Research Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2020;10:3:101-106.

Bonding Procedures in Orthodontics

Suhrajeet Narayan Sahoo[1*]

[1]Assistant Professor, Department of Orthodontics and Dentofacial Orthopedics, Institute of Dental Sciences, Siksha, Anusandhan (Deemed to be University), Bhubaneswar, Odisha, India.

ABSTRACT

Background: In the early days of fixed-appliance orthodontic treatment, brackets were welded to gold or stainless-steel bands. Before treatment, the orthodontist had to create enough space around each tooth to accommodate the bands, and then those spaces had to be closed at the end of treatment, when the bands were removed. This was time-consuming for the orthodontist and uncomfortable for the patient. Banded appliances frequently caused gingival trauma when fitted, and decalcification could occur under the band. In the mid-1960s, Dr George Newman, an orthodontist in Orange, New Jersey, and Professor Fujio Miura, chair of the Department of Orthodontics at Tokyo Medical and Dental University in Japan, pioneered the bonding of orthodontic brackets to enamel. Many developments have occurred in the decades that followed, including many new adhesives, sophisticated base designs, new bracket materials, faster or more efficient curing methods, self-etching primers, fluoride-releasing agents, and sealants. The purpose of this article is to review the history of orthodontic bonding and the materials used in the bonding process.

Keywords: Bonding, dentistry, orthodontics.

INTRODUCTION

The introduction of bonding to orthodontics added a new dimension to fixed appliance therapy. With a considerable reduction in the need for banding teeth, there was an improvement in patient comfort, esthetics and oral hygiene maintenance. The incidence of caries was reduced as was chair side time and there were no interproximal spaces left after finishing the treatment[1].

HISTORY:

Buonocore in 1955, was the first to demonstrate that bonding of acrylic restorative material was substantially increased by conditioning the enamel surface with 85% H_3PO_4 for 30 seconds. **Newman in 1965** was the first to apply these findings and bonded plastic brackets with an epoxy resin after etching with 40% H_3PO_4 for 60 seconds. **Mitchell in 1967** described a successful, although limited clinical trial using black copper cement and gold direct attachment. **Smith in 1986** introduced zinc polycarboxylate cement and bracket bonding with this cement was reported. **Miura in 1971** described an acrylic resin Orthomite using a modified trialkyl borane catalyst that proved to be particularly successful for bonding plastic brackets and for enhanced adhesion in the presence of moisture[2].

Bonding Procedure

Steps involved in direct and indirect bracket bonding on facial or lingual surfaces are as follows;

1. Cleaning
2. Enamel conditioning
3. Sealing
4. Bonding

Direct Bonding[3]

1. Cleaning

Received: Apr. 23, 2020: **Accepted**: May. 18, 2020
*Correspondence Dr. Suhrajeet Narayan Sahoo.
Department of Orthodontics and Dentofacial Orthopedics, Institute of Dental Sciences, Siksha, Anusandhan (Deemed to be University), Bhubaneswar, Odisha, India.
Email: drsubhrajeetsahoo1789@gmail.com

pISSN 2278-0076
eISSN 2321-9270

Thorough cleaning of the teeth with pumice is essential to remove plaque and the organic pellicle that normally covers all teeth. Cleaning is done using rotary instruments, either a rubber cup or polishing brush.

2. Enamel Conditioning

A. Moisture control

After the rinse, salivary control and maintenance of a completely dry working field is absolutely essential. Some of the measures used are;

- Lip expanders and / or cheek retractors
- Saliva ejectors
- Tongue guards with bite blocks
- Saliva duct obstructers
- Cotton or gauze rolls

- Antisialagogues (generally not needed, when indicated, banthine tablets 50mg per 100 lbs body weight 45 kgs.) in sugar free drink 15 minutes before bonding, may provide adequate results.

B. Enamel Pretreatment

After the operating field has been isolated, the teeth to be bonded are dried. The conditioning solution or gel, 37% H_3PO_4 is lightly applied over the enamel surface with a foam pellet, brush for 60 seconds.

At the end of etching period, the etchant is rinsed off with abundant water spray.

Teeth are thoroughly dried with a moisture and oil free source to obtain dull frosty appearance. Salivary contamination of the etched surface must not be allowed.

Study of etched enamel surface under Scanning Electron Microscope

Various studies have been carried out to define optimal concentrations of the acid used for etching and the duration of etching with H_3PO_4. These investigations include study of the etched enamel surface pattern under Scanning Electron Microscope highlighting the loss of enamel, test of shear bond strength of a bonded attachment to a correlated etchant concentration and duration of etching and the trauma to the enamel and the amount of adhesive on the surface of enamel subsequent to debonding[4].

Died rich typed action of the etchant on the enamel in three stages

Honeycomb pattern of the etched enamel (initially periphery of the prism head is delineated by micro clefts [0.1 to 0.2 micro meter]) continued action of acid leads to loss of substance predominantly in the area of prism cores with simultaneous conservation of the marginal areas[5].

Least amount of enamel is lost in this etch pattern designated as Type I.

As action of acid proceeds, there is dissolution of crest like marginal ridges, while the marginal clefts continue to widen. This is the transitional zone of central and peripheral etching pattern, in which existing marginal ridges are elevated approximately to 3 micro meter designated as Type III.

Peripheral etching pattern is an advanced stage in which the fragile prism peripheries break off. Maximum enamel loss takes place in this stage designated as Type II.

The above-mentioned patterns of the etched enamel surface were named as Type I, II and III by **Silverstone et al**[6].

Galil and Wright described Type IV and Type V etching patterns.

Type IV etch pattern is commonly seen in cervical areas. It shows pitted irregular pattern and displays no rod or prism pattern.

Type V shows no pattern of prism outline. Enamel surface is extremely flat and smooth and they lack micro irregularities for penetration of resin.

3. Sealing

After teeth are completely dried and appear frosty white, a thin layer of sealant is applied over the entire etched enamel surface with a small foam pellet or brush with a single gingivoincisal stroke.

The sealant coating should be thin and even because excess sealant may induce bracket drift and unnatural enamel topography when polymerized.

Bracket placement should be started immediately after all etched surfaces are coated with sealant[7].

Research is going on to determine the exact function of the sealant in acid etch procedure.

1. Some investigators conclude that sealant is necessary to achieve proper bond strength.
2. Sealant permits a relaxation of moisture control.
3. It permits easier bracket removal.
4. It protects against enamel tearouts at debonding.

Ceen and Gwinnett[8] found that light polymerized sealants protect enamel adjacent to brackets from dissolution and subsurface lesions, whereas, chemical curing sealants polymerized poorly, exhibit drift, and have low resistance to abrasion.

4. Bonding

At present, the majority of clinicians routinely bond brackets with the direct rather than the indirect technique.

The recommended bracket bonding procedure consists of the following steps;

1. Transfer
2. Positioning
3. Fitting
4. Removal of excess

1. Transfer

The Clinician grips the bracket with a pair of cotton pliers or a reverse action tweezer and then applies the mixed adhesive to the back of the bonding base. The bracket is immediately placed on the tooth close to its correct position.

2. Positioning

A placement scaler, such as the RM 349 or, preferably, one with parallel edges, is used to position the brackets mesiodistally and incisogingivally and angulate them correctly.

The placement scaler with parallel edges allows visualization of the bracket slot relative to the incisal edge and long axis of the teeth, with the scaler seated in the slot.

Proper vertical positioning may be enhanced by different measuring devices (Boon's gauge) or height guides on the brackets themselves.

A mouth mirror will aid in horizontal positioning particularly on rotated premolars[9].

3. Fitting

Next, the scaler is turned, and with one – point contact with the bracket, it is pushed firmly toward the tooth surface. The tight fit will result in good bond strength, little material to remove on debonding, and reduced slide when excess material extrudes peripherally.

The scaler should be removed after the bracket is in correct position and no attempts should be made to hold the bracket in place with the instrument.

Totally undisturbed setting is essential for achieving adequate bond strengths[10].

4. Removal of Excess

A slight bit of excess adhesive is essential to minimise the possibility of voids and to be certain that it will be buttered into the entire mesh backing when the bracket is being fitted. The excess is particularly helpful on teeth with abnormal morphology.

Excess will not be worn away by tooth brushing and other mechanical forces, it must be removed with a scaler before the adhesive has set or with burs after setting (oval or tapered tungsten carbide bur no. 7006, no. 2).

Removal of excess adhesives prevents gingival irritation and plaque build up around the periphery of the bonding base.

It also improves esthetics by providing a neater and cleaner appearance, and eliminating exposed adhesive that might become discoloured in the oral environment.

Bonding to Premolars

The visibility for direct bonding is facilitated if these teeth are bonded without a lip expander one at a

time. Bracket positions should be controlled using a mouth mirror. For newly erupted mandibular premolars, gingivally offset brackets are recommended.The gingival third of these teeth may have a high incidence of aprismatic enamel and an enamel rod direction that is less retentive of resin tags[11].

Bonding to Molars

The molar teeth are bonded separately from the other teeth to permit concentration on access, visibility and moisture control.

Dry field is obtained by a Dri-Angle in the buccal side and a cotton roll. The saliva is ejector is positioned on the side to be bonded, the mouth mirror is placed over the Dri-Angle for tissue retraction.

The bonding procedures are performed on one side, bonding the mandibular and maxillary molars in sequence. The same procedures are then repeated on the contralateral side.

Bonding to Crowns and Restorations

Many adult patients have crown and bridge restorations fabricated from porcelain and precious metals, in addition to amalgam restorations of molars. Banding becomes difficult, on the abutment teeth of fixed bridges.

The Micro Etcher (FDA approved intraoral sandblaster) uses 50 micro meter white or 90 micro meter tan aluminium oxide particles and approximately 7kg/cm^2 pressure, has been advantageous for bonding to different artificial tooth surfaces[12,13].

This tool is also useful for;

- Rebonding loose brackets
- Increasing the retentive area inside molar bands
- Creating micro mechanical retention for bonded retainers and
- Bonding to deciduous teeth

Bonding to Porcelain

Following technique is recommended

1. Isolate the working field adequately.
2. Deglaze an area slightly larger than the bracket base by sandblasting with 50 micro meter aluminium oxide for three seconds.
3. Etch the porcelain with 9.6% hydrofluoric acid gel for two minutes.
4. Carefully remove the gel with cotton roll, then rinse using a high volume suction.
5. Immediately dry with air and bond bracket with highly filled Bis GMA resin. The use of silane is optional[14,15].

Bonding to Amalgam[16]

Improved techniques for bonding to amalgam restorations may involve;

1. Modification of the metal surface (sandblasting, diamond bur roughening)
2. The use of intermediate resins that improve bond strength (All-Bond 2, Enhance, Metal Primer)
3. New adhesive resins that bond chemically to non-precious as well as precious metals (4-META resins)

The following procedure is recommended;

A. Small amalgam filling with surrounding sound enamel

1. Sandblast amalgam alloy with 50 micro meter aluminium oxide for 3 seconds.
2. Condition sound enamel with 37% H_3PO_4 for 15 to 30 seconds.
3. Apply sealant and bond with composite resin.

B. Large amalgam restoration or amalgam only

1. Sandblast amalgam alloy with 50 micrometer aluminium oxide for 3 seconds.
2. Apply a uniform coat of suitable metal primer and wait for 30 seconds (according to manufacturer's instructions).
3. Apply sealant and bond with composite resin.

It is made sure that the bonded attachment is not in occlusion with antagonists.

Bonding to Gold[17,18]

Different new technologies that bond chemically to precious metals include;

1. Sandblasting
2. Electrolytic tin-plating or plating with gallium-tin solution (Adlloy)
3. Intermediate primer
4. New adhesives that bond chemically to precious metals (Superbond C & B, Panavia Ex & 21)

Present clinical experiments include the use of new one component primer based on Triazine-Dithiol and 4-META adhesive resin.

Bonding to Composite Restoratives

The bond strength obtained with the addition of a new composite to mature composite is substantially less than the cohesive strength of the material. Brackets bonded to a fresh, roughened surface of old composite restorations appear to be clinically successful in most instances. It is advantageous to use an intermediate primer as well.

CONCLUSION

Bonding has changed the face of orthodontics. Initially banding was the procedure to correct the malocclusion but it was tedious, unesthetic, more discomfort to patient, proper hygiene cannot be maintained and many more disadvantages were faced by the then orthodontists. Nowadays with bonding we can achieve desired results with less difficulty.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

REFERENCES

1. Bjorn U Zachrisson. Bonding in orthodontics. Orthodontics, current principles and techniques. Thomas M Graber, Brainerd F Swain 1985; 485-561.
2. Ralph W Phillips. Restorative resins. Skinner's science of dental materials 1992; 215-248.
3. Pramod K Sinha, Ram S Nanda. Bonding in clinical orthodontics 23b, 2: 1-11.
4. Claude G Matasa. Adhesion and its ten commandments. Am J Orthod Dentofac Orthop 1989; 355-56.
5. Vanessa Leal Tavares Barbosa et al. Direct bonding to porcelain. Am J Orthod Dentofac Orthop 1995; 159.
6. Gerald Anthony Smith. Orthodontic bonding to porcelain – bond strength and refinishing. Am J Orthod Dentofac Orthop 1998; 245.
7. Samir E Bishara. Effect of an acid primer on shear bond strength of orthodontic brackets. Am J Orthod Dentofac Orthop 1998; 114(3): 243-247.
8. Bjorn U Zachrisson. Recent advances in bonding to gold amalgam and porcelain. J Clin Orthod 1993; 27(12): 661-75.
9. Leonard Chumak. An in vitro investigation of lingual bonding. Am J Orthod Dentofac Orthop 1989; 95: 120-27.
10. Mark T Underwood. Clinical evaluation of a fluoride – exchanging resin as an orthodontic adhesive. Am J Orthod Dentofac Orthop 1989; 96(2): 93-99.
11. Penvadee Phijaisanit. Comparison of the shear bond strength of a so called "dual-cured GIC" and a conventional resin composite used in orthodontic bonding. Am J Orthod Dentofac Orthop 1997; 15(1): 23-29.
12. John P Fricker. A new self-curing resin – modified GIC for the direct bonding of orthodontic brackets in vivo. Am J Orthod Dentofac Orthop 1989; 17(3): 29-37.
13. Andrew L Sonis. An evaluation of a fluoride – releasing, visible light-activated bonding system for orthodontic bracket placement. Am J Orthod Dentofac Orthop 1989; 95(4): 306-10.
14. Eliakim Mizrahi. Tooth surface and pulp chamber temperatures developed during

electrothermal bonding. Am J Orthod Dentofac Orthop 1996; 109(5): 506-14.

15. Maijer, Smith. Crystal growth on outer enamel surface. Am J Orthod Dentofac Orthop 1986; 183-93.

16. Vorster. Electrothermic bonding. J Clin Orthod 1979; 816-19.

17. Larry W White. A new and improved indirect bonding technique. J Clin Orthod 1999; 17-23.

18. Jay Collins. A precise and predictable laboratory procedure for indirect bonding. J Clin Orthod 2000; 702-05.