CHAPTER I
INTRODUCTION

PRINCIPLE, THEORY, RATIONALE AND HYPOTHESIS

Permanent magnets have been used for various dental applications since 1970s. Initially, they have been used to aid the retention of denture and overdenture (Javid, 1971, Gillings, 1981).

The use of magnets for generating orthodontic forces has been increased, particularly in the treatment of unerupted teeth, in the anterior open bite correction, in functional appliances, for tooth movement along archwires, expansion and fixed retention. Magnets had significant advantages over other materials used to move teeth such as elastic chain or coil spring as they could produce continuous force over long period of time. They could be made to attract or to repel, in other words, to push or to pull the teeth. The force they delivered could be controlled directionally (Blecham and Smiley, 1978). Other advantages of magnets are that attractive magnets obviate the need for guiding auxillaries, implying no friction, and that permanent magnets do not show any material fatigue which often occurs with coil spring and elastic chain in conventional orthodontic mechanics.

The magnets have been increasingly used in orthodontic practice because of the development of small and powerful magnet alloys called rare earth magnets such as samarium cobalt ($SmCo_5$ and Sm_2Co_{17}) and neodymium-iron-boron ($Nd_2Fe_{14}B$) magnetic alloys. Both magnetic alloys had special properties superior to previously used magnetic alloys like alnico, ferrite, and platinum-cobalt (Pt-Co) magnets (Tsutsui *et al.*, 1979, Chin, 1980). However, magnets have not been routinely used, owing to high costs, brittleness and low corrosion resistance.

The influence of the magnet alloys and their surrounding static magnetic fields on human tissues has been debated. Several studies have shown that magnets had

good biocompatibility. However, cellular changes in tissues exposed to static magnetic fields have been reported.

Some available commercial magnets can attract the orthodontic bracket with strong forces and can be made in various shapes. However, their composition and force generated are unidentified. It is interesting to apply the magnetic force in clinical orthodontic treatment. Before the magnets can be used in clinical orthodontic practice, their composition and force generated should be analyzed.

This study was aimed to measure the forces generated by commercial magnets to orthodontic bracket in the various magnet sizes and distances, to compare the magnetic forces generated by commercial and orthodontic magnets, to find a correlation between magnetic force of commercial magnet attracting to orthodontic bracket and size of the commercial magnet and to find the composition of commercial and orthodontic magnets.

THE PURPOSES OF THE STUDY AND HYPOTHESIS

1. To measure the magnetic forces generated by the orthodontic and commercial magnets attracting to orthodontic bracket in various magnet dimensions and in various distances.

2. To compare the magnetic forces generated by commercial and orthodontic magnets attracting to orthodontic bracket. Therefore, the null hypotheses, H_0, is :

"There is no significant difference of the magnetic forces generated by the commercial and by orthodontic magnets attracting to orthodontic bracket."

The hypothesis will be rejected if there are significant differences of the magnetic forces generated by the commercial and by orthodontic magnets attracting to orthodontic bracket.

3. To find the correlations between magnetic force of commercial magnets attracting to orthodontic bracket and size of commercial magnets by compare the magnetic force among three sizes of commercial magnets (6.0x6.0x2.0 mm., 8.0x8.0x2.0 mm., 10.0x10.0x2.0 mm). Therefore, the null hypotheses, H_0, is :

"There is no correlation between magnetic force of commercial magnets attracting to orthodontic bracket and size of commercial magnets."

The hypothesis will be rejected if there are significant correlations between magnetic force of commercial magnets attracting to orthodontic bracket and size of commercial magnets.

4. To find the composition of commercial and orthodontic magnets being tested in this study.

ANTICIPATED BENEFITS

1. To indicate the proper dimension of the commercial magnets that are most effective for use in clinical orthodontic practice.

2. To be basic knowledge for future use of commercial magnets in orthodontic treatment.

SCOPE OF THE STUDY

This study was aimed to investigate the force generated by orthodontic and commercial magnets, to calculate the correlations between size of commercial magnets and magnetic force attracting to orthodontic bracket and to analyze the composition of orthodontic and commercial magnets. There were four sizes of commercial magnets and one size of orthodontic magnet used in this study.

GLOSSARY OF TERMS

Coercivity (Hc) – Coercivity is the strength of the external field needed to demagnetize the material. A high coercivity is needed to prevent the demagnetization of permanent magnets when they encounter field produced by other sources.

Commercial magnets - The available magnets can attract the orthodontic bracket with strong forces and can be made in various shapes. However, their composition and force generated are unidentified.

Coulomb's law - The force between two magnetic poles is proportional to their magnitudes and inversely proportional to the square of the distance between them; therefore, the exponent "n" in the equation force = separation^n should have a value of –2.0.

Energy product (BH) – Energy product is a composite parameter determined by strength of the magnet and the coercivity. The maximum energy product (BHmax) is simply a measurement of maximum amount useful work that a permanent magnet is capable of doing outside the magnet.

Flux density (magnetic induction, B) – When a magnetic field "H" has been generated in the medium. Flux density is the line of magnetic force become concentrated within the medium.

Hall probe – Hall probe is the instrument used to measurement of the flux density.

Magnetic field (H) – The magnetic field is an energy gradient that a force is produced which can be detected by the acceleration of an electric change moving in the field, by the force on a current-carrying conductor, by the torque on a magnetic dipole such as a bar magnet or even by a reorientation of spin on electron within certain types of atoms.

Orthodontic magnets - The samarium-cobalt magnets (Ormco, U.S.A., Part No. 671-0001).

Remanence (Br) – The remanence is the value of either remaining induction or magnetization when the field has been removed after the magnetic material has been magnetized to saturation.