COMPARISON OF SURFACE HARDNESS, POST POLISHING OF VARIOUS HYBRID COMPOSITES AT VARIOUS PRICE POINTS. AN IN-VITRO STUDY.

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1. Introduction

When reconstructiong teeth, dentists can choose from a wide variety of materials nowadays. One of the most popular aesthetic restorative materials that is suitable for the restoration of posterior teeth is resin composite. This matrial has superior physical and mechanical qualities (Topcu et al. 2010; Lee et al. 1975). Various factors such as the concentration of the filler material and particle size of the filler have a significant impact on the mechanical and physical characteristics of dental composites. Lately , newer materials with smaller particles and more filler have been developed as a result of recent research on resin matrix. (Wang et al. 2008; Aguiar et al. 2005)A recent significant improvement in the wear resistance of resin composites has been achieved by decreasing the average filler particle size and increasing the filler loading, following rigorous study of the wear resistance of composite resins. This is due to the fact that larger filler particles in composite materials are often associated with increased wear rates in the contact area. (Aguirar et al. 2008; Ozdemir et al. 2022) New composites may have lower particle sizes as a result, but they do not include more filler. One of the most significant advancements in this area has been the introduction of nanofilled materials, which are created by mixing nanometric particles and nanoclusters with a traditional resin matrix. The synthesis and use of materials and structures in the range of around 0.1-100 nanometers using various physical or chemical techniques form the basis of nanotechnology..(Pala et al. 2016) The mechanical qualities of nanocomposite materials, such as tensile strength, compressive strength, and resistance to fracture, were found to be on par with or better than those of other commercial composites studied (hybrids, microhybrids, and microfill).(Pala et al. 2016; Dhananjaya et al. 2019) Nanotechnology is therefore of tremendous interest in the research on resin composites.Topcu et al. 2010)

2. Materials and Methodology

The composites used in this study include Mani Micro (Mani Inc.,Japan), Tetric Te Econom (Ivoclar Vivadent AG, Liechtenstein), Tetric EvoCeram (Ivoclar Vivadent AG, Liechtenstein) and Coltene Brilliant EverGlow (COLTENE Group, Altstatten, Switzerland). Details given in Table1. The Sof-lex abrasive diskpolishing system was used (3M ESPE, MN, USA). Details given in table 2.

Table a Composites used in study

Material	Abbreviatin	Classificatin	Composition	Filler Ratio (wt%/vol%)	Manufacture
Coltene Brilliant Everglow	CBE	Sub-Microhybrid	Methacrylates, Photoinitiators, Ethanol, Water		Coltene
Tetric EvoCeram	TEC	Nanohybrid	Dimethacrylate, barium glass,ytterbium fluride, oxides mixture, prepolimer	75-76/53-55	Ivoclar vivodent

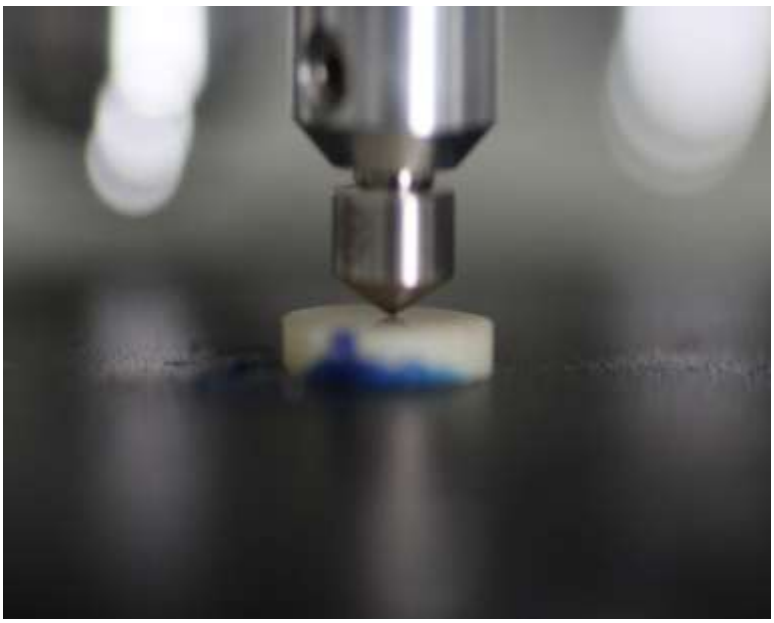
Mani Micro	MM	Microhybrid	Glass powder, diurethane dimethacrylate, silicon dioxide, Bis-GMA, Tetramethylene dimethacrylate	75/53	Mani Inc
Tetric Te Econom	TTE	Microhybrid	arium glass, ytterbium trifluoride, mixed oxide and copolymers	76/60	Ivoclar vivodent

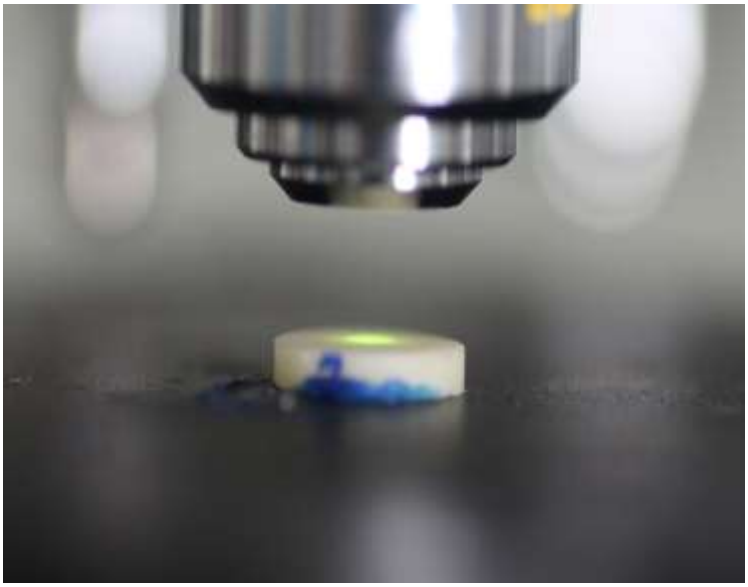
Table b Polishing System used in study

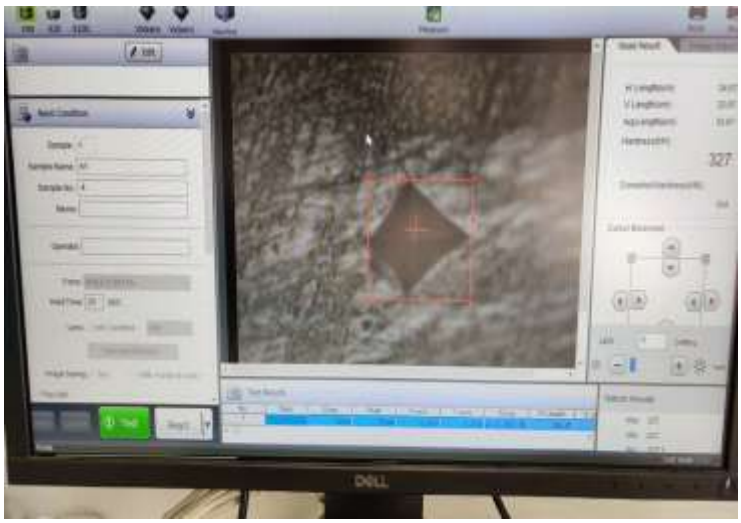
Polising Systems	Average Particle Size
SofLex Red (aluminum oxide)	60 micro metres (electrostatically coated)
SofLexMedium orange (aluminum oxide)	30 micro metres (electrostatically coated)
SofLex Light orange (aluminum oxide)	30 micro metres (slurry coated)
SofLex Yellow (aluminum oxide)	3 micro metres

Specimen preparation:
Each composite sample was placed in a stainless-steel mould (8mm diameter, 2mm thickness) and packed against a mylar matrix strip sandwiched between a glass slab. The samples were light cured for 60 seconds total, with 30 seconds on each side with all samples were light cured for 60 seconds in total with each side being cured for a 30s duration

with DTE O-Light Plus Light Cure Unit (Guilin Woodpecker, China). Ten samples were prepared per group: Group CBE (Coltene Brilliant Everglow), Group TTE (Tetric Te Econom), Group MM (Mani Micro) and Group TEC (Tetric EvoCeram). Samples with visible voids were discarded. All samples were then stored in distilled water at 37 degrees C for 24 hous







Finishing and polishing procedures:
With the Sof-Lex discs (four-step procedure), each group was polished: The medium (red) disc was applied for 20 seconds, washed, and dried with an air/water syringe for a total of 10 seconds in Step 1, the course (dark orange) disc was used in Step 2 the medium grit was applied for 20 seconds before being rinsed and dried with an air/water syringe for a total of 10 seconds. The fine (light orange) disc was applied in Step 3, washed for 20 seconds, and then dried for a total of 6 seconds using an air/water syringe. Step 4, a superfine (yellow disc) was used for 20 seconds before being rinsed and dried for a total of 6 seconds with an air/water syringe.All preparations were performed by one operator. Polishing disks were used using light hand pressure. Polishing disks were replaced after use on each sample. Samples were cleaned with distilled water and air dried before starting the next finishing and polishing step(Zhang et al. 2021).

Surface Hardness Tests:
The microhardness test is done using a Shimadzu HMV-G Vickers hardness tester. The Hardness tester was set at a 100gf load for a duration of 15 seconds. 2 tests were done for each sample and the mean was calculated.
Result:

Surface Hardness

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
coltene brilliant everglow	20	46.7600	2.73733	1.22417	43.3612	50.1588	42.40	49.80
tetric t economy	20	42.8400	2.53239	1.13252	39.6956	45.9844	39.90	46.50
mani micro	20	54.4400	5.82992	2.60722	47.2012	61.6788	50.00	61.50
tetric evo ceram	20	57.6800	5.70061	2.54939	50.6018	64.7582	51.00	66.70
Total	80	50.4300	7.32753	1.63849	47.0006	53.8594	39.90	66.70

ANOVA

Surface Hardness

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	698.598	3	232.866	11.587	.000

Within Groups	321.564	16	20.098		
Total	1020.162	19			

3. Discussion

Composites boast reasonably high surface hardness although still not achieving the levels of hardness seen in enamel which range at 230 to 250 VH. Nano hybrid composites usually show higher surface hardness as compared to micro hybrid. This is due to the higher filler content stated by St Pierre et al in 2017

From the results in can be inferred that although the different groups show various compositions such as Nano Hybrid, Sub Micro Hybrid and Micro Hybrid, there is no clinical significance that can be elicited from these different composites. Studies with larger sample sizes may be required for further information.

4. References

Topcu FT, Erdemir U, Sahinkesen G, Yildiz E, Uslan I, Acikel C. Evaluation of microhardness, surface roughness, and wear behavior of different types of resin composites polymerized with two different light sources. J Biomed Mater Res B Appl Biomater. 2010 Feb;92(2):470-8. doi: 10.1002/jbm.b.31540. PMID: 19957350.

Lee HL, Orlowski JA, Kidd PD. Surface roughness of composite filling materials. Biomater Med Devices Artif Organs. 1975;3(4):503-19. doi: 10.3109/10731197509118641. PMID: 1225378.

Topcu FT, Erdemir U, Sahinkesen G, Yildiz E, Uslan I, Acikel C. Evaluation of microhardness, surface roughness, and wear behavior of different types of resin composites polymerized with two different light sources. J Biomed Mater Res B Appl Biomater. 2010 Feb;92(2):470-8. doi: 10.1002/jbm.b.31540. PMID: 19957350..

Zhang L, Yu P, Wang XY. Surface roughness and gloss of polished nanofilled and nanohybrid resin composites. J Dent Sci. 2021 Oct;16(4):1198-1203. doi: 10.1016/j.jds.2021.03.003. Epub 2021 Mar 26. PMID: 34484588; PMCID: PMC8403785.

Aguiar FH, Braceiro AT, Ambrosano GM, Lovadino JR. Hardness and diametral tensile strength of a hybrid composite resin polymerized with different modes and immersed in ethanol or distilled water media. Dent Mater. 2005 Dec;21(12):1098-103. doi: 10.1016/j.dental.2004.11.010. PMID: 15921735.

Awareness of three kinds of new composite resins]. Hua Xi Kou Qiang Yi Xue Za Zhi. 2008 Feb;26(1):15-8. Chinese. PMID: 18357875.

Aguirar FH, e Oliveria TR, Lima DA, Ambrosano Gm, Lovadino JR. Microhardness of different thicknesses of resin composite polymerized by conventional photocuring at different distances. Gen Dent. 2008 Mar-Apr;56(2):144-8. PMID: 18348370.

Ozdemir B, Ilday NO, Ozdemir SB, Suleyman F, Duymus ZY. The effect of erosive beverages and polishing systems on the surface properties of nanohybrid composite resin. Niger J Clin Pract. 2022 Mar;25(3):248-254. doi: 10.4103/njcp.njcp_1361_21. PMID: 35295044.

Pala K, Tekçe N, Tuncer S, Serim ME, Demirci M. Evaluation of the surface hardness, roughness, gloss and color of composites after different finishing/polishing treatments and thermocycling using a multitechnique approach. Dent Mater J. 2016;35(2):278-89. doi: 10.4012/dmj.2015-260. PMID: 27041019.

Dhananjaya KM, Vadavadagi SV, Almalki SA, Verma T, Arora S, Kumar NN. In Vitro Analysis of Different Polishing Systems on the Color Stability and Surface.