EGYPTIAN
DENTAL JOURNAL

Vol. 66, 1383:1395, April, 2020

Print ISSN 0070-9484 • Online ISSN 2090-2360

Fixed Prosthodontics, Dental materials, Conservative Dentistry and Endodontics

www.eda-egypt.org • Codex : 00/2004 • DOI : 10.21608/edj.2020.26971.1093

COMPARATIVE EVALUATION OF WEAR RESISTANCE OF THREE BULK-FILL COMPOSITE AND SURFACE ROUGHNESS WITH ANTAGONIST HUMAN ENAMEL AND PORCELAIN

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ABSTRACT

Objective: The aim of this study was to compare the two-body wear resistance and the surface roughness of three different bulk-fill composite resins and a conventional resin composite materials with against human enamel and porcelain.

Materials and methods: Eighty cylindrical specimens were fabricated from three bulk fill resin composites and one conventional composite : group I (n=20) discs of Sonic, group II (n=20) discs of Tetric Evoceram , group III (n=20) Filtek and group IV(n=20) Filtek Z250. All specimens were subjected to a programmable logic controlled equipment was used to record the two-body wear of tested composites. Enamel and porcelain were used as antagonists. Wear were determined by weight loss and images analysis software were evaluated the tested samples surface topography. All data were statistically analyzed by Kruskal-Wallis test followed by Dunn's and Wilcoxon signed-rank test.

Result: With enamel and porcelain antagonist; there was no statistically significant difference between weight loss and ΔRa of the four materials.

Porcelain antagonist showed statistically significantly higher weight loss than enamel antagonist with Tetric Evo Ceram, Sonic fill, Filtek as well as Z250 composite types;

While with Filtek, there was a statistically significant difference between ΔRa of the two antagonists(P-value = 0.025, Effect size = 2.714). Enamel showed an increase in roughness while porcelain showed a decrease in roughness.

Conclusion Nanofillers bulkfill resin composite did not significantly influence the wear resistance. Porcelain antagonist showed more wear than enamel antagonist. However, enamel showed decrease the roughness

KEYWORDS: Resin composite, wear resistance, enamel, porcelain fused to metal.

INTRODUCTION

Tooth wear is a multifactorial procedure based on pathologic or physiologic mechanisms which result to loss of tooth surface and leading to alterations in tooth anatomy. In physiological wear, abrasion tacks place gradually after deterioration of tooth surface during mastication when third object were present. [1] While, when opposing teeth are in direct contact during occlusal movements and

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swallowing, attrition was the result,[2,3] consequently, lose convexity of cusps and flattened of posterior teeth occurred and shortened of incisal edges and slightly loss of mammelons of anterior teeth.[4]

Clenching and bruxism regularly causing a pathological wear, which characterized by great attrition and tooth damage, with change of the path of masticatory movements. Also, affect the esthetic, and guidance function of teeth. Tempromandibular joint dysfunction and increasing stress on the masticatory system also associated by pathological wear. Advanced wear of dental restorative materials also can occur by attrition and abrasion, and the wear behave depends on the type of restorative material.[1]

Ideal restorative material should possess the similar wear property of human enamel. Esthetics and functional long term outcome of occlusal rehabilitations adversely affected by great abrasiveness and excessive wear. [5,6]

Since early of 1970s resin composite materials were promoted for posterior teeth, the main apprehension of the dentist has been the wear resistance. Clinical trials of wear of resin composite materials showed significant results when compared with metallic restorations.

Advanced resin fillers and matrix of resin composite lead to observably improved resin materials for posterior restoration [7-11]

Recent generation of composite resin showed progress in performance in clinical studies over the years [12-19]

Heintze [20] studied resin composite wear *in vivo* and *in vitro* and found that to achieve clinically continuing serviceability restorations of resin composites; it should be of high wear resistance.

Bulk-fill composites is a new generation of resin composite which conducted to the dental markets for saving time and costs [21]

The full-body bulk-fill composites can be regarded as the only true bulk filling type, since the whole restoration can be placed at once without requiring any coverage. These materials generally have higher filler loads, which create them highly viscous; for this reason, these materials are often referred to as paste-like bulk-fill composites. The higher filler load renders the surface more wear resistant and due to the associated viscous consistency, the surface is sculptable.

Occlusal and proximal wear are the most common causes for the failure of posterior composites. High wear resistance leads to an increased lifespan of the restoration, function, and color stability. Conversely, low wear resistance may lead to tooth migration, TMJ tenderness, and periodontal diseases. [22]

Wear resistance is one of the most difficult properties to evaluate in material sciences.

Clinical trials are mandatory for illustrating the multifaceted oral wear condition but also it is costly and time consuming. Variables such as masticatory forces or oral environments cannot be controlled.

Consequently, vitro tests considered as a practical way for evaluation the wear performance of any recent advanced materials.[23-25] Different methods [25-27] and materials,[28,29] have been recommended for the opposed natural cusps, but the requirement for a standardized of artificial abrader has been well defined.[30] Even if enamel antagonists appear to realize in vivo similar circumstances in laboratory trials, the morphologic and structural differences of enamel confuse the standardization of wear evaluation .

The aim of this in vitro study was to assess the two-body wear resistance of three different bulk-fill composite resin available in the market and one conventional resin composite with different compositions against, human enamel and porcelain.

MATERIALS AND METHODS

Three bulk fill resin composite materials and one conventional were evaluated in this study. Bulk fill composites were Sonicfill, Tetric EvoCeram, and Filtek bulkfill. The conventional resin materials was Filtek Z250, their composition and manufacturer are listed in Table 1.

Grouping of samples

A total of eighty discs were prepared to determine the wear resistance of three different bulk fill resin composites and one conventional. They were divided into four groups, twenty specimens for each composite. Group I (Sonicfill), Group II (Tetric Evoceram), and Group III(Filtek bulkfill) and Group IV (Z250) .

Each group was subdivided into two subgroups, ten specimens each. The first subgroup was abraded against feldspathic porcelain, and the second subgroup was abraded against enamel natural teeth. Table 2

TABLE (1) Composition and manufacturer of the tested materials

Resin Composite	Composition	Manufacturer
SonicFill (Nanohybrid)	**The resin matrix** 3-trimethoxysilylpropyl methacrylate,ethoxylated bisphenol-A-dimethacrylate (Bis-EMA), bisphenol-A-bis-(2-hydroxy-3methacryloxypropyl)ether,triethyleneglycoldimethacrylate (TEGDMA) **The filler:** Silicon dioxide, barium glass 83%wt(67%vol)	Kerr Corporation
Tetric EvoCeram Bulk Fill (Nanohybrid)	**The resin matrix** UDMA, bisphenol Aglycidylmethacrylate (Bis-GMA) **The filler:** Barium glass,ytterbium trifluoride, mixed oxide prepolymer **filler load** 82-84%wt(64%vol) **Filler size** 550 nm mean particle size; range: 40 nm to 3000 nm	Ivoclar Vivadent, In
Filtek bulk-fill, posterior restorative (Nanohybrid)	**The resin matrix** AUDMA, UDMA and 1, 12-dodecane-DMA **The filler:** non-agglomerated/non-aggregated 20 nm silica filler, a non-agglomerated/non-aggregated 4 to 11 nm zirconia filler, anaggregated zirconia/silica cluster filler (comprised of 20 nm silica and 4 to 11 nm zirconia particles) and a ytterbium trifluoride filler consisting of agglomerate 100 nm particles **filler load** 76.5%wt(58.4%vol) **Filler size** 0.01 to 3.5 μm	3M/ESPE, St. Paul, MN, USA
Filtek Z250 (MicroHybrid)	**The resin matrix** Bis-GMA, Bis-EMA , UDMA with small amount of TEGDMA Filler Silanized zirconia/silica particles **Filler load** 77% wt 57% vol **Filler size:**size range 0.01 to 3.5 μm, average size 0.6 μm	3M/ESPE, St. Paul, MN, USA

TABLE (2) Materials, Composition, and manufacture of Antagonists.

Material	**Type**	**Composition**	**Manufacture**
PFM	Feldspathic Porcelain	Fine crystalline powders of alumina, feldspar, and silica oxide (or quartz,) mixed with a flux of sodium or lithium carbonate.	Dentsply Caulk
Natural Tooth Structure	Enamel	Calcium, Phosphate, Hydroxyapatite crystals, Water.	

Specimens preparation:

A standardized cylindrical mold measuring10 mm thickness x 2 mm diameter was used to fabricated the bulk-fill and conventional resin composite specimens. A clear Mylar strip(Mylar Uni-strip, Caulk/ Dentsply, Milford, DE,USA) was placed on top of clean glass slab. The composite resin was packed in the mold using a plastic instrument. A clear Mylar strip and a 1-mm thick-glass slide was placed on top of the specimen and then gently pressed to remove excess material on the mold. To prevent the formation of an oxygen-inhibited layer and ensure smooth and flat surfaces, Mylar strips were placed on either side of the mold during curing. Each specimen was light cured using light emitting diode(LED) for 40 seconds(Demi Plus, Kerr, Orange Co., CA,USA) with a spectral range of 450-470 nm wavelength and 1200mW/cm^2 intensity and then it was extruded from the mold by applying positive pressure using a pestle of 9 mm diameter to allow equal distribution of pressure.

In this study two different wear antagonists were used. Porcelain and Natural Teeth Table (2). The Porcelain and Natural teeth attached to the machine holder and tightened with a screw

Wear testing:

Prior to wear simulation, composites specimens were weighed (W1) in an Electronic Analytical Balance with an accuracy of 0.0001 gram. The two -body wear test was performed using a programmable logic controlled equipment (four-station multimodal ROBOTA chewing simulator) integrated with thermo-cyclic protocol operated on servo-motor*(Figure1) (Model ACH-09075DC-T, AD-TECH TECHNOLOGY CO., LTD.)

Robota chewing simulator has four chambers mimicking the vertical and horizontal movements concurrently in a thermodynamic condition. Each of the chambers contains of an upper Jacob's chuck as an antagonist holder that can be tightened with a screw, and a lower plastic sample-holder in which the specimen can be inserted. (Figure 1)

Fig. (1) Chewing simulator device ROBOTA

The specimens were inserted in Teflon housing in the lower sample-holder (Figure 2) while the antagonist were holed in upper Jacobs (Figure 3). A weight of 5 kg, which is comparable to 49 N of chewing force, was exerted. The test was repeated 75,000 times to clinically simulate the 6 months chewing condition, accompanying thermo-cycling according to previous studies.[31] (Table3)

TABLE (3)

Wear test parameters	
Cold/hot bath temperature: 5°C/55°C	Dwell time: 60 s
Vertical movement: 1 mm	Horizontal movement: 2 mm
Rising speed: 90 mm/s	Forward speed: 90 mm/s
Descending speed: 40 mm/s	Backward speed: 40 mm/s
Cycle frequency 1.6 Hz	Weight per sample: from 5 kg
Torque; 2.4 N.m	

After wear simulation, the specimen was then weighed on the same balance* for measurement of weight after wear (W2). The loss of weight was calculated by subtraction of weight before and after wear tests (W1-W2) as this electronic balance had a fully automated calibration technology and a micro weighing scale.

The optical methods tend to fulfill the need for quantitative characterization of surface topography without contact. [31]

USB digital microscope with a built-in camera (Scope Capture Digital Microscope, Guangdong, China;) photographed composite samples. This microscope was connected with an IBM compatible personal computer using a fixed magnification of 120×. The images with a resolution of 1,024 × 1,280 pixels were recorded. Areas of roughness measurements were specified and standardized by image cropping to 350 × 400 pixels using Microsoft Office Picture Manager.

Final images were analyzed for roughness areas, using WSxM software (Ver5 develop 4.1, Nanotech, Electronica, SL). [32] Finally, 3D image of the surface profile of composite samples was recorded using a digital image analysis system (Image 1.43U, National Institute of Health, and USA) (Figure 4).

Fig. (2) Prepared sample of resin composite

Fig. (3) antagonise holded in upper jacobe

Fig. (4) capture digital microscope

Statistical Analysis

Numerical data were explored for normality by checking the distribution of data and using tests of normality (Kolmogorov-Smirnov and Shapiro-Wilk tests). Data showed non-normal (non-parametric) distribution. Data were presented as mean, standard deviation (SD), median and range values. Kruskal-Wallis test was used to compare between the materials. Dunn's test was used for pair-wise comparisons. Mann-Whitney U test was used to compare between the two antagonists. Wilcoxon signed-rank test was used to compare between the material and its antagonist. Statistical analysis was achieved with IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp. The level of significance was set at $P \leq 0.05$.

RESULTS

Weight loss

1. Comparison between materials

With enamel antagonist; there was no significant difference between weight losses of the four materials (*P*-value = 0.269, Effect size = 0.116).

Similarly, with porcelain antagonist; there was no significant difference between weight losses of the four materials (*P*-value = 0.127, Effect size = 0.337).

2. Comparison between material weight losses with different antagonists

With Tetric Evo Ceram, Sonic fill, Filtek as well as Z250 composite types; porcelain antagonist showed statistically significantly higher weight loss than enamel antagonist (*P*-value <0.001, Effect size = 4.932), (*P*-value <0.001, Effect size = 5.806), (*P*-value = 0.001, Effect size = 1.748) and (*P*-value = 0.003, Effect size = 1.520), respectively.

TABLE (4) Descriptive statistics and results of Kruskal-Wallis test for comparisons between weight losses of the different materials with each antagonist

Antagonist type	Tetric Evo Ceram	Sonic fill	Filtek	Z250	*P*-value	*Effect size (Eta squared)*
Enamel						
Mean (SD)	0.00017 (0.00015)	0.00057 (0.00021)	0.00053 (0.00059)	0.00023 (0.00023)	0.269	0.116
Median (Range)	0.0002 (0-0.0003)	0.0005 (0.0004-0.0008)	0.0003 (0.0001-0.0012)	0.0001 (0.0001-0.0005)		
Porcelain						
Mean (SD)	0.00107 (0.00021)	0.00237 (0.00031)	0.00233 (0.00103)	0.00137 (0.00075)	0.127	0.337
Median (Range)	0.001 (0.0009-0.0013)	0.0023 (0.0021-0.0027)	0.0026 (0.0012-0.0032)	0.0014 (0.0006-0.0021)		

***: Significant at P ≤ 0.05**

TABLE (5) Descriptive statistics and results of Mann-Whitney U test for comparisons between each material's weight loss with different antagonists

Antagonist type	Tetric Evo Ceram	SonicFill	Filtek	Z250
Enamel				
Mean (SD)	0.00017 (0.00015)	0.00057 (0.00021)	0.00053 (0.00059)	0.00023 (0.00023)
Median (Range)	0.0002 (0-0.0003)	0.0005 (0.0004-0.0008)	0.0003 (0.0001-0.0012)	0.0001 (0.0001-0.0005)
Porcelain				
Mean (SD)	0.00107 (0.00021)	0.00237 (0.00031)	0.00233 (0.00103)	0.00137 (0.00075)
Median (Range)	0.001 (0.0009-0.0013)	0.0023 (0.0021-0.0027)	0.0026 (0.0012-0.0032)	0.0014 (0.0006-0.0021)
P-value	<0.001*	<0.001*	0.001*	0.003*
Effect size (d)	4.932	5.806	1.748	1.520

***: Significant at P ≤ 0.05**

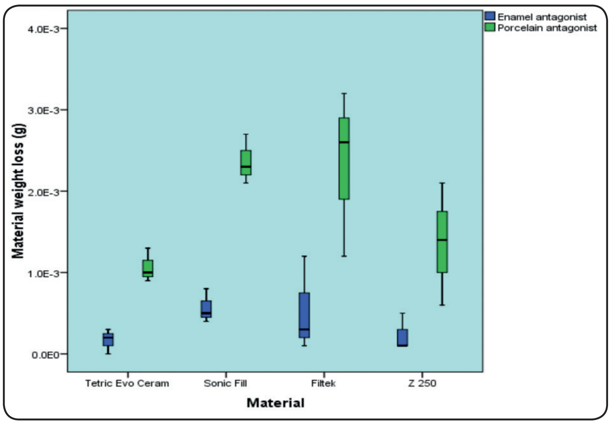

Fig. (5) Box plot representing median and range values for weight losses of the different materials

3. Comparison between weight losses of each material with its antagonist

With all materials; there was no statistically significant difference between weight losses of each material and its antagonist

Change in surface roughness (ΔRa)

1. Comparison between materials

With enamel antagonist; there was no statistically significant difference between ΔRa of the four materials (*P*-value = 0.062, Effect size = 0.542).

TABLE (6) Descriptive statistics and results of Wilcoxon signed-rank test for comparisons between weight losses of each material with its antagonist

Material and Antagonist	Material weight loss	Antagonist weight loss	*P*-value	*Effect size (r)*
Tetric Evo Ceram vs. Enamel				
Mean (SD)	0.00017 (0.00015)	0.00883 (0.00045)	0.109	0.904
Median (Range)	0.0002 (0-0.0003)	0.0088 (0.0084-0.0093)		
Sonic Fill vs. Enamel				
Mean (SD)	0.00057 (0.00021)	0.0066 (0.00072)	0.102	0.943
Median (Range)	0.0005 (0.0004-0.0008)	0.0068 (0.0058-0.0072)		
Filtek vs. Enamel				
Mean (SD)	0.00053 (0.00059)	0.00287 (0.00006)	0.109	0.904
Median (Range)	0.0003 (0.0001-0.0012)	0.0029 (0.0028-0.0029)		
Z250 vs. Enamel				
Mean (SD)	0.00023 (0.00023)	0.02143 (0.00085)	0.109	0.904
Median (Range)	0.0001 (0.0001-0.0005)	0.0214 (0.0206-0.0223)		
Tetric Evo Ceram vs. Porcelain				
Mean (SD)	0.00107 (0.00021)	0.00877 (0.00025)	0.109	0.904
Median (Range)	0.001 (0.0009-0.0013)	0.0088 (0.0085-0.009)		
Sonic Fill vs. Porcelain				
Mean (SD)	0.00237 (0.00031)	0.00027 (0.00015)	0.109	0.904
Median (Range)	0.0023 (0.0021-0.0027)	0.0003 (0.0001-0.0004)		
Filtek vs. Porcelain				
Mean (SD)	0.00233 (0.00103)	0.001 (0.00125)	0.109	0.904
Median (Range)	0.0026 (0.0012-0.0032)	0.0006 (0-0.0024)		
Z250 vs. Porcelain				
Mean (SD)	0.00137 (0.00075)	0.0069 (0.0007)	0.109	0.904
Median (Range)	0.0014 (0.0006-0.0021)	0.0069 (0.0062-0.0076)		

: Significant at $P \leq 0.05$

Similarly, with porcelain antagonist; there was no statistically significant difference between ΔRa of the four materials (*P*-value = 0.259, Effect size = 0.128).

2. Comparison between antagonists

With Tetric Evo Ceram; there was no statistically significant difference between ΔRa of the two antagonists (*P*-value = 0.084, Effect size = 0.552).

Similarly with Sonic Fill; there was no statistically significant difference between ΔRa of the two antagonists (*P*-value = 0.058, Effect size = 1.643).

While with Filtek, there was a statistically significant difference between ΔRa of the two antagonists (*P*-value = 0.025, Effect size = 2.714). Enamel showed an increase in roughness while porcelain showed a decrease in roughness.

And finally with Z250 composite, there was no statistically significant difference between ΔRa of the two antagonists (*P*-value = 0.052, Effect size = 1.800).

TABLE (7) Descriptive statistics and results of Kruskal-Wallis test for comparisons between ΔRa of the different materials with each antagonist

Antagonist type	Tetric Evo Ceram	Sonic Fill	Filtek	Z250	*P*-value	*Effect size (Eta squared)*
Enamel						
Mean (SD)	0.0015 (0.002)	-0.0033 (0.0009)	0.0003 (0.001)	0.002 (0.0018)	0.062	0.542
Median (Range)	0.0013 (-0.0004-0.0035)	-0.0028 (-0.0043--0.0028)	0.0005 (-0.0008-0.0012)	0.0018 (0.0003-0.0038)		
Porcelain						
Mean (SD)	0.0005 (0.0016)	-0.001 (0.0014)	-0.0016 (0.0007)	-0.0016 (0.002)	0.259	0.128
Median (Range)	0.0008 (-0.0012-0.002)	-0.0015 (-0.0021-0.0005)	-0.0016 (-0.0022--0.0009)	-0.0019 (-0.0034-0.0005)		

**: Significant at P ≤ 0.05*

Table 8: Descriptive statistics and results of Mann-Whitney U test for comparisons between ΔRa of each material with the different antagonists

Antagonist type	Tetric Evo Ceram	Sonic Fill	Filtek	Z250
Enamel				
Mean (SD)	0.0015 (0.002)	-0.0033 (0.0009)	0.0003 (0.001)	0.002 (0.0018)
Median (Range)	0.0013 (-0.0004-0.0035)	-0.0028 (-0.0043--0.0028)	0.0005 (-0.0008-0.0012)	0.0018 (0.0003-0.0038)
Porcelain				
Mean (SD)	0.0005 (0.0016)	-0.001 (0.0014)	-0.0016 (0.0007)	-0.0016 (0.002)
Median (Range)	0.0008 (-0.0012-0.002)	-0.0015 (-0.0021-0.0005)	-0.0016 (-0.0022--0.0009)	-0.0019 (-0.0034-0.0005)
P-value	0.084	0.058	0.025*	0.052
Effect size (Eta squared)	0.552	1.643	2.714	1.800

****: Significant at P ≤ 0.05***

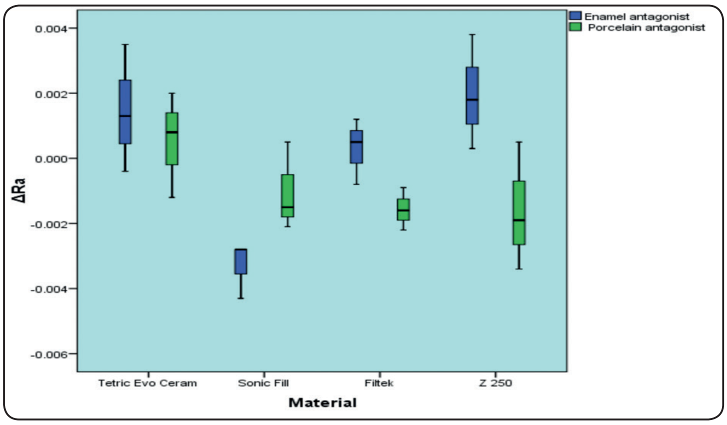

Fig. (6): Box plot representing median and range values for ΔRa of the different groups

2. Comparison between ΔRa of each material with its antagonist

With all materials; there was no statistically significant difference between ΔRa of each material and its antagonist.

TABLE (9) Descriptive statistics and results of Wilcoxon signed-rank test for comparisons between ΔRa of each material with its antagonist

Material and Antagonist	Material ΔRa	Antagonist ΔRa	*P*-value	*Effect size (r)*
Tetric Evo Ceram vs. Enamel				
Mean (SD)	0.0015 (0.002)	0.0011 (0.0016)	0.414	0.471
Median (Range)	0.0013 (-0.0004-0.0035)	0.0002 (0.0002-0.0029)		
Sonic Fill vs. Enamel				
Mean (SD)	-0.0033 (0.0009)	0.0007 (0.0016)	0.109	0.904
Median (Range)	-0.0028 (-0.0043- -0.0028)	0.0004 (-0.0007- -0.0025)		
Filtek vs. Enamel				
Mean (SD)	0.0003 (0.001)	-0.0015 (0.0019)	0.109	0.904
Median (Range)	0.0005 (-0.0008-0.0012)	-0.0014 (-0.0035-0.0003)		
Z250 vs. Enamel				
Mean (SD)	0.002 (0.0018)	-0.001 (0.001)	0.109	0.904
Median (Range)	0.0018 (0.0003-0.0038)	-0.0005 (-0.0022- -0.0003)		
Tetric Evo Ceram vs. Porcelain				
Mean (SD)	0.0005 (0.0016)	-0.0011 (0.0013)	0.285	0.617
Median (Range)	0.0008 (-0.0012-0.002)	-0.0011 (-0.0024- -0.0002)		
Sonic Fill vs. Porcelain				
Mean (SD)	-0.001 (0.0014)	0.0017 (0.0007)	0.109	0.904
Median (Range)	-0.0015 (-0.0021- 0.0005)	0.0015 (0.0011-0.0024)		
Filtek vs. Porcelain				
Mean (SD)	-0.0016 (0.0007)	0.0003 (0.0027)	0.285	0.617
Median (Range)	-0.0016 (-0.0022- -0.0009)	-0.0005 (-0.0018-0.0033)		
Z250 vs. Porcelain				
Mean (SD)	-0.0016 (0.002)	0.0004 (0.001)	0.109	0.904
Median (Range)	-0.0019 (-0.0034-0.0005)	-0.0001 (-0.0003-0.0015)		

**: Significant at $P \leq 0.05$*

DISCUSSION

Wear resistance is an essential factor to be measured when selecting proper restorative material for clinical use. Adequate wear resistance and reducing of abrasiveness of restorative material ideally, be closely as possible to the characteristic of natural enamel. Thus wear behavior in the oral cavity could be evaluated.

Wear is commonly a slow process. The clinical appearance of wear displays the presence of a flat distinct facet on the restorative material. As the wear progresses, there is an affinity toward reduction of the cusp height and the flattening of the occlusal planes which may lead to loss of vertical dimension. A well-distributed occlusion has a significant effect on the wear progression.

The most important changes in recent composites in latest years were changes of the filler system. The size of filler particles incorporated into the resin matrix of recent composites has continuously decreased, resulting in nanohybrid and nanofilled materials with improved material properties.

Previously, several trials for wear testing devices have been established to simulator the clinical wear resistance. However these devices cannot be efficient in perfectly clinical evaluation of restorative materials.

Clinical studies are the gold standard methods for evaluation the properties of a new material. A 3-years clinical study was assessed to evaluate the clinical performance of microhybrid composite (Z100, 3M ESPE, USA) against nano hybrid composite (Filtek Supreme). The material loss through wear was evaluated by a 3D laser scanning device and the vertical loss was measured of the microhybrid composite (Z100), and nano hybrid composite (Filtek Supreme). The result were 64 ± 26 µm and 75 ± 27 µm, respectively, after 3 years of clinical service. However, there were no significant differences between the two materials for other evaluative indices considered, including wear. [33]

In a 4-year clinical assessment of a fine hybrid and nanohybrid composite resin using the modified USPHS (United States Public Health Service) criteria [34], and In a 2-year clinical evaluation of a fine-particle hybrid, and nanofiller resin composite with the Ryge criteria, [35] none of the evaluative indices showed any significant difference between the two groups. The results of these clinical studies are in agreement with the results of the current study.

In the present study there was no statistically significant difference between weights losses of the four resin composite materials tested with enamel antagonist explaining for this finding that the higher filler content shows the lesser wear. Thus, wear of composites is recognized to depend on filler particle-related features, particularly on the concentration and size of the filler reinforcement and resin formulation. Finer particles for a fixed-volume-fraction of filler have been documented to result in decreased inter particle spacing and thereby reducing wear. This result is consistent with the reports of several studies [36-39]

The maximum size of the filler in composite resin is 50 μm. In Tetric Evo Ceram Bulk-fill the largest particles of the inorganic fillers measure 3 μm. In the polymerized form, they act like the smaller inorganic primary particles. The larger filler particles do not protrude from the surface. Composite wear resistance and its excellent polishing properties are responsible of the fine primary particles of the fillers which are showed in smooth surface texture and high luster.

As for the resin formulation, the studies has shown that increasing resin viscosity generally lowers the wear resistance.[40] Due to the higher filler content of bulk-fill composites, greater will be the depth of cure which reduced volume of resin matrix for polymerization and increased hardness.[41]

In the present study, it was found that Tetric Evo Ceram, Sonic fill, Filtek as well as Z250 composite types; showed statistically significantly higher weight loss with porcelain antagonist than enamel antagonist. This finding could be explained by difference in the friction coefficient, which is higher in the porcelain, this finding is consistent with Ghazal etal.[41]

Surface roughness is a major surface property of composites resin restorative material. It has been recognized as a factor of high clinical application for wear resistance, material discoloration, gingival inflammation, plaque accumulation, and surface gloss.

Surface roughness after simulated wear was mainly associated with filler size and distribution of composite resins. Microhybrid resin composite contain combinations of submicroscopic and microscopic sized particles. While Nanofilled composites contain both discrete nanocluster and nanomer particles[42]

In the present study there was no statistically significant difference between the four resin composite materials with the two antagonists (enamel & porcelain). This may be improved the polishability of nano-fillers in such composite resin. The smaller the filler size, the lower the degree of filler pluck-out, therefore the better the polishability.[43]

In addition this result in agreement with Mitra et al[44] who stated that smooth wear surface of nanofilled composite were induced by breaking out of individual primary particles or parts of the clusters rather than by debonding of larger particles.

CONCLUSION

With the limitation of this study, the tested bulk-fill resin composite showed improvement in surface roughness, while nano filler composite did not significantly affect wear resistance. Different results may be obtained by using 3-body wear test with other antagonists. Testing in more oral simulation environments is needed to full characterize the wear behavior of restorative materials and to reach clinically relevant conclusion.

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