CHAPTER I

INTRODUCTION

PRINCIPLES, THEORY, RATIONALE AND HYPOTHESIS

Orthodontic treatment is a way to correct malocclusion. The objectives of treatment are to improve function, stability, esthetics and oral health. Crowding and protrusion of the dental arches are the problems most frequently found. The main problem of these kinds of malocclusions is the space discrepancy, which can be solved in several ways such as arch expansion, molar distalization, incisor proclination and extraction. Extraction is the major way to gain spaces, and they often necessitate the extraction of first premolars to create spaces in each dental arch for resolving tooth size - arch size discrepancy. Then, the treatment requires some mechanisms for consolidating this space to achieve the desired treatment objectives.

Closure of spaces in the dental arch may be accomplished with closed coil springs, open coil springs, retraction springs, closing loop arch wires, elastomeric chains and threads and more recently magnets. The coiled springs are difficult to keep clean, the retraction springs and the closing loop arch wires can impinge the gingiva and irritate mucosa. The magnets currently in use are bulkly, expensive and also difficult to keep free from food debris. In contrast, elastomeric chains are economical, easily applied, relatively hygienic and require little or no patient cooperation, but they have some disadvantages. When elastomeric chains expose to an oral environment, they absorb water and saliva, permanently stain, and suffer breakdown of internal bonds leading to permanent deformation. They also experience rapid loss of force due to stress relaxation, resulting in a gradual loss of effectiveness and consequently do not produce the continuous forces which are the most effective force for tooth movement.

Several previous researches reported that several factors affected to the properties of synthetic elastics such as basis material, force decay rate and pattern, application of initial force, the environment, and their elastic properties such as elastic limit, percent elongation, etc.

The characteristics of an orthodontic force system including magnitude, frequency, direction, moment to force ratio, constancy and range of activation affect the type of biologic response in tooth movement. The required force to achieve physiologic tooth movement is still in some controversy, but it is generally agreed that light continuous force was optimal. Proffit (1993) stated that the amount of tooth movement was directly proportional to the pressure that applied to a tooth when the pressure was above a minimal threshold and below the optimal force level. The derived force from elastomeric chains depended on the magnitude of the initial force, the length of time from activation and the rate of force decay. Therefore, the elastomeric chains might be applying an ineffective force for some period during treatment before the next appointment.

The clinician can control both the amount of the initial force applied and the time between elastic changings, but the factors influencing the force decay rate of elastomeric chains are not completely understood. Therefore, this study was designed to evaluate generated force (elastic strength) and percent elongation at elastic limit, and the remaining force and force degradation of orthodontic elastomeric chains with simulated tooth movement during 6 weeks. The benefits of this study in order to clinical application show the proper form and number of loops, amount of extension and the effective time in using the elastomeric chains for canine retraction.

This study was aimed to determine and compare magnituded of generated force, displacement and percent elongation at elastic limit, the remaining force, and force degradation of closed, open and wide space of orthodontic elastomeric chains with simulated tooth movement. The hypotheses in this study were:

1. Generated force and percent elongation at elastic limit among closed, open and wide space elastomeric chains in the same number of loops were different.

2. Generated force and percent elongation at elastic limit between three-loop and four-loop closed, open and wide space elastomeric chains were different.

3. Percent remaining force and percent force decay rate among closed, open and wide space elastomeric chains in each time period were different.

4. Percent remaining force and percent force decay rate of closed, open and wide space elastomeric chains among different time period were different.

PURPOSES OF THE STUDY

The purposes of this experiment were:

1. to investigate the force-displacement curves, generated force, displacement and percent elongation at the elastic limit of three-loop and four-loop closed, open and wide space orthodontic elastomeric chains,

2. to differentiate generated force and percent elongation at elastic limit among three-loop and four-loop groups of closed open and wide space orthodontic elastomeric chains,

3. to determine remaining force and force degradation of closed, open and wide space elastomeric chains with simulated tooth movement during six weeks period,

4. to compare remaining force and force degradation among closed, open and wide space elastomeric chains with simulated tooth movement during six weeks period, and

5. to find out force decay patterns of closed, open and wide space elastomeric chains with simulated tooth movement.

ANTICIPATED BENIFITS

1. To indicate proper form, number of loops and amount of extension of elastomeric chains that is the most effective for canine retraction.

2. To approximate the effective timing for each form of elastomeric chains in tooth movement.

3. To apply for clinical using of elastomeric chains in canine retraction.

4. To be a scientific basic knowledge of orthodontic elastomeric chains for the further study.

SCOPE OF THIS STUDY

This *in vitro* study was aimed to investigate three and four loops of closed, open and wide space of grey orthodontic elastomeric chains (Ormco® Power Chain Generation II). The investigation was separated in two parts. The purposes in Part I were aimed to evaluate force magnitude, displacement and percent elongation at elastic limit in 25°C ± 1°C with 50 ± 5% humidity condition (Table 1.1), and in Part II were aimed to study the remaining force, force degradation and force decay pattern in six-week period with simulated tooth movement, 0.5 millimeters per week, at 37°C ± 1°C with 100% humidity condition.

Table 1.1 The conditions in Tension testing of orthodontic elastomeric chains

Tension Test condition:		
Load Cell	=	10 Kilonewtons
Initial Strain Rate	=	200% per minute
Initial Gage Length	=	Variable (see Table 3.2)
Temperature	=	25°C ± 1°C
Humidity	=	50 ± 5%

GLOSSARY OF TERMS

ELASTIC LIMIT The greatest stress which a material is capable of sustaining without any permanent strain remaining upon complete release of the stress. *Note:* Measured values of proportional limit and elastic limit vary greatly with the sensitivity and accuracy of the testing equipment, eccentricity of loading, the scale to which the stress-strain diagram is plotted, and other factors. Consequently, these values are usually replaced by yield strength (ASTM D 638).

ELASTIC STRENGTH The load or stress coordinate of the elastic limit.

ELASTOMERIC CHAIN A type of orthodontic appliance that made from synthetic polymer, thermoplastic polyurethane elastomer, but its exact composition is proprietary information depended on its manufacturer.

ELONGATION The increase in gage length of a body subjected to a tension force, referenced to a gage length on the body. Usually elongation is expressed as a percentage of the original gage length.

FORCE DECAY The decrease over time of force internal to a body maintained under conditions of strain.

REMAINING FORCE The force values measured from extension of elastomeric chains in each time interval. The remaining force were calculated in pecent of the initial force for comparable.