CHAPTER 1

GENERAL INTRODUCTION

1.1. Overview introduction

Fluoride is known as an anti-cariogenic substance due to the formation of fluorapatites (ten Cate and Duijsters,1983a and b; Arends and Christoffersen,1986; Margolis, Moreno and Murphy,1986). It has been discovered that the favorable conditions for fluorapatite formation in sound enamel require constant and low level of fluoride ions for at least 24 hours (Arends and Schuthof,1975). If fluoride ions (F^-) are present during caries demineralization, the tooth protection is provided due to F^- precipitation of hydroxyapatites which will limit the lesion formation (Brown, Gregory and Chow,1977; Moreno, Kresak and Zahradnik,1977). The role of fluoride is to inhibit demineralization and then provide remineralization. Having fluoride in the solution around the enamel dissolution was confirmed to be able to inhibit caries (Beltran and Burt,1988; Groeneveld, van Eck and Backerdirks 1990). As a consequence, an idea of providing a source of fluoride compounds in cavity liners, cements and also in tooth-colored restorative materials such as conventional glass ionomer cements, resin-modified glass ionomer cements, polyacid modified resin composites, is respected in order to prevent secondary caries.

Nowadays, tooth-colored restorative materials are widely used because of their improved properties and some of them also provide a long term release of F^-. Fluoride ion released from the restorative materials is exchanged and replaced with hydrogen ion in the structure of hydroxyapatite. Then the formation of fluorapatite which is more acid resistant than hydroxyapatite occurs. The hardness changes of the tooth surface can be detected and thus confirm effect on enamel and dentin. If the tooth hardness increases with the presence of fluoride released from the restorative material, it will be useful to maintain fluoride level to protect tooth structure.

There was no comparative study between the hardness of enamel and dentin when restored with different tooth-colored restorative materials. The fluoride released from materials is also another factor that may inhibit demineralization of the enamel and dentin. The purpose of this study was to investigate the effect of fluoride released from tooth colored materials on the hardness of enamel and dentin as a function of distance using an indentation technique on the surface and the subsurface of enamel and dentin.

1.2. Importance of the study

Fluoride has been proved to have an anti-cariogenic effect on enamel and dentin but the effect on the hardness of enamel and dentin has not been clarified. It was also essential to quantify the fluoride release level and to quantify the hardness change influenced by experimented materials.

Questions

1. Fluoride is known to have caries inhibitive effect, but the effect of fluoride released from the fluoride releasing restoration on hardness of enamel and dentin has not been clarified.

2. If fluoride does influence the hardness, how far can fluoride alter the hardness of enamel and dentin?

1.3. Hypothesis

Fluoride released from experimented restorative materials alters the hardness of human enamel and dentin under experimented conditions.

1.4. Objectives

1. To quantify the change of hardness of enamel and dentin on the outer tooth surface and tooth subsurface next to the fluoride releasing materials.

2. To compare the effect on hardness of enamel and dentin by two types of fluoride releasing restorative materials.

3. To correlate changes of hardness and amount of fluoride uptake in the tooth structure.

1.5. Preliminary agreement

1.5.1. The present study would conduct an in vitro experiment using non carious premolar teeth from young adult of 10-15 years old. The teeth would be kept in sterilized deionized water at $4^{\circ}C$ and would be experimented within 2 months.

1.5.2. The hardness tests used in this experiment were

- a micro hardness test

The micro-indentation hardness test would be conducted using Vickers indenter and the force of 100 and 50 grams would be used for enamel and dentin, respectively. The duration of applied forces would be 15 seconds. The Vickers hardness number (VHN) would be calculated from the following equation

$$\text{VHN (Vickers hardness number)} = F \times 1.89 \times 10^{5} / d^{2}$$

where F is the applied force in gram (g) and d is the diameter of the indenter in micron.

- a nanohardness test

The nanohardness test would be employed using a triangular indenter. This new technology is capable of indentation with initial forces less than 0.1 mN and depth of penetration with the resolution less than 1 nm. The applied force in this experiment would be 80 mN (8 g) for enamel and 20 mN (2 g) for dentin. The indenter would be set every 20 , 50 μm for enamel and 15 , 50 μm for dentin. The computer program automatically calculated the maximum penetration depth which refer to the surface hardness of enamel and dentin

1.5.3. Both hardness tests would be carried out by single operator.

In this study, there were seven chapters including preliminary study. The preliminary study was conducted to evaluate the methodology and lead to the microhardness test and nanohardness test in chapters IV and V. In addition, an EDS was performed to trace fluoride elements which were expected to have an effect on the hardness of enamel and dentin. Future research is expected to continue on elements and also composition of element on enamel and dentin.