.6	1.4	1.4	1.4	1.4	1.4	1.4	1.5	1.6	1.4	1.4	1.4	1.4	1.5	1.6	1.4	1.4	1.4	1.4	1.5	1.6	1.4	1.4	1.4	1.4	1.5	1.6	1.4																		
6-7	M	2.3	2.8	2.5	2.7	3.2	2.8	3.2	3.7	3.3	4.0	4.5	4.2	5.3	6.0	5.5	5.5	5.5	5.5	5.5	5.5	5.3	6.0	5.5	5.5	5.5	5.5	5.3	6.0	5.5	5.5	5.5	5.5	5.3	6.0	5.5	5.5	5.5	5.5	5.3	6.0	5.5																		
	SD	0.7	0.8	0.6	0.8	1.0	0.7	1.1	1.2	0.9	1.4	1.4	1.2	1.8	1.6	1.7	1.7	1.7	1.7	1.7	1.7	1.8	1.6	1.7	1.7	1.7	1.7	1.8	1.6	1.7	1.7	1.7	1.7	1.8	1.6	1.7	1.7	1.7	1.7	1.8	1.6	1.7																		

Significance of $P < 0.05$; ** $P < 0.01$. I, Skeletal I; II, Skeletal II; III, Skeletal III relationships

In the maxilla, the available interradicular space for miniscrew implant placement, i.e., the interradicular distance, was always greater than 3 mm, and was between the second premolar and the first molar, at 9-11 mm from the alveolar crest, in the patients with skeletal Class I and II relationships, and was at 11 mm from the alveolar crest in the patients with skeletal Class III relationships.

In the mandible, the available interradicular space was divided between two locations, between the first and second premolars, at 5-11 mm from the alveolar crest, and between the first and second molars, at 7-11 mm from the alveolar crest, in all 3 skeletal patterns.

Significant differences in interradicular distance between the first and second molars in the maxilla were observed. Significant differences in interradicular distance between the first and second premolar, between the second premolar and the first molar, and between the first and second molars in the mandible were also observed.

In the maxilla, the patients with skeletal Class I relationships presented greater interradicular distance at all depths of measurement between the first and second molars than did the patients with skeletal Class II and III relationships.

In the mandible, the interradicular distances between the first and second premolars, at all depths of measurement, and between the second premolar and the first molar, at 7, 9 and 11-mm depths, of the patients with skeletal Class III relationships were greater than those of the patients with skeletal Class II relationships. However, the interradicular distances between the first and second molars, at 3 and 5-mm depths, of the patients with skeletal Class II relationships were greater than those of the patients with skeletal Class I relationships ($P < 0.01$ and $P < 0.05$, respectively).

4.2.3 Interradicular area

The measurements of the interradicular area of the maxillary and mandibular posterior regions on the right and left sides of the jaw in the patients with skeletal Class I, II and III relationships and comparisons of the interradicular area measurements between the sides are reported in Table 4.6. Student's t-test showed no difference in interradicular area between the right and left sides.

Table 4.6 Means and standard deviations of the interradicular area measurements on the right and left sides of the maxilla and mandible in the patients with skeletal Class I, II and III relationships and comparisons between sides

Location		Skeletal I				Skeletal II				Skeletal III			
Maxillae		Rt side	Lt side	P-value		Rt side	Lt side	P-value		Rt side	Lt side	P-value	
4-5	M	28.1	28.2	0.99	NS	29.8	28.8	0.69	NS	27.9	26.8	0.69	NS
	SD	9.7	10.9			10.4	9.7			8.6	12.0		
5-6	M	33.5	34.9	0.59	NS	38.8	38.6	0.96	NS	31.2	35.4	0.15	NS
	SD	9.8	11.5			10.9	15.4			14.6	10.3		
6-7	M	18.0	19.7	0.44	NS	19.1	19.5	0.87	NS	13.2	16.3	0.07	NS
	SD	7.3	7.5			10.5	10.3			6.2	8.5		
Mandibles		Rt side	Lt side	P-value		Rt side	Lt side	P-value		Rt side	Lt side	P-value	
4-5	M	57.2	49.2	0.09	NS	48.7	42.5	0.14	NS	58.3	57.6	0.87	NS
	SD	16.7	13.3			18.7	16.7			12.0	15.3		
5-6	M	39.2	44.6	0.12	NS	36.6	37.7	0.69	NS	43.6	45.3	0.72	NS
	SD	11.2	12.5			13.9	12.2			13.9	15.4		
6-7	M	40.4	38.7	0.39	NS	46.8	44.9	0.55	NS	38.0	37.2	0.71	NS
	SD	16.8	14.7			17.0	16.7			11.1	10.8		

NS: not significant. Rt, Right side; Lt, Left side

Table 4.7 shows the interradicular area measurements including the right and left sides of the maxilla and mandible in the patients with skeletal Class I, II and III relationships and comparisons between skeletal patterns.

Table 4.7 Means and standard deviations of the interradicular area measurements including the right and left sides of the maxilla and mandible in the patients with skeletal Class I, II and III relationships and comparisons between the different skeletal patterns

Location	Interradicular area (mm ²)						Turkey's Test, significance of <i>P</i>		
	Skeletal I		Skeletal II		Skeletal III		I-II	II-III	I-III
	Mean	SD	Mean	SD	Mean	SD			
Maxillae									
area 4-5	28.1	10.2	29.3	10.0	27.3	10.3			
area 5-6	34.2	10.6	38.7	13.2	33.3	12.7			
area 6-7	18.2	6.4	19.2	5.1	16.2	3.7		*	
Mandibles									
area 4-5	53.2	15.5	45.6	17.8	57.9	13.6		**	
area 5-6	41.9	12.0	37.1	12.9	44.4	14.5		*	
area 6-7	39.6	15.6	45.9	16.6	37.6	10.9		*	

* Significance of $P < 0.05$; ** $P < 0.01$. I, Skeletal I; II, Skeletal II; III, Skeletal III relationships

There was significant difference in interradicular area between the first and second molars in the maxilla. Significant differences in interradicular area between the first and second premolars and between the second premolar and the first molar in the mandible were also observed.

In the maxilla, the interradicular areas between the first and second molars of the patients with skeletal Class III relationships were significantly less than those of the patients with skeletal Class II relationships ($P < 0.05$).

In contrast, in the mandible, the interradicular areas between the first and second premolars and between the second premolar and the first molar of the patients with skeletal Class III relationships were significantly larger than those of the patients with skeletal Class II relationships ($P < 0.01$ and $P < 0.05$, respectively). However, the patients with skeletal Class II relationships presented significantly more interradicular

area between the first and second molars than did the patients with skeletal III relationships ($P < 0.05$).

4.3 Effects of other factors on the interradicular area

The effects of other factors, such as sex, age and severity of relationship, on the interradicular area in the maxilla and mandible, are reported in Tables 4.8 and 4.9, respectively.

Table 4.8 The effects of sex, age, severity of malocclusion and presence or absence of the maxillary third molar on the interradicular areas in the maxilla

Other factors	Interradicular area		
	Maxilla		
	4-5	5-6	6-7
	<i>P-value</i>	<i>P-value</i>	<i>P-value</i>
Sex	0.31	0.41	0.16
Age	0.50	0.92	0.39
Severity of malocclusion - Maxillary arch length discrepancy	0.65	0.53	0.37
Presence or absence of the maxillary third molar	0.26	0.78	0.04*

* Significance of $P < 0.05$

Table 4.9 The effects of sex, age, severity of malocclusion and presence or absence of the mandibular third molar on the interradicular areas in the mandible

Other factors	Interradicular area		
	Mandible		
	4-5	5-6	6-7
	<i>P-value</i>	<i>P-value</i>	<i>P-value</i>
Sex	0.54	0.17	0.98
Age	0.21	0.34	0.17
Severity of malocclusion - Mandibular arch length discrepancy	0.44	0.67	0.58
Presence or absence of the mandibular third molar	0.86	0.60	0.34

No significant difference in interradicular area between the sexes was observed. Relationships between interradicular area, age and arch length discrepancy were also not observed.

Significant differences in interradicular area between the first and second molars in the maxilla between the present and absent maxillary third molar groups were observed. No significant difference in interradicular area in the mandible between the present and absent mandibular third molar groups was observed.

Table 4.10 shows the amounts of interradicular area between the present and absent maxillary third molar groups in the patients and comparisons between these groups. The amounts of interradicular area between the maxillary first and second molars in the present maxillary third molar group was significantly less than in the absent maxillary third molar group ($P < 0.05$).

Table 4.10 The interradicular area measurements between the present and absent maxillary third molar groups in the patients and comparisons between these groups

Variable	Maxillary third molar present		Maxillary third molar absent		Mann-Whitney <i>U</i> Test, <i>P-values</i>
	Mean (mm ²)	SD	Mean (mm ²)	SD	
area U 4-5	27.8	10.4	30.5	8.4	0.26
area U 5-6	35.6	13.0	34.4	8.7	0.78
area U 6-7	17.2	5.0	20.0	5.8	0.04*

* Significance of $P < 0.05$