CHAPTER 4

RESULTS

Sixteen patients, ten females and six males, aged 16.91 ± 2.99 years (ranged from 12.3 to 22.5 years), with class I malocclusion, who required orthodontic treatment with first premolar extractions participated in the study, as are shown in **Table 1**. They had good oral hygiene and no inflammatory clinical signs of gingival and periodontal status throughout the study. Thirty-two miniscrew implants (2.0 mm diameter, 10.0 mm length) were placed, two in each patients. At placement, and during both the unloaded and the loaded periods, all miniscrew implants were clinically immobile. The success rate was 100%.

Table 1 Age (year) distributed by gender and number of the subjects (n) in the present study.

Gender	n	Age (years)			
		Minimum	**Maximum**	**Mean**	**Std. deviation**
Female	10	12.3	22.5	16.85	3.13
Male	6	12.3	20.5	17.01	3.03
Total	16	12.3	22.5	16.91	2.99

The right and the left experimental maxillary canines were moved with 70 and 120 grams retraction force, respectively. The GCF samples around the right and the left experimental maxillary canines and the right and the left control mandibular canines were collected with Periopaper® strips. The competitive ELISA with WF6 monoclonal antibody and protein assay were used to detect the CS (WF6 epitope) and protein levels, respectively. The CS (WF6 epitope) levels in all samples were measured in nanograms per microgram (ng/μg) of total protein content. It should be noted that the data from failed or excluded cases were not included in the calculated results.

The CS (WF6 epitope) levels (ng/μg of total protein) around the right and the left experimental maxillary canines and the right and the left control mandibular canines during the unloaded and the loaded periods are shown in **Table 2**.

Table 2 The CS (WF6 epitope) levels (ng/μg of total protein) around the right and the left experimental maxillary canines and the right and the left control mandibular canines during the unloaded and the loaded periods.

Tooth	CS (WF6 epitope) levels (ng/μg of total protein)					
	Unloaded period			Loaded period		
	Min.	Max.	Median	Min.	Max.	Median
Rt. control mand. canines	0.001	3.446	0.786	-	-	-
Lt. control mand. canines	0.007	3.562	0.626	-	-	-
Rt. experimental maxillary canines (70 grams retraction force)	0.003	3.269	0.794	0.042	28.615	1.421
Lt. experimental maxillary canines (120 grams retraction force)	0.116	1.762	0.669	0.002	31.106	1.861

During the unloaded period, the CS (WF6 epitope) levels around the right control mandibular canines ranged from 0.001 to 3.446 ng/μg of total protein and the median of CS (WF6 epitope) levels was 0.786 ng/μg of total protein (n = 126). The CS (WF6 epitope) levels around the left control mandibular canines ranged from 0.007 to 3.562 ng/μg of total protein and the median of CS (WF6 epitope) levels was 0.626 ng/μg of total protein (n = 126). The CS (WF6 epitope) levels around the right experimental maxillary canines ranged from 0.003 to 3.269 ng/μg of total protein and the median of CS (WF6 epitope) levels was 0.794 ng/μg of total protein (n = 16). The CS (WF6 epitope) levels around the left experimental maxillary canines ranged from 0.116 to 1.762 ng/μg of total protein and the median of CS (WF6 epitope) levels was 0.669 ng/μg of total protein (n = 16).

During the loaded period, the CS (WF6 epitope) levels around the right experimental maxillary canines (70 grams retraction force) ranged from 0.042 to 28.615 ng/μg of total protein and the median of CS (WF6 epitope) levels was 1.421 ng/μg of total protein (n = 128). The CS (WF6 epitope) levels around the left experimental maxillary canines (120 grams retraction force) ranged from 0.002 to 31.106 ng/μg of total protein and the median of CS (WF6 epitope) levels was 1.861 ng/μg of total protein (n = 128).

Comparison of CS (WF6 epitope) levels around the right and the left control mandibular canines during the unloaded periods (8 weeks) are shown in **Figure 5**. The medians of CS (WF6 epitope) levels during the unloaded period were not significantly different from each other.
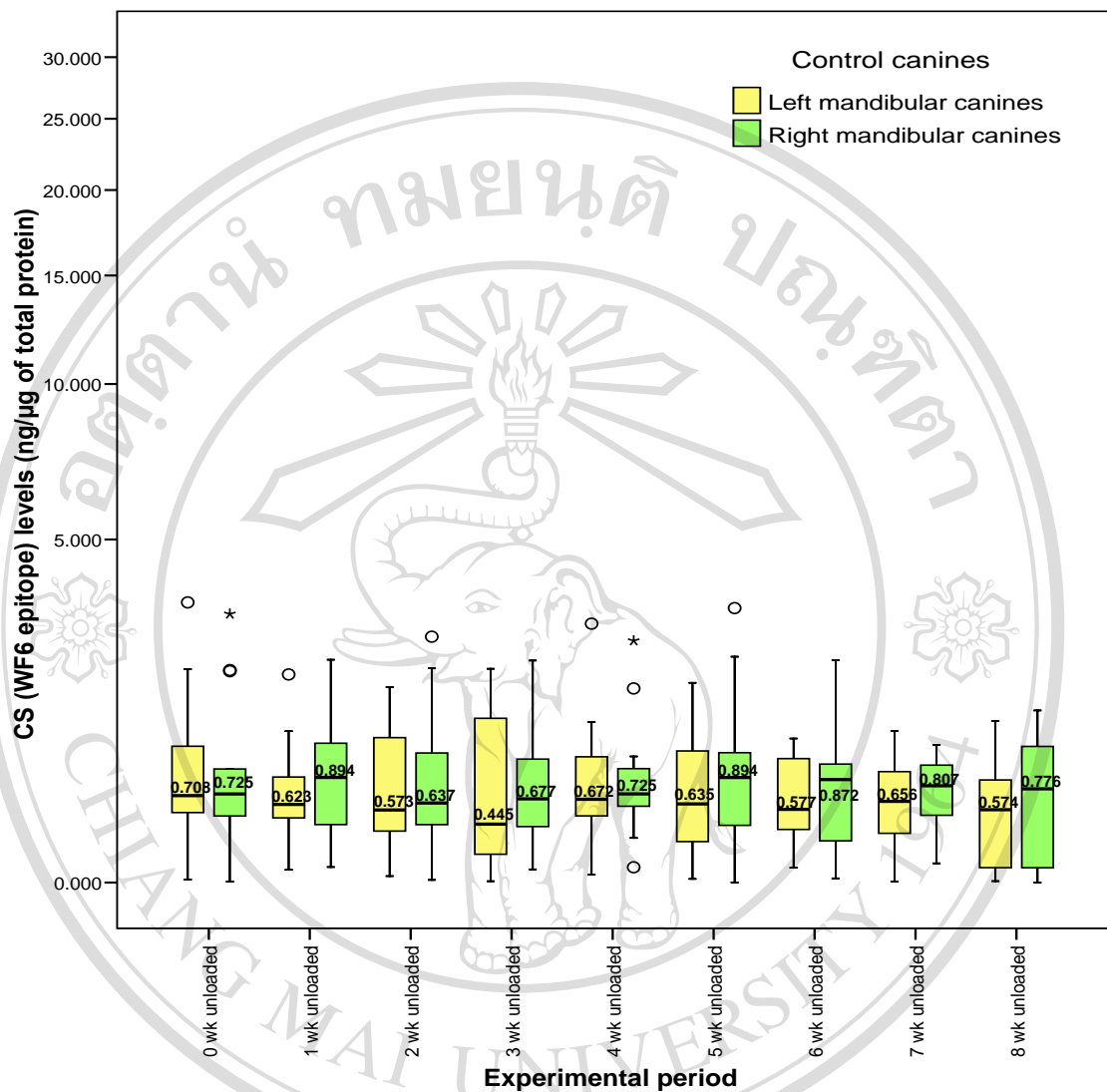
Figure 5 Boxplot graphs of the medians of CS (WF6 epitope) levels around the right
and the left control mandibular canines during the unloaded periods.

The medians of CS (WF6 epitope) levels around the right and the left
experimental maxillary canines, during the unloaded (1 week) and the loaded periods
(with 70 or 120 grams retraction force: 8 weeks) are shown in **Figure 6**. The
medians of CS (WF6 epitope) levels during the loaded period were significantly

greater than those during the unloaded period around the right (*P*=0.002) and the left (*P*=0.001) experimental maxillary canines.
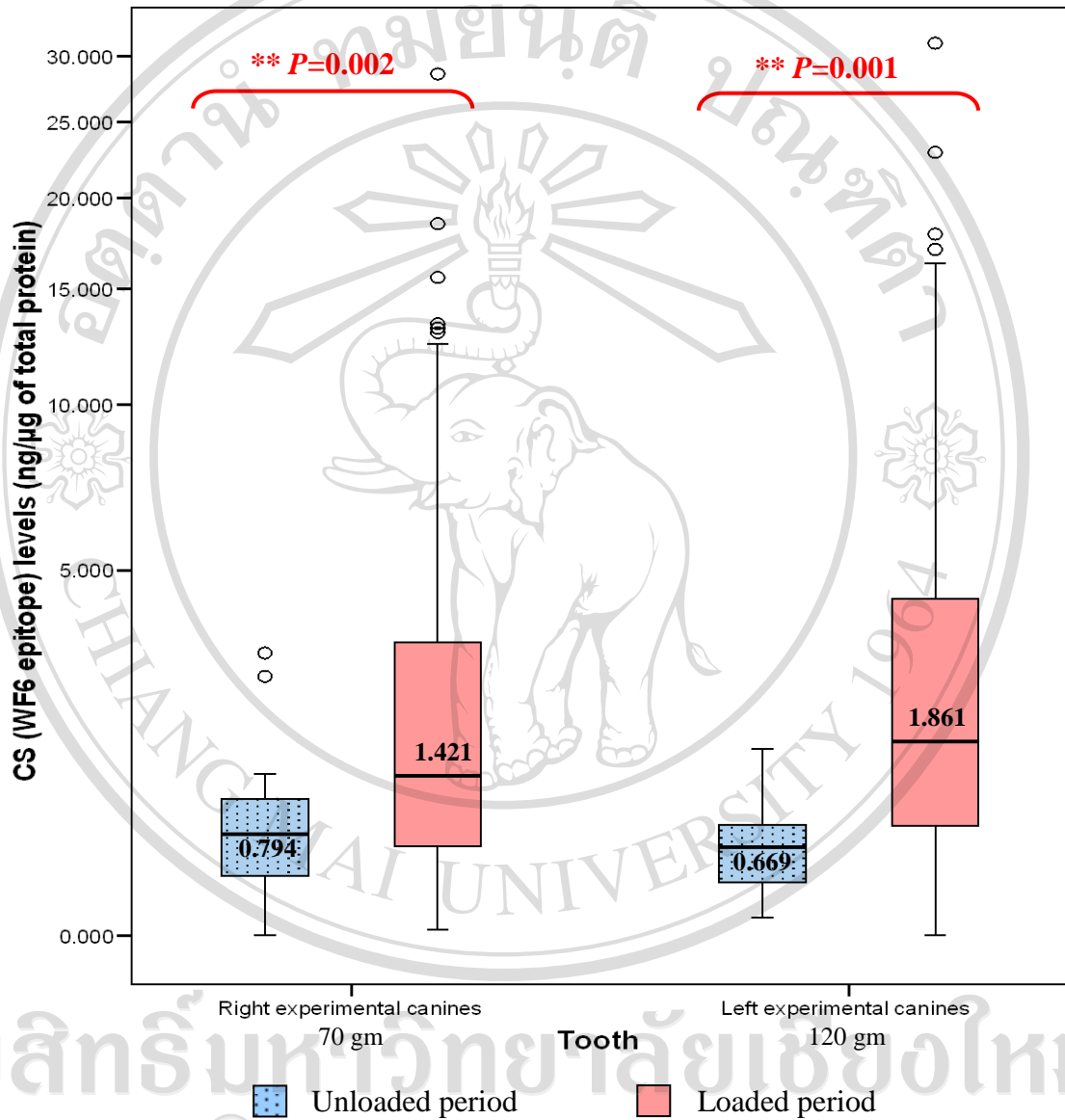

Figure 6 Boxplot graphs of the medians of CS (WF6 epitope) levels around the right and the left experimental maxillary canines during the unloaded and the loaded periods (with 70 or 120 grams retraction force).

The medians of CS (WF6 epitope) levels around the right and the left experimental maxillary canines (70 and 120 grams retraction force, respectively) during each one-week period (unloaded and 1st to 8th loaded week) are shown in **Figure 7**. In **Table 3**, around the right experimental maxillary canines (70 grams retraction force), the medians of CS (WF6 epitope) levels during the loaded period (1st week) were significantly greater than those during the unloaded period ($P<0.05$). In **Table 4**, around the left experimental maxillary canines (120 grams retraction force), the medians of CS (WF6 epitope) levels during the loaded period (1st, 2nd, 5th, 6th and 7th week) were significantly greater than those during the unloaded period ($P<0.05$). However, the differences between the medians of CS (WF6 epitope) levels around the right and the left experimental maxillary canines (70 and 120 grams retraction force, respectively) during each one-week period (unloaded and 1st to 8th loaded week) were not significant.

The study casts after orthodontic canine movement were measured using an ABSOLUTE digimatic caliper and the rates of canine movement were calculated. The rates of canine movement in all experimental canines were measured in millimeters per month (mm/month).

The rates of canine movement (mm/month) induced with 70 and with 120 grams of orthodontic force (n = 16) are shown in **Table 5.** There were no significant differences in rates of canine movement induced by the two force magnitudes.
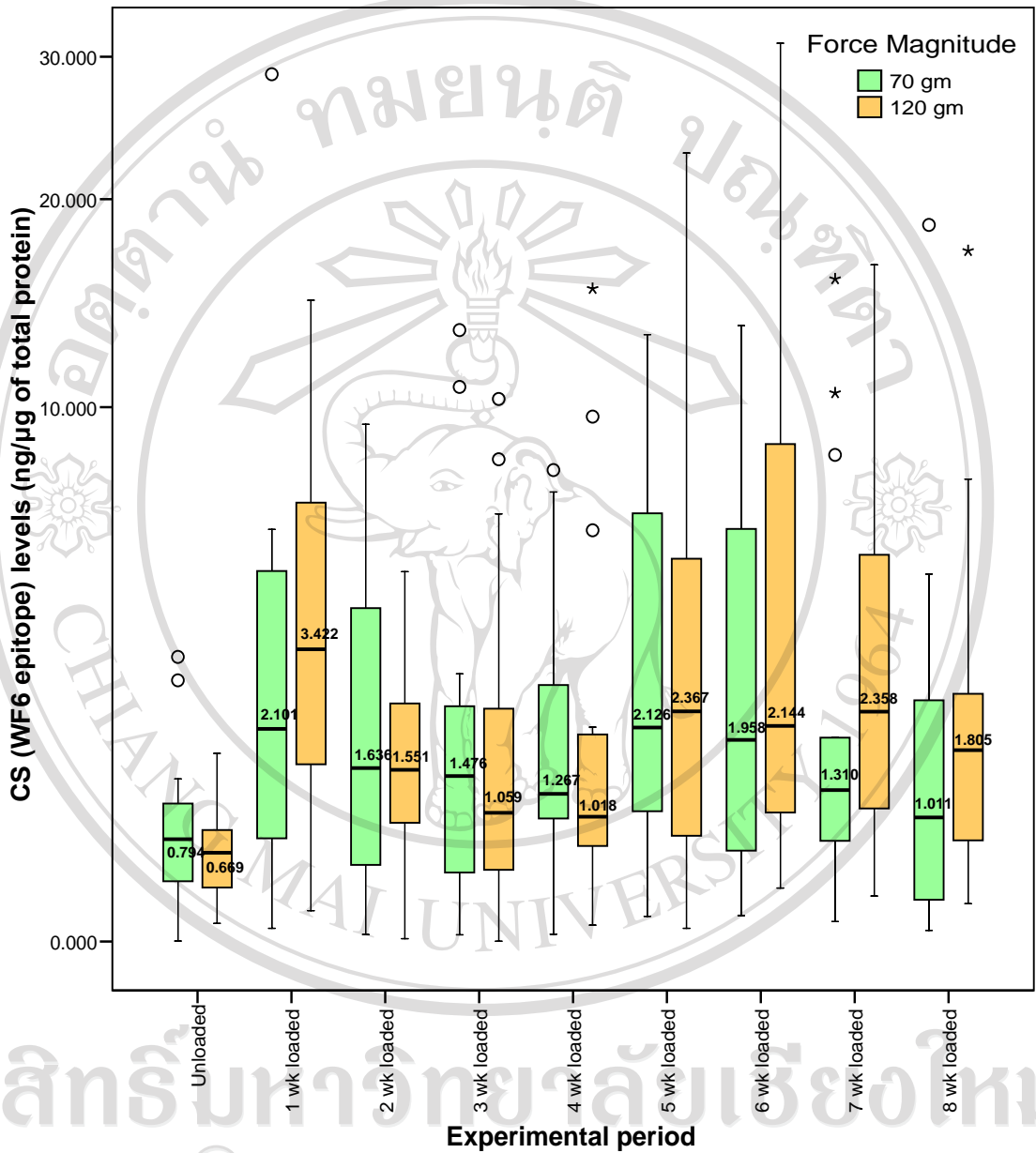
Figure 7 Boxplot graphs of the medians of CS (WF6 epitope) levels around the right and the left experimental maxillary canines (70 and 120 grams retraction force, respectively), during each one-week period.

Table 3 Statistically significant differences between the medians of CS (WF6 epitope) levels during the unloaded period and those during each one-week period during the loaded period (8 weeks) around the right experimental maxillary canines (70 grams retraction force).

Periods	Loaded period							
	1st wk	2nd wk	3th wk	4th wk	5th wk	6th wk	7th wk	8th wk
Unloaded	**							

** Significant difference: *P*< 0.05

Table 4 Statistically significant differences between the medians of CS (WF6 epitope) levels during the unloaded period and those during each one-week period during the loaded period (8 weeks) around the left experimental maxillary canines (120 grams retraction force).
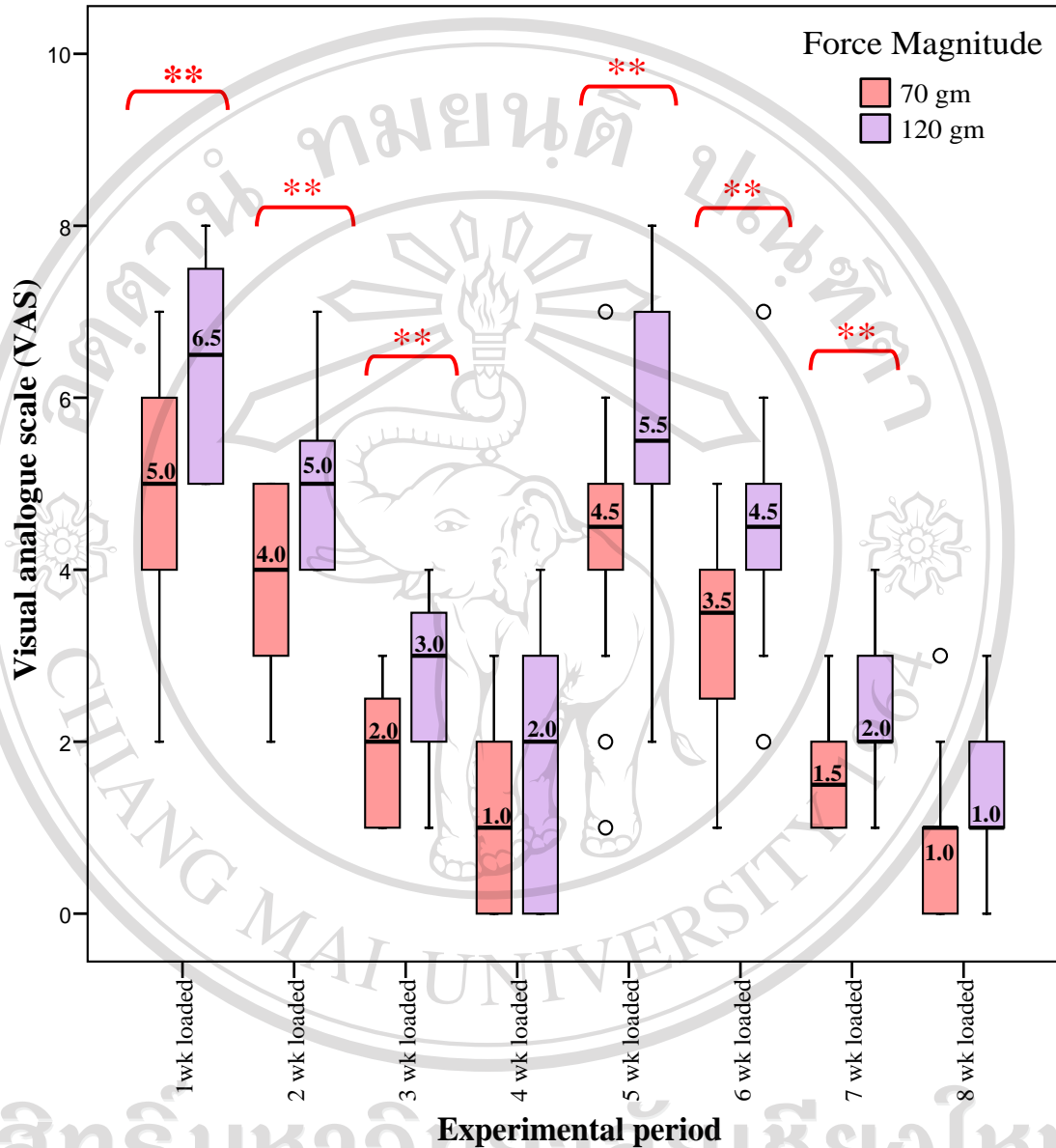
Periods	Loaded period							
	1st wk	2nd wk	3th wk	4th wk	5th wk	6th wk	7th wk	8th wk
Unloaded	**	**			**	**	**	

** Significant difference: *P*< 0.05

Table 5 The rate of canine movement (mm/month) distributed by range of force magnitude.

Force Magnitude	Rate of canine movement (mm/month)			
	Minimum	**Maximum**	**Mean**	**Std. Deviation**
70 grams	0.67	1.21	0.95	0.16
120 grams	0.21	1.45	0.87	0.28

The VAS scores represented the amount of pain that the patients felt. The VAS scores induced with 70 and with 120 grams of orthodontic force (n = 16) are shown in **Figure 8**. With both force magnitudes, the VAS scores had a peak one week after force application (1st week), then they gradually decreased and had a peak again one week after reactivation force (5th week), then they gradually decreased again. With 120 grams of orthodontic force, the medians of the VAS scores were significantly greater than those with 70 grams of orthodontic force at the 1st, 2nd, 3rd, 5th, 6th and 7th weeks, but not significantly different at the 4th and 8th weeks.

** Significant difference: *P* < 0.05

Figure 8 Boxplot graphs of the medians of the VAS score distributed by range of force

magnitude (70 and 120 grams of orthodontic force) during the loaded periods.