CHAPTER I

INTRODUCTION

PRINCIPLES, THEORY AND RATIONALE

In recent years, elastomeric ligatures are widely used in orthodontic practices. They have been used to tie arch wires into Edgewise orthodontic brackets, to correct minor tooth rotation, and to close spaces (elastic module system). They are quickly and easily applied, are comfortable to the patient, have greater patient acceptance and are available in various colors. Their advertised properties are continuous gentle force, consistent long-lasting arch wire seating, water sorption resistance, and shape memory properties. However, they have some disadvantages, such as incomplete arch wire seating in a bracket slot during torquing or rotational correction, binding effect during sliding mechanics (Echols, 1975; Thurow, 1975), water and saliva absorption when exposed to an oral environment, rapid force loss and permanent deformation when stretched (Taloumis *et al.*, 1997), and increasing the microbial accumulation on tooth surfaces adjacent to the brackets (Forsberg *et al.*, 1991).

Elastomeric ligatures are sold in stick form. A stick has a number of modules attached such as a stick of Power "O" with 50 modules (Ormco corporation), a Quik-Stick™ with 60 modules (3M Unitek) and a Carouse Ring Las-Tie with 100 modules (Tomy International Inc). Many manufacturers attempt to produce elastomeric ligatures in stick form with enough ligatures for both arches of a single patient and introduce a delivery systems for use (Davies, 1998). However, orthodontists may use ligatures varied from 1 to 28 modules for each appointment. If an entire stick is not used at once, the remaining ligatures are either wasted or exposed to potential cross-contamination. This leaves the task of disinfecting or sterilizing the remaining modules before they can be used for another patient. Therefore, disinfecting or sterilizing the remaining modules is necessary for another patient.

Recent reports on infection control recommend a 2% glutaraldehyde solution for heat-sensitive and plastic items such as elastomeric materials (Payne, 1986; Campbell, 1986; Cash, 1988; Jakush, 1988). They must be immersed in a 2% glutaraldehyde solution for at least 10 minutes at room temperature for disinfection and 6.75 to 10 hours for sterilization, depending on formulation (Council on dental therapeutics, 1985). Elastomeric ligatures are categorized into semicritical medical items which contact only the mucous membrane, but do not usually penetrate normally sterile body areas. Sterilization is recommended whenever practical, otherwise disinfection is acceptable (Scott and Gorman, 1983; Payne, 1986; Cottone and Molinar, 1996).

Elastomeric material properties are changed when exposed to chemical or environmental factors such as water, saliva and disinfectant solution which may accelerate the breakage of the cross-links among the long chain molecules of polyurethane polyesters, producing free radicals of polyurethane that lead to rapid relaxation of elastomeric materials (Wong, 1976; Killiany and Duplesis, 1985). Jeffries and von Fraunhofer (1991) studied the effect of repeated and long-term immersion in a 2% alkaline glutaraldehyde solution on the elastic properties of elastomeric chain and found that disinfection and sterilization treatment with glutaraldehyde produced a small decrease in the strength and this decrease was clinically irrelevant.

Two percent glutaraldehyde solution may affect the generated force and dimensions of elastomeric ligatures. Elastomeric ligatures are distinct from elastomeric chains in their compositions and their clinical usage. There are no published reports about the effects of a 2% glutaraldehyde solution on the generated force and dimensions of elastomeric ligatures. Therefore, this study was undertaken to evaluate the effects of immersion in a 2% glutaraldehyde solution on the generated force and dimensions of elastomeric ligature.

PURPOSES OF THE STUDY

The purposes of this investigation were:

1. to compare the initial dimensions of elastomeric ligatures treated with a 2% glutaraldehyde solution and untreated elastomeric ligatures,

2. to compare the initial force of elastomeric ligatures treated with a 2% glutaraldehyde solution and untreated elastomeric ligatures,

3. to compare the percentage of remaining force during seven time intervals within 28 days of elastomeric ligatures treated with a 2% glutaraldehyde solution and untreated elastomeric ligatures.

HYPOTHESIS

The hypothesis of this study were:

1. the initial dimensions of elastomeric ligatures treated with a 2% glutaraldehyde solution were larger than those of untreated elastomeric ligatures,

2. the initial force of elastomeric ligatures treated with a 2% glutaraldehyde solution was lower than that of untreated elastomeric ligatures,

3. the percentage of remaining force during seven time interval within 28 days of elastomeric ligatures treated with a 2% glutaraldehyde solution was lower than that of untreated elastomeric ligatures.

ANTICIPATED BENEFITS

The anticipated benefits of this study were:

1. to apply for clinical use of a 2% glutaraldehyde solution in disinfection of elastomeric material,

2. to be basic knowledge for further studies.

SCOPE OF THIS STUDY

This *in vitro* study was aimed to investigate the effects of repeated immersion in a 2% glutaraldehyde solution (Pose-Dex®) on the dimensions and generated force of elastomeric ligatures (Ormco® Power "O" modules). The dimension measuring was performed by a ten-time magnifying glass and the force testing was performed by a universal testing machine under room condition, $27^{\circ}C \pm 2^{\circ}C$ and $50\% \pm 5\%$ humidity. This investigation was conducted at the laboratory of Industrial Chemistry Department, Faculty of Science, Chiang Mai University, Thailand.

GLOSSARY OF TERMS

Sterilization : The destruction of all microbial life, including highly resistant bacteria spores.

Disinfection : The destruction of most microorganisms but not highly resistant spores.

Initial force : The force values measured from extension of elastomeric ligatures at beginning.

Remaining force : The force values measured from extension of elastomeric ligatures at each time interval.

Percentage of remaining force (%) : $\frac{\text{Remaining force (gram) in each time interval}}{\text{Initial force (gram)}} \times 100$