Polishing of Two Composites - Effectiveness of One-Step System

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ABSTRACT

Over the years several changes have been made in the fabrication of dental resin composites to obtain better color stability over time, greater wear resistance and clinically acceptable final surface smoothness of placed restorations. To achieve this last goal, manufacturers have reduced the diameter of filler particles.Therefore the composite materials in this study were taken according to a difference in filler particle size so as to check the polishing ability of a single-step polishing system (PoGo) in respect to different composite materials. The composites used were Z100, and Esthet-X.

Key words: Z-100, Esthet-X, PoGo, Profilometer.

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INTRODUCTION

Over the years several changes have been made in the fabrication of dental resin composites to obtain better color stability over time, greater wear resistance and clinically acceptable final surface smoothness of placed restorations. To achieve this last goal, manufacturers have reduced the diameter of filler particles[1].Therefore the composite materials in this study were taken according to a difference in filler particle size so as to check the polishing ability of a single-step polishing system (PoGo) in respect to different composite materials. The composites used were Z100, and Esthet-X

Composite is a heterogeneous material that is composed of three major components i.e resin matrix, filler particles and silane coupling agent. Currently three categories of composite have been proposed, they are microfilled, microhybrid (minifilled) and nanocomposites

Z100 composite [**Figure.1**],(Micro-hybrid) restorative material is visible-light activated, radiopaque, restorative composite restorations. The filler in Z100 restorative is zirconia/silica. The inorganic filler loading is 66% by volume with a particle size range of 3.5 to 0.01 micron.Z100 restorative contains BIS-GMA and TEGDMA resins. The advantages are low polymerization shrinkage, high fracture resistance, and high wear resistance.

Esthet-X[**Figure.2**]is a visible light cured, radiopaque, composite restorative material. The composition is Bis-GMA, Bis-EMA, TEGDMA, Photoinitiators, stabilizers, Barium fluoro alu-

Figure.1:Filtek Z100

mino boro silicate, silicon dioxide(highly dispersed).The percentage by volume of total inorganic filler is 60% and percentage by weight is 77% and particle size is 0.7 microns. It has superior

Figure.2: ESTHET-X

strength, durability and fracture toughness through its patented matrix

The present study evaluated a polishing systems that is PoGo ,on the surface of two aesthetic materials namely Filtek Z-100 and Esthet-X by checking its surface roughness using Profilometer[**Figure.3**].

Figure.3: PoGo

MATERIAL AND METHOD

This present 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 made. Specimen were made of light activated resin composite Z-100 (Group 1), Esthet-X (Group 2) 10 of each, approximately 3mm in diameter and 2mm in height. The specimens were prepared from a stainless steel mold. The composite was filled with a composite filling hand instrument. The mold was slightly overfilled with composite resin and a Mylar strip 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.

TABLE I

Roughness Average (Ra)

(After Finishing)

S.No		
	Z100 (PoGo)	Esthet-X (PoGo)
1	.437	.417
2	.430	.410
3	.435	.419
4	.429	.417
5	.432	.412
6	.440	.416
7	.431	.415
8	.435	.418
9	.433	.414
10	.436	.412

The composite resin was cured with a light curing unit for 40 seconds on both sides of the mold through the glass plates to standardize curing distance (1.35mm). Light intensity of the curing unit was standardized to 400mW/cm2 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 15,000 rpm to create surface irregularities. The surfaces were finished for 10 seconds each. In this way all the blocks were prepared to a standard surface[**Figure.4**].

Table 2

Comparison Between the Groups For PoGo (Mean Average Roughness)

	N	Mean Average (PoGo)	Std. Deviation	Minimum	Maximum	'F' value	'p' value
Group 1	10	.22830	.01229	.206	.244	224.003	.000
Group 2	10	.18530	.00707	.174	.195		

Table 3

Comparison Between the Groups For PoGo (Mean Difference)

Group	Group	Mean Difference	'p' value
Group1	Group 2	.04300	.000

POLISHING PROCEDURE

10 samples of Z-100 and Esthet-x were polished with PoGo

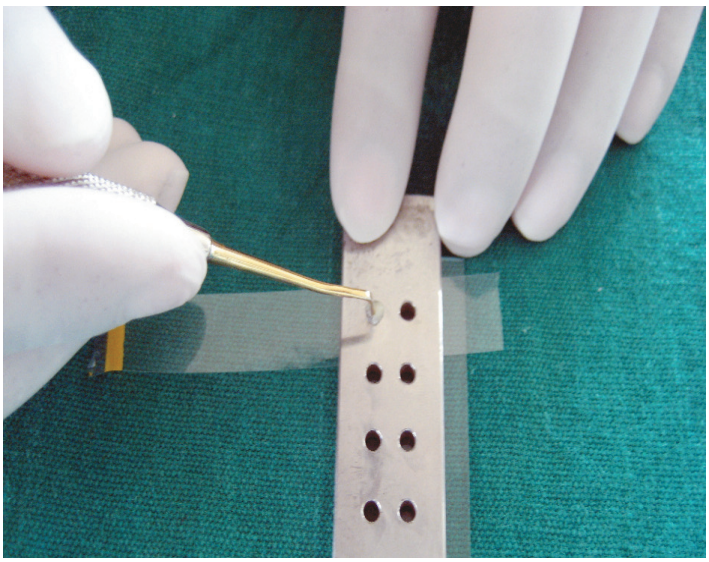

Figure.4: STAINLESS STEEL CYLINDRICAL MOLD

which is 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 at the Indian Institute Of Science, Bangalore. The Roughness average (Ra) of a specimen was defined as the arithmetic average height of roughness com-

ponent irregularities from the mean line measured within the sampling length. The diamond stylus had a diameter of 2 microns . Profilometer readings were made at the centre of each specimen, and the numerical average was determined for each group.

RESULT

Profilometer [**Figure.5**] results provide quantitative recording of surface irregularities. The profilometer is a device that uses a diamond stylus of precise dimensions to trace a fixed linear distance over the surface of the prepared sample. The profilometer produces a tracing and, using digital and analogue hardware and software, also calculates the average surface roughness (Ra value) for the resultant tracing.

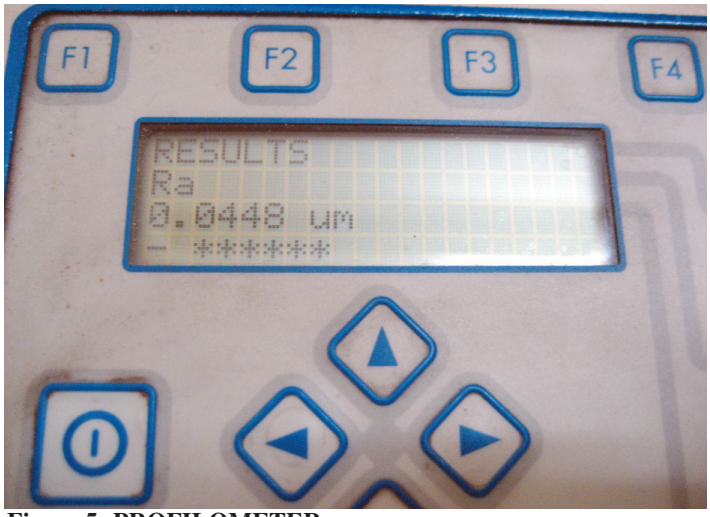

Figure.5: PROFILOMETER

Results were tabulated and the ANOVA TEST was used to determine the significant differences in microleakage between the groups. A P- value of 0.05 or less was considered as statistical significance.

Z-100 showed maximum roughness average of 0.440 and a minimum of 0.429 while Esthet-X showed maximum of 0.418 and minimum of 0.410 microns.

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

DISCUSSION

After introduction of synthetic resins in the late 1940s and early 1950s following their initial success, certain drawbacks such as high polymerization shrinkage and high coefficient of thermal expansion led to their clinical failures. Thus to overcome these deficiencies, inert filler particles were added in order to reduce the volume of the resin component. But these early attempts were not fruitful till Dr.Bowen in 1956 developed a new composite material. His main formulation was dimethacrylate resin viz. BIS-GMA, used along with silane to coat filler particles which would chemically bond to the resin[2]. Since then newer composites have been introduced like macrofilled composites, UV light cured composite, visible light cured composite, microfilled composite, hybrid composite, indirect composite, flowable composites, packable composites, ion-releasing composite, fibre-reinforced composite and nanocomposites.

The finishing and polishing procedures involves some fundamental principles that allow us to understand its application in dentistry. The effectiveness of any finishing or polishing device and the resultant surface roughness of the restoration is determined by a number of factors[3]:-

1) Structure and mechanical properties of the substrate being finished and polished.
2) Difference in the hardness between the abrasive device and the substrate.
3) Particle hardness, size and shape of abrasive used in the device.
4) Physical properties of the backing or bonding material used to carry the abrasive material or substance (eg, rigidity, elasticity, flexibility, thickness, softness, porosity).
5) Speed and pressure at which the abrasive is applied to the substrate.
6) Lubrication and use of the lubricants during the application of the abrasive.
7) Increased filler volume results in decreased wear. A higher filler volume results in a higher fracture toughness. Keeping volume fraction constant, wear resistance is increased by decreasing the size of the filler particle. Large, hard particles transmit considerable stress to the matrix, possibly resulting in microcracking and subsequent loss of material. By contrast, a reduced load per particle results when a large number of small particles is present per unit volume[4].

In this study Esthet-X has shown significantly less surface roughness than Z100 with both Sof-Lex and PoGo, which may be because of the particle size and distribution in Esthet-X which allows it to be polished to a better surface than Z100.The result in this study is in agreement to a previous study where Esthet-X showed significantly less surface roughness than Z100[5].

CONCLUSION

Following conclusions were drawn from this study that Esthet-X gave less roughness average than Z100 when polished with Sof-Lex and PoGo.

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