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ORIGINAL ARTICLE

THE EFFECT OF DIFFERENT POLISHING SYSTEM ON THE SURFACE ROUGHNESS OF COMPOSITE MATERIALS

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ABSTRACT:

The search for an ideal polishing agent for dental composite is ongoing. Several polishing tools have been used over the years ranging from multiple step system using fine and super fine diamond finishing burs, abrasive disks, diamond and silicon impregnated soft rubber cups, to one step polishing system. The present study evaluates two polishing system i.e SofLex (multi-step polishing system) and PoGo (single-step polishing system) on a composite material namely Filtek Z-100.

Key Words: Z-100, Sof-lex, PoGo, Profilometer.

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INTRODUCTION:

The search for an ideal polishing agent for dental composite is ongoing. Several polishing tools have been used over the years ranging from multiple step system using fine and super fine diamond finishing burs, abrasive disks, diamond and silicon impregnated soft rubber cups, to one step polishing system. The present study evaluates two polishing system i.e SofLex (**Figure.1**) (multi-step polishing system) and PoGo (**Figure.2**) (single-step polishing system). Sof-Lex is an aluminum oxide abrasive manufactured from bauxite, as impure aluminum oxide and available as various particle sizes. The particles are applied to paper disks in coarse, medium fine and extra-fine grits. It has reversible discs, which makes aligning disc easier for polishing various surfaces and are flexible. PoGo Polishers are pre -mounted single use diamond impregnated cured urethane dimethacrylate resin polishing devices designed for use in final polishing of all composite restorations. Advantage of the one-step system is the convenience and efficiency of producing a very smooth surface without having to switch to finer polishing items or having to wash and dry between each step to ensure removal of the larger abrasives from the previous step.[1]

Figure.1:Soflex

Figure.2: POGO

Z100 composite (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. The present study evaluated two polishing systems that is Sof-lex and PoGo ,on the surface of an aesthetic material namely Filtek Z-100(**Figure.3**).

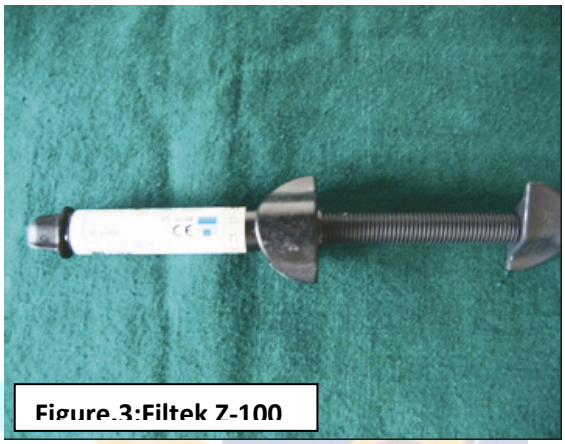

Figure.3:Filtek Z-100

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.

Materials used in this study

Resin Composite	Composition	Shade	Mean Particle Size	Weight % of Mineral Filler
Z100	BIS-GMA and TEGDMA	A-2	Zirconium silicate 0.6microns	84.5%

Polishing System	Composition	Usage
Sof-Lex	Aluminium oxide disc Coarse Medium Fine Ultra fine	Dry 4 strokes 4 strokes 4 strokes 4 strokes
PoGo	Diamond coated micro-polisher	Dry, 16 strokes

A total of 20 specimens were made. Specimen were made of light activated resin composite Z-100, 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.

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/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 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. Now all the blocks were equally divided into two groups for final polishing. One group of 10 blocks was polished with Sof-Lex and another group of 10 Blocks was polished with PoGo.

Polishing Procedure

10 samples were polished with Sof-Lex and 10 samples were polished with PoGo. For Sof-Lex the 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 was used to finish at higher speeds of 30,000 rpm for 15 to 20 seconds. The superfine grit was used to polish at high speed of 30,000 rpm for 15 to 20 seconds. In total 10 samples were polished with Sof-Lex, 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 at the Indian Institute Of Science, Bangalore. 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. The diamond stylus had a diameter of 2 microns . Profilometer (**Figure.4**) readings were made at the centre of each specimen, and the numerical average was determined for each group.

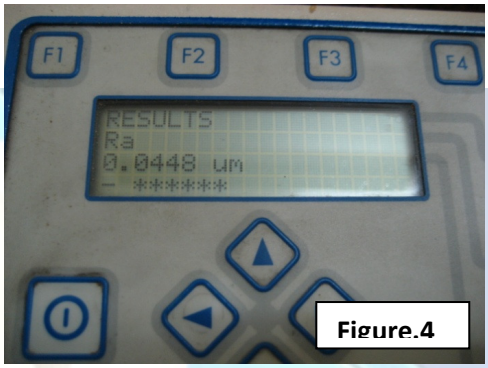

Figure.4

RESULT:

The Profilometer (**Figure.5**) 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. 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.

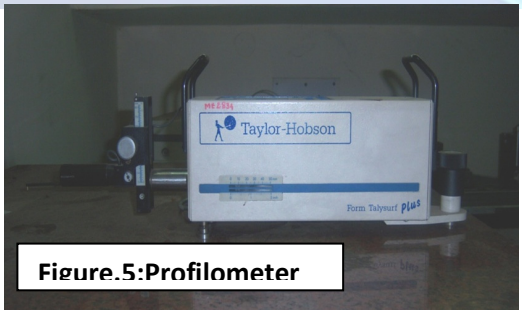

Figure.5:Profilometer

Table I

Roughness Average (Ra)Of Sof-Lex and PoGo

GROUP (Filtek Z-100)

S.No	Average (Sof-lex)	Average (PoGo)
1	.208	.239
2	.222	.244
3	.221	.230
4	.214	.211
5	.207	.222
6	.217	.228
7	.227	.235
8	.204	.229
9	.198	.206
10	.211	.239

The results were evaluated statistically by ANOVA TEST.

Mean roughness in Group 1 was 0.2283 with standard deviation ±.0122

Mean roughness in Group 2 was0.1853 with standard deviation ±0.007

Maximum mean roughness was seen with Group 1.

Results of one-way ANOVA test for surface roughness showed P < .000 which is statistically significant. Pair wise significance showed:

GROUP	P-VALUE	
Group I Vs Group 2	P < 0.000	**Statistically Significant**

DISCUSSION:

Instrument designed to contour dental restorations must be sufficiently abrasive to establish the final geometry, conversely, the least abrasive rotary instrument that adequately establishes contour should be used to leave the smoothest surface.[2] Finishing and polishing devices, materials, and procedures are intended to produce intentional, selective and controlled wear of dental restorative material surfaces. The wear mechanism is the transfer of energy with removal or displacement of material. In polishing with abrasive particles, the wear mechanism is mostly abrasive wear, but other mechanisms are also possible. These include surface fatigue and the development of ploughing grooves or scratches.

There are two types of abrasive wear modes, i.e. two-body abrasion and three body abrasion. In a two-body mode, the bound abrasive particles is solidly fixed to the substrate. In the three-body mode, free (or loose) particle slurry between the specimen surface to be polished and a flat polishing substrate. In this study two-body mode abrasion was used.[1] Since improper application of different polishing systems could lead to decrease effectiveness strict adherences to manufacturers instruction on polishing procedures were followed. In this study one operator performed all the finishing and polishing procedure to simulate clinical procedure and to reduce the variation of the force used on the specimen. A previous study showed that dry finishing of composites was superior or equal to produce a smooth surface, so a dry condition was chosen.[3] This was also in accordance to manufacturer's instructions. The number of strokes as well as the hand piece speed were also standardized so that the variation of the roughness average value could be kept to a minimum. The results were analyzed using ANOVA test. Descriptive data presented as numbers with corresponding surface roughness scores for each group. The ANOVA

test was used to determine the significant differences in roughness average between the groups. A P- value of 0.05 or less was considered as statistically significant. When the comparison was done between the two polishing systems Sof-Lex gave statistically significant better polish than PoGo.

Hardness determines the degree of deformation of a material and it is generally accepted as an important property and a valuable parameter of comparison with the tooth structure.[4] Changes in hardness may reflect the state of cure of a material and the presence of an on-going reaction or maturity of the restorative material.[5] To assure an optimized clinical performance of restorations, it is of paramount importance to employ materials with hardness at least similar to that of the dentinal substrate, not only superficially, but also in depth, since an accentuated decrease in hardness would adversely affect their mechanical properties and marginal integrity.[4] The incorporation of softer filler particles with hardness characteristics similar to that of enamel appears to result in decreased wear. It is thought that soft particles are more capable than hard particles of absorbing energy generated during the masticatory process, thereby transmitting lower stresses to the matrix.[5]

Correlation to clinical practice may be limited to situations where accessible relatively flat surface are finished. Further studies are needed to determine which polishing technique are best suited to clinical situation where access is limited and restoration surfaces are not flat. Studies should be done in combination with Scanning Electron Microscope more valid predictions of study values can be made.

CONCLUSION:

Following conclusions were drawn from this study that the statistical analysis shows that all materials i.e. Z100 (0.2129) and Esthet-X (0.1206) showed least roughness average with Sof-Lex when compared to PoGo. Therefore Sof-Lex should be used as preferable polishing system as it shows better result.

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