

CHAPTER 4

RESULTS

The results of this study are presented as follows:

4.1 Clinical observations

Fifteen orthodontic patients completed the 20-week study period. Subjects included 10 females and five males and had an age range from 11.97 to 22.92 years (mean age of 17.00 ± 3.18 years) (Table 4.1).

Table 4.1 Age (years) distribution by gender and number of the subjects (n) in each group in this study.

Gender	n	Age			
		Min	Max	Mean	Standard deviation
Female	10	11.97	22.92	17.03	3.46
Male	5	12.46	19.83	16.93	2.90
Total	15	11.97	22.92	17.00	3.18

The mean rate of mandibular canine movement by a continuous force pattern was 0.86 ± 0.37 mm/month, and that by an interrupted force pattern was 0.70 ± 0.55 mm/month (Table 4.2). Comparison of mean rates showed statistically insignificant differences ($P = 0.369$).

Table 4.2 Range (Min, Max), Mean (\bar{x}), standard deviation (SD) of rate of mandibular canine movement (mm/month) by either a continuous or an interrupted force pattern.

Force pattern	Rate of canine movement			
	Min	Max	Mean	Standard deviation
Continuous	0.25	2.17	0.86	0.37
Interrupted	0.25	1.67	0.70	0.55

*Significant difference: $P < 0.05$, Independent T-test

Table 4.3 show means and standard deviations of VAS scores of the patients' pain and discomfort resulting from either a continuous or an interrupted force pattern at the end of the 1st and 5th weeks during the loaded period. At the end of the 1st week, mean VAS scores of the patients' pain and discomfort resulting from continuous and from interrupted force patterns were 4.89 and 5.33, respectively. At the end of the 5th week,

Table 4.3 Mean (\bar{x}) and standard deviation (SD) of VAS scores of the patients' pain and discomfort resulting from either continuous or interrupted force patterns at the end of the 1st and 5th weeks during the loaded period.

VAS score	Force pattern	Mean	Standard deviation	Independent T-test
1 st week	continuous	4.89	2.15	$P = 0.707$
	interrupted	5.33	2.74	
5 th week	continuous	5.11	1.62	$P = 0.512$
	interrupted	4.44	2.51	

*Significant difference: $P < 0.05$, Independent T-test

mean VAS scores of the patients' pain and discomfort were 5.11 and 4.44, respectively. Comparison of mean of VAS scores of the patients' pain and discomfort during mandibular canine movement at the end of the 1st and 5th week during the loaded period between continuous and interrupted force patterns demonstrated statistically insignificant differences ($P = 0.707$ and 0.512 , respectively).

Boxplot graphs of forces, generated by elastomeric chains and measured at the beginning of the 1st week and the end of each week during the 8-week loaded period, are shown in Figure 4.1. Medians of forces, generated by elastomeric chains and measured at the beginning of the 1st week and the end of each week during the 8-week loaded period,

were 120.0, 60.0, 50.0, 37.5, 25.0, 62.5, 37.5, 25.0 and 25.0, respectively. At the beginning of the 1st week during the loaded period, all elastomeric chains were calibrated to generate an initial force of 120 gm. At the beginning of the 5th and the 9th weeks, the new elastomeric chains were calibrated to generate an initial force of 120 gm before replacement.

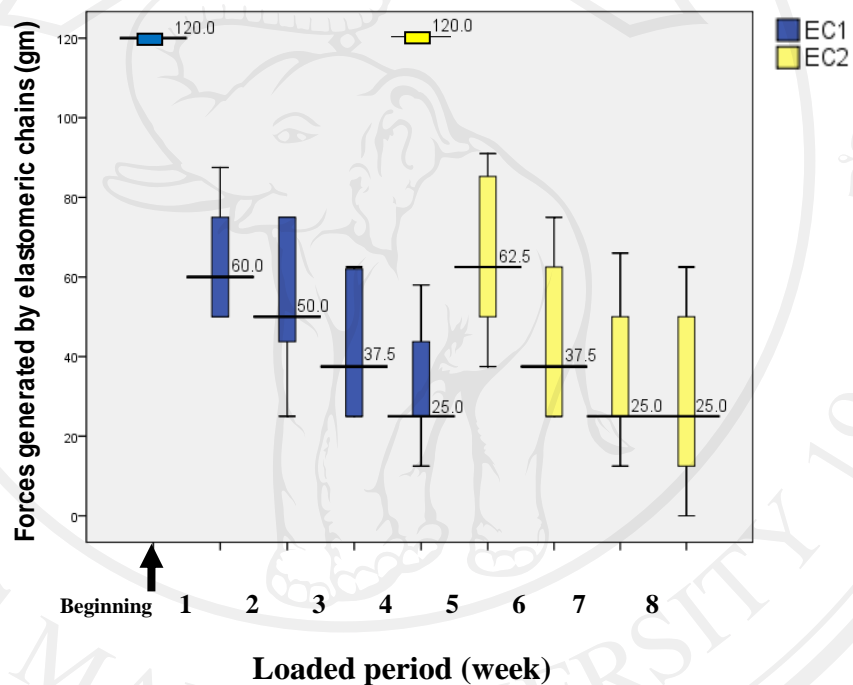


Figure 4.1 Boxplot graphs of forces, generated by elastomeric chains and measured at the beginning of the 1st week and the end of each week during the 8-week loaded period.

EC1 represents forces, generated by elastomeric chains and measured at the beginning of the 1st week and the end of each week from the 1st to the 4th weeks during the loaded period. **EC2** represents forces, generated by elastomeric chains and measured at the beginning of the 5th week and the end of each week from the 5th to the 8th weeks during the loaded period.

Profiles of forces generated by the 1st and the 2nd elastomeric chains and by a Nickel-Titanium closed coil spring from a subject (S16) are shown in Figure 4.2. The profile of forces generated by the 1st elastomeric chain (EC1) and that for the 2nd elasto-

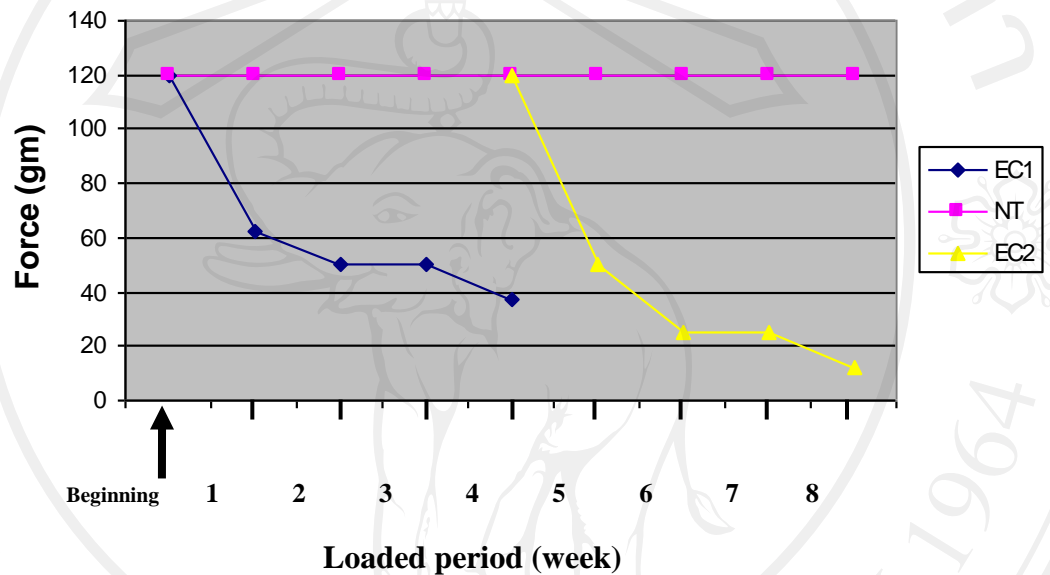


Figure 4.2 Profile of forces generated by either the 1st and the 2nd elastomeric chains or a Nickel-Titanium closed coil spring from a subject (S16) during the loaded period. **EC1** represents forces, generated by the 1st elastomeric chain and measured at the beginning of the 1st week and the end of each week from the 1st to the 4th weeks during the loaded period. **EC2** represents forces, generated by the 2nd elastomeric chain and measured at the beginning of the 5th week and the end of each week from the 5th to the 8th weeks during the loaded period. **NT** represents forces, generated by a Nickel-Titanium closed coil spring and measured at the beginning of the 1st week and the end of each week during the 8-week loaded period.

meric chain (EC2) were quite similar. The forces generated by the elastomeric chains decayed 50 - 60 % in the first week after elastomeric chain placement and more gradually thereafter. Meanwhile, the profile of force generated by the Nickel-Titanium closed coil spring (NT) was quite stable.

4.2 Chondroitin sulfate (WF6 epitope) levels

All GCF samples collected from the distal sulcus of experimental mandibular canines, the CS (WF6 epitope) was detected by a competitive ELISA with WF6 monoclonal antibody, and proteins by protein assay.

For the continuous force pattern, the medians of CS (WF6 epitope) levels at the end of each week during the 8-week unloaded period and the baseline data (collected at the beginning of the 1st week during the loaded period) were 0.61, 0.47, 0.42, 0.53, 0.46, 0.60, 0.53, 0.42 and 0.37 ng/ μ g of total protein content, respectively (Figure 4.3). No significant difference was found among the medians of CS (WF6 epitope) levels at the end of each week during the 8-week unloaded period and the baseline data during the loaded period.

For the interrupted force pattern, the medians of CS (WF6 epitope) levels at the end of each week during the 8-unloaded period and the baseline data (collected at the beginning of the 1st week during the loaded period) were 0.90, 0.49, 0.66, 0.70, 0.75, 0.87, 0.77, 0.84 and 0.21 ng/ μ g of total protein content, respectively (Figure 4.4). No significant difference was found among the medians of CS (WF6 epitope) levels at the

end of each week during the 8-week unloaded period and the baseline data during the loaded period.

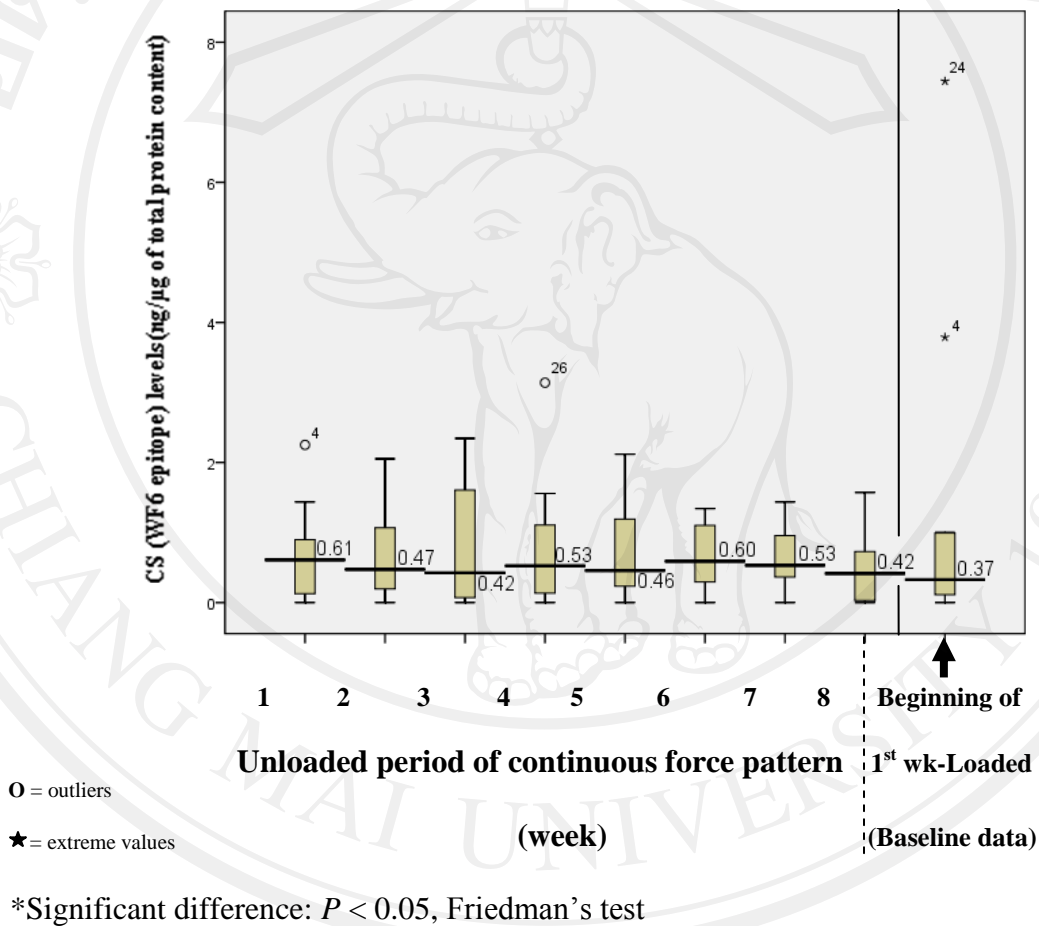


Figure 4.3 Boxplot graphs of CS (WF6 epitope) levels of continuous force pattern at the end of each week during the 8-week unloaded period and the baseline data from the loaded period (collected at the beginning of the 1st week during the loaded period).

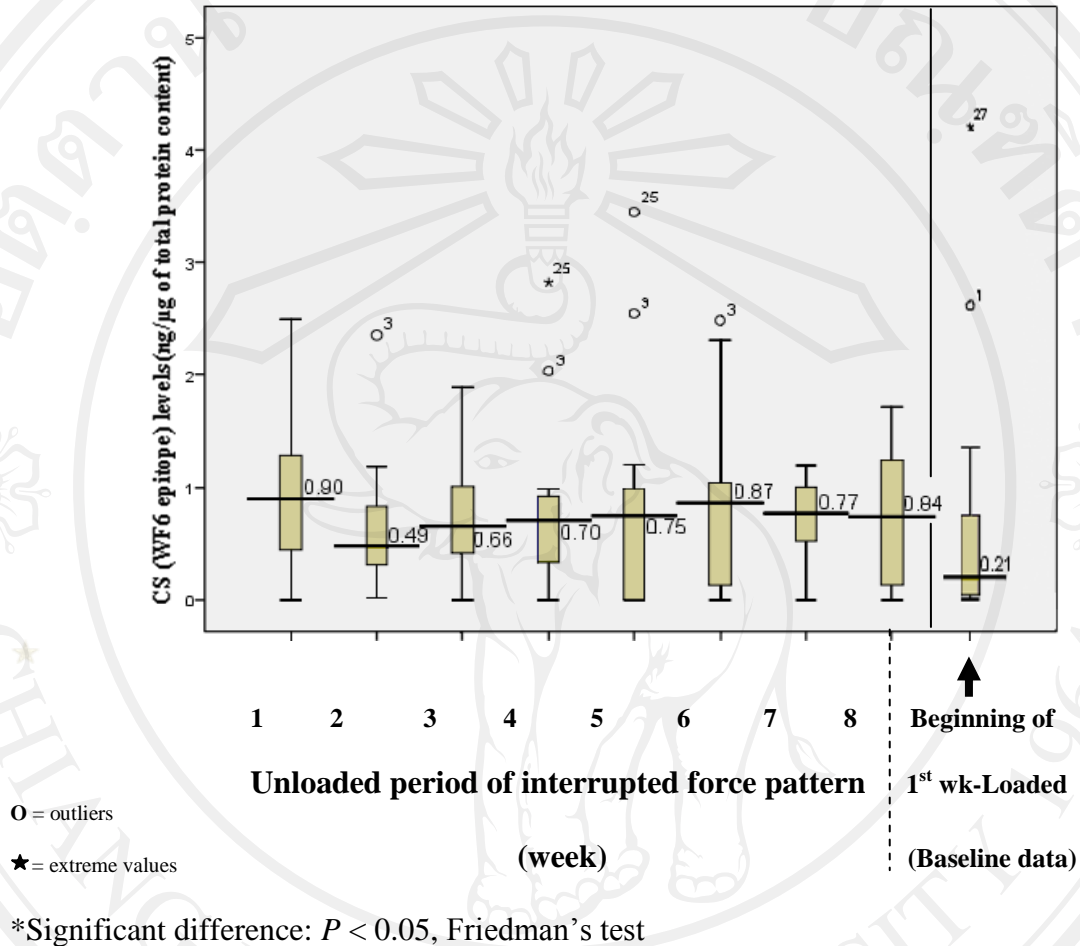
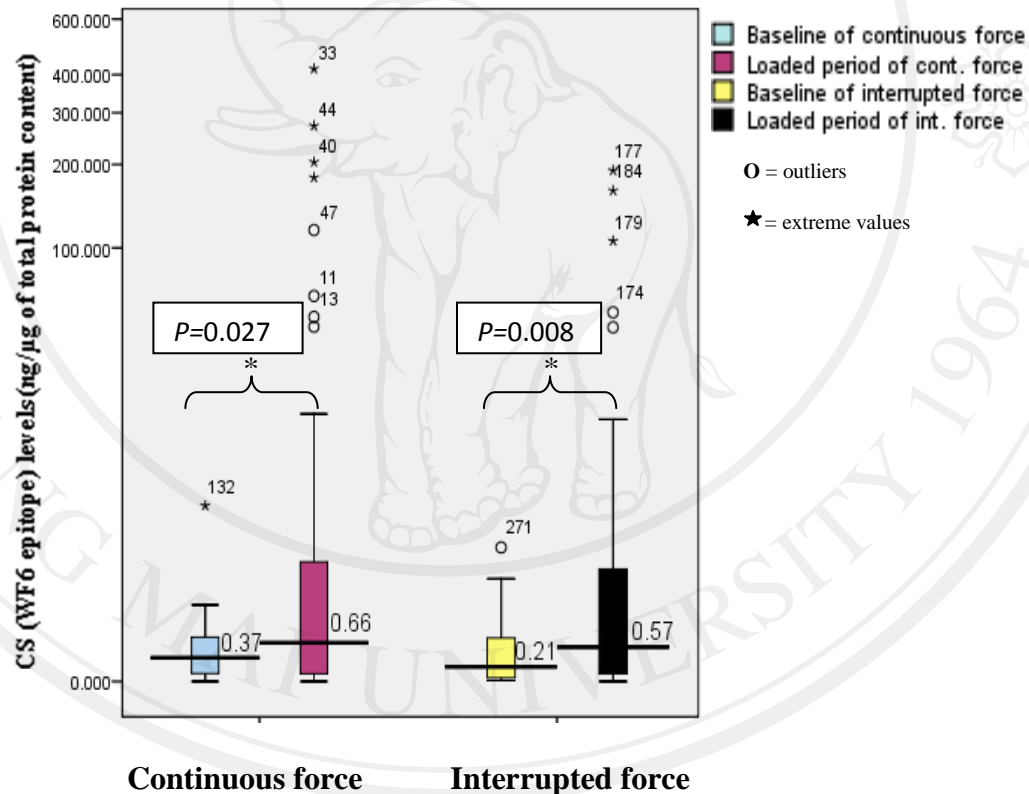


Figure 4.4 Boxplot graphs of CS (WF6 epitope) levels of interrupted force pattern at the end of each week during the 8-week unloaded period and the baseline data from the loaded period (collected at the beginning of the 1st week during the loaded period).

Boxplot graphs of CS (WF6 epitope) levels at the beginning of the loaded period (baseline data) and at the 8-week loaded periods in the GCF from loaded left (moved by a continuous force) and from loaded right (moved by an interrupted force) experimental

mandibular canines are shown in Figure 4.5. It should be noted that the means of the CS (WF6 epitope) levels of each subject from fifteen subjects were used for being calculated in the Wilcoxon signed ranks test.

CS (WF6 epitope) levels for left mandibular canines, moved by a continuous force, ranged from 0.001 to 7.44 ng/ μ g of total protein content (median 0.37) at the beginning



*Significant difference: $P < 0.05$, Wilcoxon signed ranks test

Figure 4.5 Boxplot graphs of CS (WF6 epitope) levels at the beginning of the loaded period (baseline data) and at the 8-week loaded periods in the GCF of experimental mandibular canines.

of the loaded period (baseline data), and from 0.001 to 417.68 ng/ μ g of total protein content (median 0.66) during the loaded periods (Figure 4.5). The median of CS (WF6 epitope) levels by a continuous force during the loaded period was significantly greater than that at the beginning of the loaded period (baseline data) ($P=0.027$).

CS (WF6 epitope) levels for right mandibular canines, moved by an interrupted force, ranged from 0.001 to 4.29 ng/ μ g of total protein content (median 0.21) at the beginning of the loaded period (baseline data), and from 0.001 to 190.53 ng/ μ g of total protein content (median 0.57) during the loaded periods (Figure 4.5). The median of CS (WF6 epitope) levels by an interrupted force during the loaded period was significantly greater than that at the beginning of the loaded period (baseline data) ($P=0.008$).

GCF collections from a subject (S16) are shown in Figure 4.6. Profiles of CS (WF6 epitope) levels from the same subject at the beginning of the 1st week and the end of each week during the 8-week unloaded period are shown in Figure 4.7. During the unloaded period, CS (WF6 epitope) levels around left and right mandibular canines (control data) showed a non-cyclical pattern.



Figure 4.6 GCF collections from a subject (S16) during the unloaded period.

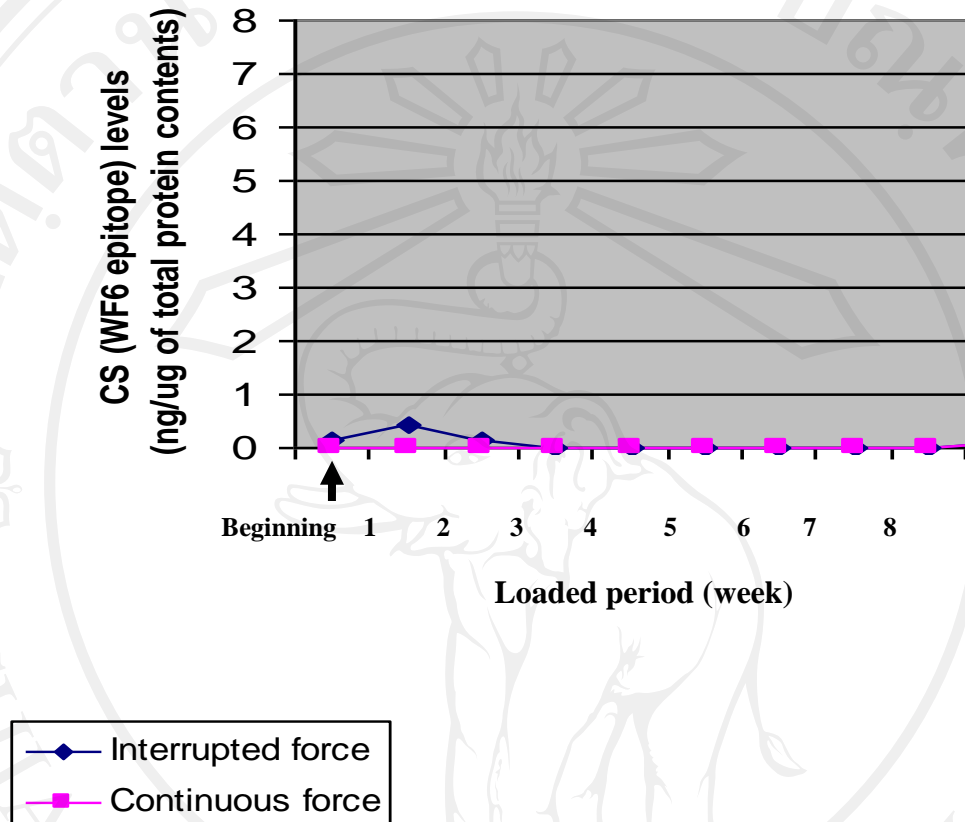


Figure 4.7 Profile of CS (WF6 epitope) levels from a subject (S16) at the beginning of the 1st week and the end of each week during the 8-week unloaded period.

Profiles of CS (WF6 epitope) levels from the same subject (S16) at the beginning of the 1st week and the end of each week during the 8-week unloaded and the 8-week loaded periods are shown in Figure 4.8. During the loaded period, CS (WF6 epitope) levels around the left mandibular canines moved by a continuous force showed a cyclical pattern. CS (WF6 epitope) levels were increased at the end of the 2nd week (the first peak

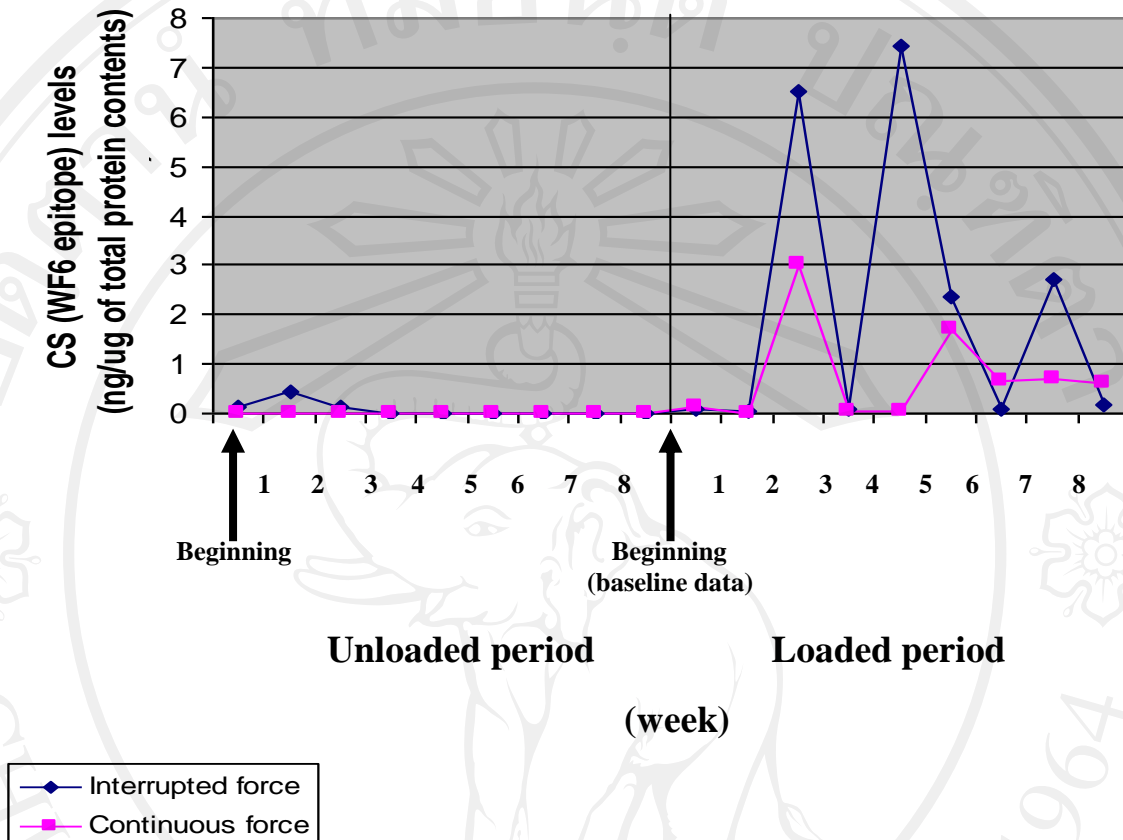


Figure 4.8 Profile of CS (WF6 epitope) levels from a subject (S16) at the beginning of the 1st week and the end of each week during the 8-week unloaded and the 8-week loaded periods.

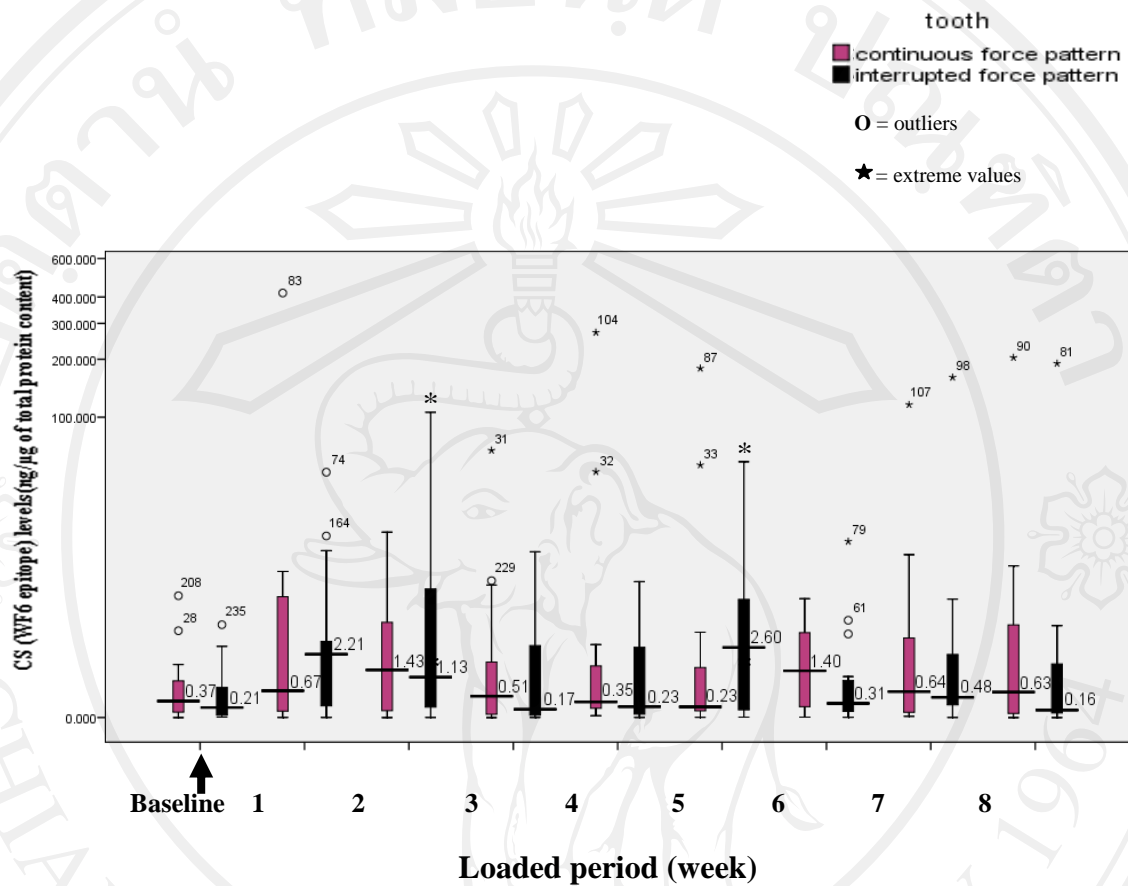
of the loaded period in Figure 4.8) and then decreased to baseline levels at the end of the 3rd week. A second peak was reproduced at the end of the 5th week.

During the loaded period, CS (WF6 epitope) levels around the right mandibular canines moved by an interrupted force showed a cyclical pattern. CS (WF6 epitope) levels were increased at the end of the 2nd week (the first peak of the loaded period in Figure 4.8) and then decreased to baseline levels at the end of the 3rd week. A second peak was reproduced at the end of the 4th week.

The medians of CS (WF6 epitope) levels by a continuous force pattern in the baseline data (collected at the beginning of the 1st week during the loaded period) to the end of the 8th week during the 8-week loaded period (experimental data) were 0.37, 0.67, 1.43, 0.51, 0.35, 0.23, 1.40, 0.64 and 0.63 ng/ μ g of total protein content, respectively (Figure 4.9). The medians of CS (WF6 epitope) levels in the baseline data and in the experimental data for each week were statistically compared. However, comparing the medians of CS (WF6 epitope) levels of all pairs demonstrated statistically insignificant differences ($P > 0.05$).

The medians of CS (WF6 epitope) levels by an interrupted force pattern in the baseline data (collected at the beginning of the 1st week during the loaded period) to the end of the 8th week during the 8-week loaded period (experimental data) were 0.21, 2.21, 1.13, 0.17, 0.23, 2.60, 0.31, 0.48 and 0.16 ng/ μ g of total protein content, respectively (Figure 4.9). The medians of CS (WF6 epitope) levels in the baseline data and in the experimental data for each week were statistically compared. The medians of CS (WF6 epitope) levels at the end of the 2nd and the 5th weeks during the loaded period (1.13 and 2.60 ng/ μ g of total protein content, respectively) were significantly greater than that of the baseline data ($P = 0.031$; $P = 0.041$). However, comparing the medians of CS (WF6 epitope) levels of all remaining pairs demonstrated statistically insignificant differences.

During the loaded period, the medians of CS (WF6 epitope) levels by a continuous and those by an interrupted force at each week were compared. The results at each week were not significantly different ($P > 0.05$) (Figure 4.9)



*Significant difference: $P < 0.05$; Wilcoxon signed ranks test, Mann-Whitney U-test

Figure 4.9 Boxplot graphs of CS (WF6 epitope) levels by either a continuous or an interrupted force pattern show baseline data (collected at the beginning of the 1st week during the loaded period) and experimental data (collected at the end of each week during the 8-week loaded period).