

CHAPTER 4

Results

General information of samples

The sample consisted of the CBCT images of IZ crest sites obtained from 20 growing UCLP with Class III skeletal pattern ($ANB < 0^\circ$) and 10 growing non-cleft patients with Class III skeletal pattern ($ANB < 0^\circ$). Each UCLP provided two CBCT image of the IZ crest from non-cleft side and cleft side, therefore the number of samples included 20 samples from non-cleft side and 20 samples from cleft side in cleft patients group. Each non-cleft patient provided two CBCT image of the IZ crest from left and right side. There was no statistically significant difference between the left and right sides. The measurements from both sides of non-cleft patients were pooled for statistical analysis, therefore the number of samples included 20 samples from non-cleft patients. The age of the unilateral cleft lip and palate patients (9 female and 11 male) ranged from 7.9 to 13.9 years (mean age: 10.69 ± 1.79 years), and The age of the non-cleft patients (5 female and 5 male) ranged from 8.2 to 13.8 years (mean age: 11.63 ± 1.90 years), as are shown in Table 4.1.

Table 4.1 Number of samples (n), gender, and means (\bar{X}), standard deviations (SD) and range of the age of each group of patients

| Group of patients | n | Gender | | Age | |
|-------------------|----|--------|------|------------------|-------------|
| | | Female | Male | $\bar{X} \pm SD$ | Range |
| Cleft patients | 40 | 18 | 22 | 10.69 ± 1.79 | 7.9 to 13.9 |
| • Non-cleft side | 20 | 9 | 11 | | |
| • Cleft side | 20 | 9 | 11 | | |

Table 4.1 (Continued)

| Group of patients | n | Gender | | Age | |
|--------------------|----|--------|------|------------------|-------------|
| | | Female | Male | $\bar{X} \pm SD$ | Range |
| Non-cleft patients | 20 | 10 | 10 | 11.63 \pm 1.90 | 8.2 to 13.8 |
| • Right side | 10 | 5 | 5 | | |
| • Left side | 10 | 5 | 5 | | |

Measurement error

The intra-examiner reliability test for the buccal cortical bone thickness, buccal plate thickness and IZ crest thickness measurement showed high intra-class correlation ($r = 0.956$ for buccal cortical bone thickness measurement, $r = 0.993$ for buccal plate thickness measurement and $r = 0.955$ for the IZ crest thickness measurement) and suggested high reliability in measurement. The buccal cortical bone, buccal plate and IZ crest thickness in both groups were normally distributed.

Assessment of the result

4.1 Buccal cortical bone thickness

4.1.1 The means, standard deviations and comparisons of the buccal cortical bone thickness of non-cleft sides and cleft sides in cleft patients

The buccal cortical bone thickness at non-cleft side were from 0.98 ± 0.26 to 1.76 ± 0.65 mm. The thinnest was found at the MB4.8 site while the thickest was at the B9.6 site. At cleft side, the measurements were from 1.15 ± 0.33 to 2.28 ± 1.05 mm. The thinnest was found at the B4.8 site while the thickest was at the DB9.6 site. The mean and standard deviations of all measurements are shown in Table 4.2. All of the buccal cortical bone thicknesses at cleft sides were greater than those at non-cleft sides. The buccal cortical bone thicknesses at cleft sides were significantly greater than those at non-cleft sides at MB4.8, MB7.2, MB9.6, B7.2, B9.6 and DB9.6 sites, as shown in Table 4.2.

Table 4.2 Means (mm) and standard deviations of the buccal cortical bone thickness at mesiobuccal (MB) root, middle of buccal furcation (B) and distobuccal (DB) root of maxillary first molar for each vertical level of non-cleft and cleft sides

| Vertical cut level | MB root of 1 st molar | | | Middle of buccal furcation | | | DB root of 1 st molar | | |
|--------------------|----------------------------------|------------------------------|----------|----------------------------------|------------------------------|----------|----------------------------------|------------------------------|----------|
| | Non-cleft side of cleft patients | Cleft side of cleft patients | <i>P</i> | Non-cleft side of cleft patients | Cleft side of cleft patients | <i>P</i> | Non-cleft side of cleft patients | Cleft side of cleft patients | <i>P</i> |
| 4.8 | 0.98±0.26 | 1.15±0.33 | ** | 1.13±0.25 | 1.21±0.35 | NS | 1.14±0.29 | 1.24±0.35 | NS |
| 6 | 1.08±0.30 | 1.19±0.37 | NS | 1.21±0.26 | 1.26±0.31 | NS | 1.21±0.35 | 1.23±0.32 | NS |
| 7.2 | 1.16±0.38 | 1.43±0.38 | ** | 1.31±0.32 | 1.53±0.42 | * | 1.32±0.44 | 1.52±0.44 | NS |
| 8.4 | 1.41±0.52 | 1.63±0.66 | NS | 1.55±0.45 | 1.71±0.64 | NS | 1.57±0.59 | 1.81±0.87 | NS |
| 9.6 | 1.48±0.55 | 1.86±0.82 | ** | 1.76±0.65 | 2.09±0.94 | * | 1.74±0.47 | 2.28±1.05 | ** |

NS: Not significant, *: $P < 0.05$, **: $P < 0.01$

The thickness of buccal cortical bone at non-cleft sides in cleft patients increased from the buccal CEJ level towards the apical area. In addition, the bone thicknesses increased from mesial to distal section. At non-cleft sides of cleft patients, the buccal cortical bone thicknesses were greater than 1.0 mm at all sites, excepted for the MB4.8 site (Figure 4.1).

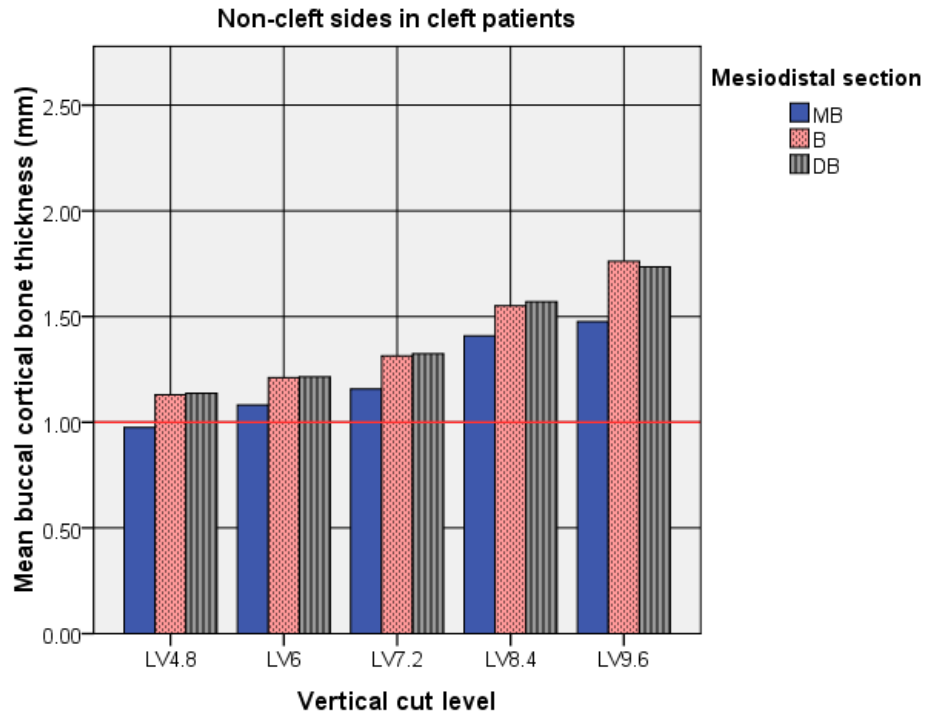


Figure 4.1 The combined plots between each vertical cut level and mesiodistal section of the average buccal cortical bone thickness at non-cleft sides in cleft patients. The red line was inserted at the 1.0 mm level of mean buccal cortical bone thickness, revealing the sites where the average buccal cortical bone thickness was greater than 1.0 mm.

As for the buccal cortical bone thickness at non-cleft sides, the thickness of buccal cortical bone at cleft sides in cleft patients also increased from the buccal CEJ level towards the apical area and also increased from mesial to distal section. However, at cleft sides of cleft patients, the buccal cortical bone thicknesses were greater than 1.0 mm at all sites (Figure 4.2).

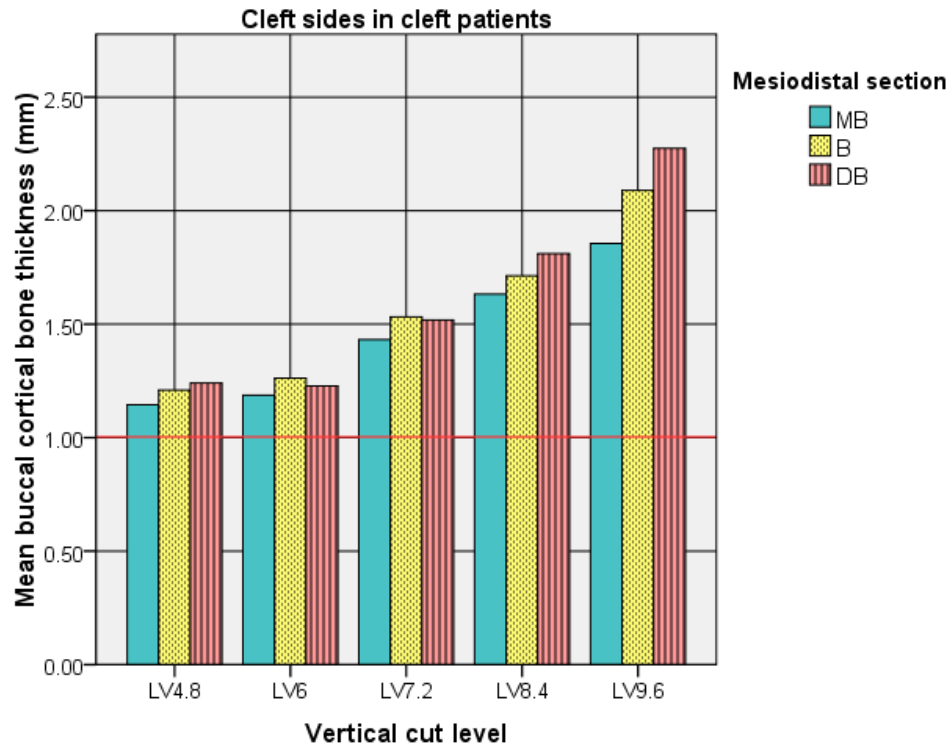


Figure 4.2 The combined plots between each vertical cut level and mesiodistal section of the average buccal cortical bone thickness at cleft sides in cleft patients. The red line was inserted at the 1.0 mm level of mean buccal cortical bone thickness, revealing the sites where the average buccal cortical bone thickness was greater than 1.0 mm.

4.1.2 The means, standard deviations of non-cleft patients and comparisons of the buccal cortical bone thickness in non-cleft patients and non-cleft sides of cleft patients

The buccal cortical bone thicknesses of non-cleft patients were from 1.15 ± 0.21 to 1.85 ± 1.18 mm. The thinnest was found at the DB4.8 site while the thickest was at the B8.4 site. The mean and standard deviations of all measurements are shown in Table 4.3. Almost all of the buccal cortical bone thicknesses of non-cleft patients and non-cleft sides of cleft patients were not significantly different, excepted for the MB4.8 and MB7.2 sites, as shown in Table 4.3.

Table 4.3 Means (mm) and standard deviations of the buccal cortical bone thickness at mesiobuccal (MB) root, middle of buccal furcation (B) and distobuccal (DB) root of maxillary first molar for each vertical level in non-cleft patients and non-cleft sides of cleft patients

| Vertical cut level | MB root of 1 st molar | | | Middle of buccal furcation | | | DB root of 1 st molar | | |
|--------------------|----------------------------------|----------------------------------|----------|----------------------------|----------------------------------|----------|----------------------------------|----------------------------------|----------|
| | Non-cleft patients | Non-cleft side of cleft patients | <i>P</i> | Non-cleft patients | Non-cleft side of cleft patients | <i>P</i> | Non-cleft patients | Non-cleft side of cleft patients | <i>P</i> |
| 4.8 | 1.18±0.21 | 0.98±0.26 | ** | 1.16±0.25 | 1.13±0.25 | NS | 1.15±0.21 | 1.14±0.29 | NS |
| 6 | 1.23±0.24 | 1.08±0.30 | NS | 1.26±0.16 | 1.21±0.26 | NS | 1.29±0.19 | 1.21±0.35 | NS |
| 7.2 | 1.50±0.36 | 1.16±0.38 | ** | 1.43±0.25 | 1.31±0.32 | NS | 1.42±0.25 | 1.32±0.44 | NS |
| 8.4 | 1.83±0.85 | 1.41±0.52 | NS | 1.85±1.18 | 1.55±0.45 | NS | 1.63±0.66 | 1.57±0.59 | NS |
| 9.6 | 1.79±0.48 | 1.48±0.55 | NS | 1.65±0.40 | 1.76±0.65 | NS | 1.57±0.40 | 1.74±0.47 | NS |

NS: Not significant, *, *P* < 0.05, **, *P* < 0.01

4.2 Buccal plate thickness

4.2.1 The means, standard deviations and comparisons of the buccal plate thickness at non-cleft and cleft side in cleft patients

The buccal plate thicknesses at non-cleft sides were from 2.23±1.25 to 5.34±3.67 mm. The thinnest was found at the MB4.8 site while the thickest was at DB9.6 site. At cleft sides, the measurements were from 2.57±1.42 to 6.53±3.40 mm. The thinnest was found at MB4.8 site while the thickest was at DB9.6 site. The mean and standard deviations of all measurements are shown in Table 4.3. All of the buccal plate thicknesses at cleft sides were greater than those at non-cleft sides. The buccal plate thicknesses at cleft sides were significantly greater than those at non-cleft side at the MB8.4, MB9.6, B6 and B8.4 sites, as shown in Table 4.4.

Table 4.4 Means (mm) and standard deviations of the buccal plate thickness at mesiobuccal (MB) root, middle of buccal furcation (B) and distobuccal (DB) root of maxillary first molar for each vertical level of non-cleft sides and cleft sides of unilateral cleft lip and palate patients

| Vertical cut level | MB root of 1 st molar | | | Middle of buccal furcation | | | DB root of 1 st molar | | |
|--------------------|----------------------------------|------------------------------|----------|----------------------------------|------------------------------|----------|----------------------------------|------------------------------|----------|
| | Non-cleft side of cleft patients | Cleft side of cleft patients | <i>P</i> | Non-cleft side of cleft patients | Cleft side of cleft patients | <i>P</i> | Non-cleft side of cleft patients | Cleft side of cleft patients | <i>P</i> |
| 4.8 | 2.23±1.25 | 2.57±1.42 | NS | 2.78±1.09 | 3.13±1.29 | NS | 3.13±1.11 | 3.37±1.20 | NS |
| 6 | 2.39±1.40 | 2.85±1.45 | NS | 3.00±1.40 | 3.51±1.34 | * | 3.31±1.63 | 3.80±1.37 | NS |
| 7.2 | 2.61±1.72 | 3.18±1.57 | NS | 3.43±1.83 | 3.97±1.60 | NS | 3.85±1.63 | 4.31±1.63 | NS |
| 8.4 | 3.06±2.10 | 3.92±2.00 | * | 3.92±2.30 | 4.71±2.12 | * | 4.37±2.55 | 5.00±3.67 | NS |
| 9.6 | 3.83±2.86 | 4.78±2.47 | * | 4.88±3.14 | 5.77±2.73 | NS | 5.34±3.67 | 6.53±3.40 | NS |

NS: Not significant, *: $P < 0.05$, **: $P < 0.01$

The thickness of buccal plate at non-cleft sides in cleft patients increased from the buccal CEJ level towards the apical area. In addition, the bone thicknesses increased from mesial to distal section. At non-cleft sides of cleft patients, the buccal plate thicknesses were greater than 2.0 mm at all sites (Figure 4.3).

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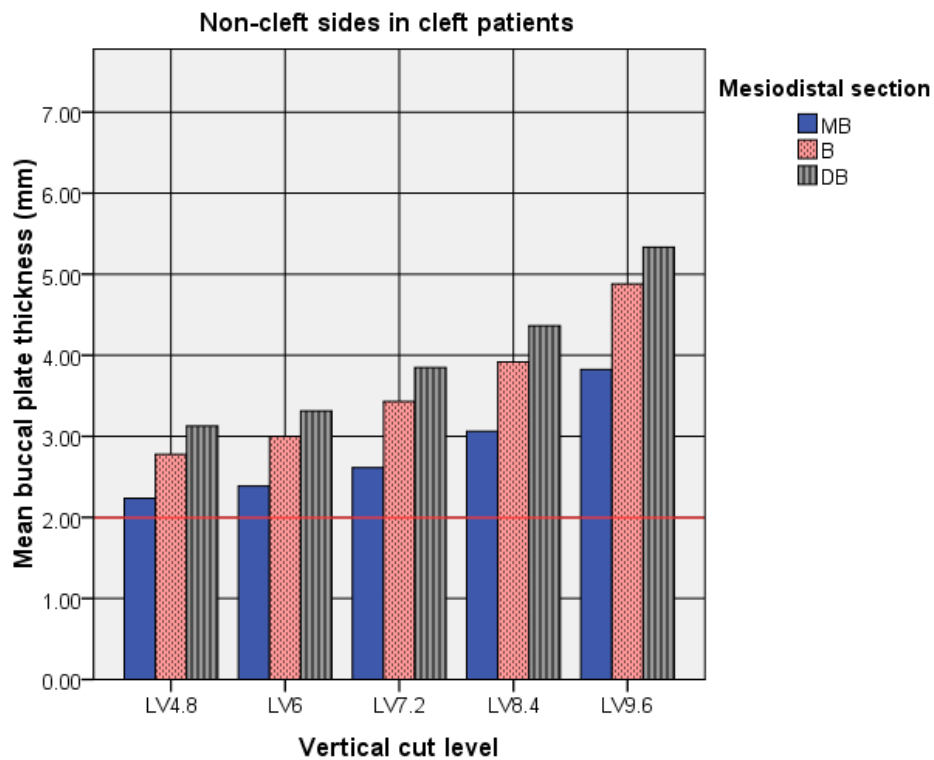


Figure 4.3 The combined plots between each vertical cut level and mesiodistal section of the average buccal plate thickness at non-cleft sides in cleft patients. The red line was inserted at the 2.0 mm level of mean buccal plate thickness, revealing the sites where the average buccal plate thickness was greater than 2.0 mm.

As for the buccal plate thickness at non-cleft sides, the thickness of buccal plate at cleft sides in cleft patients also increased from the buccal CEJ level towards the apical area and also increased from mesial to distal section. In addition, at cleft sides of cleft patients, the buccal plate thicknesses were greater than 2.0 mm at all sites (Figure 4.4).

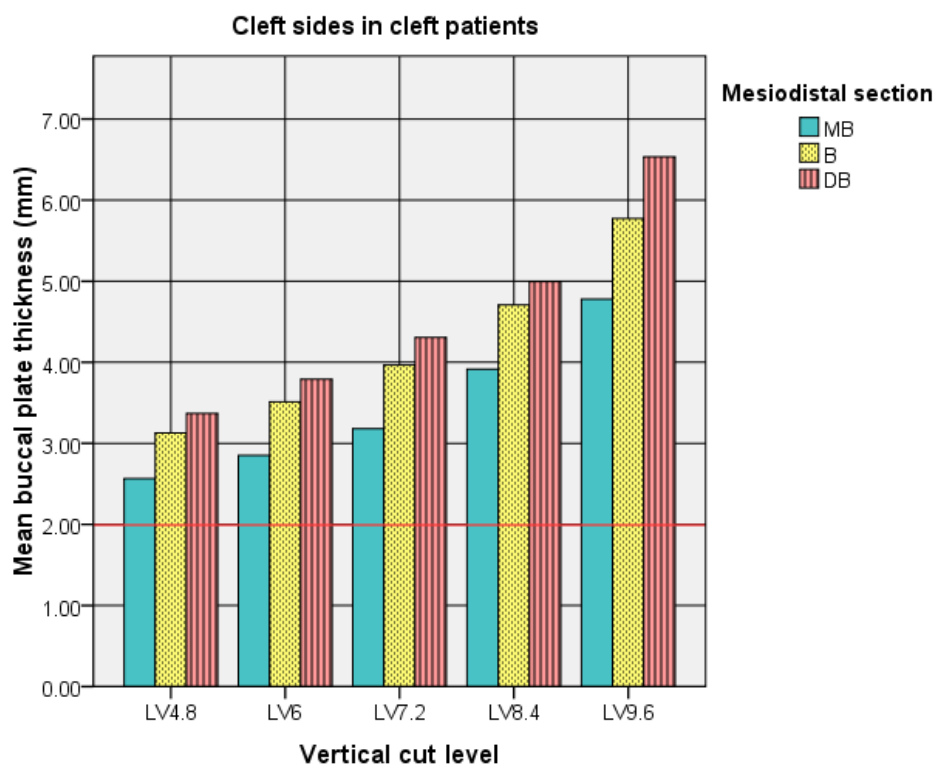


Figure 4.4 The combined plots between each vertical cut level and mesiodistal section of the average buccal plate thickness at cleft sides in cleft patients. The red line was inserted at the 2.0 mm level of mean buccal plate thickness, revealing the sites where the average buccal plate thickness was greater than 2.0 mm.

4.2.2 The means, standard deviations and comparisons of the buccal plate thickness in non-cleft patients and comparisons of the buccal plate thickness in non-cleft patients and non-cleft side of cleft patients

The buccal plate thicknesses of non-cleft patients were from 2.88 ± 0.99 to 5.01 ± 2.70 mm. The thinnest was found at MB4.8 site while the thickest was at B9.6 site. The mean and standard deviations of all measurements are shown in Table 4.5. All of the buccal plate thicknesses of non-cleft patients and non-cleft sides of cleft patients were not significantly different, as shown in Table 4.5.

Table 4.5 Means (mm) and standard deviations of the buccal plate thickness at mesiobuccal (MB) root, middle of buccal furcation (B) and distobuccal (DB) root of maxillary first molar for each vertical level of non-cleft patients and non-cleft side of cleft patients

| Vertical cut level | MB root of 1 st molar | | | Middle of buccal furcation | | | DB root of 1 st molar | | |
|--------------------|----------------------------------|----------------------------------|----------|----------------------------|----------------------------------|----------|----------------------------------|----------------------------------|----------|
| | Non-cleft patients | Non-cleft side of cleft patients | <i>P</i> | Non-cleft patients | Non-cleft side of cleft patients | <i>P</i> | Non-cleft patients | Non-cleft side of cleft patients | <i>P</i> |
| 4.8 | 2.88±0.99 | 2.23±1.25 | NS | 3.22±1.07 | 2.78±1.09 | NS | 3.28±1.11 | 3.13±1.11 | NS |
| 6 | 3.05±1.14 | 2.39±1.4 | NS | 3.35±1.07 | 3.00±1.40 | NS | 3.45±1.12 | 3.31±1.63 | NS |
| 7.2 | 3.42±1.42 | 2.61±1.72 | NS | 3.69±1.45 | 3.43±1.83 | NS | 3.67±1.18 | 3.85±1.89 | NS |
| 8.4 | 4.07±2.19 | 3.06±2.1 | NS | 4.65±2.62 | 3.92±2.3 | NS | 4.27±1.63 | 4.37±2.55 | NS |
| 9.6 | 4.60±2.78 | 3.83±2.86 | NS | 5.01±2.70 | 4.88±3.14 | NS | 4.57±1.72 | 5.34±3.67 | NS |

NS: Not significant, *: $P < 0.05$, **: $P < 0.01$

4.3 The biting depth

4.3.1 The means, standard deviations and comparisons of the biting depth of non-cleft patients and comparisons of the biting depth at non-cleft side and cleft side of cleft patients

The biting depth at MB root of maxillary first molar at non-cleft sides of cleft patients were from 3.22±1.78 to 6.79±2.98 mm. The thinnest was found at the MB4.8 site with insertion angle of 45° to the maxillary molar occlusal plane while the thickest was found at the MB6.0 site with insertion angle of 70° to the maxillary molar occlusal plane. At cleft side of cleft patients, the bone thicknesses of IZ crest at MB root of maxillary first molar were from 4.48±3.46 to 7.80±4.31 mm. The thinnest was found at the MB4.8 site with insertion angle of 45° while the thickest was found at the MB4.8 site with insertion angle of 70°. The biting depth at MB root of maxillary first molar at non-cleft and cleft sides of cleft patients were reported in Table 4.6 and 4.7 respectively. There was no significant difference for

each combination of vertical cut level and insertion angle at MB root of maxillary first molar between non-cleft and cleft sides of cleft patients, excepted for the MB4.8 site with 50° angulation (Table 4.8).

Table 4.6 Means and standard deviations of the biting depth at each combination of vertical cut level (mm) and insertion angle (°) at MB root of maxillary first molar at non-cleft sides of cleft patients

| Vertical cut level \ Insertion angle | Insertion angle | | | | | |
|--------------------------------------|-----------------|-----------|-----------|-----------|-----------|-----------|
| | 45 | 50 | 55 | 60 | 65 | 70 |
| 4.8 | 3.22±1.78 | 3.74±1.94 | 4.96±4.18 | 5.37±3.98 | 6.04±3.05 | 6.38±2.61 |
| 6.0 | 4.70±5.35 | 5.50±3.73 | 5.41±4.08 | 5.77±3.88 | 6.35±2.99 | 6.79±2.98 |
| 7.2 | 4.75±4.46 | 5.37±4.11 | 5.49±3.93 | 5.35±2.98 | 6.23±3.52 | 6.28±3.10 |
| 8.4 | 4.75±3.83 | 5.14±3.83 | 5.62±4.19 | 5.64±3.35 | 5.72±3.00 | 5.81±2.63 |
| 9.6 | 6.5±4.88 | 6.03±3.81 | 5.88±3.54 | 5.88±3.33 | 5.85±3.21 | 5.76±3.08 |

Table 4.7 Means and standard deviations of the biting depth at each combination of vertical cut level (mm) and insertion angle (°) at MB root of maxillary first molar at cleft sides of cleft patients

| Vertical cut level \ Insertion angle | Insertion angle | | | | | |
|--------------------------------------|-----------------|-----------|-----------|-----------|-----------|-----------|
| | 45 | 50 | 55 | 60 | 65 | 70 |
| 4.8 | 4.48±3.46 | 5.49±3.73 | 5.92±3.39 | 6.47±3.12 | 7.00±3.23 | 7.80±4.31 |
| 6.0 | 5.24±3.8 | 5.60±3.42 | 6.04±3.29 | 6.49±3.22 | 7.03±2.64 | 7.44±3.74 |
| 7.2 | 5.18±3.51 | 5.74±3.73 | 5.85±3.59 | 6.84±4.39 | 6.75±3.81 | 6.90±3.96 |
| 8.4 | 5.61±3.22 | 6.04±4.36 | 6.38±5.25 | 5.74±3.91 | 5.67±3.97 | 5.69±4.07 |
| 9.6 | 5.74±4.47 | 5.83±4.49 | 5.73±3.95 | 5.58±3.86 | 5.36±3.46 | 5.27±3.36 |

Table 4.8 The comparisons of the biting depth at MB root of maxillary first molar between non-cleft and cleft sides of cleft patients

| Vertical cut level | Insertion angle | | | | | |
|--------------------|-----------------|--------|-------|-------|-------|-------|
| | 45 | 50 | 55 | 60 | 65 | 70 |
| 4.8 | 0.099 | 0.029* | 0.364 | 0.280 | 0.231 | 0.154 |
| 6.0 | 0.618 | 0.913 | 0.473 | 0.429 | 0.252 | 0.471 |
| 7.2 | 0.659 | 0.714 | 0.709 | 0.154 | 0.426 | 0.430 |
| 8.4 | 0.424 | 0.470 | 0.545 | 0.882 | 0.934 | 0.872 |
| 9.6 | 0.486 | 0.848 | 0.860 | 0.687 | 0.448 | 0.442 |

The biting depth at middle of buccal furcation of maxillary first molar of non-cleft sides of cleft patients were from 5.26 ± 2.95 to 12.96 ± 6.42 mm. The thinnest was found at B9.6 site with insertion angle of 70° while the thickest was found at the B4.8 site with insertion angle of 45° to the maxillary molar occlusal plane. At cleft sides of cleft patients, the biting depth at the middle of buccal furcation of maxillary first molar were from 5.19 ± 3.64 to 11.65 ± 6.10 mm. The thinnest was found at the B9.6 site with insertion angle of 60° while the thickest was found at the B4.8 site with insertion angle of 45° to the maxillary molar occlusal plane. The biting depth at middle of buccal furcation of maxillary first molar of non-cleft and cleft side of cleft patients were reported in Table 4.9 and 4.10 respectively. There was no significant difference for each combination of vertical cut level and insertion angle at middle of buccal furcation between non-cleft and cleft sides of cleft patients (Table 4.11).

Table 4.9 Means and standard deviations of the biting depth at each combination of vertical cut level (mm) and insertion angle (°) at middle of buccal furcation of maxillary first molar at non-cleft sides of cleft patients

| Insertion angle Vertical Cut level | Insertion angle | | | | | |
|---------------------------------------|-----------------|------------|------------|-----------|-----------|-----------|
| | 45 | 50 | 55 | 60 | 65 | 70 |
| 4.8 | 12.96±6.42 | 12.54±6.04 | 10.78±5.11 | 9.54±3.64 | 9.34±3.41 | 8.99±3.44 |
| 6.0 | 11.02±6.11 | 10.11±5.5 | 9.07±4.25 | 8.10±3.56 | 7.88±3.47 | 7.67±3.50 |
| 7.2 | 8.63±5.65 | 8.54±5.66 | 7.52±3.99 | 6.97±3.58 | 6.94±3.41 | 6.74±3.36 |
| 8.4 | 6.7±4.82 | 6.66±4.36 | 6.22±3.51 | 5.88±3.28 | 5.98±3.18 | 5.94±3.13 |
| 9.6 | 5.45±3.33 | 5.49±3.2 | 5.42±3.19 | 5.24±3.12 | 5.34±3.18 | 5.26±2.95 |

Table 4.10 Means and standard deviations of the biting depth at each combination of vertical cut level (mm) and insertion angle (°) at middle of buccal furcation of maxillary first molar at cleft sides of cleft patients

| Insertion angle Vertical Cut level | Insertion angle | | | | | |
|---------------------------------------|-----------------|------------|------------|------------|-----------|-----------|
| | 45 | 50 | 55 | 60 | 65 | 70 |
| 4.8 | 11.65±6.10 | 11.57±5.74 | 10.85±5.22 | 10.49±5.04 | 9.87±4.31 | 9.06±4.46 |
| 6.0 | 10.53±5.45 | 10.42±5.50 | 9.88±5.05 | 9.21±5.09 | 8.30±4.34 | 7.62±4.37 |
| 7.2 | 8.75±5.69 | 8.83±5.84 | 8.46±5.62 | 7.21±4.36 | 6.81±3.91 | 6.38±3.69 |
| 8.4 | 6.94±5.55 | 7.05±5.78 | 6.50±4.58 | 5.77±3.88 | 5.68±3.84 | 5.58±3.67 |
| 9.6 | 6.37±5.64 | 5.89±4.64 | 5.35±3.79 | 5.19±3.64 | 5.32±3.62 | 5.38±3.68 |

Table 4.11 The comparisons of the biting depth at middle of buccal furcation of maxillary first molar between non-cleft and cleft sides of cleft patients

| Vertical cut level | Insertion angle | | | | | |
|--------------------|-----------------|-------|-------|-------|-------|-------|
| | 45 | 50 | 55 | 60 | 65 | 70 |
| 4.8 | 0.269 | 0.265 | 0.925 | 0.223 | 0.443 | 0.935 |
| 6.0 | 0.577 | 0.644 | 0.238 | 0.181 | 0.579 | 0.946 |
| 7.2 | 0.884 | 0.731 | 0.249 | 0.730 | 0.848 | 0.568 |
| 8.4 | 0.750 | 0.616 | 0.716 | 0.857 | 0.621 | 0.552 |
| 9.6 | 0.337 | 0.626 | 0.912 | 0.928 | 0.976 | 0.800 |

The biting depth at DB root of maxillary first molar of non-cleft sides of cleft patients were from 4.50 ± 2.14 to 6.80 ± 1.31 mm. The thinnest was found at DB4.8 site with insertion angle of 45° while the thickest was found at the DB4.8 site with 70° to the maxillary molar occlusal plane. At cleft sides of cleft patients, the biting depth at DB root of maxillary first molar were from 4.93 ± 3.09 to 6.60 ± 3.53 mm. The thinnest was found at DB8.4 site with insertion angle of 50° while the thickest was found at the DB6.0 site with insertion angle of 60° to the maxillary molar occlusal plane. The biting depth at DB root of maxillary first molar of non-cleft and cleft sides of cleft patients were reported in Table 4.12 and 4.13 respectively. There was no significant difference for each combination of vertical cut level and insertion angle at DB root between non-cleft and cleft sides of cleft patients (Table 4.14).

Table 4.12 Means and standard deviations of the biting depth at each combination of vertical cut level (mm) and insertion angle (°) at DB root of maxillary first molar at non-cleft sides of cleft patients

| Insertion angle Vertical Cut level | Insertion angle | | | | | |
|---------------------------------------|-----------------|-----------|-----------|-----------|-----------|-----------|
| | 45 | 50 | 55 | 60 | 65 | 70 |
| 4.8 | 4.50±2.14 | 5.11±1.87 | 5.78±1.94 | 6.25±2.03 | 6.48±1.51 | 6.80±1.31 |
| 6.0 | 4.68±2.29 | 5.18±2.61 | 5.59±2.24 | 5.92±1.92 | 5.97±1.48 | 5.94±1.40 |
| 7.2 | 4.92±2.63 | 5.15±2.35 | 5.19±1.84 | 5.31±1.67 | 5.46±2.27 | 5.38±2.05 |
| 8.4 | 4.56±1.84 | 4.69±2.13 | 4.68±2.02 | 4.78±1.91 | 4.59±1.90 | 4.64±2.20 |
| 9.6 | 5.22±3.62 | 4.92±3.41 | 4.87±3.27 | 4.90±3.32 | 4.74±3.32 | 4.76±3.30 |

Table 4.13 Means and standard deviations of the biting depth at each combination of vertical cut level (mm) and insertion angle (°) at DB root of maxillary first molar at cleft sides of cleft patients

| Insertion angle Vertical Cut level | Insertion angle | | | | | |
|---------------------------------------|-----------------|-----------|-----------|-----------|-----------|-----------|
| | 45 | 50 | 55 | 60 | 65 | 70 |
| 4.8 | 5.04±2.20 | 5.65±2.63 | 5.95±2.46 | 6.49±2.49 | 6.33±2.15 | 6.28±2.19 |
| 6.0 | 5.53±3.08 | 6.21±4.10 | 6.62±3.71 | 6.60±3.53 | 6.33±3.03 | 6.26±3.05 |
| 7.2 | 6.29±4.31 | 5.73±2.72 | 5.65±2.5 | 5.80±2.39 | 5.64±2.73 | 5.43±2.84 |
| 8.4 | 5.44±4.76 | 4.93±3.09 | 5.30±3.26 | 5.54±3.39 | 5.17±3.35 | 5.14±3.37 |
| 9.6 | 5.10±3.91 | 5.15±3.91 | 5.18±3.92 | 5.41±4.20 | 5.49±4.93 | 5.43±4.63 |

Table 4.14 The comparisons of the biting depth at DB root of maxillary first molar between non-cleft and cleft sides of cleft patients.

| Vertical cut level | Insertion angle | | | | | |
|--------------------|-----------------|-------|-------|-------|-------|-------|
| | 45 | 50 | 55 | 60 | 65 | 70 |
| 4.8 | 0.093 | 0.184 | 0.672 | 0.588 | 0.671 | 0.278 |
| 6.0 | 0.244 | 0.249 | 0.186 | 0.370 | 0.565 | 0.633 |
| 7.2 | 0.132 | 0.173 | 0.299 | 0.283 | 0.734 | 0.907 |
| 8.4 | 0.427 | 0.603 | 0.369 | 0.308 | 0.399 | 0.474 |
| 9.6 | 0.855 | 0.701 | 0.623 | 0.465 | 0.392 | 0.408 |

4.3.2 The means, standard deviations and comparisons of the biting depth in non-cleft patients and comparisons of the biting depth in non-cleft patients and non-cleft sides of cleft patients

The biting depth at MB root of maxillary first molar in non-cleft patients were from 4.85 ± 1.88 to 7.63 ± 4.50 mm. The thinnest was found at the MB7.2 site with 50° while the thickest was found at the MB6.0 site with 70° to the maxillary molar occlusal plane. The bone thicknesses of IZ crest at MB root of maxillary first molar in non-cleft patients were reported in Table 4.15. There was no significant difference for each combination of vertical cut level and insertion angle at MB root between non-cleft patients and non-cleft sides of cleft patients (Table 4.16).

Table 4.15 Means and standard deviations of the biting depth at each combination of vertical cut level (mm) and insertion angle (°) at MB root of maxillary first molar in the non-cleft patients

| Insertion angle Vertical Cut level | Insertion angle | | | | | |
|---------------------------------------|-----------------|-----------|-----------|-----------|-----------|-----------|
| | 45 | 50 | 55 | 60 | 65 | 70 |
| 4.8 | 4.88±2.65 | 5.34±2.28 | 6.11±2.41 | 6.43±2.33 | 6.89±1.98 | 7.06±1.89 |
| 6.0 | 4.97±2.30 | 5.46±2.41 | 5.43±2.16 | 5.65±2.00 | 6.12±1.80 | 7.63±4.50 |
| 7.2 | 4.79±2.13 | 4.85±1.88 | 5.01±1.71 | 5.23±1.73 | 6.20±4.73 | 6.40±4.53 |
| 8.4 | 5.44±3.51 | 5.41±3.70 | 5.48±3.94 | 5.60±4.38 | 6.97±5.75 | 7.09±5.75 |
| 9.6 | 4.88±3.78 | 4.95±4.10 | 5.93±5.69 | 5.97±5.75 | 5.98±5.60 | 6.63±5.92 |

Table 4.16 The comparisons of the biting depth at MB of maxillary first molar between non-cleft sides of cleft patients and non-cleft patients.

| Vertical cut level | Insertion angle | | | | | |
|--------------------|-----------------|-------|-------|-------|-------|-------|
| | 45 | 50 | 55 | 60 | 65 | 70 |
| 4.8 | 0.055 | 0.058 | 0.378 | 0.373 | 0.295 | 0.269 |
| 6.0 | 0.858 | 0.978 | 0.985 | 0.915 | 0.756 | 0.522 |
| 7.2 | 0.968 | 0.586 | 0.606 | 0.872 | 0.983 | 0.925 |
| 8.4 | 0.539 | 0.821 | 0.914 | 0.974 | 0.443 | 0.425 |
| 9.6 | 0.274 | 0.424 | 0.976 | 0.959 | 0.941 | 0.621 |

The biting depth at middle of buccal furcation of maxillary first molar in non-cleft patients were from 6.03±5.34 to 10.24±4.80 mm. The thinnest was found at the B9.6 site with 55° while the thickest was found at the B4.8 site with 50° to the maxillary molar occlusal plane. The biting depth at middle of buccal furcation of maxillary first molar in non-cleft patients were reported in Table 4.17. There was

no significant difference for each combination of vertical cut level and insertion angle at middle of buccal furcation of maxillary first molar between non-cleft patients and non-cleft sides of cleft patients excepted for the MB4.8 site with 45° angulation (Table 4.18).

Table 4.17 Means and standard deviations of the biting depth at each combination of vertical cut level (mm) and insertion angle (°) at middle of buccal furcation of maxillary first molar in the non-cleft patients

| Insertion angle \ Vertical Cut level | Insertion angle | | | | | |
|--------------------------------------|-----------------|------------|-----------|-----------|-----------|-----------|
| | 45 | 50 | 55 | 60 | 65 | 70 |
| 4.8 | 9.22±3.90 | 10.24±4.80 | 9.96±5.21 | 9.75±5.75 | 9.57±5.69 | 9.53±5.66 |
| 6.0 | 8.89±4.38 | 9.09±5.23 | 8.96±5.70 | 8.70±5.78 | 8.41±5.47 | 8.25±5.26 |
| 7.2 | 7.78±5.05 | 8.04±5.76 | 7.69±5.40 | 7.65±5.58 | 7.45±5.40 | 7.27±5.09 |
| 8.4 | 7.01±5.40 | 6.88±5.36 | 6.98±5.76 | 6.69±5.39 | 6.67±5.40 | 6.62±5.18 |
| 9.6 | 6.21±5.34 | 6.11±5.44 | 6.03±5.34 | 6.05±5.28 | 6.19±5.57 | 6.26±5.56 |

Table 4.18 The comparisons of the biting depth at middle of buccal furcation of maxillary first molar between non-cleft sides of cleft patients and non-cleft patients.

| Vertical cut level | Insertion angle | | | | | |
|--------------------|-----------------|-------|-------|-------|-------|-------|
| | 45 | 50 | 55 | 60 | 65 | 70 |
| 4.8 | *0.041 | 0.229 | 0.643 | 0.890 | 0.883 | 0.745 |
| 6.0 | 0.245 | 0.590 | 0.952 | 0.716 | 0.744 | 0.714 |
| 7.2 | 0.648 | 0.810 | 0.920 | 0.683 | 0.757 | 0.741 |
| 8.4 | 0.863 | 0.902 | 0.667 | 0.616 | 0.679 | 0.683 |
| 9.6 | 0.646 | 0.711 | 0.714 | 0.607 | 0.615 | 0.551 |

The biting depth at DB root of maxillary first molar in non-cleft patients were from 5.27 ± 3.08 to 8.96 ± 3.72 mm. The thinnest was found at the DB4.8 site with 45° while the thickest was found at the DB4.8 site with 70° to the maxillary molar occlusal plane. The biting depth at DB root of maxillary first molar in non-cleft patients were reported in Table 4.19. There was no significant difference for each combination of vertical cut level and insertion angle at DB root between non-cleft patients and non-cleft sides of cleft patients, excepted for the DB4.8 site with 70° angulation (Table 4.20).

Table 4.19 Means and standard deviations of the biting depth at each combination of vertical cut level (mm) and insertion angle ($^\circ$) at DB root of maxillary first molar in the non-cleft patients

| Insertion angle Vertical Cut level | 45 | 50 | 55 | 60 | 65 | 70 |
|---|-----------|-----------|-----------|-----------|-----------|-----------|
| 4.8 | 5.27±3.08 | 5.62±2.83 | 6.49±2.65 | 7.06±2.39 | 7.51±2.10 | 8.96±3.72 |
| 6.0 | 5.47±2.91 | 5.63±2.32 | 6.01±2.18 | 6.34±2.00 | 6.43±1.61 | 7.47±4.44 |
| 7.2 | 5.98±2.46 | 5.93±2.10 | 5.85±1.79 | 5.70±1.73 | 6.55±4.40 | 6.86±4.68 |
| 8.4 | 5.65±3.71 | 5.66±4.26 | 5.55±4.39 | 5.45±4.18 | 6.28±4.68 | 6.31±4.68 |
| 9.6 | 5.35±4.89 | 5.32±4.93 | 5.68±4.84 | 5.71±4.98 | 5.69±4.87 | 5.71±4.84 |

Table 4.20 The comparisons of the biting depth at DB root of maxillary first molar between non-cleft sides of cleft patients and non-cleft patients.

| Vertical cut level | Insertion angle | | | | | |
|--------------------|-----------------|-------|-------|-------|-------|--------|
| | 45 | 50 | 55 | 60 | 65 | 70 |
| 4.8 | 0.400 | 0.527 | 0.317 | 0.318 | 0.123 | *0.029 |
| 6.0 | 0.400 | 0.587 | 0.589 | 0.565 | 0.401 | 0.149 |
| 7.2 | 0.302 | 0.363 | 0.364 | 0.546 | 0.342 | 0.230 |
| 8.4 | 0.231 | 0.362 | 0.429 | 0.546 | 0.185 | 0.206 |
| 9.6 | 0.933 | 0.797 | 0.602 | 0.618 | 0.540 | 0.536 |

In non-cleft sides and cleft sides of cleft patients, and non-cleft patients, the biting depth varied with the vertical cut levels, mesiodistal sections and insertion angles. The higher the vertical cut levels, the lower the bone thicknesses of the IZ crest. Similarly, the greater the insertion angle of miniscrew implant placement, the lower the bone thicknesses of the IZ crest in the area that not related to the root of maxillary first molar, i.e., middle of buccal furcation area. For the thickness of IZ crest in mesiodistal sections, the DB section was thinnest and the middle of buccal furcation (B) section was thickest (Figure 4.5, 4.6).

At non-cleft sides, the combination of MB4.8, MB6.0 and MB7.2 sites with insertion angle ranging from 65 to 70 degree, the combination of MB9.6 site with the 45-50 degree angulation to the maxillary molar occlusal plane (MB4.8-7.2/65-70°, MB9.6/45-50°), The combination of B4.8, B6.0 and B7.2 sites with insertion angle ranging from 45 to 70 degrees, the combination of B8.4 site with insertion angle of 45-50 degree (B4.8-7.2/45-70°, B8.4/45-55°) and the combination of DB4.8 site with insertion angle of the 60 -70 degree (DB4.8/60-70°) provided bone thickness greater than 6.0 mm (Figure4.5)

At cleft sides, the combination of MB4.8, MB6.0 and MB7.2 sites with insertion angle of 60-70 degree, The combination of MB8.4 site with the 50-55 degree angulation (MB4.8-7.2/60-70°, MB8.4/50-55°), The combination of B4.8, B6.0 and B7.2 site with the 45-70 degree angulation, The combination of B8.4 site

with the 45-55 degree angulation (B4.8-7.2/45-70°, B8.4/45-55°), and the combination of DB4.8 site with the 60-70 degree angulation, the combination of DB6.0 site with the 50-70 degree angulation and the combination of DB 7.2 with the 45 degree angulation (DB4.8/60-70°, DB6.0/50-70°, DB7.2/45°) provided bone thickness greater than 6.0 mm (Figure 4.6).



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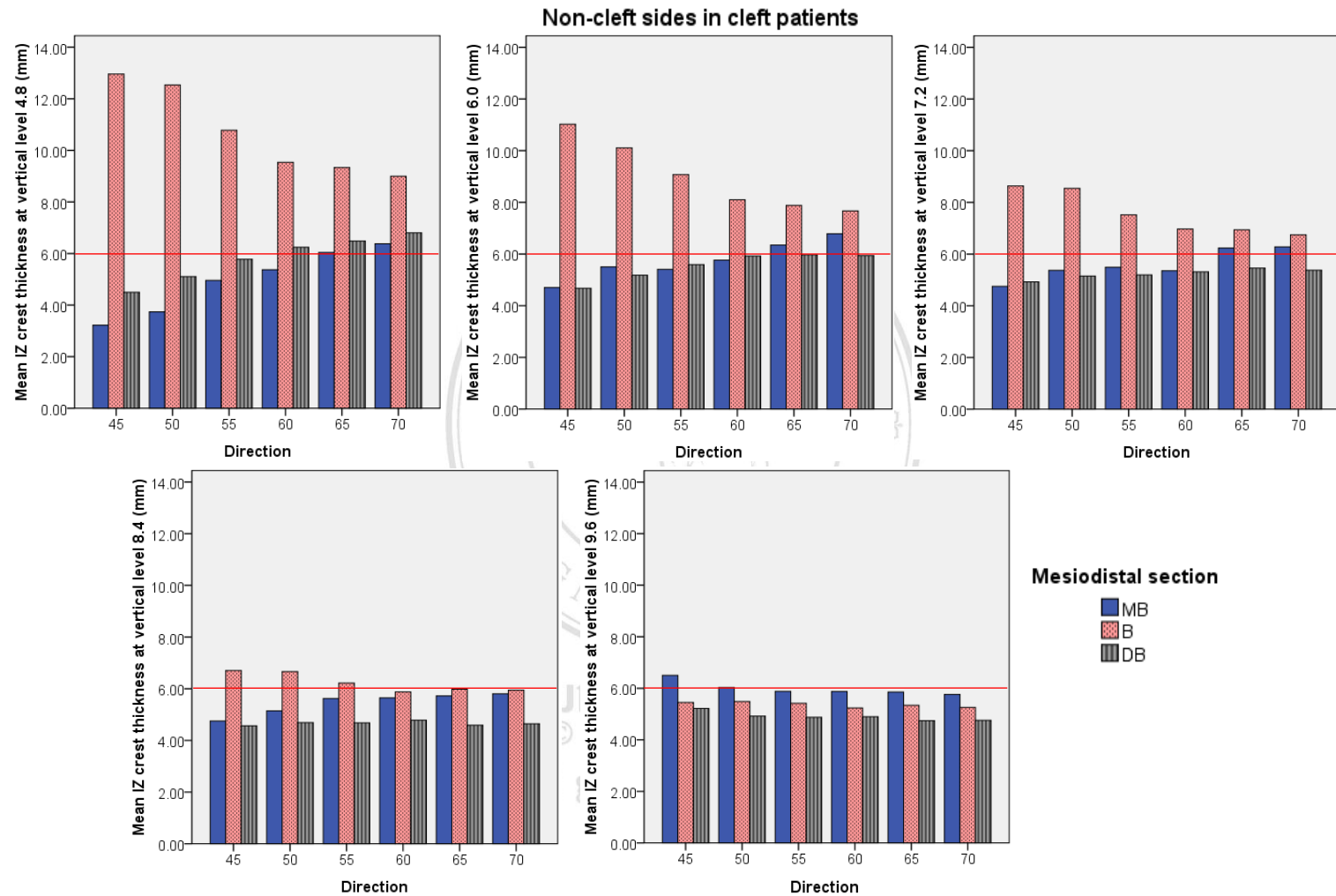


Figure 4.5 Mean IZ crest thickness at various sites at non-cleft sides in cleft patients. The red lines were inserted at the 6.0 mm level of mean IZ crest thickness, revealing the sites where the average IZ crest thickness were greater than 6.0 mm.

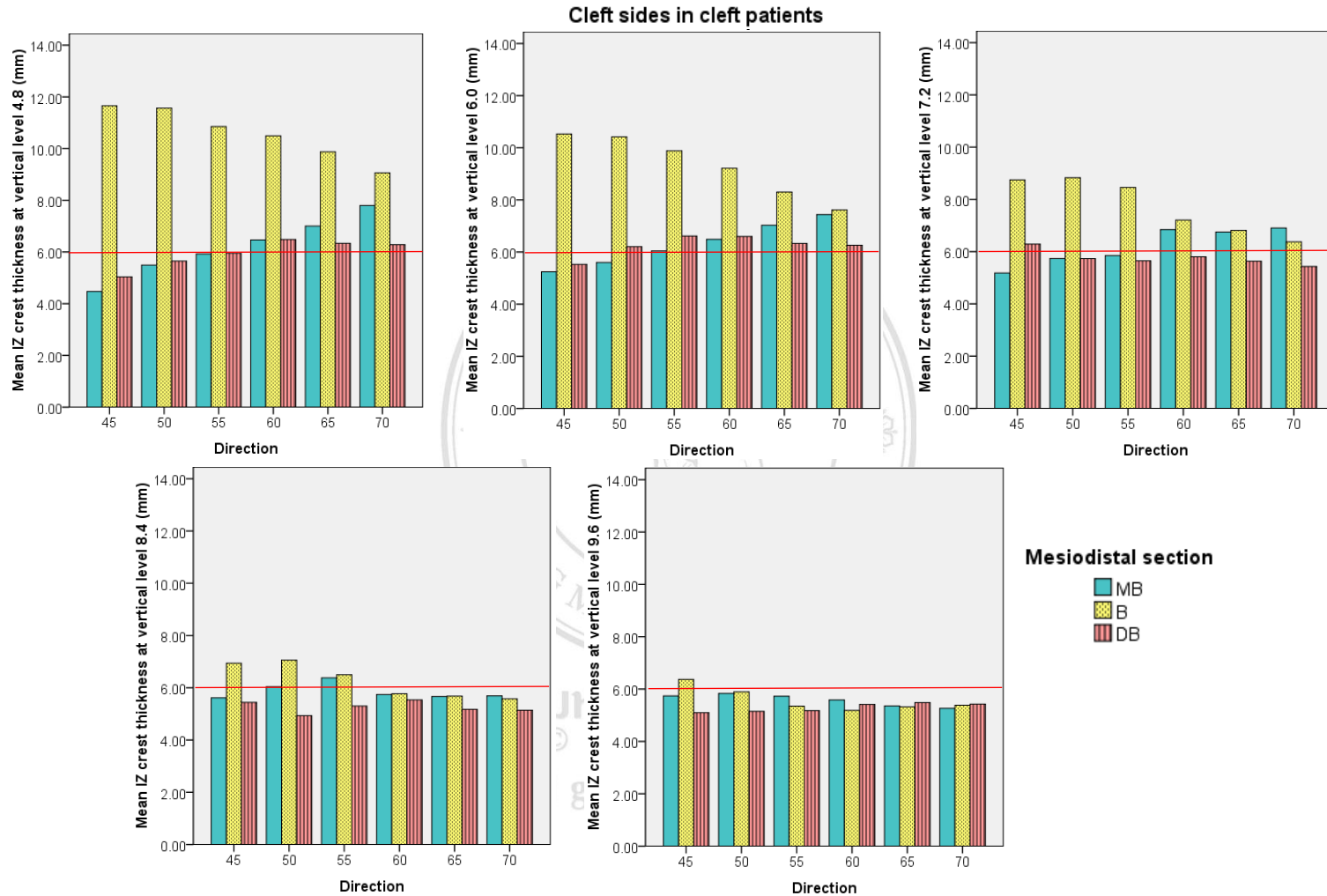


Figure 4.6 Mean IZ crest thickness at various sites at cleft sides in cleft patients. The red lines were inserted at the 6.0 mm level of mean IZ crest thickness, revealing the sites where the average IZ crest thickness were greater than 6.0 mm.