CHAPTER I

INTRODUCTION

PRINCIPLES, THEORIES, AND RATIONALE

Magnetic forces have been employed in clinical applications for many years. In the early year of their use, conventional permanent magnet was applied in fixation of maxillofacial prosthesis (Javid, 1971). Later, they were also used as part of intraoral prostheses such as overdenture (Gillings, 1988) and as part of tooth moving appliances in orthodontics (Kawata *et al.*, 1977; Blechman and Smiley, 1978). The large applicable size and low force generated by these conventional magnets were main disadvantages (Kawata, 1987).

Recently, the rare earth magnets developed by utilizing a transitional element (cobalt or iron) combined with a rare earth element, have been put into practical uses. These new magnetic alloys, such as samarium-cobalt magnets and neodymium-iron-boron magnets, offer superior properties to the conventional magnets. The samarium-cobalt magnets can generate more powerful magnetic field and have more resistance to demagnetization than the Alnico type, which is the strongest conventional magnet (Becker, 1970). Moreover, the neodymium-iron-boron magnet generates greater magnetic force than the samarium-cobalt magnet, which has a similar size (Chin, 1980).

Subsequent to their development, the rare earth magnets have been used as an alternative way in orthodontic practices. A number of clinical advantages, including continuous application of force, better directional force control, and decreased treatment time, have been reported. Additionally, it was previously found that the commercial magnets that had compositions similar to the neodymium-iron-boron magnets, could generate high force comparable to the orthodontic magnets (Watanakit and Jotikasthira, 2001). Therefore, the commercial magnets, which are several times cheaper and more readily available than the orthodontic magnets, can be alternatively used as a material of choice for orthodontic treatment. However, it is important to investigate whether there are any deleterious effects on human cells before applying the commercial magnets for clinical uses.

PURPOSES OF THE STUDY AND HYPOTHESES

1. To investigate and compare the viability and growth of cultured human gingival fibroblasts grown under low and high intensity of static magnetic field and without the magnetic field for 3 and 7 days. Therefore, the null hypothesis, H_0 is:

"There is no significant difference between the viability and growth of cultured human gingival fibroblasts grown under the static magnetic field and without the magnetic field."

The hypothesis will be rejected if there are significant differences between the viability and growth of human gingival fibroblasts grown under the magnetic field and without the magnetic field

2. To investigate the correlation between the viability and growth of cultured human gingival fibroblasts and the extent of magnetic field intensity. Therefore, the null hypothesis, H_0 is

" There is no correlation between the viability and growth of cultured human gingival fibroblasts and the extent of magnetic field intensity."

The hypothesis will be rejected if there is significant correlation between the viability and growth of cultured human gingival fibroblasts and the extent of magnetic field.

ANTICIPATED BENEFITS

1. To understand the biological effect of static magnetic field generated by magnets, whose dimensions are applicable for orthodontic treatment.

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

SCOPE OF THE STUDY

The aim of this study was to investigate the viability and growth of cultured human gingival fibroblasts grown under static magnetic field of commercial magnets, while the comparisons of the viability and growth of cultured human gingival fibroblasts under low and high magnitudes of magnetic field were determined as well.

GLOSSARY OF TERMS

Magnetic field – The magnetic field is a change in energy of a volume of space, which can be produced by electrical charge in motion due to an electrical current flowing in a conductor or produced by the orbital motions and spins of electrons within the permanent magnet material.

Commercial magnet – The available magnet can attract the orthodontic bracket with strong forces and can be made in various shapes. Previously, it was reported that commercial magnet was composed of iron (Fe), neodymium (Nd), cobalt (Co), Copper (Cu), and gadolinium (Gd); moreover, the generated force was greater than the orthodontic magnet.

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

Remanence – 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.

Flux density – The flux density is the lines of magnetic force that becomes concentrated within the medium, when a magnetic field has been generated in the medium.

Gaussmeter or Tesla meter with a Hall probe – This equipment measures the magnetic flux density of magnet at any distance from the pole surfaces. The value of the magnetic flux density can be expressed in gauss (G) or Kilogauss (KG), tesla (T) or millitesla (mT), Wb/m^2, or Vs/m^2, where 100 mT = $1Wb/m^2$ = $1Vs/m^2$ = 1,000 G. In this study, all flux density values are expressed in millitesla (mT).

Flow cytometry – The flow cytometry is a process in which certain physical and chemical characteristics of cells are measured as they flow in a moving fluid stream past a fixed laser beam. It provides information about the cell size, cytoplasmic granularity, intracellular complexity of the cell. Moreover, by the use of specific fluorochromes to detect DNA and the binding of specific antibodies, cell cycle and the expression of cell surface and intracellular antigens can be determined.