The possible numbers of repair can be Carried on the same light-cured Composite resin surface (*In vitro* study)

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Abstract

This study was done to determine the possible number of repair that can be carried out on the same light-cured microfilled composite resin (Helioprogress, vivadent, Germany). 40 specimens were prepared, stored in deionized distilled water at 37°C for 24 hours and divided into 4 groups.

Group 1: The repair procedure done once.

Group 2: The repair procedure done twice.

Group 3: The repair procedure done for three times.

Group 4: The repair procedure done for four times.

All the specimens stored in deionized distilled water at 37°C for 24 hours before testing. A universal zwick testing machine with a special designed chisel was used to evaluate the shear bond strength of the repaired composite resin. The results showed reduction in mean shear bond strength value from group 1 to group 4, furthermore a significant difference was found between group 1 Vs group 3 and group 1 Vs group 4.

Introduction

As the esthetic aspect of dental care becomes increasingly important to patients, the dental practitioner should aware of the application and the limitation of various tooth colored restorative system[(1)].

The wider use of composite resin in dentistry has necessitated repair of fractured, discolored and worn restoration. Laboratory investigation has demonstrated that new composite resin can be bonded to previously cured composite resin[(2)]. Therefore the adhesive ability of dental restorative material is both desirable and valuable, thus defects in a composite restoration and failures in reconstituting the correct contour could be repaired simply by adding resin without replacing the entire restoration[(3)].

One measure of reparability is the development of excellent bond at the interface between the initial and repaired surfaces of the restoration which usually referred to as the interfacial bond strength. For brittle plastic materials such as dental composite resin the bond strength should be evaluated in shear[(1,4)], as it prefers by the majority of authors and suggested by Robbins et al[(5] and was used in this study by the aid of a specially designed stainless steel chisel.

The purpose of this study was to determine the possible numbers of repair that can be carried out on the same light cured composite resin surface.

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Materials & Methods

Forty acrylic block of (25x23x10mm) were constructed from self cure acrylic resin, contain a cylindrical hole of (6mm diameter and 3 mm depth) in the center of one of its square faces. After complete polymerization of acrylic resin, the acrylic blocks were placed in boiling water for 1/2 h to get rid of the free monomer.

The micro filled light cured composite resin was applied in each hole according to the manufacturer instruction using plastic instruments and light cured through plastic strip that covered with glass slide for 40 sec. Figure (1).

All the specimens stored in deionized distilled water under constant temperature oven at 37°C in 24h for aging. The whole samples divided into 4 groups according to the numbers of repair procedure that was done on each specimen:

Group 1: Repair procedure done once.

Group 2: Repair procedure done twice.

Group 3: Repair procedure done three times.

Group 4: Repair procedure done four times.

Repair Procedure:

Involve roughness of the composite surface with coarse soflex disc, rinsed for 20sec, then a 37% phosphoric acid gel applied for 15sec., rinsing with compressed air-water spray for 15sec, dried with oil free air for 10sec. Heliobond applied and activated with light for 10 second, then a (3 diameter and 6 mm height) cylindrical piece of standardized translucent plastic straw filed with helioprogress composite resin directly applied on the composite surface in a vertical position and light cured for 40 second in four direction after removing the excess material from the periphery with probe(Fig 2,3).

Debonding Procedure:

From group 2 up to group 4, the debonding procedure carried out manually by hand followed by repair procedure again. All the specimens stored in deionized distilled water in a constant temperature oven at 37°C for 24 hours before testing.

Testing Procedure:

For the shear bond testing, a special designed chisel shaped stainless steel rod was made, and a universal zwick testing machine used with displacement speed of 5 mm/min. The resultant force obtained in Newton was divided on the surface area (7.065 mm^2).

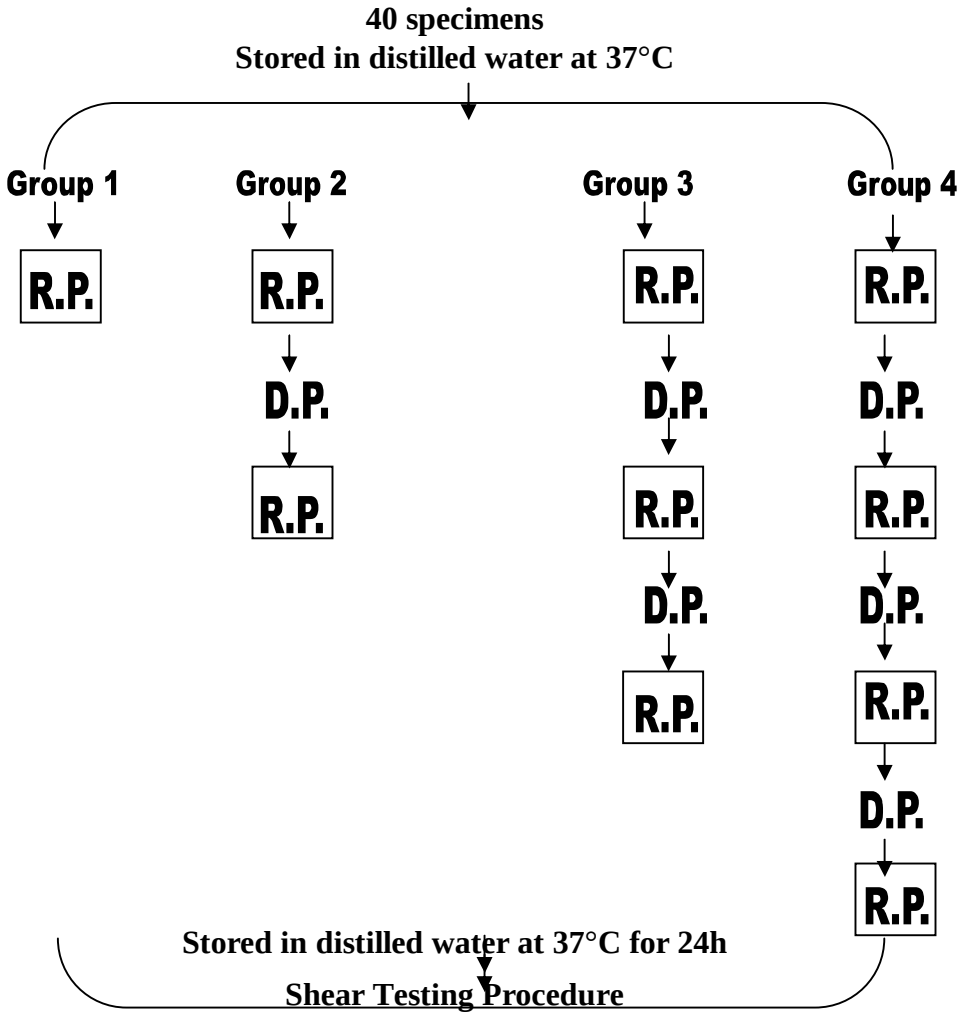

Fig. 4 Summery of the Methodology

R.P. = Repair **P**rocedure
D.P. = Debonding **P**rocedure

Result

The shear bond strength (mean values) of all groups are decrease as the number of repair carried on the composite surface increase (Table 1 & figure 2).

ANOVA test for all groups showed statistically not a significance difference at P > 0.05 level (Total F = 1.738).

T test between groups showed a statistically significant difference between:

Group IVs group 3

Group I Vs group 4

But these was no statistically significant difference between the other groups

Table (1): Shear bond strength mean values in Mpa for all the tested specimens.

Specimen No.	Group No.			
	1	2	3	4
1	9.059	6.59	8.676	5.307
2	7.82	8.56	10.415	7.36
3	4.031	4.74	7.36	3.255
4	5.667	6.297	5.817	5.506
5	8.602	7.278	4.632	4.049
6	7.293	5.451	3.381	8.005
7	8.912	6.625	6.547	2.112
8	6.939	8.021	3.025	7.801
9	8.053	5.375	5.501	3.727
10	4.566	5.962	7.22	5.698
Mean	7.099	6.0899	5.257	5.2820
SD ±	1.7866	1.5773	2.2498	2.0110

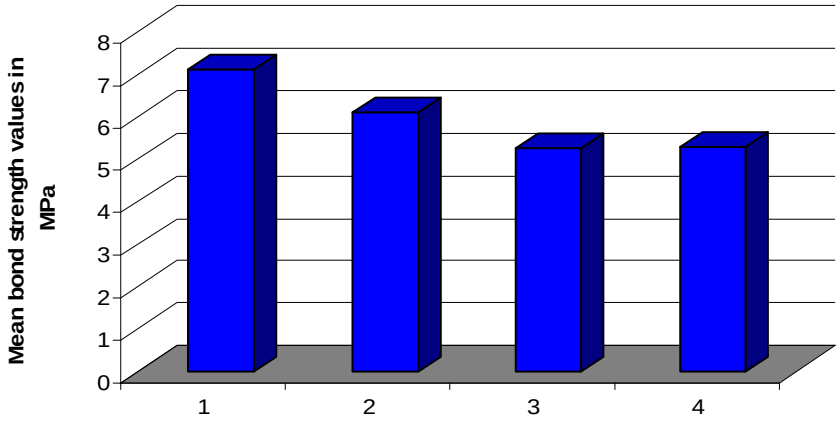

Figure (5): Bar chart show the difference in mean bond strength values between the groups.

Table (2): Analysis of variance (ANOVA test)

Source of variation	SS	df	MS	F-test	P-value
Between groups	17.034	3	5.678	1.7381	0.182 P > 0.05 NS
Within groups	88.205	27	3.266		
Total	105.240	30			

SS = Sum of square , df = Degree of freedom , MS = Mean square , NS =Not significant

Table (3): T test between groups

Group	t	df	P-value	Sig.
I Vs 2	1.640	9	0.135	NS
3 Vs 4	0.062	9	0.952	NS
1 Vs 3	1.758	9	0.049	S
2 Vs 4	1.056	9	0.318	NS
1 Vs 4	2.049	9	0.049	S
2 Vs 3	0.697	9	0.503	NS

S = Significant , NS = Not Significant

Discussion

There are three possible mechanisms during composite repair:

A - Chemical bond to the matrix, this bond depends on the degree of polymerization of the adhered surface[3,6].

B - Chemical bond to the exposed filler particle, this bond depend on the amount and quality of the remaining saline coupling agent of these fillers[4,6].

C - Micromechanical bonding, this bond resulted from penetration of the monomer compound in the matrix that has been resulted from the polishing disc, and phosphoric acid forming a resin tag[7].

Tÿÿs micromechanical loading considered tÿÿ most important and stronger mechanism[6,7] this fact explain the non-significant affect of the multiple repairing of the same light cured composite resin surface, while the chemical bond can explain why mean bond strength value decrease as number of repair procedure increase, due to the reduce in the available amount of un reacted double bond[4,6].

Conclusions

1 - At reduction in mean shear bond strength values with the increase number of repair.

2 - Unlimited number of repair can be carried out on the same light-cured composite restoration but still the first repair produce the strongest bond.

References

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Fig.1

Fig.2

Fig.3