Research Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2017;7:1:245-250.

Comparing the Cuspal Deflection using Total Bonding and Selective Bonding Technique: An In Vitro Study

Mohan Pujari[1*] M Robert Justin[2] Madhu Pujar[3] Saleem Makandar[4]

[1]Senior Lecturer, Department of Conservative Dentistry, MMNGH Institute of Dental Sciences & Research Centre, Belgaum, Karnataka, India.
[2]Professor, Department of Conservative Dentistry and Endodontics, Aditya Dental College, Beed, Maharastra, India.
[3]Professor and Head, Department of Conservative Dentistry, MMNGH Institute of Dental Sciences & Research Centre, Belgaum, Karnataka, India.
[4]Senior Lecturer, Department of Conservative Dentistry, MMNGH Institute of Dental Sciences & Research Centre, Belgaum, Karnataka, India.

ABSTRACT

Aim: The aim of this study was to assess the cuspal deflection related to different adhesive techniques called total bonding and selective bonding techniques in class II composite restorations in human premolar teeth.

Materials and methods: Forty freshly extracted human premolar teeth were prepared with class II cavities and then restored with composite (esthetx HD A2, USA) using etch-and-rinse (Prime and Bond ,Dentsply USA) or self etch (One Coat, coltene and whaledent, Switzerland) adhesive systems under different bonding techniques (total bonding and selective bonding). The cuspal distance was measured before and after the restorative procedure, and the difference was recorded as mean cuspal deflection. The results were subjected to statistical analysis by ANOVA and Scheff's multiple comparison tests.

Results: For both adhesive systems, the teeth restored with selective bonding technique showed lower values of cuspal movement.

Conclusions: Both the adhesive techniques tested were not able to prevent the cuspal movement. However, selectively bonded class II composite restorations demonstrated lower values of cuspal movement comparing with total bonding technique.

Keywords: Cuspal deflection, total bonding technique, selective bonding technique, etch-and-rinse adhesive, self etch adhesive.

INTRODUCTION

After extensive research work by Buonocore[1] dentistry is being constantly shifting towards 'life like appearance of restorative materials. Aesthetic dentistry is now much more concerned and consulted. Composite restorations are most important part of aesthetic dentistry. Due to this aesthetic reason, resin composite is widely used as a restorative material in posterior teeth too.

However, even considering the intense research on bonding mechanism between composites and the dental substrate, clinical failure due to the disruption of the bonded interface remains a frequent occurrence.The cuspal movement may be perceived by the patient as post-operative pain and the interfacial debonding at the tooth-restoration interface may lead to marginal staining, pulpal inflammation and secondary caries.[3] Hence, polymerization shrinkage stresses produce either gap formation at tooth-restoration interference or cuspal deflection, but both the problems ultimately lead to failure of the restoration.

Received: Feb. 17, 2017: **Accepted**: Apr. 9, 2017
***Correspondence Dr. Mohan Pujari.**
Department of Conservative Dentistry, MMNGH Institute of Dental Sciences & Research Centre, Belgaum, Karnataka, India.
Email: mohanpujari712@gmail.com

pISSN 2278-0076
eISSN 2321-9270

According to Versluis et al. (8), tooth deformation offers the closest relationship to shrinkage stresses and can be quantified, whilst many of the other clinical symptoms are substantially subjective.[4] Linear displacement of the cusps was previously reported using other devices such as Linear Variable Differential Transformers (LVDTs) and Direct Current Differential Transformers (DCDTs), which are reported to be highly sensitive to the vertical angle of inclination. Cuspal deflection has also been measured with a digital micrometer and by using strain gauges to measure strains generated in the deformed cusp.[5]

Although adhesion is generally associated with the total bonding technique, adhesive systems can be applied in different manners. Krejci and Stavridakis[6] have defined the adhesion types as following: total bonding – adhesion is established to the entire surface of the cavity; selective bonding – adhesion is restricted to the margins of the preparation; separate bonding – the cavity is sealed by an adhesive system that does not adhere to or is insulated against the restorative material; and secure bonding – adhesion between the restorative material and the adhesive system is not completely eliminated, but is weaker than the adhesion between the adhesive system and the tooth. Selectively bonded class II composite restorations demonstrated lower values of cuspal movement comparing with total bonding technique [7]

Hence, the aim of this study was to assess the cuspal deflection related to different adhesive techniques (total bonding and selective bonding techniques).

MATERIALS AND METHODS

Collection and storage of samples

Forty intact freshly extracted human premolar teeth were used in this study. The teeth were stored in 0.1% thymol solution at 5°C. [8]

Methods of specimen preparation

Each tooth was subjected to preparation of a large mesio-occluso-distal (MOD) cavity, with the bucco-lingual width (BLW) of the proximal boxes being prepared to two-thirds of the BLW of the tooth and the occlusal isthmus being prepared to half the BLW. The cavity depth at the occlusal isthmus was standardized to 3.0 mm and the cervical wall was located 1 mm above the amelocemental junction (ACJ) of the proximal boxes. The teeth showing pulpal exposure after the preparation were discarded. Facial and lingual walls of the cavity were prepared parallel[9] (figure 1).

Measurement of intercuspal distance

A 1.5 mm diameter glass ball was fixed to each cusp vertex as reference point for intercuspal distance measurements**.** Digital micrometer is used to measure intercuspal distance. It is a device which can measure difference up to the .0001mm. Each tooth is attached to the metal box with screw to standardize the position. Measurements were taken by skilled operator to remove bias. The initial distance between reference balls was measured with a digital micrometer and recorded as 'initial distance'**.** (Figure 2 and 3)

Adhesive systems

Two different adhesive systems were used for this study

- *Total etch adhesive system(Prime and Bond ,Dentsply)*
- *Self-etch adhesive system (One Coat, coltene and whaledent)*

After the cavity preparation, thin glass ionomer cement (Fuji type III,Singapore) liner is applied to the exposed dentinal surface. Teeth were randomly distributed in four groups (n=10) according to the adhesive protocol. (table1)

Restorative procedure

All the restorative procedures were made under simulated dentinal hydrostatic pressure, employing a previously described protocol. Water Column of 364 mm will produce pressure of 24 cm of H_2O which will simulate intrapulpal pressure. [10-12] (figure 4-5). All the materials were applied in accordance with the manufacturer's guidelines.

For total bonding groups

Prime and Bond adhesive system, the dental surface which includes enamel and Type II GIC liner was acid etched with 37% phosphoric acid gel for 15 seconds, rinsed for 30 seconds and gently dried with absorbent paper to keep the dentinal surface

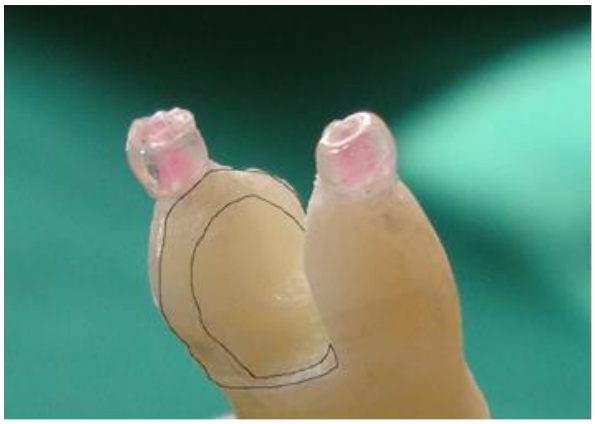

Fig 1: MOD cavity preparation on humen premolar and glss ball attched to cusps as a referenece pont to measure intercuspal distance,

Fig 2: Initial intercuspal distance measurement.

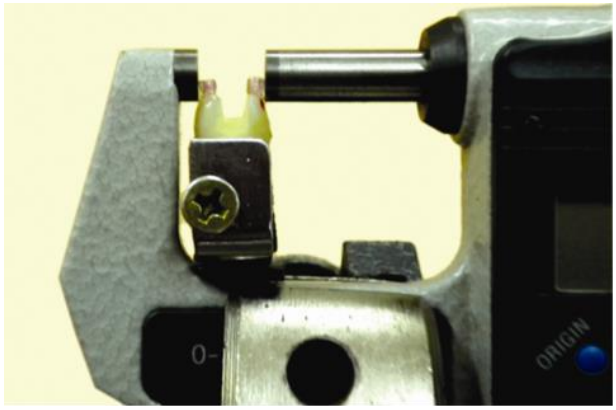

Fig 3: Lose view.

visibly moist.[13] The bonding agent was applied and dried for 5 seconds prior to the application of the adhesive that was light cured for 10 seconds. The adhesive layer was polymerized for 10 seconds prior to the application of the composite.

The One Coat adhesive was applied and dried with high-pressure air after 20 seconds and then light-cured for 10 seconds.

Fig 4: Simulation of intrapulpal pressure.

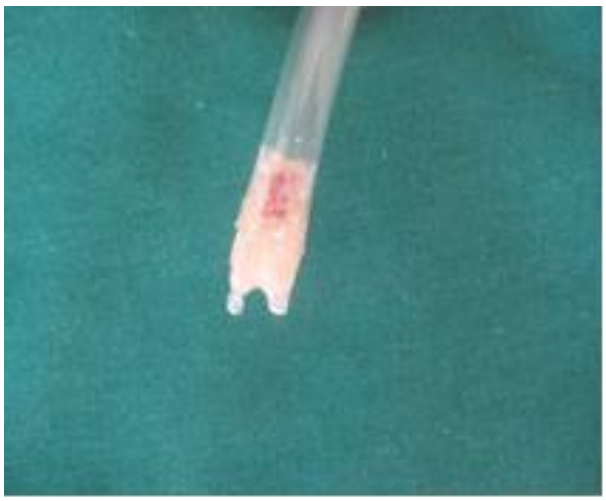

Fig 5: Close view of attachment.

For the selective bonding groups

After application of adhesive system as done for total bonding groups the margins of the preparations were refined with a super-fine diamond bur and then a new adhesive procedure was carried out only on the cavity finish lines. The self-etch adhesive system was applied immediately

Table 1: Study design of different groups.

Groups	Type of bonding
Group -I	Total etch and total bonding
Group –II	Total etch and selective bonding
Group-III	Self etch and total bonding
Group-IV	Self etch and selective bonding

Table 2: Statistical analysis.

Group	Initial intercuspal distance	Final intercuspal distance	Mean cuspal deflection
I	7.261± .768	7.236±.765	.025± .004
II	7.656± .549	7.644±.550	.012±.001
III	7.706±.625	7.683±.621	.023± .013
IV	7.716±.643	7.704±.643	.012±0.003

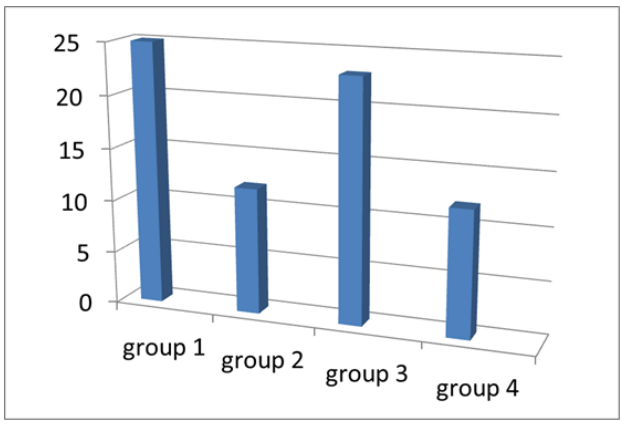

Fig 6: Graphical representation of results.

after the refinishing procedure, following the protocol already described. As previously mentioned, the objective of this technique is to achieve a new and strong adhesion on the margins of the cavity (to prevent gaps and microleakage) while maintaining a good quality of dentinal sealing (provided by the first adhesive procedure).

Composite restoration

The composite resin shade (esthetx HD) shade A2 was inserted in 3 increments and each layer was light-cured for 40 seconds.[14] After the polymerization of the last increment of composite, the distance between the glass balls was measured and recorded as 'final distance' The cuspal movement was obtained by calculating the difference between 'final' and 'initial' distance. The results were subjected to statistical analysis by ANOVA and Scheff's multiple comparison tests.

RESULTS

Intragroup comparison was done with ANOVA test and for all groups results were statistically significant p<0.001.which indicates that cuspal deflection had occurred after restoration. Intergroup comparison is done with Scheff's multiple comparison test.In group I and II p value was 0.007.In group III and IV p value was 0.010. The influence of the bonding technique on the cuspal movement was statistically significant for both the adhesive systems evaluated in this study. The teeth restored with selective bonding technique showed lower values of cuspal Deflection (table2), (Figure 6).

DISCUSSION

This is the first kind of study, using selective bonding technique with Type II GIC liner. The storage media used to store the extracted teeth should be selected carefully it should prevent dehydration of teeth and also provide an effective sterilization or disinfection. 0.1% thymol solution is most extensively used disinfectant. [9]

It has been accepted that the demineralized dentin surface must be kept ideally moist during adhesive procedures in order to promote proper resin monomer infiltration into the exposed collagen fibrils.[11] To simulate intrapulpal pressure the column height of water was adjusted to 34 cm to provide approximately 25mmHg pressure, which is the average tissue pressure in healthy pulp as previously mentioned method.[12] According to laws of fluid mechanics pressure of static fluid depends on depth (i.e. height) of fluid whatever the shape of any solid boundaries may be.[13]

It is most extensively studied that due to strong bonding between the composite and tooth, the polymerization shrinkage stresses in the composite are transmitted to the tooth and result in cusp deformation. [15,16,17,] The experimental groups in this study consisted of extracted human premolars because they represent a more severe situation

than molars due to longer clinical crown and less dentinal surface for bonding.[18] Cavities utilized in this study were large MOD cavities with a high C-factor and remaining tooth structure weakened, to facilitate the cuspal movement during restoration.

Total bonding technique is the simplest adhesive technique and may be indicated in restorations with a small volume and/or a low C-factor (fissure sealing, small group I and III composite restorations, large flat onlays). Selective bonding is better indicated for large group I and III composite restorations and for class II composite fillings, inlays and small onlays[7].Selective bonding technique creates free surfaces within the cavity, thus reducing the C-factor of the restoration.[8] GIC liner is applied to exposed dentinal surface and bonding done.

Selective bonding may improve sealing and marginal adaptation of large restorations with a high c factor and those restored with incremental technique. In addition a distinct advantage of selective bonding is that it creates two independent penetration barriers within restorative system. The first barrier is the margins of restoration. The thickness of occlusal enamel is approximately 1.2 mm which provides sufficient tooth structure for bonding. In the event, if this barrier fails, a second barrier is established. Selective bonding creates free surface within the cavity thus reducing C factor of restoration one concern with this technique is that dentin within cavity remains unprotected and thus prone to post operative sensitivity. To resolve this concern a liner or base has to be introduced in to the system which is second barrier. DUAL SEAL effect is established here, first is of GIC liner which protects dentin surface and second seal is of adhesive layer which protects liner surface.[7]

All experimental groups showed a reduction in intercuspal distance after the restorative procedure. However, the values of this displacement were significantly lower when selective bonding technique was employed. Numerous factors, such as hydration of dentin, flow, creep, hygroscopic expansion of the material, and fracture within the tooth structure determine the recovery of cuspal deformation to its original position.[19,20]

So, along with above worked selective boding technique, if recent advances in composite restoration such as low shrink composite, proper cavity design and correct restoration technique are used, a stable restoration can be given which will meet and enhance aesthetic and functional demands.

CONCLUSION

Teeth restored with selective bonding technique showed lower values of cuspal deflection than teeth restored with total bonding technique but cuspal deflection was not totally eliminated in all groups submitted for study. As it is first study done on selective bonding technique with GIC liner long term clinical evaluations are necessary.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. Michael g. Buonocore. A simple method of increasing the adhesion of acrylic Filling materials to enamel surfaces. *J dent res* 1955; 34; 849-53

2. Roberto r. Bragaa, rafael y. Ballestera, jack l. Ferracaneb.Factors involved in the development Of polymerization shrinkage stress in Resin-composites: a systematic review. Dental materials 2005 21, 962–70

3. Lutz f, kreici i, barbakow f. Quality and durability of Marginal adaptation in bonded composite restorations. Dental materials 1991;7:107–13.

4. Versluis A, Tantbirojn D, Pintado MR, DeLong R, Douglas WH. Residual shrinkage stress distributions in molars after composite restoration. Dent Mater 2004;20:554-64.

5. González lópez, maria victoria sanz chinesta, laura ceballos garcía et al. Influence of cavity type and size of composite restorations on cuspal flexure. Med oral patol oral cir bucal 2006;11:e536-40.

6. Ivo krejci and minos stavridakis.New perspective on dentin adhesion perspective. Pract periodont Aesthet Dent 2000;12:727-32.

7. Edson Alves Camposa,Marcelo Ferrarezi Andradeb,Sizenando Toledo Porto-Netob et al. Cuspal movement related to different bonding

techniques using etch-and-rinse and self-etch adhesive systems. European journal of dentistry 2009;3:213-18.

8. Gul tosun1, yagmur sener1 and abdulkadir sengun ;Effect of storage duration/solution on microshear bond strength of composite to enamel. Dental material 2007;61:116-21.

9. William m. Palina,, garry j.p. Fleminga, henal nathwani et al. In vitro cuspal deflection and microleakage of maxillary premolars restored with novel low-shrink Dental composites. Dental materials 2005; 21:324–35.

10. Marcio vivan cardoso, simone gonçalves moretto, rubens côrte real de carvalho, et al. Influence of intrapulpal pressure simulation on the bond strength of adhesive systems to dentin. Braz oral res 2008;22:170-5.

11. R gupta • s tewari,Effect of Rotary instrumentation On composite bond strength With simulated Pulpal pressure. Operative dentistry 2006;31: 188-96.

12. Bernard Massey, revised by Jonh Word Smith. Mechanics of fluid 7th edition. page 47-49.

13. Alvaro DELLA BONA,Caroline PINZETTA,Vinicius ROSA. Microleakage of acid etched glass ionomer sandwich Restorations. j Appl Oral Sci 2007;15:230-34.

14. A. Versluis, W.H. Douglas, M. Cross et al. Does an incremental filling technique Reduce polymerization shrinkage stresses?. J dent res 1996;75: 871-78.

15. G.j.p. Fleminga,, d.p. Halla, a.c.c. Shortalla, f.j.t. Burkeb. Cuspal movement and microleakage in premolar Teeth restored with posterior filling materials of Varying reported volumetric shrinkage values. Journal of dentistry 2005; 33: 139–46.

16. S. Bouillaguet, J. Gamba, J Forchelet et al. Dynamics of composite polymerization mediates the development of cuspal strain. Dental materials 2006;22:896-02.

17. Cornelis J. Kleverlaan , Albert J. Feilzer Polymerization shrinkage and contraction stress of dental resin composites. Dental Materials 2005; 21: 1150–57.

18. I Krejci, O Duc, D Dietschi et al. Marginal adaptation, Retention and fracture resistance of adhesive composite restorations on devital teeth with or without posts. Operative dentistry 2003;28:127-35

19. Causton BE, Miller B, Sefton J. The deformation of cusps by bonded posterior composite restorations: an in vitro study. Br Dent J 1985;159:397-400.

20. Krejci I, Schupbach P, Balmelli F, Lutz F. The ultra structure of a compomer adhesive interface in enamel and dentin, and its marginal adaptation under dentinal fluid as compared to that of a composite. *Dent Mater* 1999;15:349-358.