Esthetics and Biocompatibility of Composite Dental Laminates

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Abstract

Background: Advances in modern dental materials provide patients with a choice of natural looking veneers to provide esthetic restorations. These may be directly fabricated composite resin veneers or indirectly fabricated veneers. This study was carried out to evaluate the clinical effect of new generation indirect veneering composites and to compare them with veneers fabricated from direct composite restorations.

Methods: The present study was carried out in the Prosthodontics department of a medical college. A total of forty patients requiring restoration of the anterior teeth using composite veneers were selected and either of the two materials was used to fabricate the veneers.

Result: Clinical evaluation was done for esthetics and periodontal health. Statistical analysis showed that there were no significant changes to the periodontal health during the period of the study.

Conclusion: The evidence obtained from this study indicates that both direct as well as indirect composite materials had clinically acceptable outcomes in terms of restoration of esthetics. Biocompatibility with the periodontal tissues of both materials was also evident by the improvement in oral health indices used in the study.

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Key Words : Veneers; Indirect composites; Biocompatibility

Introduction

The desire to have better esthetics is one of the reasons that an increasing number of patients report for purely cosmetic dentistry. Advances in modern dental materials provide practitioners a number of choices from which to create more pleasing and natural looking veneers to provide esthetic restorations. Direct materials are those that can be placed directly in the tooth cavity during a single appointment. Indirect materials are used to fabricate restorations in the dental laboratory that are subsequently bonded to the teeth and thus generally require two or more visits to complete the restoration. The art of veneering has progressed over thirty years to the current generation of concepts and materials, which can be divided into directly fabricated composite resin veneers and indirectly fabricated veneers e.g. preformed laminates or laboratory fabricated acrylic resin, micro-filled resin / indirect composite or porcelain veneers [1,2].

The resin based esthetic materials originally were designed and intended for anterior restorations only but later on their use expanded into nearly all classes and types of dental restorations. Today, composites are commonly used for anterior restorations and also used extensively for small to moderate sized posterior fillings

in teeth without severe chewing loads. While they generally are not as strong or durable as metals, as per the findings of studies carried out by Eliades et al and Wendt et al, resin-based composites have shown the promise of improvement in durability and length of service in clinical studies of their performance in Class I and Class II restorations [3,4].

Indirect composite restorations fabricated in a dental laboratory were developed in an attempt to improve the overall durability of the restorations. However, indirect composites may require a second appointment for placement. While some improvement in properties was achieved as shown by Terry et al, current clinical evidence has shown that direct composite restorations when used as per existing clinical guidelines probably are as successful as the indirect laboratory-fabricated equivalents [3]. A study was carried out to evaluate the clinical outcome of new generation veneering indirect composites and to compare them with veneers fabricated from direct composite restorations. The study attempted to evaluate the new generation material SR Adoro® as compared to the existing direct composites using esthetics and biocompatibility as parameters.

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Material and Methods

The present study was carried out in the Prosthodontics department of a medical college. A total of 40 patients requiring restoration of the anterior teeth using composite veneers were selected and were randomly divided into two groups of 20 patients each. Each group was then informed about the procedure and the time period (six to eight months) of the study and consent obtained. Each group was blinded to the other group / material being used. For group A the material of choice for preparation of the laminates was the new generation composite material SR Adoro® and for group B the material was Esthet X® a direct composite veneering material. The clinical evaluation was done immediately after luting, at an interval of one month, three months and at an interval of six months. The assessment was done for esthetics and periodontal health by noting the vertical recession, gingival index (GI) and plaque index (PI) [5,6]. All the values were obtained and then subjected to statistical analysis as applicable.

Results

Each group comprised a total of 20 subjects out of sample size of 40 patients. Group A (indirect composite resin) consisted of 11 males and nine females where as group B (direct composite resin) comprised of 12 males and eight females. They presented with age ranging from 19 to 51 years. Cases were selected randomly in each clinical grouping to rule out any selection bias.

The esthetic outcome of the treatment was evaluated by each patient as well as two independent operators. This was done to simulate a likely clinical scenario where the patient, clinician or patients' family would be asked for their opinions regarding the clinical acceptability of the restorations. No attempt was made to use additional colour matching by spectrophotometer etc as this would not be the case in routine use of these materials in the dental clinic. Three options of satisfactory, good and excellent were given to each. The remarks were recorded and tabulated. It was interesting to note that patients were largely satisfied with the outcome of treatment giving values of excellent 40%, good 50% and satisfactory 10% for group A and excellent 30%, good 65% and satisfactory 5% for group B.

Various clinical recordings obtained were analyzed with proper statistical analysis. Paired 't' test was carried out for comparing parameters within the group and unpaired 't' test was carried out for comparison between the groups. The following observations can be made under different heads.

Mean values of gingival recession in group A at one, three, and six months postoperatively were $1.15 (\pm 0.95)$, $0.73 (\pm 0.68)$ and $0.6 (\pm 0.48)$ respectively. The observed baseline to postoperative difference in vertical gingival recession in group A at one, three and six months were highly significant with the 'p' value 0.000. A statistically significant decrease in gingival recession was observed between one, three and six months with the 'p' values 0.001 and 0.000 respectively. However the change between three and six months was statistically not significant ('p' > 0.05).

Similarly in group B vertical gingival recession at one, three and six months interval presented a mean value of $0.85 (\pm 0.56)$, $1.25 (\pm 0.79)$ and $1.15 (\pm 0.61)$ respectively. All the three results were statistically highly significant (p = 0.000). A statistically significant reduction in the vertical recession between one, three and six month with the 'p' values 0.001 and 0.007 respectively was seen. However the changes between three month and six month were statistically not significant ('p' > 0.05) as depicted in Table 1.

In the inter-group comparison regarding vertical gingival recession it is observed that at baseline and one month the

Table 1
Comparison of gingival recession length (vertical dimension) within the group (in mm)

Time of comparison		Mean	Standard deviation	t	'p'
Group A					
Pair 1	VR-B	4.300	1.1743	12.137	0.000
	VR-01	1.150	0.9473		
Pair 2	VR-B	4.300	1.1743	14.040	0.000
	VR-03	0.725	0.6781		
Pair 3	VR-B	4.300	1.1743	16.679	0.000
	VR-06	0.600	0.4757		
Pair 4	VR-01	1.350	0.9473	3.865	0.001
	VR-03	0.752	0.6781		
Pair 5	VR-01	1.350	0.9473	4.567	0.000
	VR-06	0.600	0.4757		
Pair 6	VR-03	0.725	0.6781	1.097	0.287
	VR-06	0.600	0.4757		
Group B					
Pair 1	VR-B	4.200	1.0052	16.833	0.000
	VR-01	0.850	0.5643		
Pair 2	VR-B	4.200	1.0052	13.968	0.000
	VR-03	1.250	0.7864		
Pair 3	VR-B	4.200	1.0052	16.212	0.000
	VR-06	1.150	0.6091		
Pair 4	VR-01	0.850	0.5643	-4.000	0.001
	VR-03	1.250	0.7864		
Pair 5	VR-01	0.850	0.5643	-3.040	0.007
	VR-06	1.150	0.6091		
Pair 6	VR-03	1.250	0.7864	1.285	0.214
	VR-06	1.150	0.6091		

VR – Vertical Recession; B – Baseline; 01 – 1 month; 03 – 3 month; 06 – 6 month. Baseline data varied from 0.5 – 3.5 mm (Group A) and 0.0 to 2.0 mm (Group B)

Table 2
Inter group comparison of gingival recession (in mm)

Time of Comparison	Mean		Std. Deviation		t	'p'
	Group A	Group B	Group A	Group B		
Recession length (vertical dimension)						
1 month	1.150	0.850	0.9473	0.5643	2.028	0.050
3 months	0.725	1.250	0.6781	0.7864	-2.261	0.030
6 months	0.600	1.150	0.4757	0.6091	-3.182	0.003

Table 3
Comparison of plaque index within the group

Time of comparison		Mean	Standard deviation	t	'p'
Group A					
Pair 1	PI-B	1.420	0.3636	3.818	0.001
	PI -01	0.890	0.3878		
Pair 2	PI -B	1.420	0.3636	7.471	0.000
	PI -03	0.790	0.2594		
Pair 3	PI -B	1.420	0.3636	8.786	0.000
	PI -06	0.700	0.3340		
Pair 4	PI -01	0.890	0.3878	1.019	0.321
	PI -03	0.790	0.2594		
Pair 5	PI -01	0.890	0.3878	1.746	0.097
	PI -06	0.700	0.3340		
Pair 6	PI -03	0.790	0.2594	1.552	0.137
	PI -06	0.700	0.3340		
Group B					
Pair 1	PI-B	1.540	0.3235	4.074	0.001
	PI -01	1.050	0.3441		
Pair 2	PI -B	1.540	0.3235	6.808	0.000
	PI -03	0.875	0.4089		
Pair 3	PI -B	1.540	0.3235	7.194	0.000
	PI -06	0.790	0.4844		
Pair 4	PI -01	1.050	0.3441	0.303	0.208
	PI -03	0.875	0.4089		
Pair 5	PI -01	1.050	0.3441	1.072	0.105
	PI -06	0.790	0.4844		
Pair 6	PI -03	0.875	0.4089	1.254	0.225
	PI -06	0.790	0.4844		

Table 4
Comparison of plaque index between the groups

Time of Comparison	Mean		Standard deviation		t	'p'
	Group A	Group B	Group A	Group B		
Baseline	1.420	1.540	0.3676	0.3235	-1.103	0.277
1 month	0.890	1.050	0.3878	0.3441	-1.380	0.176
3 month	0.790	0.875	0.2594	0.4089	-0.785	0.437
6 month	0.700	0.790	0.3340	0.4844	-0.684	0.498

PI – Plaque Index; B – Baseline; 01 – 1 month; 03 – 3 month; 06 – 6 month. Baseline data varied from 0.5 – 1.8 (Group A) and 0.7 to 2.0 (Group B)

result were clinically significant ('p' value ≤ 0.05). It was also significant at three and six months postoperatively ('p' value < 0.05) (Table 2).

Plaque Index (PI)

Table 3 shows the plaque index scores in both groups when compared at baseline, one, three and six months postoperatively. The changes from baseline to one, three and six months postoperatively were highly significant in both groups ($p < 0.05$). However, the difference between one, three and six months postoperatively were statistically not significant in both groups.

Similarly in the inter-group comparison regarding plaque index, it is noticed that the results at baseline as well as post

Table 5
Comparison of plaque index within the group

Time of comparison		Mean	Standard deviation	t	'p'
Group A					
Pair 1	GI-B	1.240	0.1635	3.344	0.003
	GI -01	0.985	0.2943		
Pair 2	GI -B	1.240	0.1635	6.150	0.000
	GI -03	0.710	0.3007		
Pair 3	GI -B	1.240	0.1635	7.531	0.000
	GI -06	0.615	0.2720		
Pair 4	GI -01	0.985	0.2943	4.440	0.000
	GI -03	0.710	0.3007		
Pair 5	GI -01	0.985	0.2943	5.771	0.000
	GI -06	0.615	0.2720		
Pair 6	GI -03	0.710	0.3007	1.901	0.073
	GI -06	0.615	0.2720		
Group B					
Pair 1	GI-B	1.280	0.2042	9.558	0.000
	GI -01	0.780	0.2042		
Pair 2	GI -B	1.280	0.2042	6.168	0.000
	GI -03	0.790	0.2490		
Pair 3	GI -B	1.280	0.2042	8.316	0.000
	GI -06	0.660	0.2437		
Pair 4	GI -01	0.780	0.2042	-0.139	0.891
	GI -03	0.790	0.2490		
Pair 5	GI -01	0.780	0.2042	2.161	0.044
	GI -06	0.660	0.2437		
Pair 6	GI -03	0.790	0.2490	2.557	0.019
	GI -06	0.660	0.2437		

Table 6
Comparison of plaque index between the groups

Time of Comparison	Mean		Standard deviation		t	'p'
	Group A	Group B	Group A	Group B		
Baseline	1.655	1.215	0.5661	0.3617	-1.103	0.277
1 month	0.985	0.780	0.2943	0.2042	-2.560	0.015
3 month	0.710	0.790	0.3007	0.2490	-0.916	0.365
6 month	0.615	0.660	0.2720	0.2437	-0.551	0.585

PI – Plaque Index; B – Baseline; 01 – 1 month; 03 – 3 month; 06 – 6 month. Baseline data varied from 0.5 – 2.7 (Group A) and 0.7 to 1.8 (Group B)

operatively were statistically not significant ('p' > 0.05) (Table 4).

Gingival Index (GI)

The observation recorded in Table 5 shows the gingival index scores in both groups when compared at baseline, one, three and six months post operatively. All the values from baseline to one, three and six months post operatively as well as in between post operative time intervals were highly significant in both groups ($p < 0.05$) except in three to six months in group A ('p' = 0.073) and one to six months in group B ('p' = 0.891). Similarly in the intergroup comparison of plaque index, it was noticed that the results at baseline as well as postoperatively were statistically not significant ('p' > 0.05) (Table 6).

Discussion

Advances in the field of adhesive restorative biomaterials have resulted in adhesive restorations that provide increased retention, marginal adaptation, seal and reduced microleakage. Modern adhesive restorative materials and techniques now provide clinicians with more conservative treatment avenues to preserve tooth structure while improving the longevity and aesthetics of the dental restoration. Veneering materials such as direct composite resins and indirect composite materials were introduced to overcome the disadvantages of porcelain laminate veneers. The advantages of using direct composite veneer are that it consumes less time for rehabilitation and repair of fractured portion is possible, but the biggest disadvantage of using direct composite resin as veneering material is its polymerization shrinkage leading to the development of marginal gaps and subsequently micro-leakage. Indirect composite resins were introduced to overcome the drawbacks of direct composite resins. Additional clinical benefits include not only precise marginal integrity, wear resistance similar that is similar to enamel and wear compatibility with opposing natural dentition but also ideal proximal contacts, excellent anatomical morphology and optimal aesthetics. This is as a result of a higher degree of conversion obtained from the utilization of different polymerization procedures that involve heat, pressure, light, vacuum or nitrogen atmosphere. The degree of conversion increases when multifunctional monomers are present, offering extra reactive sites that enlarge the polymer chains. Better mechanical properties may also be ensured through reinforcements of glass and polyethylene fibres added to indirect composite resin materials [7-9].

Indirect laboratory processed composite resin systems are capable of aesthetic results that may also reinforce tooth structure. The adhesive luting procedure strengthens the tooth and provides additional support for tooth structure, so more conservative preparation designs can be utilized. These systems restore mechanical and biological function while achieving optimal aesthetic results with minimal resin cement shrinkage and limited tooth reduction.

The laboratory processed composite resin used in this study was SR Adoro[®] composite which is a micro-filled composite resin. It consists of 65% weight filler. It also incorporates aromatic-aliphatic urethane dimethacrylate [10]. The direct composite resin used in the study was Esthet X[®]. It is a hybrid composite resin and consists of 23% by weight of modified urethane Bis-GMA resin and 77% by weight or 60% by volume of filler. Direct composite resin was applied to the prepared tooth surfaces using standardised operative procedures with

layering technique. In the present study the patients in Group A in were explained about the advantages about the indirect composites and the need to come back for the second appointment. All patients were agreeable to the procedural steps.

The methods of assessing the periodontal health were by recording vertical recession, GI of Lang et al [5] and the PI to check if there was any detrimental effect of either form of the restorative method that was used. The scores were recorded after initial placement, three to six months respectively. Statistical analysis showed that there were no significant changes to the periodontal health during the period of the study. This demonstrated that either material was biocompatible when used as per indications and could be effectively used to treat various forms of anterior tooth discolouration or fractures.

Certain considerations that have to be kept in mind are that the period of study was relatively short and the further follow up is being carried out to assess the long term changes. The patients after being initially selected for the restoration process were given thorough oral prophylaxis and also had been encouraged to brush three times daily. At the start of the study the patients had been informed that they were part of a study to ensure that they were available and also that they would return for the follow up. This probably ensured that the patients took better care of their oral health to make a good impression on the clinician. These factors probably played an important part in ensuring both groups of patients had excellent maintenance of their oral condition at follow up [5,6]. Long term follow up of both groups of patients is being maintained to observe the long term effects if any.

The evidence obtained from this study indicates that both direct as well as indirect composite materials had clinically acceptable outcomes in terms of restoration of esthetics. Biocompatibility of both materials with the periodontal tissues was also evident by the improvement in oral health indices used in the study. Each restoration is unique in terms of material related factors such as strength, wear resistance, tolerance to water, dimensional stability and colour stability. Added to this are procedural factors generally encountered in making and placing a restoration, such as the size, depth and access of the restoration. The clinician needs to consider all of these factors and discuss them with patients for them to make the best informed decision. The clinical evidence gathered from this study indicates that direct composite restorations carefully fabricated from quality materials are clinically as successful as the indirect laboratory-fabricated equivalents and either one can be used depending on the availability and laboratory support

available. Further long term studies should also be carried out to assess the restorative potential and the clinical success of all such newly developed veneering materials rather than be swayed by the manufacturer's claims of excellence.

Conflicts of Interest

This study has been funded by research grants from the O/o DGAFMS.

Intellectual Contribution of Authors

Study Concept : Col DSJ D'Souza, Lt Col M Kumar

Drafting & Manuscript Revision : Col DSJ D'Souza, Lt Col M Kumar

Statistical Analysis : Col DSJ D'Souza

Study Supervision : Col DSJ D'Souza, Lt Col M Kumar

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Events Calendar

I. September 20-25, 2010

Theme: Surgery Update 2010 - 27th National CME Programme in Surgery.

Venue: Maulana Azad Medical College, New Delhi

Contact Person: Prof AK Sarda

Dept of Surgery, Maulana Azad Medical College,

230, BL Taneja Block, MAMC, New Delhi-110002

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II. As part of an Indo-US Collaboration, the National Institute of Health, USA has sponsored a series of workshops since 2006 on various aspects of clinical research (with an emphasis on clinical trials), including biostatistics, study design and randomization issues, data management, research ethics and regulatory aspects. As a continuation of this series, two workshops are planned as follows. Both workshops are aimed primarily at biomedical researchers. Investigators involved in clinical research, who are in a position to lead clinical research studies should find these workshops useful.

(i) **Workshop on 'Scientific Writing', to be held in Goa on September 11-15, 2010.** It will consist of an initial two and a half day didactic and practical teaching section, open to all selected participants. This will be followed by a two-day intensive practical exercise open only to a few selected participants.

Applicants for this workshop are encouraged to submit a draft manuscript based on their research work. A few (around 6-8) draft manuscripts and their authors will be selected to participate in the intensive practical exercise, during which course faculty will work with the selected participants to improve the draft manuscripts

and take these closer to finished manuscripts.

(ii) **Workshop on 'Introduction to Clinical Trials and Good Clinical Practices', to be held in Trivandrum on December 3-5, 2010.**

Only a limited number of applicants will be accepted. Applicants should email a short (less than one page; **please do not send a CV**) summary of their experience and expertise in clinical research, as an email attachment (MS Word or PDF) to sgpgi.courses@gmail.com by July 15, 2010 (for the workshop on 'Scientific Writing') and October 5, 2010 (for the workshop 'Introduction to Clinical Trials and Good Clinical Practices'). Applicants for the former workshop also need to send a draft manuscript for discussion during the workshop. A selection committee will notify the successful applicants of acceptance by early August 2010 ('Scientific Writing' workshop) and late October 2010 ('Clinical Trials and GCP' workshop).

Contact Person: Rakesh Aggarwal, Department of Gastroenterology SGPGI, Lucknow 226014.

III. October 14-16, 2010

Theme: APHS 2010 – Asia Pacific Hernia Society Conference

Venue: Seoul, Singapore – 119074.

Address: Asia Pacific Hernia Society,

Minimally Invasive Surgical Centre (MISC),

Department of Surgery,

National University Hospital

5 Lower Kent Ridge Road,

Singapore-119074

Email: info@hernia.com