CHAPTER V

DISCUSSION

The discussions of this research would be presented in two parts as follows :

1. Discussion the results of the study

1.1 The comparison of fluoride concentration of the three sample groups

1.2 The comparison of shear bond strength of the three sample groups

1.3 The correlations between the fluoride concentration and the shear bond strength

2. Discussion of the errors in the study

2.1 Error from the varieties of the sample

2.2 Error from the method of fluoride concentration determination

2.3 Error from the method of shear bond strength testing

2.4 Error from the operator

1. Discussion of the results of the study

1.1 The comparison of fluoride concentration of the three sample groups (Table 3-5)

The fluoride concentration of group 1 (normal teeth) was slightly different from that of group 2 (very mild to mild fluorosis teeth). However, the fluoride concentrations of group 1 and 2 were greatly different from that of group 3 (Moderate to severe fluorosis teeth). The differences in the fluoride concentration among the three groups were verified by an ion specific electrode and were found to be in accordance with the findings of a recent study by Ng'ang'a et al. (1992). The fluoride concentration determination in this study were modified from the method by Vogel et al. (1983), therefore some different results were found. In this study the fluoride concentration determination was performed only on the outer surface enamel by pumicing and etching procedure. In previous study (Ng'ang'a et al., 1992), the fluoride concentration determination was performed on the cut slap of enamel surface and etching with the different concentration and exposing time of hyperchloric acid. This made the different results when compared with the present study. The outer enamel surface of each tooth might be different in fluoride concentration. There were many factors, such as attrition, age of tooth, that influenced the fluoride concentration in the outer enamel surface. This research tried to simulate the actually clinical process that performed only on the outer enamel surface in bonding procedure. Therefore, only the pumiced preparation surface was used for fluoride concentration determination. The wide range of fluoride concentration were found in all three groups but the mean fluoride concentrations were statistically different. Table 3 and table 9 showed that fluoride concentrations in the high degree fluorosis teeth (group 3) were greater when compared with the lower degree fluorosis teeth (group 1 and 2). When compared group 1 and 2, there was no siginficant difference in fluoride concentration ($p < 0.01$). There was significant difference in fluoride concentration between group 3 and 1 and also

between group 3 and 2 ($p < 0.01$). Some samples in group 1 showed relative high fluoride concentration when compare with group 2 and 3. This might be due to the error of sample classification. It was difficult to classify the questionable fluorosis teeth from the normal teeth therefore some of fluorosis teeth in score 0.5 (questionable) were unintentionally assemble in group 1 samples. Previous study showed similar results. Ng'ang'a et al (1992) compared the fluoride concentration of fluorosis and non-fluorosis teeth, and summerized that there were higher mean concentrations and greater variations of fluoride concentrations in fluorosis teeth than in non-fluorosis teeth.

1.2 The shear bond strength of the three sample groups (Table 6-8)

The dislodge force of bonded brackets was mainly parallel to the bracket base, therefore the shear bond strength was used in this research. Arici and Regan (1997) stated that the shear forced test tended to simulate the direction of the occlusal force applied to debond the bracket, and that the tensile force test indicated possible failure due to archwire ligation. Table 6 and table 10 showed the shear bond strength of the three groups. The first and the second groups showed no significant difference in shear bond strength. While compared with the group 3, significant difference occurred ($p < 0.01$). This indicated that the more severity of fluorosis, the less shear bond strength of bonded brackets. Some samples in group 3 such as sample 13 and 18 showed the differented results. Although they had high fluoride concentrations but the shear bond strength were still high. That might be due to the distribution of fluorosed area on lingual surface and were not conform to the fluorosis surface of buccal side. Other factors such as the enamel surface irregularities, hypoplasia and surface porosity of enamel surface effected the shear bond strength of high fluorosis teeth too. When the outer enamel surface of fluorosis teeth had no porosity or corroded surface, the high shear bond strength can be

achieved. Previous study of the bond strength in fluorosis teeth showed similar results. Opinya et al. (1986) studied 40 normal and 40 Kenyan fluorosis teeth, and concluded that there were significant difference in tensile bond strength of fluorosis and non fluorosis teeth. However, Ng'ang'a et al. (1992) showed no significant difference in tensile bond strength between the fluorosis and the non-fluorosis teeth. The different results might come from the unlikely sample groups and from the direction of force applied. It should be noted that most samples, in this study, had adequate shear bond strength for orthodontic practice, except in the high severity of fluorosis teeth (Table 10). These high severity of fluorosis teeth should have special surface preparation in order to produce the optimal shear bond strength. Opinya et al. (1986) suggest to used prolonged etching time in fluorosis teeth to produced the same surface preparation when compare with normal teeth. Furthermore they suggested to grind the outer enamel surface of fluorosis teeth by green stone to produce more tensile bond strength of orthodontic brackets.

1.3 The correlations between the fluoride concentration and the shear bond strength

There was negative correlations between fluoride concentrations and shear bond strengths of fluorosis teeth in group 2 and 3 ($r = -0.408$, $p < 0.001$). The results showed that the more fluoride concentration, the less shear bond strength. It should be noted that many samples in moderate to severe fluorosis teeth in group 3 had too little shear bond strength to produce an adequate retention of orthodontic bracket. These particular samples showed the enamel surface irrgularities, hypoplasia or severe corroded enamel surface that might be the cause of lower shear bond strength. Special preparation for fluorosis teeth such as grinding the outer surface or the longer etching time to produce adequate shear bond strength for orthodontic purposes needed further investigations.

2. Discussion of the errors in the study

2.1 Error from the varieties of the samples

Prevalence of high degree fluorosis teeth (score3-4) was rather low. As a results, the maxillary and the mandibular teeth were used in the study to produce adequate studied samples. It was known that there were differences in the enamel contour of the maxillary and mandibular teeth. These difference enamel contours were effected in shear bond strength results of the bonded premolar brackets. The results of this study revealed the wide range of shear bond strength in all groups especially in group 3. To minimize these errors, the equal sample size were used as possible. In this research the samples composed of 17 maxillary and 13 mandibular premolars in each group. The proportion of the upper and lower premolar samples were derived from group 3 because its rare collective samples. During the shear bond strength testing, there were some teeth fractured and the substitute samples were added to make the suitable number of samples for statistical analysis.

2.2 Error from the method of fluoride concentration determination

The error of fluoride concentration determination might be from many causes such as the volume of solution, the fluoride electrode, and old testing solution. These problems were solved by following adjusted procedures :

1. The calibration curve of fluoride electrode were made and repeated every 2 hours during the fluoride concentration determination process.

2. The preparation solution used should be as fresh as possible.

3. Testing samples should be immediately prepared or kept in the refrigerator before the fluoride concentration determination. In this study the

testing solution were prepared in the previous day and kept in the refrigerator before the fluoride concentration determination.

4. All samples were carefully determined by one operator. In this study, all sample were tested by the same specific fluoride technician from Community Dentistry Department, Faculty of Dentistry, Chiang Mai University.

5. In order to produce accurate data, the fluoride concentration were determined twice. The means of the two determinations were used for statistical analysis.

2.3 Error from the method of shear bond strength testing

Fox et al. (1994) advised the criteria of bond strength testing in orthodontics, based on an extensive literatures reviews, and proposed a standard protocol for future bond strength testing in orthodontics as follows :

1. Surface premolar enamel should be used on teeth extracted from adolescent patients for orthodontic reasons.

2. Teeth should be used after 1 month, but before 6 months from extraction and should be stored in distilled water prior to bonding.

3. The specimens should be immersed in water for 24 hours at 37 °c.

4. Debonding should take place on an instron® or equivalent testing machine at a cross-head speed of 0.1 millimeter per minute.

5. Care should be taken to ensure the point of application and direction of the debonding force is the same for all specimens.

6. At least 20 and preferable 30 specimens should be used per test.

7. Site of failure should be reported.

8. Statistical analysis should include survival analysis to give a prediction of the performance of the material which can be related to the clinical situation.

9. Bond strengths should be quoted in either Newtons or MegaPascals.

The error from the shear bond strength testing in this study might be from many causes as follows :

1. In bonding procedure, the thickness of the bonding material on several samples might not be equivalent due to the different enamel contour of maxillary and mandibular teeth. Furthermore, the error could come from the technic of bonding procedure. These problems were minimized by care in the bonding procedure to ensure that all bracket were not underloaded with adhesive, and that all processes were done by the same operater.

2. In the process of shear bond strength testing, it was difficult to align the testing apparatus. This problem was minimized by adjusting all the sample positions during the shear bond testing, and all processes were done by the same operator.

2.4 Error from the operator

In this study, the error from the operator might be from :

1. The experience in placing the same bracket position on each sample

Scott and Symon (1982) reported the slight difference in the enamel prism orientations of the occlusal, middle and cervical third of teeth. Therefore the error in bracket positioning might effect shear bond strength. This problems were dissolved by using the bracket positioning jig and all bonding processes were carried out by the same operator.

2. The aligning of testing apparatus during the bond strength testing

This problem was minimized by care aligning the testing apparatus and all shear bond strength testing were carried out by the same operator.

Limitation of the research

Fox et al. (1994) suggested to used the fresh 1 to 6 months extracted teeth sample for any investigation. Some teeth in this investigation were collected and used after 1 year because of its rare collecting problem. However the large adequate sample were used to generate acceptable meaningful data.

Suggestions

1. More samples used in further study should be the same type of maxillary or mandibular teeth to generate more reliable data.

2. Site of failure evaluation and microstructure evaluation of surface enamel under scanning electron microscope should be done for more meaningful derived data.