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Surface Degradation of Enamel Due To Debonding Of Brackets

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Abstract: *Preserving the dental enamel structure during removal of orthodontic brackets is a clinician's obligation. Debonding aims to remove orthodontic attachments and all remaining adhesives from the tooth and to restore the surface to its permanent state as much as possible. The occurrence of scarring on the enamel surface after adhesive removal appears to be inevitable but, the damage can be reduced to a negligible level if selecting a proper technique. This review discusses about the various materials used for debonding of brackets and the damage caused to the enamel due to debonding of brackets.*

Keywords: *Dental debonding, Enamel, Orthodontics, LASER*

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I. Introduction

Direct bonding of brackets became the procedure of choice in orthodontic treatment after the introduction of acid-etching bonding technology by Bounocore (1). One of the goals of orthodontists is to prevent the enamel surface structure after orthodontic treatment with minimal loss of enamel during bracket debonding (2). The objective of debonding are to remove the attachment and all the adhesive resin from the tooth and to restore the tooth surface as closely as possible to its permanent condition without inducing iatrogenic damage to it (3). To achieve these objectives proper bonding and debonding techniques are of fundamental importance.

Materials involved in removal of brackets are scaler or band removing plier (manual), various shapes of tungsten carbide burs, so flex discs, special composite finishing systems with zirconia paste and slurry pumice as well as ultrasonic applications. Novel approaches involve carbon di oxide laser application, Nd:YAG laser has demonstrated potent structural degradation of the composite, suggesting that it could be used as an adjunct to the removal of residual resin (4). Along with the introduction of novel methods, the armamentarium of conventional instruments has been fortified by the introduction of specially designed burs which are less aggressive to enamel (5).

This review discuss about the various materials used for debonding of brackets and the damage caused to the enamel due to debonding of brackets.

II. Characteristics of Normal Enamel Surface

Understanding of characteristic of normal enamel surface is important to evaluate the damage caused due to debonding of brackets. Enamel is composed of crystallites embedded in a sparse organic matrix. Normal wear of enamel range of 0-2 µm/year. Throughout and individuals lifetime enamel undergoes many different abrasion phenomenon.

Mannerberg in 1960 (6) described about the changing pattern of perikymata as an individualage. Horizontal ridges called perikymata run continuously around the crown in a circular pattern in young tooth. The pattern of perikymata varies between one part of the tooth to another. Pronounced ridges run closer to the cervical region of the tooth and shallow ridges more incisally (7). With aging the organized perikymata is generally lost and gradually replaced by a scratched pattern were as in a middle and late teen the pattern may be intact and present over entire tooth surface.

Methods of Enamel Surface Evaluation

Since the 1950's various studies has been focused on evaluation of enamel surface. The methods used for evaluation involves strict visual evaluation to complex algorithmic measurements.

The 3 most commonly used methods are:

- Scanning electron microscopy (8)
- Profilometry (9)
- Atomic force microscopy (10)

III. Effect of Enamel Surface on Various Debonding Procedures

Debonding process most commonly involves using a pair of brackets removing pliers to remove bracket from the both, followed by different polishing burs to clean the remaining adhesive resin from the enamel surface (11).

In 1977, Gwinnett and Gorlick (8) were the first to publish a study which discuss about the damage to the enamel surface due to debonding. Human teeth were used in this study and bracket removal was done using pliers. Teeth were divided into various groups and the remaining adhesive resin are removed using green stone followed by white stone , sand paper disks, green rubber wheel and debonding burs.

The result of this study concludes that, deep grooves were cut into the enamel surface on using green stone followed by white stone. The sand paper disks removed the enamel in varying degrees and also it is inefficient, green rubber wheel was the most effective. Tungsten carbide burs were used in this study showed enamel loss only when they are used at high speed.

In 1979, Zachrisson and Arthur (7) conducted a study with 55 extracted human premolars using SEM. In this study rotary instruments at low speed with no water cooling were used to finish the surface. The methods include five diamond burs, green rubber wheels, sand paper disk of different coarseness, plain cut and spiral fluted tungsten carbide finishing burs. Based on the SEM images, an enamel surface index (ESI) score of 0 was given to a perfect surface with no scratches and with distinct perikymata pattern and score 4 was assigned to an unacceptable surface with coarse scratches.

The results showed that all the effective methods of removal of adhesive resin result in abrasion of enamel at varying degrees. None left at a perfect score of 0. The study conclude that diamond burs produced more damage to the enamel surface compared to all other techniques and both plain cut and spiral fluted tungsten carbide bur in slow speed.

Contrary to the study by Gwinnett and Gorlick (8) they found green rubber wheel to be abrasive to the enamel surface and not acceptable.

Theodore Eliades et al (12) in 2014 proposed a study which assess the roughness of enamel surface following debonding using two resin removal methods.

In this study, the enamel surface of 30 premolar crown are covered with black tape with a 3 mm window on the middle buccal third to standardize the area of analysis. The initial enamel surfaces were subjected to profilometry registering. Four roughness parameters (Ra,Rq,Rt & Rz). Brackets are bonded with chemically cured, no-mix adhesive and debonded after a week. Resin removal in half of the specimen was performed with an 8-bladed carbide bur and other half with an ultra- fine diamond bur, both attached to a high speed hand piece and second profilometric measurements was made after resin removal. Finishing achieved with soflex disks and third registration of roughness is recorded.

The results of this study were analyzed with one – way analysis of variance (ANOVA) (13). They suggest that all roughness variables with the exception of Rq for both resin removal methods and Rz for diamond burs, presented elevated values at resin removal intervals, which can be reversed with the use of polishing media at the post finishing stages.

Contrary to the study by Piacentini and Sfondrini (14) that usage of rotary instruments produces irreversible damage to the enamel surface, not accepted. Ra and Rqshowed decreased values, were the adhesive resin removed witth8-bladed carbide bur. This shows the superior method for removal of adhesive resin.

Material removal by tungsten carbide blade occurs by flow driven processes rather than brittle fracture, carbide burs are ideal cutting tools for ductile substances such as resins. Diamond burs are more suitable for brittle materials such as dental enamel and ceramics or hard alloys, not suitable for resin removal (15).

Ulusoy in 2009 (110, performed study to compare the effects of 8 different one step polishing procedures. In clinical set up multi-step procedures is time consuming so one step system have become more popular. Single-step system results in less contact time between the polishers and tooth surface, reducing enamel surface damage. 85 extracted premolars were used in this study in which 5 were used as control and so were etched and bonded following the standard bonding techniques brackets were removed 24 hrs. after bonding and polishing was done with 12 fluted tungsten carbide bur, 30 fluted tungsten carbide bursfollowed by optishine brush. SEM analysis were used to compare the enamel surfaces. The time required for each polishing procedures were also recorded.

The results showed that maximum clean up time was found with PoGo polishing system and minimum clean up time with 30 fluted tungsten carbide bur. Fast removal of adhesive resin was seen with 12 fluted bur but they result in scarring of enamel visible on SEM micrographs.

Maximum time recorded with PoGo micro polishers and they are most effective in removal of residual resin but they produce surface roughness. The two multistep procedures (soflex disks & super snap disks) also resulted in scarring of the enamel surface. All finishing systems were found to be clinically acceptable except for the optishine brush group without any pretreatment.

Karan et al (10), proposed post debonding enamel surface roughness was studied using atomic force microscopy (AFM). This study quantitatively assessed the enamel roughness using roughness values. 20 extracted maxillary premolars were scanned using AFM. 3 different points were measured on the surface of each tooth. Roughness value were measured in terms of average roughness, root mean square roughness and maximum roughness depth. Brackets were bonded on the tooth according to the standard protocol and were removed after 24 hrs. 8- bladed tungsten carbide and the fiber reinforced composite bur is used in this study.

The result of the study showed increase in roughness value with the use of 8 bladed carbide bur but decreased roughness value compared to the original surface roughness with the use of composite bur.

Ozer et al (16) evaluated the roughness of enamel surface using profilometry. Human premolars were used in this study and they are divided into 9 group of 11teeth. One tooth in each group was used for SEM and remainder for profilometry. After normal bonding and bracket removal, teeth were randomly assigned to one of the 9 groups.

- Tungsten carbide bur used with high speed hand piece
- Tungsten carbide bur used with low speed hand piece
- Tungsten carbide- high speed followed by soflex disks
- Soflex disks alone
- Tungsten carbide bur with high speed hand piece and a fiber glass bur
- Tungsten carbide with slow speed hand piece followed by fiber glass bur
- Fiber glass bur
- Intact enamel

Profilometer measurements were taken on tooth surfaces after debonding was completed.

Results showed that soflex disks and fiber glass burs requires more time than carbide burs to remove the remaining adhesive resin. The soflex disks were the most successful for restoring the roughness of enamel near to its original value.

Animal study by Brauchli et al (17) in 2011, used the confocal laser microscope (CLSM) for the first time to measure enamel surface roughness. 42 bovine incisors were divided into 3 groups and abraded with either 37% phosphoric acid, air abrasion or combination of two. The remaining adhesive resin is removed with carbide bur or air abrasive. The enamel surface roughness was measured with the CLSM and 3D images were visually inspected for surface structure and adhesive resin remnants. Undesirable results shown for air abrasive and due to potential risk of initially increased amount of ambient dust from air abrasive it's not recommended. Removal with a carbide bur is recommended in this study.

In 2011, an in vitro study (18) compared the effectiveness of 33 different pliers in debonding stainless steel and ceramic brackets and also evaluated the enamel surface damage due to debonding 60 premolars divided into 3 groups of 20. Debonding pliers, bracket removal pliers, ligature wire cutter were used for debonding. The enamel surface after debonding were assessed using stereomicroscope. The images obtained through SEM were analyzed and assigned a score to each photo according to the following scale (Kitabara-Ceria et al, 2008) (19).

Score 0- enamel surface form cracks/ tear outs
Score 1- enamel surface with cracks
Score 2- enamel surface with tear outs
Score 3- enamel surface with cracks and tear outs.

Result s show that number of enamel cracks was relatively similar between the 3 types of pliers. The number of enamel cracks were higher in debonding of ceramic pliers rather than the debonding of stainless-steel brackets. They conclude that stainless steel brackets exhibit least damage on the enamel surface while debonding.

In 2012, another study proposed about the effect of various debonding burs on the surface of enamel after debonding of metal brackets (20). Methods of analysis used in this study were scanning electron microscopy (SEM) and to obtain quantitative comparison between roughness value of individual teeth profilometry is used. 8 human maxillary and mandibular premolar had been previously extracted from orthodontic patients is used in this study. Teeth were randomly divided into 4 group of 20 teeth. 12 fluted, 20 fluted and 30 fluted carbide burs, white stone burs used for resin removal. In each group 155 teeth were tested using profilometry and 5 teeth were used for SEM. From the profilometry measurements of a single tooth, 5 spots were measured and the average roughness value was calculated for each tooth based on 5 spots. The roughness value of 15 teeth in each group were then calculated and reported ass the mean roughness value for that particular group.

Results showed that surface roughness measurements showed that the initial mean roughness value of enamel surface of the teeth were very similar. The roughness value increases after polishing regardless of the bur used. SEM images also demonstrated that none of the final surfaces had the same appearance as the original surface of enamel. These findings show that current commercially available burs produce some scaring of

enamel surface (21). The result of this study were similar to the findings of Ozer et al, Pont et al, but with slight different results in 2010 with ARI score of 3 has the higher frequency.

IV. Conclusion

The scarring of enamel following the removal of bonded brackets is inevitable. The loss of surface enamel and exposure of the enamel prism endings may induce a decrease in the resistance of enamel to organic acids produced in plaque and matrix is more prone to decalcification (22). In oral cavity, bacterial plaque can easily adhere to hard surfaces if they are rough. Reduction in surface roughness will lead to reduction in plaque formation and maturation (23,24). So, scarred enamel surface should be polished in proper sequence without damaging the pulpal tissues and with minimal loss of enamel.

Reference

[1]. Buonocore MG. A simple method of increasing the adhesion of acrylic filling materials to enamel surfaces. J Dent Res. 1955;34:849-53.
[2]. Hosein I, Sherriff M, Irland AJ. Enamel loss during bonding, debonding, and cleanup with use of a self-etching primer. Am J Orthod Dentofac Orthop. 2004;126:717-24
[3]. Graber TM, Swain BF. Orthodontics currents principles and techniques. Ch. 8 Taypee brothers India. 1991; pp: 485-563.
[4]. Thomas B W, Hook C R, Draughn R A 1996 laser-aided degradation of composite resin. Angle orthodontist 66:281-286.
[5]. Radlanski R J 2001 A new carbide finishing but for bracket de bonding. Journal of orofacial orthopaedics 62:296-304.
[6]. Mannerberg, F.: Appearance of tooth surface. Odontol Revy .11; supp 6:1960.
[7]. Zachrisson, B.U. and Årthun, J.: Enamel surface appearance after various debonding techniques. Am J Orthod. 75(2);121-127:1979.
[8]. Gwinnett, A.J. and Gorelick, L.: Microscopic evaluation of enamel after debonding: clinical application. Am J Orthod. 71;651-655:1977
[9]. Eliades, T., Gioka, C., Eliades, G., and Makou, M.: Enamel surface roughness following debonding using two resin grinding methods. Eur J Orthod. 26;333-338:2004.
[10]. Karan, S., Kircelli, B.H., and Tasdelen, B.: Enamel surface roughness after debonding. Angle Orthod . 80;1081-1088:2010.
[11]. Ulusoy, Ç.: Comparison of finishing and polishing systems for residual resin removal after debonding. J Appl Oral Sci. 17;209-215:2009.
[12]. Enamel surface roughness following de bonding using two resin grinding methods. Theodore eliades, christiana Gioka, George eliades and Margarita makou. Vol.26 no.3 2004.
[13]. Sokal RR, Rohlf F J 1995 Biometry : the principles and practice of statistics in biological research, 3rd edn. Freeman, New York, pp.330-335.
[14]. Zachrisson, B.U. and Årthun, J.: Enamel surface appearance after various debonding techniques. Am J Orthod. 75(2);121-127:1979.
[15]. Sokal RR, Rohlf F J 1995 Biometry: the principles and practice of statistics in biological research, 3 rd edn. Freeman, Newyork , pp. 330-335. Vol.:8 no.:3 2011.
[16]. Özer, T., Başaran, G., and Kama, J.: Surface roughness of the restored enamel after orthodontic treatment. Am J Orthod Dentofacial Orthop. 137;368-374:2010.
[17]. Brauchli, L.M., Baumgartner, E.M., Ball, J., and Wichelhaus, A.: Roughness of enamel surface after different bonding and debonding procedures. An in vitro study. J Orofac Orthop . 72;61-67:2011.
[18]. Evaluation of enamel surface damage after debonding using three different pliers "An in vitro study" Dr. Hadeel A. Mahdi, Prof. Dr. Nidhal H .Ghaib, Assist. Prof. Dr. Hayder Fadhil Saloom vol.:8 no.:3 2011.
[19]. Kitahara-Céia FM, Mucha JN, Santosc PA.Assessment of enamel damage after removal of ceramic brackets. Am J Orthod Dentofacial Orthop. 2008; 134:548-55.
[20]. The Effect of Various Debonding Burs on the Enamel Surfaces of Teeth After Debonding Metal Brackets. NILOUFAR NOURI MAHDAVIE B.S., University of California, Los Angeles, 2004 D.D.S., University of California, Los Angeles, School of Dentistry, 2009.
[21]. Campbell, P.M.: Enamel surfaces after orthodontic enamel debonding. Angle Orthod 65;103-110:1995.
[22]. Ogaard B. Oral microbiological changes, long-term enamel alterations due to decalcification and caries prophylactic aspects. In: Brantly WA, Eliades T, eds. Orthodontic Materials: Scientific and Clinical Aspects. Thieme: Stuttgart; 2001:124–139.
[23]. Quirynen M, Bollen CM. The influence of surface roughness and surface-free energy on supra- and subgingival plaque formation in man: a review of the literature. J Clin Periodontol. 1995;22:1–14.
[24]. Gaikwad RM, Sokolov I. Silica nanoparticles to polish tooth surfaces for caries prevention. J Dent Res. 2008;87:980–983.

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