OPTIMIZING ADHESION OF ORTHODONTIC BRACKETS TO FLUOROSED TEETH

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Abstract:
Introduction: Bonding of orthodontic brackets to fluorosed enamel is a challenge for all dental clinicians. The objective of this study was to determine the success of bracket retention in patients with dental fluorosis using a different acid etch protocol.
Methods: 12 patients with varying degrees of dental fluorosis were bonded in vivo with a split mouth design with one side of the arch treated with 37% phosphoric acid for 60 seconds and then bonded. The other side of the arch in all patients was pretreated with Opalustre (ultradent) containing 6.6 % hydrochloric acid and silicon carbide micro particles in a water-soluble paste for 45 seconds and then bonded.
Results: Over a period of 12 months, 17 bond failures occurred in the side treated with 37% phosphoric acid and 7 bond failures occurred in the side treated with Opalustre containing hydrochloric acid and silicon carbide micro particles. An unpaired t test statistical analysis revealed p=.0108 which is statistically significant by conventional criteria, demonstrating the effectiveness of pretreatment of teeth with Opalustre for orthodontic bonding in cases of dental fluorosis.
Conclusions: The rate of bond failure with 37% phosphoric acid is high in patients with dental fluorosis. The rate of bond failure is higher with pretreatment with phosphoric acid than with Opalustre, so Opalustre containing hydrochloric acid can be recommended for pretreatment of teeth with fluorosis for orthodontic bonding. The recommended acid etch protocol also saves chair side time of the orthodontist, improves success rate of the treatment and minimizes cost of the treatment by preventing recurrent bond failures.

Keywords: dental fluorosis, micro abrasion, bonding, acid etch

INTRODUCTION

Dental fluorosis is a developmental disturbance of dental enamel, caused by successive exposures to high concentrations of fluoride during tooth development, leading to enamel with lower mineral content and increased porosity. The severity of dental fluorosis depends on when and for how long the overexposure to fluoride occurs, the individual response, weight, degree of physical activity, nutritional factors and bone growth.

Bonding orthodontic attachments to fluorosed teeth is a clinical challenge as the frequency of bond failures at the compromised enamel surface is high. The fluorosed enamel surface is a challenge to clinicians same as bonding to gold, amalgam and porcelain.[1]

Fluorosed enamel presents an outer hypermineralized, acid resistant layer and retention of more porous enamel in the areas of the subsurface hypomineralization [6], where it is difficult to bond attachments because it does not produce a reliable and uniform etched surface [2]. In a clinical situation, debonding of brackets from fluorosed enamel can occur soon after the orthodontic bracket is positioned and put under stress [1, 12]. Repeated bonding is time consuming and has a negative effect on successful orthodontic treatment.

The difficulty in bonding to fluorosed enamel is likely attributable to the inability of fluorosed enamel to be etched by 37% phosphoric acid which results in a decreased amount of enamel irregularity and hence, decreased enamel bonding. Scanning electron microscope studies have confirmed the above fact [4, 5].

Some investigators have recommended extended enamel conditioning with phosphoric acid when bonding composite resin to fluorosed enamel to remove the acid resistant hypermineralized surface layer and increase bonding [7,8].

OBJECTIVES

The aim of this study was to apply a different acid etch protocol for fluorosed teeth. As the problem with bonding lies in the surface of enamel, alteration of the surface with a different acid was suggested as is the case for amalgam or porcelain.

A clinical study with two different acids was undertaken and the results were noted for a statistical analysis.

Opalustre (3M) containing 6.6 % HCl with silicon carbide particles in a water soluble paste was used for etching fluorosed enamel. The Opalustre paste was used as a micro abrasive agent which safely removes a controlled and limited amount of superficial enamel (around 70 µm) and increases the enamel irregularity of the enamel for better bonding.

Figure1. Severe dental fluorosis

MATERIALS AND METHODS

Twelve patients with moderate to severe dental fluorosis according to Dean's Fluorosis Index were used in this clinical study. A total of 240 teeth were bonded using a split mouth design with the following protocol:

- All teeth were cleaned and polished with pumice and water slurry.
- Contra lateral sides from the upper and lower arch in each patient (quadrant 1 and 3) were etched with 37% phosphoric acid for a period of 60 seconds.
- Quadrants 2 and 4 were pretreated with Opalutsre containing 6.6% HCl and silicon carbide particles for a period of 45 seconds.
- The etchant was thoroughly washed with water for 10 seconds followed by air drying for 10 seconds with a three way syringe with compressed air.
- With a microbrush, a thin uniform layer of sealant was applied on the etched enamel and cured for 20 seconds.
- A thin coat of sealant was also painted on the metal bracket base and cured for 10 seconds before applying the composite. Lightbond (Reliance) was used as the bracket adhesive.
- The bracket was positioned on the tooth and light cured for 40 seconds (20 sec on the mesial side and 20 sec on the distal side) using a halogen light cure unit (DENTSPLY).

Patients were followed up at 4–6 week intervals. Each bracket was checked at each appointment for full or partial debond, microleakage, or decalcification by visual means. Hygiene status was monitored at each visit. Patients with loose brackets were questioned as whether it occurred as a result of a traumatic incident, such as chewing on hard food. Patients were also advised to call the clinic as soon as any orthodontic bracket debonded and to retain the bracket if it detached from the archwire.

RESULTS

Over a period of one year of orthodontic treatment with wires ranging from round nitinol to standard stainless steel rectangular wires, bond failures were observed in both the groups and recorded for a statistical study. Most of the bond

failures in the group of teeth etched with phosphoric acid were at the resin-tooth surface, whereas in the group treated with Opalustre (6.6% HCl) bond failures occurred at the tooth-resin surface as well as resin-bracket interface.

Most of the failures occurred in the first few weeks after bonding and during the torque control phase (with rectangular wires). Multiple bond failures were more common in group which was pretreated with phosphoric acid.

An unpaired t-test analysis revealed p=0.0108. By conventional criteria, this difference is considered to be statistically significant.

Table 1. Bond failures over a period of 12 months

	Group I	**Group II**
Patient no. 1	0	0
Patient no. 2	1	2
Patient no. 3	0	1
Patient no. 4	1	2
Patient no. 5	1	2
Patient no. 6	0	1
Patient no. 7	0	0
Patient no. 8	1	3
Patient no. 9	1	2
Patient no. 10	1	1
Patient no. 11	1	1
Patient no. 12	0	2

t test analysis, p=0.018

a. Group I – treated with Opalustre containing HCl

b. Group II – treated with phosphoric acid

Figure 2. Multiple bond failures seen on the right side treated with 37% phosphoric acid

DISCUSSION

In vivo bonding of fluorosed teeth with two different acid etch protocols has demonstrated the need to change the approach of bonding in compromised surfaces like in dental fluorosis. Clinical evidence in this study demonstrates that pretreating the compromised fluorosed enamel with Opalustre containing 6.6% HCl and silicon carbide particles provides better retention as compared to standard procedures of etching and bonding.

These findings are in correlation to the studies of Mulholland and Deshazer [3] who presented the fact that monovalent acids like HCl provide better bonding at low pH. One year clinical outcomes indicate that use of Opalustre for pretreatment is a viable method for pretreatment and bonding to compromised enamel surface in orthodontics.

Bond failures that occurred in the two groups also point to the fact that adhesion of brackets to enamel was

improved in the group pretreated with Opalustre. Bond failures occurred mainly at the resin enamel surface in the group treated with phosphoric acid. In the group pretreated with Opalustre the failures occurred at the resin enamel surface and at the resin bracket interface increasing the ARI scores. The increase in the ARI score is not recommended as it leads to enamel loss and damage but in this study presents the fact that bonding was improved.

All the studies till date in the literature have been focused on changing the bonding system in case of compromised enamel surface. The real problem lies in the enamel surface which is hypermineralized in case of dental fluorosis, making it difficult to be etched uniformly and reliably. So a different protocol for pretreatment should be looked for, which can provide a better etched and retentive surface for orthodontic bonding.

The approach followed in this study showed that clinically retention was improved and hence can be recommended in cases of dental fluorosis.

CONCLUSION

1. The bond failure rate with 37% phosphoric acid is high in patients with dental fluorosis.
2. Use of Opalustre containing 6.6% HCl and silicon carbide particles is a better pretreatment option in fluorosed enamel surface.
3. The recommended acid etch protocol also saves chair side time of the orthodontist, improves success rate of the treatment and minimizes cost of the treatment by preventing recurrent bond failures.

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