CHAPTER 1

INTRODUCTION

1.1 Statement of the problem

Canine retraction, a common orthodontic procedure for extraction space closure by using conventional fixed appliances, is normally performed by sliding mechanics. Force-generating devices, both elastomeric chains and Nickel-Titanium closed coil springs, are conventionally used (Samuels *et al.*, 1993b; Samuels *et al.*, 1998; Dixon *et al.*, 2002; Hayashi *et al.*, 2004; Robert *et al.*, 2006; Leethanakul *et al.*, 2008).

Elastomeric chains were introduced in 1970 (Andreasen *et al*., 1970). Many investigators have reported permanent deformation and force decay of elastomeric products (Andreasen *et al.*, 1970; Hershey *et al.*, 1975; Wong, 1976; Ash *et al.*, 1978; Lu *et al.*, 1993). Therefore, elastomeric chains, delivering an interrupted force pattern, must be replaced during orthodontic treatment.

Nickel-Titanium closed coil springs were introduced in 1986. Nickel-Titanium closed coil springs can deliver a long range of constant, light and continuous force (Fujio *et al.*, 1986). Moreover, several *in vivo* studies have reported that Nickel-Titanium closed coil springs produce higher rates of space closure than do elastomeric chains (Samuels *et al.*, 1993b; Samuels *et al.*, 1998; Dixon *et al.*, 2002; Leethanakul *et al.*, 2008). Nickel-Titanium closed coil springs move the canine more rapidly, do not require changing at each recall visit, and may be selected as the force-generating material of choice for orthodontic treatment. However, elastomeric chains are as effective for orthodontic tooth movement and are less expensive to use in conventional orthodontic treatment (Dixon *et al.*, 2002).

Orthodontic tooth movement involves two interrelated processes, deflection or bending of alveolar bone and remodeling of periodontal tissues, while the tooth is moved by orthodontic force. The periodontal ligament cells respond to mechanical stimuli by releasing cytokines and growth factors that trigger biological processes associated with alveolar bone resorption and apposition (Meikle, 2006). The analysis of specific constituents of gingival crevicular fluid (GCF), for example inflammatory mediators, host-derived enzymes, and tissue-breakdown products, may provide quantitative biochemical indicators for local cellular metabolic activity (Delima *et al.*, 2003; Giannobile *et al.*, 1993).

Several *in vivo* studies have compared the efficiency of a continuous orthodontic force pattern generated by Nickel-Titanium closed coil springs to that of an interrupted force generated by elastomeric chains during orthodontic canine movement. Only a study by Leethanakul *et al.* (2008) used biochemical assessment. Interleukin-1ß and interleukin-8 levels detected in human gingival crevicular fluid during orthodontic tooth movement were used as biomarkers for comparing the effects of continuous and interrupted force patterns generated by Nickel-Titanium closed coil springs and elastomeric chains, respectively. Leethanakul *et al.* (2008) found that the levels of both biomarkers were elevated at 24 hours, and then declined. Nickel-Titanium closed coil springs gave higher rates of canine retraction, which correlated with the levels of both biomarkers. However, neither interleukin -1ß nor interleukin-8 was the sole factor that explained the process of bone remodeling.

During orthodontic tooth movement, the composition of extracellular matrix breakdown products in GCF changed. A previous study pertaining to biochemical assessment of chondroitin sulfate (CS) levels in gingival crevicular fluid during orthodontic canine movement, showed that the detectable chondroitin sulfate levels were associated with the applied orthodontic forces (Jaito *et al.*, 2006). So, this present study aimed to biochemically assess the effects of a continuous orthodontic force pattern generated by Nickel-Titanium closed coil springs and those of an interrupted orthodontic force pattern generated by elastomeric chains during orthodontic tooth movement by monitoring the chondroitin sulfate (CS; WF6 epitope) levels in GCF around the experimental mandibular canines, *in vivo*. Furthermore, the rate of canine movement and VAS scores of patients' pain and discomfort during mandibular canine movement were evaluated in this study.

1.2 Purpose and hypothesis of the study

The purposes of this study were to compare chondroitin sulfate (CS; WF6 epitope) levels in gingival crevicular fluid (GCF), the rates of madibular canine movement and the VAS scores of patients' pain and discomfort during mandibular canine movement using either a continuous orthodontic force pattern generated by Nickel-Titanium closed coil springs or an interrupted orthodontic force pattern generated by elastomeric chains.

The hypothesis of this study were

1) Medians of CS (WF6 epitope) levels at each week during the 8-week loaded period by either a continuous or an interrupted orthodontic force pattern are not significant different.

2) Mean rates of mandibular canine movement by either a continuous or an interrupted orthodontic force pattern are not significant different.

3) Mean VAS scores of patients' pain and discomfort during mandibular canine movement at the end of the 1^{st} and the 5^{th} weeks by either a continuous or an interrupted orthodontic force pattern are not significant different.

1.3 Anticipated benefits

The data from this study may help clinicians or researchers to biochemically evaluate the periodontal response to either a continuous orthodontic force pattern generated by Nickel-Titanium closed coil springs or an interrupted orthodontic force pattern generated by elastomeric chains during orthodontic tooth movement.