Qualitative Analysis of the Enamel Surface After Removal of Remnant Composite

Martina Mikšić
Mladen Šlaj
Senka Meštrović

Department of Orthodontics,
School of Dental Medicine
University of Zagreb

Summary

Choosing the method of remnant composite removal after debonding is a problem, because most techniques cause deep scratches on the enamel surface. The purpose of this study was to determine the method that causes the least damage to the enamel. The study was carried out on a sample of 30 premolars. After brackets had been bonded and debonded, using the same procedure, the samples were divided at random into three groups. The composite remnants in the first group were removed using the Band Driver, in the second group using a tungsten carbide bur and in the third group using composite removing pliers. The samples were analysed using a light-stereomicroscope (Olympus). The photomicrographs were graded and the SRI (Surface Roughness Index) "calculated". The best enamel surface appearance was determined after using the tungsten carbide bur, which is considered the method which causes the least damage to the enamel surface.

Key words: *remnant composite, Surface Roughness Index.*

Acta Stomat Croat
2003; 247-250

ORIGINAL SCIENTIFIC PAPER
Received: February 20, 2003

Address for correspondence:

Martina Mikčić
Department of Orthodontics
School of Dental Medicine
Gundulićeva 5, 10000 Zagreb
Croatia
phone: +385 1 4802 141
e-mail:
martina.miksic@zg.hinet.hr

Introduction

Bonding of brackets to the tooth surface is a great improvement in the treatment of fixed orthodontic appliances, which has been presented in many papers published in the literature (1-6). Patient comfort, conservative method and simplicity of the procedure for cementing the appliances are merely a few of the advantages. However, some questions still remain unanswered. One of which is how, after removing the brackets, to return the surface to its previous condition, i.e. prior to the bonding of the fixed attachment.

Many techniques for cleaning the enamel after removing the bracket damage its surface and leave scratches. A review of the literature shows that different opinions exist on which method is most acceptable for removing the remaining layer and polishing the surface of the enamel. Retief & Denys (7) consider that a scaler and diamond bur should not be used for cleaning remaining material from the surface of the enamel because they cause deep damage to the enamel. In their study Zachrisson & Artun (8) conclude that a tungsten carbide bur, used at a low number of revolutions, causes the least damage to the enamel. Rouleau, Grayson & Cooley (9) consider that the use of a manual scaler is undesirable because it leaves deep cuts in the enamel. In 1990 the American Department for Nutrition and Drugs introduced Neodymium: Yttrium Aluminium Garnet laser (Nd:YAG lager) for limited use in the intraoral region for the treatment of soft tissues (10). This was followed by investigations into the application of the laser for other purposes, and also the

possibility of degrading the remaining layer of composite by the application of a laser, thus avoiding damage to the enamel which occurs when the remaining layer is removed by conventional, mechanical methods (11).

The importance of this question was shown in a survey, in which 80% of the orthodontists questioned notice this problem after removing the bracket, i.e. damage and visual scratches on the surface of the enamel. More than half of those questioned were dissatisfied with the appearance of the enamel after cleaning and polishing (12).

The aim of this study was to determine the method for cleaning remaining composite which causes the least damage to the enamel surface.

Material and Methods

The study was performed on a sample of 30 premolars, extracted for orthodontic reasons. The metal brackets used were Ultratrimm Edgewise Brackets, Roth. 018", Dentaurum, nar.br. 713-007-50.

The buccal surfaces of the selected teeth were without visual damage to the enamel, fillings or carious lesions. Prior to carrying out the experiment the surface of the tooth on which the bracket was to be bonded was cleaned with a brush and rinsed with water. The brackets were bonded according to the instructions given by the manufacturer of the bonding material:

1. Etching with 37% solution of orthophosphoric acid (Email Preparator blue, Etching gel, Ivoclar/Vivadent) for 30 seconds, rinsing with water and drying for 30 seconds.
2. Positioning and fixing the brackets. Ortho-One No-mix Orthodontic Primer manufactured by Bisco was used, and Ortho-One Self-cured Orthodontic Direct Bonding Paste of the same manufacturer.

In order to achieve maximum strength of the bonding material the teeth with the bonded brackets were left for 48 hours in a physiological solution at body temperature. The brackets were removed with pliers (Narrow Direct Bond Removers w/Pad 800-0348, Ormco ETM), after which the samples were divided at random into three groups of 10 teeth each.

In each group the remaining composite was cleaned by the following methods:

- Group 1 - Bank Driver 30A with an attachment for removing composite (Kavo, nar.br. 5491302), 1000 revolutions/min. (Figure 2).
- Group 2 - Tungsten carbide bur (Komet H282K, FG 016, length of working part 6 mm), 150 000 revolutions/min, with water cooling (Figure 3).
- Group 3 - Pliers for removing composite (Ormco AEZ Titanium Adhesive Removing Pliers, 803-24100) (Figure 4).

Green rubber (Rocky Mountain, ECM 1047) and polishing paste (Mira-Clin P, Hager Werken) were used for the final polishing of the samples.

Microscopic examination and analysis of microphotography

The buccal surfaces of the teeth from which remaining composite had been removed were analysed with a binocular light stereomicroscope, Olympus SZXZB 12 with 200X magnification (ocular WHS30X-H and objective DFPLAPO1XPF, and light system Highlight 3100).

The photomicrographs were analysed by evaluating the appearance of the enamel surface (assessment of smoothness), using Surface Roughness Index (SRI), proposed by Howell & Weeks in their paper in 1990 (13), and modified for quantitative analysis and statistical analysis of data (14), because the original version was shown in alphabetical form.

Thus each sample was analysed and evaluated within its group:

0 - Ideal enamel surface, with no scratches or damage.

1 - Acceptable enamel smoothness with sporadic scratches.

2 - Fine, relatively shallow scratches over much of the enamel.

3 - Rough surface, deep scratches over the whole of the enamel surface.

4 - Very uneven surface, with very deep scratches over the whole of the surface.

Statistical analysis was performed using statistical packet SPSS 10.0 (Statistical package for Social

Science). Mann Whitney U test (U = -2,791, p = 0.005) was used to test the difference between the groups for average evaluation of scratches.

Results

Method 1 (Band Driver) was not included in the statistical analysis because it was impossible to remove the remaining layer of composite from all teeth, due to wear of the working attachment. However, average evaluation for this method, calculated on the samples on which it was performed, ranked between methods 2 and 3. According to the average evaluation, cleaning with a tungsten carbide bur left the least scratches on the enamel, for which the average evaluation was 0.9. In second place was the Band driver with evaluation of 1.7, and in third place Ormco pliers for removing composite, with average evaluation of 1.9 (Figure 1, Table 1). Statistically significant difference was found ($p < 0.005$) between the average evaluation for method 2 (tungsten carbide bur) and method 3 (pliers for removing composite).

Discussion

After removing brackets the orthodontist is faced with the challenge of returning the enamel to the condition in which it had been prior to the fixing of the attachment. As the smoothness of the enamel is essential for its aesthetic appearance the patient can immediately notice any changes which may have occurred, either because of inadequate removal or work on the surface after removal. Namely, some of the bonding material remains on the tooth and has to be removed, during which the enamel surface must not be damaged. It is interesting to note that in Croatia the majority of orthodontists use rougher or finer diamond buring devices. However the majority of studies reject such instruments as the method of choice, because damage to the enamel, deeper and shallower grooves, are much more marked than with other techniques (7). Thus this method for removing composite was not used in this study. Even the application of the finest diamond burs is not recommended, as damage to the enamel occurs or excessive composite material remains which later, even in patients with excellent hygiene, changes colour and becomes rough (14). It should also be mentioned that many authors use diamond polishing instruments, even without cooling (9, 12). Although it is unclear why, it is logical to presume that such a method leads to increased temperature of the tooth and pulp, which is definitely not recommended.

In the present study three methods of cleaning enamel after the removal of orthodontic brackets were examined.

The method in which specially constructed pliers are used, manufactured by ORMCO, has already been described and analysed in the literature and has proved to be very acceptable (14).

The new tungsten carbide bur, manufactured by Komet, was chosen because in the majority of studies on this subject, the tungsten carbide bur was in fact referred to as the method of choice for cleaning remaining composite. Some authors recommend the use of these burs at low revolutions (8), and others suggest an ultra-fine tungsten carbide bur, which is used to clean at high revolutions with the use of a water spray, as the method which leaves the finest, undamaged enamel surface (9). Therefore, in this study a new fine tungsten carbide bur, manufactured by the German firm, Komet, was used. This bur is produced in two variants: for application with a low number of revolutions, using the slow handpiece of a micromotor, and for application with a high number of revolutions, using a turbine or red handpiece, speed 150000 revolutions/min. The use of a water spray is envisaged for application of the turbine and red handpiece. The red handpiece and speed of 150 000 revolutions/min. was chosen. It is considered that the method chosen should be one which, in normal clinical conditions, will be readily accepted by practitioners because of its speed and simplicity. It should also be mentioned that this bur has not been analysed in previous studies, which is interesting because it was, in fact, constructed solely for application in orthodontics.

Two methods were therefore included in this study, which have so far shown the best results, both from the aspect of simplicity, cost, efficiency in removing composite and also the final appearance of the enamel, which, although not ideal, is acceptable (6, 9).

KaVo Band Driver is rarely used for removing composite in orthodontics, and was included in the present study because it was considered that it might show some good characteristics. So far no studies in the literature have demonstrated its effectiveness or ineffectiveness, or eventual damage to enamel. Band Driver is an instrument, the head of which is attached to the handpiece of a micromotor, and during activation the attachment, shaped like a chisel, produces fine strokes/taps at higher or lower speed and the remaining composite breaks off in small pieces from the enamel surface. It is important to emphasise that it is possible to gently rotate the attachment on its base, which is suitable when removing composite as the chisel adapts to the outline of the buccal surface of the tooth and remnant composite. While performing the test it became clear that after lengthy use of the attachment it was almost impossible to remove the remaining composite from the last few samples. However, as the surface of the enamel of the first few samples was completely smooth with no visible damage after using the Band Driver, the method, with certain modifications, appeared promising. The question is what would the evaluation have been had the attachment been sharper, i.e. that it had successfully removed composite from all 10 samples included in the study? A more successful working attachment for removing composite may have left deeper scratches over the enamel surface. Thus, this needs further investigation, with the aim of constructing an instrument which, apart from completely removing composite leaves an ideal, smooth surface of the tooth. The result on the first samples was good, and although the appearance of the enamel was not ideal, it was satisfactory. The scratches found were shallow, hardly visible and did not involve a large area of the enamel.

The tungsten carbide bur is considered the method which causes the least damage to the enamel (8), which was also confirmed in this study. After cleaning the enamel, macroscopically, looked ideally smooth. However, microscopic examination revealed scattered scratches on almost all samples. Similar results have been reported in the literature (9). Analysis of the results obtained by cleaning remnant composite with a tungsten carbide bur showed that although there was no great damage to the enamel, the enamel could not be considered ideal, with no scratches. Namely, sporadic areas with fine, shallow scratches were noticed. Additional analysis of burs produced by the same manufacturer for application at lower speeds (slow handpiece and micromotor) is needed, and will be proposed for future research.

Although, initially the use of pliers for manual removal of composite appeared to be the least invasive method for removing remaining composite, it proved to be the worst choice in this study, compared to the other two methods (with the exception of the earlier mentioned data for Band Driver). At first sight the enamel again looked smooth, but after careful microscopic examination scratches were seen on the surface. This confirms data from the literature in which this method was evaluated and similar results obtained (14). One advantage of the method is comfort for the patient, for whom the method is pleasanter, compared with the relatively unpleasant vibrations registered during application of the tungsten carbide bur.

Conclusions

1. The enamel was least damaged during use of a tungsten carbide bur. In second place was the Band Driver and in third place pliers for manual removal of composite.
2. Not one of the examined methods can be proclaimed ideal, as they all left more or less scratches on the surface of the enamel. Thus this subject should be further investigated.