ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 14, Issue, 05, pp.21522-21529, May, 2022
DOI: https://doi.org/10.24941/ijcr.43561.05.2022

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

A COMPARISON OF ENAMEL LOSS AND ADHESIVE REMNANT INDEX OF METAL BRACKETS BONDED WITH TWO DIFFERENT ADHESIVES UNDER DRY AND SALIVA CONTAMINATED CONDITIONS

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ARTICLE INFO

Article History:
Received 05th February, 2022
Received in revised form
19th March, 2022
Accepted 15th April, 2022
Published online 30th May, 2022

Key words:

Bracepaste, Transbond XT,
Metal brackets,
Energy Dispersive X RaySpectroscopy,
Hydrophilic Primer,
Adhesive Remnant Index.

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ABSTRACT

Background and Objectives: The success of a fixed orthodontic appliance depends on attachments with adequate bond strengths and a low failure rate. During treatment, bondfailures between the bracket and the tooth slow down the progress of treatment, and it can also be costly for the patient in terms of clinical time, materials, and time loss. New technologies using new materials are continually developing to increase the bond strength consistency and reduce the loss of enamel on debonding. The objective of this study is to compare the enamel loss and adhesive remnant index of debonded metal brackets bonded with two different adhesives under dry and saliva contaminated conditions. **Methods:** 80 human maxillary premolar teeth freshly extracted was collected and stored. Then specimen was randomly divided into certain groups and bonded accordingly with the adhesives under study. 10 samples from each group was debonded manually by using their corresponding pliers. After debonding residual adhesive on the teeth was assessed using stereomicroscope of 10x magnification. Adhesive remnant index (ARI) of the site of bond failure was calculated. The debonded bracket base was assessed by Energy dispersive X ray spectroscopy attached to high resolution scanning electron microscope to detect calcium and phosphorus. **Result and Discussion:** Energy dispersive X ray spectroscopy analysis showed a significantly high amount of elemental Calcium and Phosphorous on Bracepaste with hydrophilic primer under dry condition compared to Transbond XT with hydrophilic primer under dry condition. Transbond XT and Bracepaste with conventional primer under saliva contaminated condition showed less elemental Calcium and Phosphorous compared to Transbond XT and Bracepaste with hydrophilic primer under saliva contaminated condition. **Conclusion:** Metal brackets bonded with Transbond XT with hydrophilic primer undersaliva contaminated condition have shown minimal enamel loss. Transbond XT and Bracepaste with hydrophilic primer under dry condition showed significantly high amount of elemental Calcium and Phosphorous, so avoid using hydrophilic primers on overdried enamel surface.

Citation: ***Dr. Rasool Karim Nizaro Siyo, Dr.Bejoy P Unni et al.*** **2022.** "A comparison of enamel loss and adhesive remnant index of metal brackets bonded with two different adhesives under dry and saliva contaminated conditions". *International Journal of Current Research*, 14, (05), 21522-21529.

INTRODUCTION

Attaching orthodontic appliances directly to enamel using an acid etched technique is the most important procedure in clinical orthodontic practice. Newman[1] in 1965 adapted the acid-etch technique of Buonocore[2] to orthodontics for the direct bonding of orthodontic brackets with a resin adhesive. This direct bonding technique is beneficial when compared to the earlier method of banding for both the patient as wellas the practitioner. Patient's benefits include decreased enamel decalcification, less irritation of gingival tissue and better esthetics. Less chair side time and patient's improved oral hygiene are the benefits from practitioner's view.[3] An ideal orthodontic adhesive should maintain sound enamel surface after debonding.[4] Since then, many new bonding adhesives have been developed to improve the quality of bond between brackets and tooth surface and also minimize the enamel loss on debonding.

The term debonding refers to removal of orthodontic attachments and the residual adhesive from the enamel surfaces to restore as closely as possible to its pretreatment condition with minimal iatrogenic damage.[5] Debonding may cause scratches and surface irregularities as Hosein[6] et al stated that more surface enamel is lost during the debonding and clean up procedures than bonding. Enamel loss during debonding procedures has clinical significance because it removes a major part of the protective fluoride-rich layer of enamel. So there is always a quest for an orthodontic bonding material which has better shear bond strength but minimal enamel loss while debonding. Assessment of the adhesive remnant after debonding is an important factor in the selection of orthodontic bonding material . In 1984 Artun and Bergland[7] introduced Adhesive Remnant Index to assess the amount of adhesive remaining on the enamel surface and site of bond failure.When bond between bracket and adhesive is excessively strong, it results in bond failure at the enamel surface which is undesirable.The bonding material may tear the enamel surface while debonding. This usually happens in ceramic brackets,due to its lack of ductility which generate stress in the adhesive–enamel interface that may produce enamel cracks at debonding[8]. The bracket-adhesive interface is the most favorable site for safe debonding , so that there is less chance of enamel fracture and it is considered ideal if the adhesive remains on the tooth surface after debonding.[9]

Debonding characterstics of brace paste (American orthodontics)haven't been researched extensively and only limited data is available to understand its bonding and debonding characterstics. It will be beneficial if a study of this material is done to compare its properties with a clinically proven acceptable material like Transbond XT(3M Unitek).
Energy dispersive X ray spectroscopy attached to high resolution scanning electron microscope , allows the quantitative analysis of the samples by emission of characteristics x rays for detecting the amount of Calcium and Phosphorous attached todebonded bracket base. The debonded tooth surface were examined under optical stereomicroscope of 10x magnification to assess the residual adhesive on the tooth surface and site of bond failure using adhesive remnant index(ARI). This study was planned to evaluate and compare adhesive remnant index (ARI) using stereomicroscope of 10x magnification and enamel loss while debonding using energy dispersive x ray spectroscopy between Brace Paste (American orthodontics) and Transbond XT(3M Unitek), using conventional and moisture insensitive primer(MIP).

MATERIALS AND METHODS

An in-vitro comprehensive study is planned to assess and compare the bonding and debonding characterstics of 2 different orthodontic adhesives with two different primers.

Bonding Materials Used Composite Adhesive: Bracepaste (American Orthodontics,Sheboygan,USA) and Transbond XT (3 M Unitek,Monrovia,California)

Primer: Bracepaste (American Orthodontics primer, Sheboygan, USA) and Transbond XT(3 M Unitek primer, Monrovia, California) Transbond MIP(3M Unitek primer, Monrovia, California)

Etchant: 37 % Phosphoric acid solution(Scotchbond 3 M Unitek, Monrovia, California)

Artificial saliva: Xerostat (Sodium Carboxymethylcellulose, Sorbitol)

Brackets Used: Stainless steel brackets- 60 Maxillary premolar brackets 0.022" slot MBT series(LEONE,Italy)

Teeth Samples: 80 human maxillary premolars extracted for therapeutic purpose were used as thesamples.

Inclusion criteria

- Teeth with intact crowns

Exclusion criteria

- Teeth with attrition, hypoplastic areas (Fluorosis), cracks, gross irregularities,caries and fractures.
- Previously bonded teeth
- Teeth with restoration
- Teeth pretreated with chemical agents such as hydrogen peroxide, formalin orfluoride**.**

Storage: The samples were stored in a 0.1% (wt/vol) aqueous solution of thymol at room temperature for seven days to prevent bacterial contamination and dehydration. Then the teeth were subsequently placed in distilled water at 4 degree C.

Mounting: The roots were completely embedded into the color coded acrylic blocks up to cementoenamel junction.

Classification of samples into eight groups

Bonding Procedure

Prophylaxis: The buccal surface of each tooth was cleaned with pumice using rubber cup micromotor handpiece with rubbercup for 10 seconds, then rinsed and dried with oil free compressed air.

Etching: The buccal enamel surface were etched with 37 percent phosphoric acid (Scotchbond – 3M ESPE) for 15 seconds rinsed and completely air dried for 30 seconds with compressed air.

For groups 2,4,6,8: Under saliva contamination, a thin coat of artificial saliva, Xerostat (Sodium Carboxymethyl, Sorbitol) is applied with a brush to etched and dried enamel surface just before the application of the primer and left for 10seconds to ensure full hydration of thesurface.

Priming: A thin, uniform film of the Bracepaste primer was applied to group 1 and group 3 and Transbond XT primer was applied to group 5 and group 6.

Applying bonding adhesive:

Group 1 and group 2:Transbond XT with conventional primer was placed onto themetallic bracket base

Group 3 and group 4: Transbond XT with hydrophilic primer was placed onto themetallic bracket base

Group 5 and Group 6 :Bracepaste with conventional primer was placed onto the metallicbracket base

Group 7 and Group 8:Bracepate with hydrophilic primer was placed onto the metallicbracket base

And the bracket was firmly pressed on the prepared enamel; the excess adhesive wasthen removed with an explorer.

Curing : Brackets were light cured for 10 seconds on occlusally and gingivally for a total of 20 seconds per tooth using Bluephase N LED light curing unit. The teeth were then stored for 24 hours in distilled water at 37°C before debonding. Each group consisted of 10 samples which were debonded manually and taken for Energy dispersive X ray spectroscopy(EDAX or EDX) and ARI index

ARI index to assess the site of bond failure on enamel surface after debonding

SEM-EDAX TEST to assess enamel loss after debonding of bracket base.

DEBONDING

10 samples from each group were debonded mechanically by using their correspondingpliers.

For metallic brackets – 001-346E Direct Bond Bracket Remover (SKODI)

ADHESIVE REMNANT INDEX (ARI): 10 samples from each group were debonded manually by using normal bracket removing pliers. For all the groups -001-346E Direct Bond Bracket Remover. The debonded tooth surface were examined under optical stereomicroscope of 10x magnification from Polymer Science Department, CUSAT to assess the residual adhesive on the tooth surface and site of bond failure using Adhesive remnant index (ARI),done by a single observer .Analysis of residual adhesive on the tooth surface was done according to Artun and Bergland– ARI score by visualizing in the microscope and the scores were made.

The criteria for scoring were as follows:

0 = No adhesive on the tooth

1= Less than half of the adhesive on the tooth 2= More than half of the adhesive on the tooth 3= All the adhesive on the tooth, with a distinct impression of the bracket mesh.

ENERGY DISPERSIVE X RAY SPECTROSCOPY: The debonded bracket base were examined under Scanning Electron Microscope(SEM) and Energy Dispersive X-ray Spectrometry (EDAX-analysis) JOEL JSM6390, from Sophesticated Testing and Instrumentation Centre(STIC), CUSAT to detect calcium (Ca) and phosphorus (P). The debonded bracket base used in the study were mounted on aluminium stubs and obtained a vacuum of 20 Pascals. Bracket base were sputter coated with gold for 30seconds and were removed and placed in scanning electron microscope, areas of elemental analysis were selected and analysed with EDAX at accelerating voltage of 20kv. Bracket bases were examined by 30x and 500x used to verify the amount of adhesive remnant on the bracket base.30x magnification to determine the mode of failure and 500× magnification for detecting enamel fragments.SEM analysis provide only qualitative evaluation so the bracket bases were examined through Energy Dispersive Spectroscopy to determine quantitative analysis of enamel loss.The EDAX uses the X- rays to identify traces of elements on the surface of the scanned specimens.

Figure 1. Debonding of metalbrackets

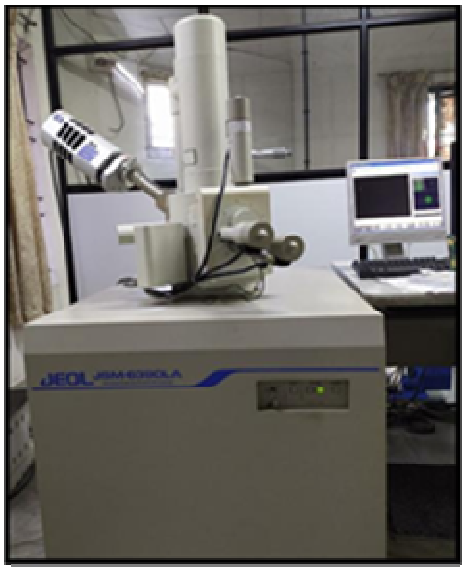


Figure 2: Energy Dispersive Spectroscopy Attached

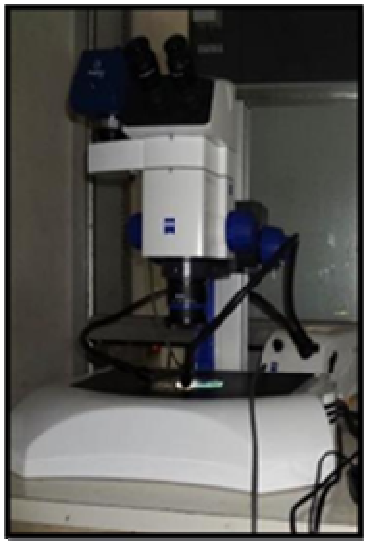


Figure 3. Stereomicroscope To High Resolution Scanning Electron Microscope

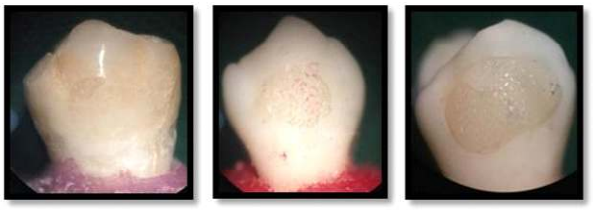
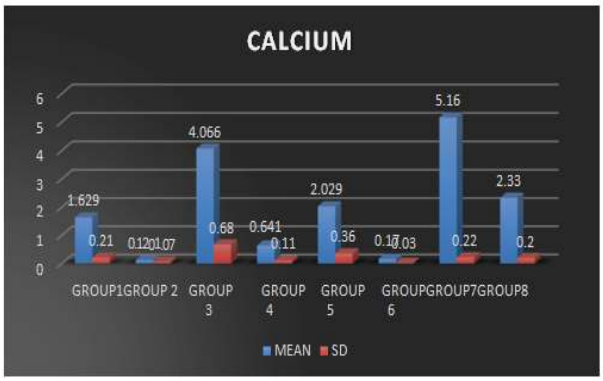


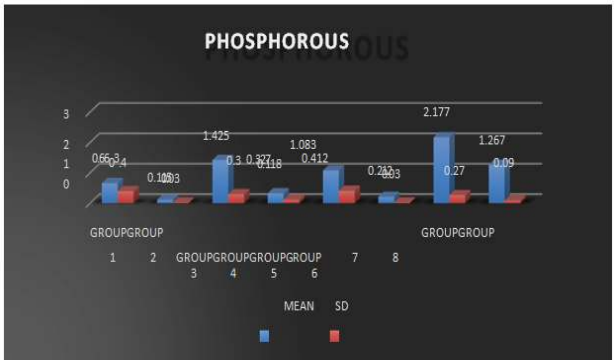
Figure 4. Adhesive remnant on the tooth surface

RESULTS

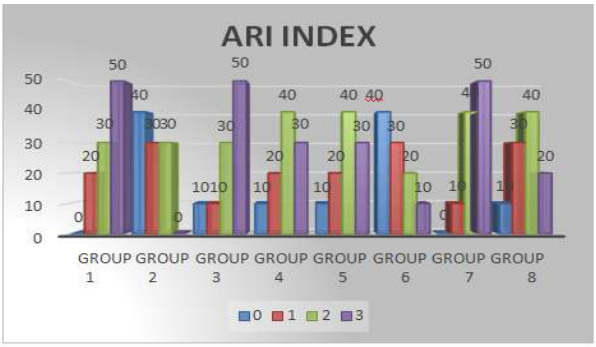
Statistical Analysis: Data was analyzed using the statistical package SPSS 22.0 (SPSS Inc., Chicago, IL) and level of significance was set at $p<0.05$. Descriptive statistics was performed to assess the mean and standard deviation of the respective groups. Normality of the data was assessed using Shapiro Wilkinson test. Inferential statistics to find out the difference between and within the groups was done using STUDENT T TEST and ONE WAY ANOVA and TUKEYS POST HOC TEST. CHI SQUARE test was used to find out the association between ARI categorical variables.



GRAPH 3- COMPARISON OF ARI: The Statistical comparison between two adhesives, Bracepaste and Transbond



Graph 2. Comparison of enamel loss in the form of phosphorus



Graph 3. Comparison Of Ari

saliva contaminated condition) shows that the highest shear bond strength is for Group 3 and enamel loss is for Group 7.But there is no significant difference in shear bond strength and enamel loss between Group 1 and Group 5.Group 4 showed significantly less shear bond strength and enamel loss compared to other groups.

DISCUSSION

The development of the acid etch technique by Buonocore[2] in 1955 led to the bonding of orthodontic brackets to enamel with resin adhesive. Bonding of orthodontic brackets generally involves etching the enamel surface, application of primer onto the etched surface, followed by a adhesive resin on the bracket base to form the final bond between the bracket and the tooth. Recently, because of increasing risk of moisture contamination orthodontic bracket bonding with hydrophilic primer has become an intresting topic. In sight of this, several manufacturers are developing orthodontic adhesive with hydrophilic primer. More adhesive material attached to the base of the bracket while debonding, less time required for residual adhesive removal. However bracket-adhesive interface can be considered, most favorable failure site for safe debonding, leaving most of the adhesive on the enamel surface, since there is less chance of enamel fracture.[9] In orthodontic procedures, the debonding of brackets either by accident or by an orthodontist is a frequent event. The adhesion between orthodontic composite resins and the tooth enamel should be temporary, but it should last enough to withstand masticatory and orthodontic forces at the same time. Iatrogenic damage to enamel on debonding is inevitable,in scenarios where the tensile bondstrength was above 14.5 mpa on debonding, enamel damage was reported. The calcium loss fromthe enamel surface can lead to dental erosion, which is a

Classification of samples into eight groups

Sl No	Adhesive material	Saliva Contamination	Total number of amples	Color
Group 1	Transbond XT(with conventionalprimer)	No	20	Red
Group 2	Transbond XT(with conventionalprimer)	Yes	20	Violet
Group 3	Transbond XT(with hydrophilicprimer)	No	20	Pink
Group 4	Transbond XT(with hydrophilicprimer)	Yes	20	Blue
Group 5	Bracepaste(with conventionalprimer)	No	20	Green
Group 6	Bracepaste(with conventionalprimer)	Yes	20	Black
Group 7	Bracepaste(with hydrophilic primer)	No	20	Yellow
Group 8	Bracepaste(with hydrophilic primer)	Yes	20	Orange

Table 2. Descriptive Data(Amount Of Calcium Present OnBracket Base)

GROUPS	MEAN	SD	MIN	MAX
GROUP 1	1.629	0.21	1.33	1.93
GROUP 2	0.121	0.07	0	0.3
GROUP 3	4.066	0.68	3.16	5.24
GROUP 4	0.641	0.11	0.43	0.78
GROUP 5	2.029	0.36	1.59	2.81
GROUP 6	0.17	0.03	0.12	0.21
GROUP 7	5.16	0.22	4.76	5.53
GROUP 8	2.33	0.20	1.96	2.6

Table 3- Comparison of calcium(edax)

	Sum of squares	df	Mean Squares	F	sig
BetweenGroups	232.25	7	33.17		
Within Groups	6.86	72	0.092	357.52	0.0001*
Total	238.932	79			

*P<0.5 is statistically significant (ONE WAY ANOVA TEST)

Table 4. Descriptive Data (Comparison Of Phosphorous)

GROUPS	MEAN	SD	MIN	MAX
GROUP 1	0.663	0.40	0.24	1.28
GROUP 2	0.115	0.03	0.08	0.18
GROUP 3	1.425	0.30	0.8	1.82
GROUP 4	0.327	0.118	0.17	0.5
GROUP 5	1.083	0.412	0.3	1.7
GROUP 6	0.212	0.03	0.16	0.27
GROUP 7	2.177	0.27	1.82	2.63
GROUP 8	1.267	0.09	1.08	1.4

Table 5. Comparison Of Phosphorous (Edax)

	Sum of squares	Df	Mean Squares	F	sig
BetweenGroups	35.48	7	5.068	79.04	0.0001*
Within Groups	4.61	72	0.064		
Total	40.09	79			

*P<0.5 is statistically significant

Table 6. Ari Index Comparison

Score	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
0	0	4(40%)	1(10%)	1(10%)	1(10%)	4(40%)	0	1(10%)
1	2(20%)	3(30%)	1(10%)	2(20%)	2(20%)	3(30%)	1(10%)	3(30%)
2	3(30%)	3(30%)	3(30%)	4(40%)	4(40%)	2(20%)	4(40%)	4(40%)
3	5(50%)	0	5(50%)	3(30%)	3(30%)	1(10%)	5(50%)	2(20%)
X2 VALUE				23.98				
P VALUE				0.0001*				

Preservation of the maximum amount of enamel surface structure with the least amount of enamel loss while removing the bracket and polishing after orthodontic treatment is beneficial.[11] The outermost layer of enamel should be left as intact as possible, as it has a higher microhardness andcontains more minerals and fluoride than the deeper zones. On the contrary, the loss of surface enamel and associated exposure of the enamel prism to the oral environment may lead to a decrease in the resistance of the enamel to the organic acids in the plaque. This eventually makes enamel more prone to demineralization.[12] Therefore, while choosing an adhesive for an orthodontic procedure, Shear bond strength, site of bond failure, amount of enamel loss, cost,chair time all need to be taken into account. In the present study the properties of two different adhesive materials: Transbond XT and Bracepaste were assessed and compared and also the performance with

conventional and hydrophilic primer under dry and saliva contaminated condition is verified. Transbond XT's debonding nature have been extensively investigated and reported to have less enamel loss while debonding with wide clinical acceptance. Bracepaste is a newer adhesive material from American orthodontics introduced into the market claimed to have similar properties and composition of substances as in Transbond XT. Bracepasteis a medium viscosity, light-curable adhesive which can be used with or without primer. The adhesive is designed to minimize bracket drift and provide easy flash cleanup. When the results of the ARI were evaluated for Group 1 and Group 5, it was noted that the most common result for Group 1 was score 3 (50%), where all the adhesives remained in the enamel after debonding. But in Group 5, the ARI score of 2 (40 %) was more frequent than ARI score of 3(30%). Shams etal [13] had a similar observation that Transbond XT had the highest score of 3 forARI compared to Brace Paste. In Group 1, higher ARI scores could be attributed to its greater penetration of adhesieve into the enamel surface. Olsen et al [14] reported that the ARI index 3 is thesafest, where the chance of enamel damage is less likely while debonding procedure. Though the bracket-adhesive interface can be considered the most favorable failure site for safedebonding, leaving most of the adhesive on the enamel surface, but the removal of composite from tooth surface will also be time consuming. EDX analysis revealed that there is no statistically significant difference between Group 1compared to Group 5.The mean amount of calcium (Ca%) and phosphorus(P%) from the scanned metal brackets were 2.029% and 1.063% respectively for group 5 and this values were 1.627% and 0.61% respectively for group 1.This mild difference in the values indicates the possible association between the decreased ARI score and the loss of enamel.

When the results of the ARI were evaluated for Group 1 and Group 3, it was noted that the most common result for Group 1 and Group 3 was score 3 (50%), where all the adhesives remained in the enamel after debonding. Hobson et al[15] and Rajagopal et al[4] had a similar observation that Transbond XT with conventional primer under dry condition and Transbond XT with hydrophilic primer under dry condition both had an ARI score of 3. Higher ARI scores could be attributed to its greater penetration of adhesieve into the enamel surface. EDX analysis revealed that there is statistically significant difference between Group 1 comparedto Group 3.

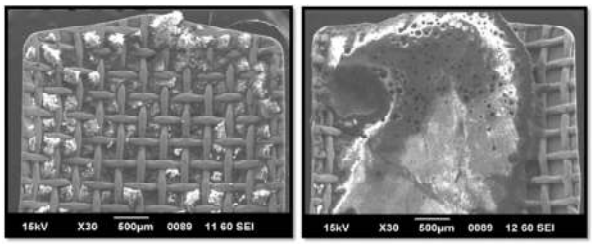


Figure 5 (a) (b)

The mean amount of calcium (Ca%) and Phosphorus(P%) from the scanned metal brackets were 4.06% and 1.42% respectively for group 3 and this values were 1.627% and 0.61% respectively for group 1.This difference in the values indicates the possible association between the increased shear bond strength and the loss of enamel.

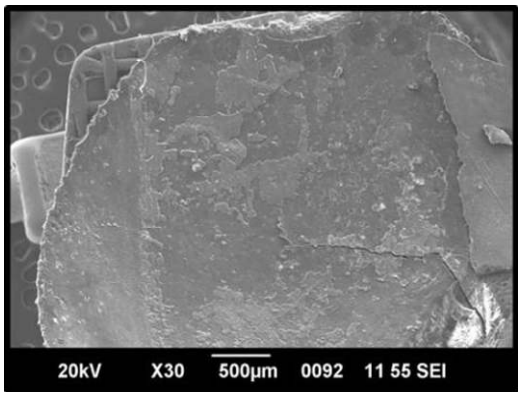


Figure 6

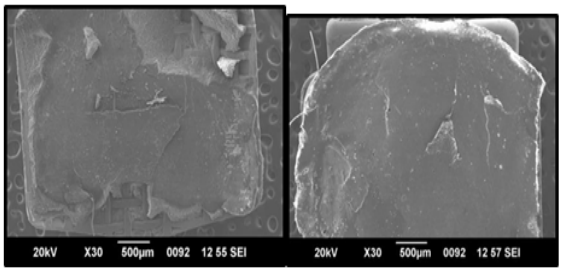


Figure 7 (a) (b)

When the results of the ARI were evaluated for Group 2 and Group 4, it was noted that the most common result for Group 2 and Group 4 were score 0 and score 2 respectively , where little adhesives remained in the enamel after debonding. Webster et al[16] had a similar observation that Transbond XT with conventional primer under saliva contaminated condition and Transbond XT with hydrophilic primer under saliva contaminated condition had an ARI score of 0 and 2 respectively. Group 2 had less ARI score due to the hydrophobic properties of the primer. EDX analysis revealed that there is statistically significant difference between Group 2 comparedto Group 4.

The mean amount of calcium (Ca%) and Phosphorus(P%) from the scanned metal brackets were 0.64% and 0.32% respectively for group 4 and this values were 0.12% and 0.11% respectively for group 1. This difference in the values indicates the possible association between the decreased ARI score and the loss of enamel Figure 7 (a) (b). When the results of the ARI were evaluated for Group 5 and Group 7, it was noted that the most common result for Group 5 and Group 7 were score 2 and score 3 respectively , where all of the adhesives remained in the enamel after debonding. Group 5 had lesser ARI score due to the hydrophobic nature of the primer. EDX analysis revealed that there is statistically significant difference between Group 5 compared to Group 7.The mean amount of calcium (Ca%) and Phosphorus(P%) from the scanned metal brackets were 2.02% and 1.06% respectively for group 5 and this values were 5.16% and 2.17% respectively for group 7. Group 7 had highest amount of enamel loss compared to all other groupsbecause of its increased shear bond strength. So, its always better to use Transbond MIP primer inslight moisture or saliva contaminated condition.

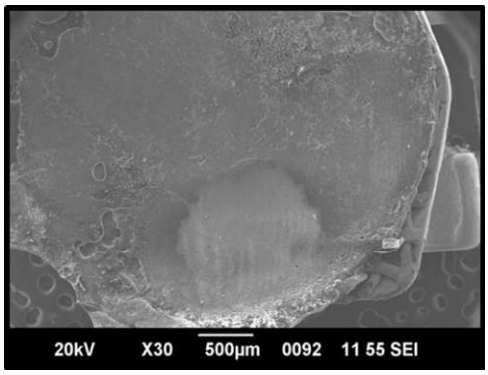


Figure 8

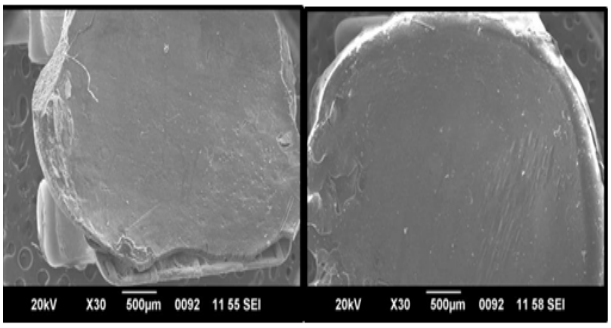


Figure 9 (a) **(b)**

When the results of the ARI were evaluated for Group 6 and Group 8, it was noted that the most common result for Group 6 and Group 8 were score 0 and score 2 respectively , where all of the adhesives remained in the enamel after debonding for group 6 and it is due to the hydrophobic nature of the primer. EDX analysis revealed that there is statistically significant difference between Group 6 compared to Group 8.The mean amount of calcium (Ca%) and Phosphorus(P%) from the scanned metal brackets were 0.17% and 0.21% respectively for group 6 and this values were 2.33% and 1.26% respectively for group 8. Group 8 had higher amount of enamel loss compared to group 6, this is due to increased shearbond strength of group 8 compared to that of group 6. Shearbond strength, ARI and enamel loss for group 8 all are in acceptable range, so its always better to use Transbond MIP primer in moisture contaminated situations.

CONCLUSION

Direct bonding of orthodontic brackets to enamel was made a reality with the introduction of acid etch technique by Buonocore.[1] There is always a quest for an orthodontic bonding material which has better shear bond strength but minimal enamel loss while debonding. Several modifications in bonding techniques to overcome various failure possibilities caused due to tooth texture, masticatory force, diet, chewing cycle, brushing technique etc, were implemented in clinical practice. Control of moisture contamination is considered to be the most challenging factor among all these. In this study ARI and enamel loss following the use of Bracepaste with conventional primer and with hydrophilic primer, both under dry and saliva contaminated condition and Transbond XT under the same conditions were assessed and compared after debonding of brackets .

Based on the result of this study, it can be concluded that

- Metal brackets bonded with Bracepaste with hydrophilic primer under dry condition had the highest enamel loss as evidenced by the Calcium and Phosphorous elementsrevealed in EDX.
- No significant differences were found in enamel loss between Bracepaste and Transbond XT, with conventional primer under dry condition.
- Significant difference were obtained in enamel loss between Transbond XT with conventional primer under saliva contaminated condition and Transbond XT with hydrophilic primer under saliva contaminated condition.
- Metal brackets bonded with Transbond XT with hydrophilic primer under saliva contaminated condition have shown minimal enamel loss.

REFERENCES

1. Newman GV (1965). Epoxy adhesives for orthodontic attachments: progressreports. *Am J Orthod Dentofacial Orthop.,* 51: 901-912.
2. Buonocore, M. G.: A simple method of increasing the adhesion of acrylic filling materials to enamel surfaces, *J. Dent. Res*., 34: 849-853, 1955.
3. Zachrisson BU. A posttreatment evaluation of direct bonding in orthodontics. *AmericanJournal of Orthodontics*. 1977 Feb 1;71(2): 173-89.
4. Rajagopal R, Padmanabhan S, Gnanamani J. A comparison of shear bond strength and debonding characteristics of conventional, moisture-insensitive, and self-etching primers invitro. The Angle Orthodontist. 2004 Apr;74(2):264-8.
5. Graber, Vanarsdall, Vig. Current principles and techniques-Fifth edition, Elsevier.
6. Hosein I, Sherriff M, Ireland AJ. Enamel loss during bonding, debonding, and cleanup withuse of a self-etching primer. *Am JOrthod Dentofacial Orthop.,* 2004; 126:717-24.
7. Artun J, Bergland S. Clinical trials with crystal growth conditioning as an alternative to acid- etch pretreatment. *Am J Orthod Dentofacial Orthop,* 1984;85:333-340
8. Bishara SE, Olsen ME. Evaluation of debonding characteristics of a new collapsible ceramic bracket. *American Journal of Orthodontics and Dentofacial Orthopedics*. 1997 Nov 1;112(5):552-9.
9. Ogaard B: Oral microbiological changes, long-term enamel alterations due to decalcification, and caries prophylactic aspects, in Bratley WA, Eliades T (eds): Orthodontic Materials: *Scientific and Clinical Aspects. Stutgard, Thieme*, 2001, pp 127.
10. Birnie D. Ceramic brackets. *Br J Orthod*., 1990; 17: 71-75.
11. Campbell PM. Enamel surfaces after orthodontic bracket debonding. AngleOrthod. 1995;65:103-10
12. Fitzpatrick, D. A, and Way, D. C. The effects of wear, acid etching, and bond removal onhuman enamel.AJO 72: 671-681, 1977.
13. Samaneh S, Stefan A, Manoharan A andAlireza H.Shear Bond Strengths of 3 Commonly Used *Orthodontic Adhesives Dentistry*. 2020 :56-8 6
14. Olsen ME, Wald LV. Evaluation of debonding characteristics of new collapsible ceramic bracket. *Am J Orthod Dentofacial Orthop*.1997;112:552-9.
15. Hobson RS, Ledvinka J, Meechan JG. The effect of

new orthodontic bonding material. *American Journal of Orthodontics and Dentofacial Orthopedics*. 2001 Jul 1;120(1):54-7.

16. Webster MJ, Nanda RS, Duncanson Jr MG, Khajotia SS, Sinha PK. The effect of saliva on shear bond strengths of hydrophilic bonding systems. *American Journal of Orthodontics and Dentofacial Orthopedics*. 2001 Jan 1;119(1):54-8

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