Effect of Finishing and Polishing Direction on Resin Based Composite Restorations - An Invitro Study

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Abstract

Aim: The aim of the present study is to compare the different finishing and polishing systems on composite restoration along with direction of finishing and polishing and marginal adaptation of resin based composites.

Materials and Methodology: A total of 80 Molars were divided into 8 groups (n=10). Class V cavities were prepared on the samples with a standard dimension in order to obtain 30 degree bevel on each specimen having a set width of 3mm & a depth of 0.8mm, restoration done with Nanofilled and Microhybird composites. Samples were then analyzed using scanning electron microscopy (SEM).

Results: The statistical analysis of the mean showed that there is a significant difference between the direction of finishing and polishing of composite restoration on the tooth($P > 0.05$).

Conclusion: Polishing of composite restorations in the direction from composite to tooth (C-T) has got better marginal adaptation than tooth to composite (T-C).

Keywords: Microhybrid composite, Nano filled composite, Scanning electron microscope (SEM).

Introduction

Composite restorative materials dictates one of the eminence of modern biomaterial research on the account of their ability to replace biological tissue in both appearance and function[1]. The mastery of these material implicate the ability to strongly bond to enamel, dentin and its exalted aesthetics[(2-4)].

Even though half of posterior direct restorations rely on composites[(5-6)], its inherent features expressly mechanical properties, polymerization shrinkage, reduced wear resistance and secondary caries left significant room for their amelioration[(7-8)].

This driving force for improvement led to embodiment of filler into resin matrix which give away the reduced ware rates and enhance surface smoothness. Resin based composite fillers display either a spheroidal or an irregular morphology which influence filler orientation and distribution within the resin matrix[(9-11)]. Two neoteric headways in composites include Microhybrid and Nano filled.

Microhybrid composites evolved from traditional composites with filler content of about 56-66% by volume. Its average particle size is about 0.4-0.8µm which emends its polishability[(12)].

The Nanofilled composites assimilated with Nano sized particles in RBC systems enables higher filler content making it a single unit. This confers to its greater resistance and improved physical and mechanical properties[(13)].

Greater reinforcement in resin matrix by Nano clusters run over the inherent failure mechanisms namely fracture and wear resistance of composites.

Finishing and polishing refer to gross contouring of the restoration with primary goals specifically good contour, occlusion, healthy embrasure form, smoothness, and a well-adapted junction between tooth and restoration[(14-16)].

Pursual for an ideal polishing agent to dental composite is unfolding. Numerous polishing tools have been used over years ranging from multiple step system to one step polishing system. The polishing systems dealt in the present study are Sof- Lex (SL) finishing and polishing discs, and Rubber cups(R).

Sof- Lex finishing and polishing discs are made from urethane coated paper that gives discs their flexibility. They are impregnated with four individual aluminium oxide grids ranging from coarse to superfine which are colour coded.

Rubber cups are known for its great stability and maximum flexibility. It aids in labial characterisation on composite restorations. The abrasives used within these cups are usually comprised of silicon carbide, aluminium oxide, or diamond.

Indefinite factors can affect the outcome of final finish of a restoration: which comprise the matrix and fillers within the material, polishing systems and direction of polishing [i.e., from composite restoration to tooth surface (C-T) or form tooth to composite restoration (T-C)]. Wherefore there is no much evidence regarding the direction of finishing and polishing of restoration by using different finishing and polishing systems.

So the aim of the present study is to compare the different finishing and polishing systems on composite

restoration along with direction of finishing and polishing and marginal adaptation of resin based composites. The null hypothesis was that there would be no difference between the various composites used and direction of finishing and polishing on marginal adaptation of restoration.

Materials and Methods

Sample Preparation: Eighty intact, non-carious, unrestored human molars, extracted for therapeutic reasons were collected for study. Calculus and soft tissue were gently removed and polishing of the specimens were done. Class V cavity preparations were done (According to G.V. Black class V - lesions on the gingival third of the crown on facial (or) lingual surface of the tooth) on specimens. The oval preparation was approximately 1.5mm deep; 3mm wide and 4mm high. The cavity preparation was maintained 2mm apical to the cemento-enamel junction (CEJ), the cavities were prepared with a high speed hand piece with 245 tungsten carbide bur using water as coolant. The enamel portion was bevelled towards crown side[17].

Two composites were used Herculite precis (Nanocomposite restorative A3.5) and Filtek Z350 XI A2 (Microhybrid composite). Two polishing systems were used. Soflex discs and Rubbercups[1]. After preparing class V cavities[11] on the molars, sample size (n=10) were divided into eight (8) groups.

The groups were as follows:

1. Group A - Micro hybrid composite was filled and Soflex discs were used for polishing and direction used for this group was from Composite to Tooth (C-T)
1. Group B - Micro hybrid composite was filled and Soflex discs were used for polishing and direction used for this group was from Tooth to Composite (T-C)
2. Group C - Micro hybrid composite was filled and Rubber cups were used for polishing and direction used for this group was from Composite to Tooth (C-T)
3. Group D - Micro hybrid composite was filled and Rubber cups were used for polishing and direction used for this group was form Composite to Tooth (T-C)
4. Group E - Nano filled composite was filled and Soflex disc were used for polishing and direction used for this group was form Composite to Tooth (C-T)
5. Group F - Nano filled composite was filled and Soflex disc were used for polishing and direction used for this group was from Tooth to Composite (C-T)
6. Group G - Nano filled composite was filled and Rubber cups were used for polishing and direction used for this group was from Composite to Tooth (C-T)
7. Group H - Nano filled composite was filled and Rubber cups were used for polishing and direction used for this group was from Tooth to Composite (T-C)

Cavity preparation, restoration, finishing and polishing were done by a single investigator. After restoring, polishing and finishing of samples, these samples were sent for the scanning electron microscopic evaluation (SEM).

Evaluation by Scanning Electron Microscopy: Specimens were sputter coated with gold to a thickness of approximately 50A in a vacuum evaporation. The samples were observed and photomicrographs of most representative regions were taken.

The photomicrographs were obtained at 500X magnification.

Evaluation of Margins: Margins were evaluated by a criteria

Marginal Quality(MQ)	Definition
MQ 1	No gap
MQ 2	No gap but severe marginal irregularities
MQ 3	Gap visible (up to 2 µm)
MQ 4	Severe gap (more than 2 µm)

Source: Blunk U, Zaslansky P. (2011). Enamel margin integrity of class 1 one bottle all in one adhesives - based restorations. *J Adhes Dent 13(1):23-29*[18].

Statistical Analysis of the Data

The categorised data were summarized by means of absolute frequency and relative percentages, and the numeric data were summarized by means of usual descriptive statistics of location and dispersion. Comparisons between groups were analysed statistically using the paired - sample t- test and wilcoxon signed rank test. A p-value of less than 0.05 was used as a criteria for statistical significance. SAS for Windows was used for the data analysis.

Results

After SEM images were obtained, the images of all the groups were observed and there was a significant difference between the Herculite precis (Nano composite restorative A3.5) and Micro filled composite Filtek Z350 XI (A2). A significant difference between directions of polishing systems was also observed.

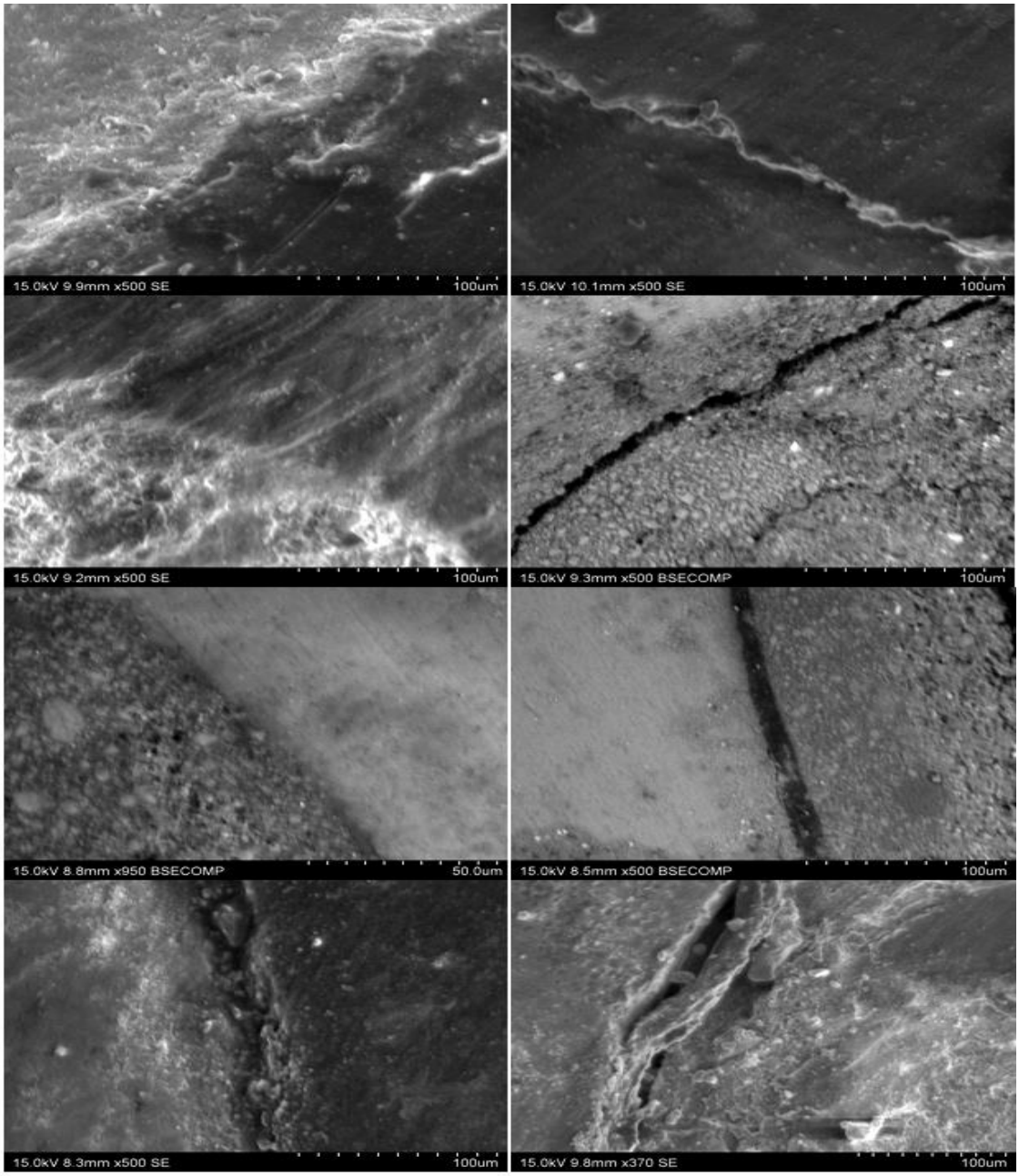
Groups Variables	N	Mean (%)	SD	Min	Max	Median	p- value
HP-Nano SL Difference in direction for MQ1	10	10.47	14.95	18.38	45.71	13.64	0.0055*
Difference in direction for MQ 2	10	-7.27	14.65	-45.71	22.44	-9.19	0.0388*
Difference in direction for MQ3+MQ4	10	-3.20	7.75	-20.07	11.34	0.00	0.0537
HP NANO R Difference in direction for MQ1	10	10.87	13.27	-15.27	41.47	6.57	0.0016*
Difference in direction for MQ 2	10	-6.40	9.76	-33.16	15.27	-5.17	0.0085*
Difference in direction for MQ3+MQ4	10	-4.48	7.50	-29.87	0.00	0.00	0.0039**
F MICRO SL Difference in direction for MQ1	10	20.22	13.46	-11.58	40.05	20.74	<0.0001*
Difference in direction for MQ 2	10	-13.99	13.78	-36.43	18.72	-12.07	0.0002*
Difference in direction for MQ3+MQ4	10	-6.23	8.89	-34.53	0.00	-1.46	0.0005**
F MICRO R Difference in direction for MQ1	10	22.25	13.86	-2.08	45.49	19.94	<0.00001*
Difference in direction for MQ 2	10	-12.71	10.87	-31.82	2.08	-9.45	<0.0001*
Difference in direction for MQ3+MQ4	10	-9.54	12.05	-44.89	0.71	-5.78	<0.0001**

* Significant different at $p<0.05$., with a paired simple t-test

** Significant different at $p<0.05$., with a Wilcoxon signed rank test

Direction change = polishing direction from resin based composite to tooth structure (C-T) - polishing direction from tooth structure to resin based composite (T-C).

It was observed that all the specimens either the group of Herculite precis (Nanocomposite composite restorative A3.5) and Micro filled composite Filtek Z350 XI (A2) specimens of direction composite restoration to tooth(C-T) were showed excellent marginal adaptation than the specimens which were polished from tooth to composite restoration(T-C).



Discussion

Composites should be polished to a finer (or) smoother surface in order to get rid of any irregularities as these may lead to lodgement of food particles, accumulation of plaque. Resin-based composites cannot be finished to an absolutely smooth surface.

The most common reason for failure of resin based composites reported in the literature is recurrent caries[10]. So maintaining of the integrity of margins by adhering to a proper finishing protocol is an important goal.

The results of this study showed that in most instances more continuous margins and less marginal irregularities, less gaps were found when the finishing and polishing procedures were performed from composite to tooth (C-T) rather than from tooth to composite restoration (T-C).

A difference between Sof-Lex discs and rubber cups were found when nano composite was finished and polished from composite restoration to tooth (C-T) direction. This difference between Soflex disc and rubber cup was found due to abrasive particles on Soflex disc which are strongly bonded to the disc and are not easily dislodged while finishing or polishing creating irregularities in the resin based composite that are not reduced and by the subsequent discs of lower abrasiveness.

Van Noort et.al who mentioned that abrasive particles in Soflex discs, they do not follow the path of least resistance as it would be the case in polishing

pastes. They dislodge filler particles from the material creating scratches or deep notches practically impossible to remove with subsequent discs of smaller abrasive particles[13].

One explanation might be that when the finishing from Composite to Tooth (C-T) the resin based composite may be pushed against the enamel margin and protects the marginal seal i.e., when composite are used for the restoration there is chance of polymerization shrinkage which create a gap between the tooth and the composite restoration. This gap which is caused by the shrinkage was filled by the particle during finishing and polishing from composite to the tooth surface(C-T).

The scanning electron microscopic photomicrographs (SEM), which were obtained sonorously show more gap when finishing and polishing is transact form tooth to composite(T-C), possible reason for this could be that the resin based composite can be pulled away from the margin and the tooth restoration interface and increasing the susceptibility to gap formation and marginal irregularities.

It has been reported that only 95% of composite restoration is cured when we follow immediate finishing and polishing, which may cause plastic deformation. This incomplete polymerization of composite material and heat generated during finishing and polishing procedures may have caused an increased level of plasticity which could have been an advantage for composite restoration to the tooth (C-T) direction by preserving the marginal seal and disadvantage for tooth to composite (T-C) direction.

An another important reason for more gap formation is that when polishing is performed from the tooth to composite, the fragile enamel rods at the border of the finish line are more susceptible to the breakdown and may be wrenched away from the enamel with a tooth to composite direction and is preserved with composite to tooth direction.

Conclusion

Within the circumscription of this study it can be concluded that polishing of composite restoration in the direction from Composite to Tooth (C-T) has got better marginal adaptation than Tooth to Composite (T-C). Soflex disc has got more marginal irregularities than rubber polishing discs. Nano Composite produces more marginal gaps when polished From Tooth Structure to Composite (T-C).

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