Original Article

Repairability of Compomers with Different Methods of Surface Conditioning

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Abstract:

Statement of Problem: Considering the cost and amount of time and also the quantity of tooth loss in the process of cavity preparation, repair of the restoration instead of its replacement would be much more efficient.

Purpose: The aim of this study was to determine the effect of different methods of surface conditioning on the shear bond strength of repaired compomers.

Materials and Methods: Sixty blocks of compomer were prepared in acrylic molds and then they were randomly divided into five groups of 12. Group I (control group) received no treatment. The remaining samples were immersed in 37 ºC distilled water for one week, then the surfaces were roughened with a coarse diamond bur. Samples in each group were prepared by different surface treatment and conditioning: In group II specimens were conditioned with 35% phosphoric acid for 20s. Specimens in group III were etched with 10% polyacrylic acid for 20s. In group IV 1.23% acidulated phosphate fluoride was applied for 30s, and compomer surfaces were sandblasted with 50µm Al_2O_3 powder in group V. After the initial preparations, all groups were treated with silane and resin before bonding of the second mix of compomer. Shear forces were applied with a universal testing machine at a cross-head speed of 5mm/min. The data were analyzed using one-way ANOVA and Duncan's multiple range tests.

Results: The mean shear bond strengths and standard deviations (in parentheses) for groups I to V were 31.56(10.86), 20.02(5.49), 17.74(7.34), 19.31(4.31) and 27.7(6.33) MPa, respectively. The mean bond strengths for Groups I and V were significantly higher than that of the other groups ($P<0.05$).

Conclusion: The results showed that among the surface treatments used in this study, sandblasting with alumina could be the best surface preparation method for repairing compomer restorations.

Key words: Compomer; Shear bond strength; Surface conditioning; Repair

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INTRODUCTION

Compomers are direct tooth colored restorative materials which have been recently introduced and several commercial products are now available [1,2]. Like many other similar materials in dentistry, problems such as lack of contour, over-finishing, fracture, voids and discoloration may be encountered [3].

Considering the cost and amount of time and the quantity of tooth loss in the process of cavity preparation, repairing a restoration would be much more reasonable. Therefore obtaining a sufficient bond between the old and new material would be essential [4-7]. The method of surface conditioning, age of the old restoration, use of silane and low viscosity resin and the method of polymerization are factors that determine the bond strength between old and new materials [8-13]. Unfortunately, bonding of new to old compomer has not been extensively investigated. Yap et al. studied the shear bond strength of repaired compomers after different methods of surface conditioning [12]. They used 37ºC distilled water to store the specimens and roughened them with abrasive disks. The materials were divided into three different groups and were treated with 10% maleic acid for 20s, 10% ployacrylic acid for 20s and sandblasted with AL2O3 powder (53 psi). The group receiving air abrasion (sandblasting), demonstrated the highest tensile bond strength [12]. In another investigation, Yap et al reported that aging did not affect the bond strength between old and new compomer except for cases that had not received conditioning [10]. Flores et al studied the effect of time and surface treatment on the resulting shear bond strength of repaired compomers. Their specimens were divided into three groups as follows: the first group received no treatment before bonding. The second group, received primer and silane and the third group was treated with 37% phosphoric acid for 30s. The mean shear bond strengths (SD) were 14.02(1.96), 9.6(3.10) and 7.53(2.31) MPa respectively [13].

The surface conditioning method could have a profound effect on the shear bond strength of repaired compomers. Thus, the aim of this study was to investigate the effect of different methods of surface conditioning on the shear bond strength of repaired compomers.

MATERIALS AND METHODS

Sixty blocks of acrylic cylinders were fabricated and cavities (2 mm deep, 6 mm wide) were prepared in the center of each block. Compoglass compomer (Vivadent, Lichtenstein) was placed in the cavities and light cured with Coltolux II (Coltene, Swiss) for 40s. The specimens were randomly divided into 5 groups as follows:

Group I (control): immediately after polymerization of the background compomer and in the presence of an air-inhibited layer, the second mix of compomer was placed on the background compomer in a plastic cylindrical mould (with an internal diameter of 2.5mm) and was light cured.

The remaining specimens were immersed in 37ºC distilled water for one week, the compomer surfaces were roughened using a coarse diamond bur (100µm), and then different surface treatments were carried out as follows:

Group II: the specimens were conditioned for 20s with 35% phosphoric acid (Ultra-Etch, Ultradent, USA), rinsed for 20s and dried for 5s. The surfaces were impregnated with silane (Ceramic Primer, 3M, USA), then low viscosity resin (Syntac, Vivadent, Lichtenstein), and subsequently were light cured for 20s. Finally the second mix of compomer was applied and light cured for 40s.

Group III: the specimens were conditioned for 20s with 10% polyacrylic acid (Dentin Conditioner, GC, Japan), then rinsed and dried for 5s. The silane, resin and compomer were applied as described for Group II.

Group IV: the specimens were treated for 30s with 1.23% acidulated phosphate fluoride (Protect, Buttler, USA), then rinsed and dried. The silane, resin and compomer were applied as described for Group II.

Group V: the surfaces of the specimens were sandblasted for 20s with 50 µm Al2O3 powder (under a pressure of 60 psi, Danville, Engineering, USA), then rinsed and dried. The silane, resin and compomer were applied as described for Group II.

After preparation of the surfaces, shear forces were applied on each sample with DARTEC universal testing machine (DARTEC, Series, HC.10, England) at a cross-head speed of 5mm/min. The blade area used was 0.5 mm^2.

The maximum forces at break were determined and the shear bond strengths (MPa) were calculated. The data were analyzed using one-way analysis of variance (ANOVA) and Duncan's multiple range tests. All specimens were examined under a stereomicroscope to determine the mode of failure.

RESULTS

The mean shear bond strengths and standard deviations (in parentheses) for groups I, II, III, IV and V were 31.655 (10.867), 20.027 (5.494), 17.841 (7.344), 19.319 (4.315) and 27.705 (6.331) MPa respectively. The statistical analysis showed significant differences between the experimental groups ($P<0.05$). The mean shear bond strengths for groups I and V were significantly higher ($P<0.05$) than that of the other three groups (Fig. 1, Table I).

Table II demonstrates the mode of failure observed in each group. As shown, the predominant mode of failure for all groups was cohesive within compomer.

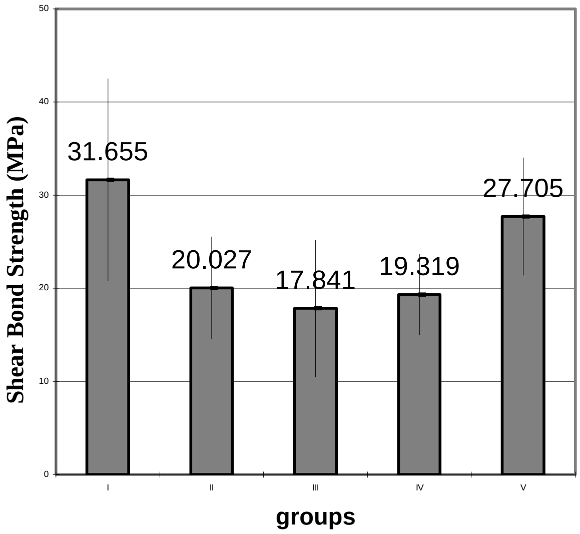

Fig.1: Mean shear bond strength of different groups

DISCUSSION

Using ANOVA and Duncan's test a statistically significant difference ($P<0.05$) in shear bond strength was noted between group I and the other groups. In addition, the difference between group V and groups II, III and IV was also statistically significant ($P<0.05$) (Table I, Fig.1). Therefore it could be concluded that the best method for repairing compomer is sandblasting followed by applying silane and resin to the surface. The high bond strength observed in group I showed that incremental layering of compomer is clinically acceptable (in the process of restoration with compomer). In this case, the high shear bond strength is because of the air-inhibited layer on the compomer surface. This layer can be polymerized with the next layer of compomer. Flores et al [13] reported a shear bond strength of 14.02 (1.96) MPa, in cases that did not receive any kind of additional surface treatment immediately prior to compomer repair. This differs from the that Flores et al had used plastic strips on the

Table I: Comparison of shear bond strength

Mean (SD)		I	II	III	IV	V
31.655 (10.867)	I		*	*	*	
20.027 (5.494)	II					
17.84 (7.344)	III					
19.319 (4.315)	IV					
27.705 (6.331)	V		*	*	*	

* Represent significant different.

Table II: Status of modes of failure in group I-V

Groups	Adhesive		Cohesive	
	Number	Percentage	Number	Percentage
I	1	8.34	11	91.66
II	2	16.67	10	83.33
III	4	33.34	8	66.66
IV	2	16.67	10	83.33
V	0	0	12	100
Total	9	15	51	85

compomer surface when it was light cured. This may keep out oxygen from the compomer surface. The mean shear bond strength aftesurface sandblasting was higher (27.7MPa) than that reported by Yap et al. (22.22MPa) [12]. A possible explanation could be the use of silane on the compomer surface in this study. The specimens that were conditioned with polyacrylic acid, demonstrated a shear bond strength of 17.84 (7.34) MPa, which was similar to the results obtained by Yap et al [12].

In this study, about 85% of the failures observed within the compomer mass and only 15% were an adhesive failure, which could be the indication of high bond strength of compomer to compomer in all groups.

CONCLUSION

Considering limitations of this study, it can be concluded that among the surface treatments used in this study the best surface preparation method for the repair of compomer restorations is sandblasting with 50 µm AL_2o_3. However, other methods of surface preparation used in this study produced acceptable clinical bond strength. Also results of this study and other studies showed that use of silan and low viscosity resin for acceptable bond of compomer to compomer is necessary.

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مقایسه ترمیم‌پذیری کامپومرها
با استفاده از روشهای مختلف آماده‌سازی سطح

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چکیده

بیان مسأله: ترمیم رستوریشن‌ها به جای جایگزینی کامل آنها از دیدگاه صرفه‌جویی در وقت و هزینه، همچنین حفظ انساج باقیمانده دندان روش مناسب‌تری به نظر می‌رسد.

هدف: مطالعه حاضر با هدف تعیین اثر روشهای مختلف آماده‌سازی سطحی بر استحکام باند برشی کامپومرهای ترمیم‌شده، انجام شد.

روش تحقیق: ۶۰ بلوک از جنس کامپومر با استفاده از مولدهای آکریلی ساخته شد و در ۵ گروه دوازده‌تایی به طور تصادفی تقسیم شدند. بر روی گروه اول (شاهد) هیچ کاری انجام نشد. بقیه نمونه‌ها به مدت یک هفته در آب مقطر ۳۷° غوطه‌ور شدند و با استفاده از فرز الماسه روی سطح آنها خشونت ایجاد شد. سطح نمونه‌های گروههای مختلف به روشهای متفاوت آماده‌سازی شدند. نمونه‌ها در گروه دوم، به مدت ۲۰ ثانیه تحت اثر اسید فسفریک ۳۵٪ قرار گرفتند و در گروه سوم به مدت ۲۰ ثانیه با اسید پلی‌اکریلیک ۱۰٪ اچ شدند. فسفات فلوراید اسیدولیت ۱/۲۳٪ به مدت ۳۰ ثانیه بر سطح نمونه‌های گروه چهارم قرار داده شد و در گروه پنجم، سطح کامپومر با استفاده از ذرات ۵۰ میکرومتری Al_2O_3 سندبلاست شد؛ سپس تمامی نمونه‌ها تحت اثر سایلن و باندینگ قرار گرفتند و کامپومر بر روی آنها قرار داده شد. نیروی برشی با استفاده از Universal Testing Machine با Cross-Head با سرعت ۵ میلیمتر در دقیقه اعمال گردید. داده‌ها با استفاده از آزمون تجزیه واریانس یک راهه و نیز آزمون چند دامنه دانکن مورد استنتاج آماری قرار گرفتند.

یافته‌ها: میانگین و انحراف معیار استحکام باند برشی گروههای یک تا پنج به ترتیب ۶/۳۳±۴۷/۷، ۴/۳۱±۱۹/۳۱، ۷/۳۴±۱۷/۴۷، ۵/۴۹±۲۰/۰۲ و ۱۰/۸۶±۳۱/۵۶ مگاپاسکال بود. میزان باند در گروههای ۱ و ۵ به طور معنی‌داری بیشتر از گروههای دیگر بود ($P<0.05$).

نتیجه‌گیری: از میان روشهای مورد بررسی در مطالعه حاضر، سندبلاست با استفاده از آلومینیوم اکساید بهترین روش آماده‌سازی سطحی در ترمیم کامپومرها می‌باشد.

واژه‌های کلیدی: کامپومر؛ استحکام باند برشی؛ آماده‌سازی سطح؛ ترمیم

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