

Comparative Evaluation of Clinical Effectiveness of Soflex and Gcdiapolishing systems in Class-I Composite Resin Restoration- A Split-Mouth Experimental Study

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Abstract

Aim: To evaluate and compare the clinical effectiveness of Soflex and GC Dia polishing systems in Class-I composite restoration.

Materials and Methods: Sixteen patients were recruited for the study according to the predefined eligibility criteria and were randomly grouped into Soflex and GC Dia groups. Class-I cavity was prepared with the desired cavity design followed by etching, bonding, and incremental composite placing. After light curing, the restorations were polished by either of the polishing systems. Clinical effectiveness was assessed using esthetic, functional, and biological properties and categorized into clinical scorings. Mann-Whitney U test was applied for statistical analysis.

Results: The excellent clinical scores were more common with the Soflex polishing system over GC Dia. This was followed by clinically good scores yet again with the Soflex system. None of the polishing systems scores unsatisfactory or poor for esthetic, functional, and biological properties. The difference between the two systems with respect to properties was statistically significant ($p < 0.05$) only for esthetics, with Soflex being superior over GC Dia. In contrast, functional and biological properties did not show any significant difference ($p > 0.05$).

Conclusion: Both the polishing systems prove to be clinically effective in polishing the surface of the composite restoration. Soflex proved to be superior over GC Dia for esthetics, while both the systems were comparable for functional and biological properties.

Keywords: Soflex, GC Dia, polishing system, composite restoration

Introduction

Various dental materials are used in restorative dentistry for functionality and replacement of the lost tooth structure, with every material having its uniqueness.¹ Gold restorations used in the past prove corrosion-free, while silver amalgam reports high durability but poor esthetics. The esthetic concern introduced tooth-colored restorative materials² like glass ionomers, ceramics, and composites, especially for anterior treatment. Composite restorations are the most widely used materials available in flowable and packable forms. The advantage of this material over amalgam and ceramics is that it requires minimal tooth structure loss, thereby making less discomfort to the patients, reducing the dentist's operating time, and reducing the time for the patient. The durability of the composite restoration depends on factors like the extent of carious tooth involvement, the procedure followed for restoring the tooth and the skills of the operating dentist while from the patient's end, the condition of the oral cavity, oral hygiene practices, risk of caries in that patient, occlusion and presence of adverse habits.³

Composite restorations are available with a variety of filler particles. These filler particles play a major role in physical properties and the handling of the material. The larger filler particles tend to make the surface irregular and thus require finishing and polishing the surface. With time there has been a modification in the filler particles as well. Initially, the particles progressed into microfills from macrofills into micro hybrids from hybrids,⁴ with the recent being nanofilled manufactured with the help of nanotechnology. The size of these particles being small over other filler particles makes the polishing and finishing process provide a superior surface. The surface of the restoration has a lot to do with good oral health. Surface roughness of more than 0.2µm tends to accumulate bacteria over the restoration leading to secondary caries.⁵ Apart from secondary caries, the accumulation also tends to lead to caries initiation in the adjacent tooth. Moreover, the bacterial presence can initiate accumulation of plaque and calculus, leading to gingivitis and periodontitis.⁶

Finishing involves providing gross contouring of the restoration to obtain the essential anatomy of the tooth, while polishing refers to the removal of rough surfaces. The finishing instruments produce these scratches.⁷ Literature reports various finishing and polishing systems used to get the accurate, smooth surface and prevent secondary caries. Disk with aluminium oxide abrasive coating, rubber cups, rubber points, finishing and polishing burs coated with diamond particles, polishing paste, and abrasive strips have been used and reported in the literature. Each system provides a varying degree of smoothness on the restorative surface.⁸ Among the newest in the market, the Soflex system provides gloss to the restorative surface. It has spirals that can adapt to all the surfaces of teeth at any angle, thereby increasing the ease of polishing.⁹ GC Dia is another polishing system that has come into the market in recent times.¹⁰ Since no studies have been reported on these polishing

systems, the present study was conducted to evaluate and compare the clinical effectiveness of Soflex and GC Diapolishing systems in Class I composite resin restoration.

Materials and Methods

Institutional Ethical clearance was obtained from the university. It was an experimental split-mouth study. A sample size of 16 was derived through G*Power 3.1.9.2 software keeping alpha at 0.05 and power at 80%. Participants were recruited for the study based on the eligibility criteria. They were randomly assigned into either of the two groups, Soflex 3M ESPE (n=8) and GC Dia (n=8), after obtaining written informed consent.

Study participants

Patients with the primary bilateral occlusal carious lesion in posterior teeth classifying under 1.1 and 1.2 according to G.J Mount classification, having vital teeth, good oral hygiene with the virgin carious tooth, presence of opposing natural teeth, and bilateral teeth were included in the study while patients having frank occlusal cavitation, enamel hypoplasia, severe dental attrition, traumatic occlusion, traumatized teeth, having opposing Fixed partial denture or Removable partial denture and with a known history of systemic diseases were excluded.

Procedure

A detailed case history of the patient was recorded, and an oral examination was performed to check for Class I caries bilaterally on the same arch. The depth of the carious tooth was evaluated by obtaining an Intra Oral Periapical Radiograph (IOPA). The tooth was classified into 1.1 or 1.2 according to G.J Mount and Hume's classification of caries.

After preparing a cavity with 245 pear-shaped tungsten carbide bur and 245 diamond bur, the surface of the cavity was etched with 37% Ortho-phosphoric acid for 15 seconds and was washed with water and blot dried. This was followed with the application of Single Bond Universal 7th Generation Bonding Agent (3M ESPE)TM, which was cured using LED light for 30 seconds. Filtek Z 350 XT composite was then inserted using an incremental technique with increments not exceeding 2 mm.

After curing the restoration, initial finishing procedures were undertaken using fine diamond burs and multi-fluted carbide burs. Final polishing procedures were carried out with Soflex polishing kit on the right maxillary/mandibular molar and GC Dia polishing kit on the left maxillary/mandibular molar.

Assessment

Esthetic, functional, and biological properties were assessed after 1 month. The esthetic property included surface lustre, staining of surface and margins; functional property comprised of fracture and retention and marginal adaptation; biological property was assessed based on post-operative sensitivity and recurrence of dental caries, erosion, and abfraction. (reference for all the properties)

Statistical Analysis

The data was entered and analyzed using the Statistical Package for Social Sciences (SPSS) for Windows 26.0. (SPSS, Inc. Chicago, Illinois) Confidence intervals were set at 95%, and a $p\text{-value} \leq 0.05$ was considered statistically significant. The data regarding esthetic properties, functional properties, and biological properties were checked for normality using Kolmogorov- Smirnov test. Mann-Whitney U test was applied for comparing the parameters between the two groups.

Results

After obtaining the data for the parameters of the polishing system, they were scored into clinically excellent, clinically good, clinically satisfactory, clinically unsatisfactory, and clinically poor. Graph 1 represents a bar diagram regarding the percentage of restorations belonging to various scorings for an esthetic property. The restorations displaying excellent scores were more in the Soflex group over the GC Dia group. The majority of the restorations had a good clinical score of esthetics. None of the restorations presented with unsatisfactory or poor scores for esthetics. Graph 2 represents descriptive data on the functional property of the two polishing systems. The majority of restorations in the Soflex group presented excellent functionality for fracture, retentions, and marginal adaptation over GC Dia. None of the restorations exhibited unsatisfactory or poor scores for functionality. Graph 3 represents biological properties, with again Soflex showing a higher frequency of excellent score over GC Dia for post-operative sensitivity and recurrence of caries, erosion, and abfraction.

The difference between the two polishing systems revealed a significant difference for all three parameters of esthetics, i.e., surface lustre ($p=0.001$), surface staining ($p=0.020$), and marginal staining ($p=0.029$). In contrast, no significant difference was observed for functional properties comprising fracture and retention, marginal adaptation, biological properties comprising postoperative sensitivity and recurrence of dental caries, erosion, and abfraction with $p>0.05$. (Table 1)

Discussion

Color matching with the natural teeth is the major criteria considered to be esthetic in composite restorations. Besides, the texture and shape of restoration supplement the esthetic look. A detailed finishing and polishing of the restoration help restore the tooth in all three dimensions resembling that of the natural tooth.¹² In the present study, two polishing systems were used in the restored composite teeth. One is Soflex, with 12.5% restorations showing clinically good lustre, slightly dull, not noticeable from speaking distance with some isolated pores. The remaining 87.5% restorations were showing clinically excellent surface lustre comparable to the enamel. Koh R et al.¹³ their study reported a surface roughness of 0.47 ± 0.09 μm by using Soflex. Similar was noted in Nair VS et al.¹⁴ studies with Soflex polishing system showing superior results for microfilled and nanoparticle composites. Turssi CP et al.¹⁵ discovered that Sof-lex disc and Soflex disc combined with prisma gloss paste gave good results by providing a smooth surface. Lins FCR et al.¹⁶ demonstrated the surface

roughness of 0.47 at immediate assessment and 0.41 at delayed assessment using the Soflex system in sequence from medium to fine grain.

Roughness over the surface of the composite is the outcome of various interactions between extrinsic or intrinsic factors, with intrinsic being composition of the restorative material, size, and shape of the grains, presence of filler particles, and its distribution within the matrix. In contrast, extrinsic factors comprise the type of polishing system, material flexibility, type and shape and size of abrasive materials incorporated, their geometry, harness, and procedure by which they are used.¹⁷⁻¹⁹

With respect to gloss,²⁰ 35.7 for the Filtek Z100, 43.7 for Filtek Z250, 55.6 for Supreme, 48.7 for Durafill, and 47.3 for Esthet-X composite material was reported using the Soflex system.²⁰ A study by Kritzinger D et al.⁹ stated that using the spiral wheel in the Soflex polishing system produced small scratches and voids along with protruding particles on the restorative material. They reported a surface roughness obtained using Soflex disc for Filtek Z100 composite material was 0.263 for Filtek Z100, 0.211 for Filtek Supreme XTE with Soflex disc, while 0.255 and 0.211 with Soflex spiral wheel.

50% restorations in the present study presented clinically good results for post-operative sensitivity property with minor hypersensitivity for a limited period while another half exhibited clinically excellent results with no hypersensitivity. These results were in accordance with Kritzinger D et al.⁹, wherein Soflex spiral wheels do the finishing and polishing. The disc demonstrated roughness below the sensory feeling threshold, thereby making it a valuable polishing system in the clinical setting.

For the recurrence of dental caries, erosion, and abfraction, 37.5% of restorations displayed clinically good results, while 62.5% presented excellent clinical results. The caries are the reason for the accumulation of food particles on the tooth surface. Along with that, the presence of plaque and calculus initiates the demineralization of the tooth surface, thereby initiating dental caries. The study conducted by Kritzinger D et al.⁹ worked on a similar parameter and found that the use of Soflex with wheels and Soflex with disc system resulted in the roughness below the plaque accumulation threshold. With the accumulation of plaque being low, the incidence of future caries is decreased down to a great extent making the Soflex system advantageous for composite restorations.

12.5% of the restorations had material chipping fracture but not affecting marginal integrity, 62.5% with a small hairline crack, and 25% with complete retention of the restoration in the present study. Lins FCR et al.¹⁶ noted significantly more microleakage at enamel margins in case of delayed polishing over immediate polishing with Soflex polishing system under SEM. The displacement of particles was present that resulted in scratches and porosities over the composite restoration.

When restorations in the present study were polished with GC Dia paste, around 25% displayed clinically good surface lustre with slightly dull, not noticeable from speaking distance with some isolated pores. In comparison, 75% showed clinically excellent results

comparable to the enamel. A scientific program reported that the surface roughness of the composite, when measured via Surfcoater tester, was 0.58 when the GC Dia pastes alone were used. At the same time, it decreased to 0.30 when preceded with a rough polishing using diamond bur, which further reduced to 0.17 by diamond bur polishing followed by white alundum silica point and finally by diamond silicone points. By concluding the procedure with diamond polishing paste (GC Dia), an improvement of 0.076 was observed. This denotes that the procedure for finishing and polishing has a great impact on the outcome. GC Dia is a paste used with cups and discs at the final step of finishing and polishing. It is expected to provide a higher gloss over direct and indirect composite restorations with superfine particles. 25% restorations in the present study displayed moderate surface stains aesthetically acceptable, 62.5% with minor stainsfacilely removable by polishing, while 12.5% with no staining. Considering marginal staining, 37.5% exhibitedmoderate staining, not esthetically acceptable, and 62.5% with minor staining, facilely removable by polishing. Machida D et al.²¹, the color changeof the composite restoration when polished by GC Dia alone gave a value of 49.5. The staining decremented to 35.5 when the composite resin was finished and polished with diamond but for rough polishing followed by GC Dia polishing paste andfurther decreased to 22.6 when a combination of diamond bur, white alundum silicone point, and diamond silicone points was used.With final polishing using GC Dia paste, the staining tendencywas minimized to 12.2.

When compared between GC Dia and Soflex polishing systems, the present study revealed that the distinction between them was significant for surface lustre and staining. Soflex polishing system was significantly better for surface lustre and surface staining, while GC Dia was altogether better thanSoflex for marginal surface staining. While for other parameters like fracture and retention, marginal adaptation, post-operative sensitivity, and recurrence of caries, abfraction and erosion were non-significant. The justification for Soflex being better over GC Dia for lustre and staining can be ascribed to the finishing and polishing process steps. With the GC Dia polishing material being incipient in the market,literature is scarce on this material. Besides, very few parameters defining polishing and finishing outcome are assessed.

Conclusion

It can be concluded that Soflex and GC Dia polishing systems have the competency to amend surface roughness, staining of surface and margins, fracture and retention, marginal adaptation, recurrence of caries, abfraction, and erosion, as well as post-operative sensitivity properties for composite resin restoration. When compared for these properties between the two systems, Soflex polishing system ends substantiating to be better over GC Dia for surface lustre, staining of margins, and the surface of composite restoration while for fracture and retention, marginal adaptation, recurrence of caries, abfraction, and erosion as well as post-operative sensitivity both the polishing systems are comparable.

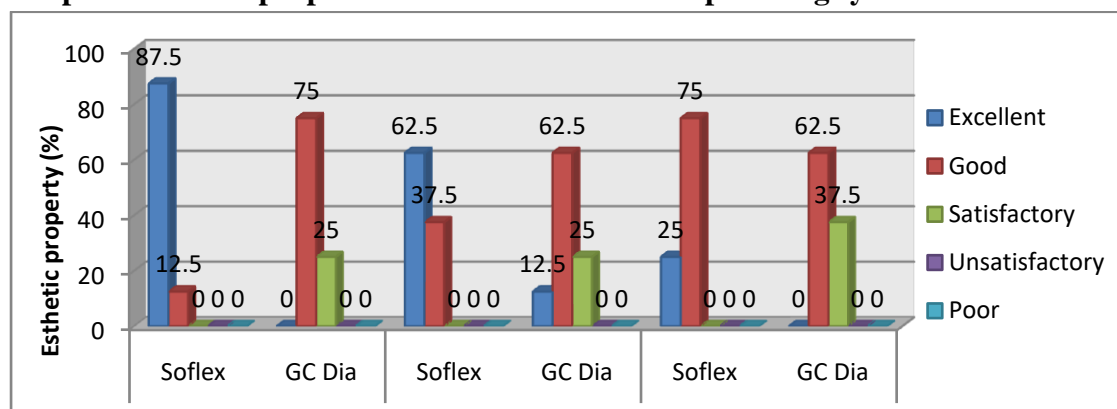
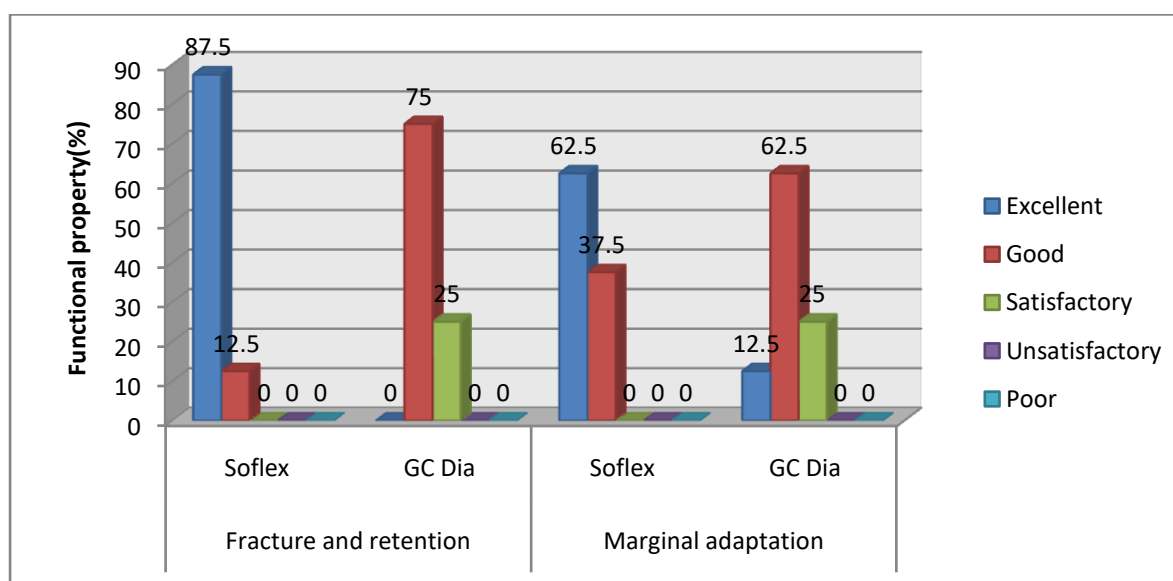
Conflict of Interest: None

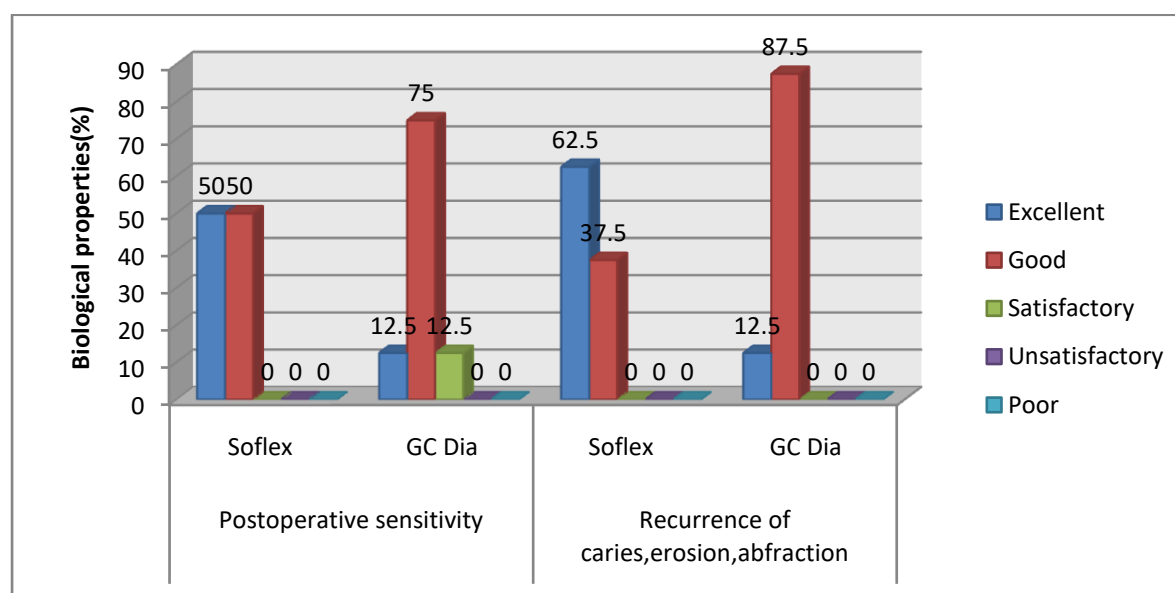
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Graph 1: Esthetic properties of Soflex and GC Dia polishing systems**Graph 2: Functional properties of Soflex and GC Dia polishing systems**

Graph 3: Biological properties of Soflex and GC Dia polishing systems**Table1: Difference between Soflex and GC Dia for esthetic, functional, and biological properties**

Properties		Mann Whitney U	p-value
Esthetics	Surface lustre	3.00	0.001*
	Staining (surface)	13.00	0.020*
	Staining (margin)	15.00	0.029*
Functional	Fracture and retention	28.50	0.65
	Marginal adaptation	18.00	0.53
Biological	Postoperative sensitivity	18.00	0.85
	Recurrence of caries, erosion, abfraction	16.00	0.10

*Significance at $p < 0.05$.