

CHAPTER 5

DISCUSSION

This investigation intended to monitor the effects of either a continuous or an interrupted orthodontic force pattern on the CS (WF6 epitope) levels during orthodontic mandibular canine movement. The selected biomarker was CS (WF6 epitope), which is a biomarker for bone (Pothacharoen, 2000) and for alveolar bone resorption (Intachai *et al.*; 2009, Jaito *et al.*, 2006). Meanwhile, other investigations used various inflammatory mediators, such as Interleukin-1 β (Lee *et al.*, 2004; Leethanakul *et al.*, 2008); Interleukin-8 (Leethanakul *et al.*, 2008), and prostaglandin E₂ (Lee *et al.*, 2004).

The CS (WF6 epitope) levels in this study were consistently low and showed a non-cyclical change during the unloaded period. CS (WF6 epitope) levels were similar to that of a recent study that evaluated this biomarker levels in periodontally healthy sites (Khongkhunthian *et al.*, 2008).

The results of this study, which showed a cyclical biological activity during the loaded period as a response to either a continuous or an interrupted force pattern, are similar to the results reported by Jaito *et al.* (2006). However, in their study, 140 gm continuous force was used to orthodontically move maxillary canines.

This study's selected biomarker was the CS (WF6 epitope), produced from the degradation process of alveolar bone resorption (Kavadia-Tsatata *et al.*, 2002; Waddington *et al.* 2001), so this experiment was designed to collect the GCF sample

at one week intervals for the 8-week study period after initial force application. However, Leethanakul *et al.* (2008) selected inflammatory mediators that were produced in the first process of alveolar bone remodeling, so their experiment was designed to collect the GCF samples at 24 hours after initial force application.

Leethanakul *et al.* (2008) also reported that the profile graphs of their inflammatory mediator levels (IL-1 β and IL-8) by either a continuous or an interrupted force pattern during canine movement were similar, and showed only one peak (24 hour) after initial force application. Meanwhile, this study showed that the profile graphs of bone degradation product (CS; WF6 epitope) levels by either a continuous or an interrupted force pattern during canine movement were also similar, but that there were two peaks (2 – 3 weeks) after initial force application.

Moreover, Leethanakul *et al.* (2008) found that the maximum levels of their selected biomarkers were detected 24 hours after initial force application and then declined. This led them to claim that neither continuous nor interrupted force patterns caused continuous release of both cytokines (IL-1 β and IL-8) from cells such as osteoclasts and fibroblast. In this study, the profile graph of CS (WF6 epitope) levels by both orthodontic force patterns showed two peaks during the loaded period. It may be assumed that the CS (WF6 epitope) levels can demonstrate at least two maximum levels of alveolar bone resorption. More frequent GCF collection during the loaded period in future studies may elucidate alveolar bone remodeling resulting from these orthodontic force patterns.

Furthermore, Leethanakul *et al.* (2008) revealed that IL-1 β and IL-8 levels caused by a continuous force pattern were significantly higher than those by an interrupted force pattern during all experimental times, and suggested that the continuous force pattern had a greater effect on cellular activity than did the interrupted force pattern. On the contrary, this study showed that the effects of both orthodontic force patterns on the CS (WF6 epitope) levels were not significantly different. The difference between the two studies may be due to the difference in experimental sites (maxillary canines versus mandibular canines) and initial force magnitude. Further studies are needed to elucidate these different results.

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). However, comparing the medians of CS (WF6 epitope) levels of all pairs between the medians of CS (WF6 epitope) levels in the baseline data and in the experimental data for each week demonstrated statistically insignificant differences ($P > 0.05$). The 120 gm continuous force (continuous heavy force) may cause hyalinization during mandibular canine movement, so less than 120 gm continuous orthodontic force may be appropriate for canine movement. However, exact magnitude of continuous force needs further investigation to elucidate. Intachai *et al.* (2009) can use only 50 gm continuous orthodontic force generated by Nickel-Titanium closed coil spring for effectively move maxillary canine.

This study revealed that the experimental elastomeric chains showed a gradual decrease in their force generation. Andreasen and Bishara (1970) previously reported

that an elastomeric chain force loss of 74% occurred one day after placement. Wong (1976) found that a force loss of 50% occurred in the first three hours. Lu *et al.* (1993) found that a force loss of 41% occurred during the first hour and 67% at the end of the 4th week during their study period. This study showed that a force loss of 60 % occurred in the first week after placement and that the loss increased to 79% at the end of the 4th week during the loaded period, corresponding to the findings reported by Lu *et al.* (1993).

While the tooth is moved by orthodontic force, deflection of alveolar bone and remodeling of periodontal tissues occur. Alveolar bone deflection starts in response to an initial orthodontic force of less than 50 gm and then osteocytes behave as mechanoreceptors. Stress produced in alveolar bone by orthodontic force can immediately generate electrical effects and may be the cause of bone remodeling (Meikle, 2006). From this reason, it may be implied that initial orthodontic forces, including an initial interrupted orthodontic force, can immediately produce rapid changes in the metabolic activity of alveolar bone after being applied to a tooth and can continue to produce bone remodeling, although loss of initial force can be measured. In this study, CS (WF6 epitope) levels from an interrupted force pattern, representing alveolar bone resorption, were detected, although the magnitude of gradual force decay can be measured in experimental elastomeric chains at each week during the loaded period. However, further studies are needed to elucidate the effect of this type of orthodontic force pattern on alveolar bone response.

Many factors from the subjects may be affected to the CS (WF6 epitope) levels, such as 1) systemic and oral condition, 2) drug using and 3) chewing habit. However,

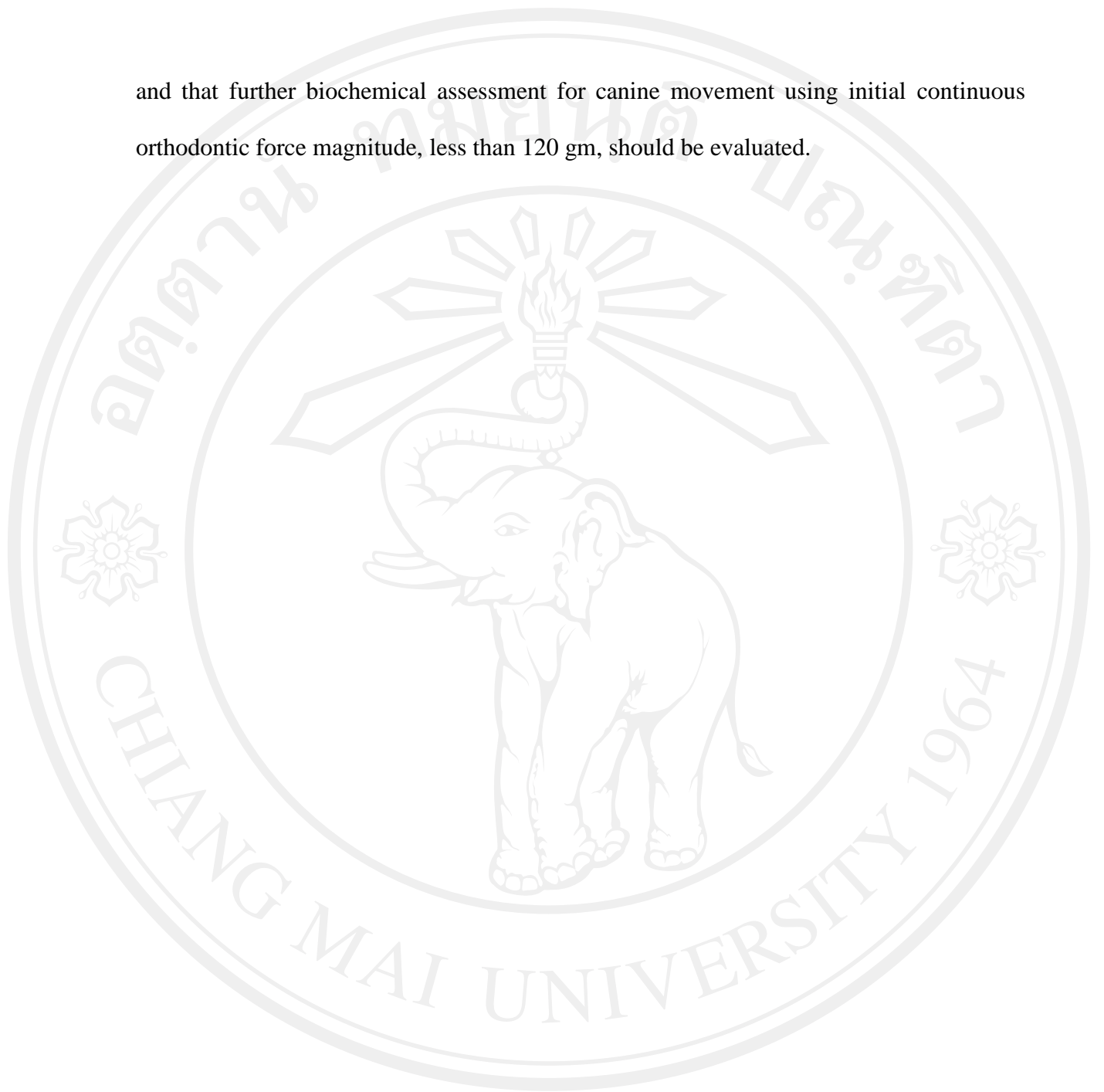
these factors were concerned and controlled before GCF collection in this study. In addition, the subjects not met this study's criteria after attendance were excluded from this project.

These results show that the mean rate of mandibular canine movement by a continuous force pattern was insignificantly different from that by an interrupted force pattern. These results agree with those reported by Lee *et al.* (2004), although the mechanics and initial force magnitudes for canine movement were different. Moreover, these results agree with those reported by Nightingale and Jones (2003), although they investigated the efficiency of continuous and interrupted force patterns for upper anterior contraction. However, many previous studies reported that a continuous force pattern produced significantly higher rates of canine movement than did an interrupted force pattern (Dixon *et al.*, 2002; Leethanakul *et al.*, 2008; Samuels *et al.*, 1993; Samuels *et al.*, 1998). In addition, those previous studies used higher initial force magnitudes (150-200 gm for Nickel-Titanium closed coil springs and 170-450 gm for elastomeric chains) than that used in this study (120 gm).

In this study, patients' pain and discomfort caused by either a continuous or an interrupted force pattern was similar. This result agrees with that of Samuels *et al.* (1993b). However, they used a 150 gm continuous force pattern and an initial 400-450 gm interrupted force pattern, and VAS score evaluation was not implemented.

Suggestions for further study are that other biomarkers that are closely related to osteoclastic activity or to the root resorption process should be simultaneously monitored, that the effects of force patterns with different force magnitudes should also be studied,

and that further biochemical assessment for canine movement using initial continuous orthodontic force magnitude, less than 120 gm, should be evaluated.



ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่
Copyright© by Chiang Mai University
All rights reserved



ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

Copyright© by Chiang Mai University
All rights reserved