Research Article

Comparative Evaluation of two Polishing Systems on the Surface Texture of an aesthetic material (nano-composite): A Profilometric Study

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Abstract:

Composites have revolutionized the concept in asthetic dentistry. Proper finishing and polishing of composites are important aspects of clinical restorative procedures that enhance both asthetics and the longevity of the restoration. A number of finishing and polishing devices are available, but to decide the efficacy of various materials is still a challenge to the dentists or clinicians. Hence the study was undertaken to determine the effectiveness of two polishing systems Sof-Lex and PoGo on Filtek Z350 by evaluating surface roughness using a Profilometer. The study concluded that Sof-Lex is a better polishing system than PoGo.

Key Words: Roughness average, Sof-lex, PoGo, Filtek Z350, Polishing.

Introduction:

Composites have revolutionized the concept in asthetic dentistry. The clinical use of composite has increased substantially over the past few years due to increased aesthetic demands by patients, improvement in formulation and simplification of bonding procedures (Gupta et al, 2002). Composite is a heterogeneous material that is composed of three major components i.e. resin matrix, filler particles and silane coupling agent (Senawongse & Pongprueksa, 2007).

Polishing is the process carried out after the finishing procedure to remove minute scratches from the surface of a restoration and obtain a smooth, light-reflective luster (Jefferies, 2007). The ultimate asthetics of these tooth coloured restoratives is strongly influenced by the final surface polish (Jefferies, 1998). Smooth highly polished restorations have been shown to be more easily maintained than restoration with rougher surfaces. Polishing also reduces plaque retention and minimizes possible gingival irritation. It also prevents staining and recurrent decay (Turkun & Turkun, 2004).

A variety of instruments are commonly used for finishing and polishing tooth-coloured restorative materials including: carbide finishing burs, 25-50 µm diamond finishing burs, abrasive impregnated rubber cups and points, aluminum oxide coated abrasive discs, abrasive strips, and polishing pastes (Uçtasli et al, 2004). A number of finishing and polishing devices are available, but to decide the efficacy of various materials is still a challenge to the dentists or clinicians. Hence the study was undertaken to determine the effectiveness of two polishing systems on an aesthetic material by evaluating surface roughness using a Profilometer.

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Materials and Method:

The study was carried out in the Department of Conservative Dentistry and Endodontics, Krishnadevraya College of Dental Sciences and Hospital in collaboration with Department Of Mechanical Engineering, Indian Institute Of Sciences, Bangalore.

A total of 20 specimens were prepared of light activated nanofill resin composite Filtek Z350 (3M ESPE, Dental products, St. Paul, USA), approximately 3mm in diameter and 2mm in height. Filtek Z350 is composed of nanomer and nanocluster. The advantages are higher filler loading, high degree of crosslinking and compact molecule which creates a very hard resin matrix with a high degree of polishiability. The specimens were prepared in a stainless steel mold (Fig. I). The composite was filled with a composite filling instrument. The mold was slightly overfilled with composite resin and a mylar strip

Fig.I: Stainless steel cylindrical mold

was placed on both sides of the mold. The composite resin was sandwiched between two glass plates to extrude the excess material. The excess material was then removed. The composite resin was cured with a light curing unit for 40 seconds on both sides of the mould through the glass plates to standardize curing distance (1.35mm). Light intensity of the curing unit was standardized to 400mW/cm^2 using a light intensity meter (radiometer). The intensity of light was checked before every use with a radiometer. The resin blocks were finished to a uniform surface using carbide bur at a speed of 10,000 rpm for 10 seconds on each of the surfaces to create baseline finishing. In this way all the blocks were prepared to a standard surface. Now all the blocks were equally divided into the two groups for final polishing. One group of 10 blocks was polished with Sof-Lex (3M ESPE, Dental products, St. Paul, USA-Fig. II) and another group of 10 blocks was

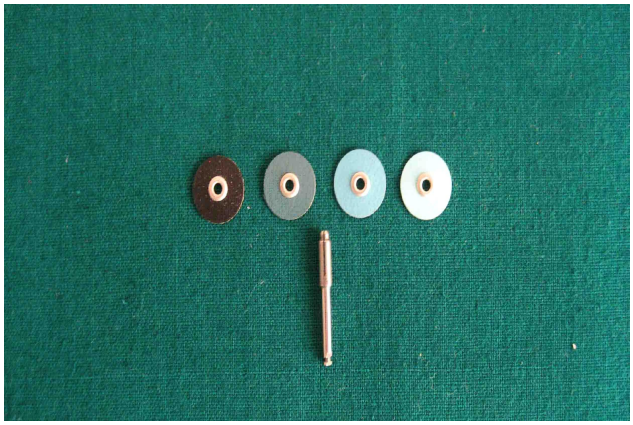

Fig.II: Showing Aluminium oxide abrasive disk (Sof-Lex) & metal mandral.

Fig.III: Showing premounted diamond impregnated cured urethane dimethacrylate resin PoGo polisher.

polished with PoGo (Dentsply caulk, Milford, USA-Fig.III). The Sof-Lex is a multi-step abrasive disks containing aluminium oxide abrasive used for polishing composites. PoGo polishers are premounted single use diamond impregnated cured urethane dimethacrylate resin polishing device designed for use in final polishing of all composite restorations.

Polishing Procedure:

10 samples were polished with Aluminium Oxide Abrasive (Sof-Lex). Disks in the kit were attached by a metal hub to the autoclavable metal mandrel. The coarse grit disk was used for gross reduction at medium speed of 10,000 rpm. The medium grit disk was used for gross contouring at medium speed of 10,000 rpm for 15 to 20 seconds. The fine grit disc followed by superfine grit disc was used to finish at high speed of 30,000 rpm for 15 to 20 seconds each. Rest of the 10 samples were polished with Diamond abrasive (PoGo) which was a one step polishing system. The polishing was done at a speed of 20,000 rpm. After the specimens were polished, the specimens were analyzed for surface roughness using a two dimensional surface profilometer (Fig.IV). The Roughness average (Ra) of a specimen was defined as the arithmetic average height of roughness component irregularities from the mean line measured within the sampling length. Profilometer readings were made at the centre of each specimen, and the numerical average was determined for each group. It provided a quantitative recording of surface irregularities. The profilometer is a device that

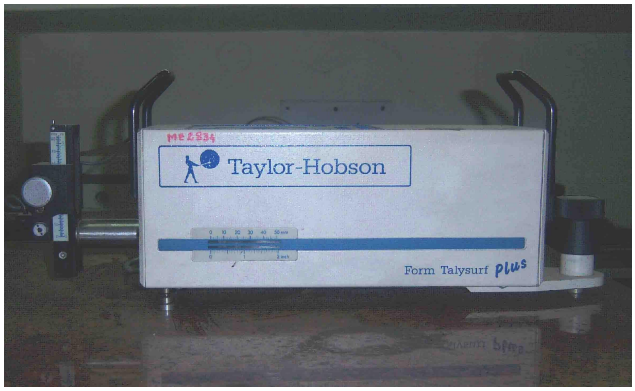

Fig. IV: Profilometer used for measurment of surface roughness (Ra).

uses a diamond stylus of 2µ diameter to trace a fixed linear distance over the surface of the prepared sample. The profilometer produces a tracing using digital and analogue hardware and software, and calculates the average surface roughness (Ra) value for the resultant tracing.

Result:

The results were tabulated (Table-I) and the ANOVA TEST was applied to determine the significant differences in microleakage between the groups (Table-II). P- value of 0.05 or less was considered as statistical significance.

The Profilometer provides a digital readout of average surface roughness(Ra) in microns. The average roughness value represents the arithmetic mean of the height of all surface irregularities over a predetermined linear segment of each specimen.

Table I : Showing roughness average (Ra) of Sof-Lex and PoGo on Z350.

Sample no.	Roughness average of (Sof-lex) in µ	Roughness average of (PoGo) in µ
1	0.134	0.146
2	0.117	0.148
3	0.127	0.139
4	0.118	0.152
5	0.107	0.131
6	0.114	0.143
7	0.127	0.136
8	0.109	0.128
9	0.120	0.144
10	0.104	0.137
Mean	0.1177	0.1404

Sof-Lex showed maximum roughness average of 0.134 and minimum of 0.104µ while PoGo showed maximum of 0.152 and minimum of 0.128µ.

Table II: Comparison in-between Sof-Lex and PoGo

Polishing material	Paired Differences			t	P-value
	Mean	Std. Deviation	Std. Error		
Sof-Lex PoGo	-0.02270	0.00929	0.00294	-7.730	<0.000

Results of one-way ANOVA test for surface roughness showed P< 0.000 which is statistically highly significant.

Discussion:

The continuous development of aesthetically acceptable adhesive restorative material has made a variety of tooth coloured materials available for clinical use. Since the introduction of composite resins, numerous studies have been initiated to develop a finishing and polishing procedure that would produce a smooth surface restoration (Dennison et al, 1981). Composites are finished and polished in order to establish a functional occlusal relationship and a contour physiologically in harmony with supporting tissues. In addition, proper contour and high gloss give the restoration the appearance of natural tooth structure (Turkun & Turkun, 2004).

The final polish obtained on a composite restoration would be determined by two factors; composition of composite with relation to matrix and filler particles and the type of polishing system used. The degree of the polymerization of the matrix, the size, composition and volume of filler particles affect the surface finish obtained on composites as the resin matrix and filler particles do not abrade to the same degree (Yap et al 2004).

This study showed that the specimen Z350 polished with diamond (PoGo) abrasive system gave high roughness average (Ra) as compared to aluminium oxide (Sof-Lex). Sof-Lex gave statistically significant smoother surface than PoGo.

Uçtasli et al (2007) studied the effect of different finishing systems on the surface roughness of different types of composite restorative materials. They found that Sof-Lex discs produced a smoother surface than Po-Go discs for all tested materials which is congruent with the findings of the present study.

Though Diamonds (PoGo) abrasives gave a good surface finish, they were found to be rougher than the surface finish produced by Aluminum Oxide (Sof-Lex) discs. This could be attributed to the fact that diamond (PoGo) discs are less flexible as compared to the extremely flexible aluminum oxide (Sof-Lex) discs. Another reason for the aluminum oxide (Sof-Lex) discs giving better surface smoothness in the study over Diamond (PoGo) could be due to the non displacement of the composite fillers particles by Sof-Lex (Herrgott et al, 1989). The aluminum oxide discs (Sof-Lex) performed better because the fillers in composite are so small that their stiffness is reduced and so their malleability promotes a homogeneous abrasion of the fillers and the resin matrix (Yap et al, 1997). Study by Mitra et al (2003) also supported the concept of homogeneous abrasion.

Conclusion:

The statistical analysis shows that Z350 showed least roughness average with Sof-Lex when compared to PoGo. Hence it is recommended that Sof-Lex should be used as preferable polishing material as it gives better results.

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