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Research Article

Artificial Saliva Sorption for Three Different Types of Dental Composite Resin (*An In Vitro Study*)

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Abstract

Aims: To evaluate the artificial saliva sorption for three different types of light- activated composite resin.

Materials and Method: A total of thirty six specimens (bars) 3 x 8 x 15) mm were prepared from three different types of light activated composite Resin. (Tetric N-ceram, Ivoclar-vivadent-Liechtenstein. Arabesk - voco - Germany. oltaire-2, Heraeus, kulzer, Germany). Twelve specimens were prepared from each type of composite resin. Complete fabrication of composite resin specimens, polished and kept in three different types of artificial saliva medium, three specimens from ach type of composite resin as interactive specimens kept in type of artificial saliva and the last three specimens kept in Deionized water as control medium. The weight of ach specimens was measured at an analytic balance before and after different time intervals of storage (1, 2, 7, 21, 35, and 60) days to measure the amount of absorption of artificial Saliva (gaining and loss of weight). The study showed a significant difference $P < 0.05$) in artificial saliva sorption among the three different types of composite resin at different time intervals when kept in different artificial saliva medium. Tetric N-ceram (nano composite) has more affect with three different types of artificial saliva medium (gaining and loss weight) followed by Arabesk, Soltaire-2 composite resin for different types of artificial saliva at different time intervals.

Conclusion: Dental composites are sensitive to artificial saliva medium (gain and loss of weight) Tetric Neram (nano - composite) interacts actively followed by Arabesk and Soltaire-2 for three different artificial saliva mediums at different time intervals.

Keywords: *Artificial Saliva; Sorption; Dental Composite*

Introduction

Human saliva consists of water, enzymes, glycoproteins, substance electrolyte and antimicrobial. Biophysical perspective saliva is a viscoelastic liquid with particular surface movement. Commercial saliva, artificial saliva used in salivary gland disorders should resemble normal saliva in biophysical properties [1]. Restorative fillings materials used in dentistry are essential to have long term strength in the oral cavity. This is often a complex environment where the materials is in contact with saliva, liquid that contains variety of inorganic and natural species, in conjunction with a bacterial vegetation complex [2]. Composite could be a heterogeneous fabric that's composed from three major components (tar network, filler particles and silane coupling agent [3]. Since 1960 dental composite presented in dentistry, they have experienced a part of changes in arrange to get to be a therapeutic fabric with satisfactory properties [4]. The interaction of these helpful materials with verbal liquid may include disintegration or debasement of surface layers whiles in others the interaction may include a filtering out of unbound or freely bound components or an up take of liquids into the structure of fabric. Such liquid retention

may influence the mechanical properties of the materials and cause harming and dimensional changes [5]. Polymer nano particles composite resin have attracted the attention of a number of researchers, due to their synergistic and cross properties derivative from several components. Whether in solution or in sample, these constituents offer unique mechanical. Tribological, electrical, optical, and thermal properties [6,7].

Such improvements are induced by the physical existence of the Nano particle and by the mixture of the polymer with the particle and the state of diffusion [6,7].

Dental composite materials reinforced with particles that usually have dimensions in the range of 0.04 - 10 micro meters. According to Wetzel., *et al*. particles favorably stiffen the material and may also increase the strength under certain load conditions but on the other hand, it has to be considered that they yield a detrimental effect on the important properties, e.g. the materials resistance against impact and fracture toughness. A new style- aiming to overcome this basic problem is associated to the nana technology and uses fillers in nanometer measure [8-10].

Later progression circuitous dental remedial fabric at time of alter for dental composite definition as prove by the entry of unused composite detailing fortified by "nano and miniaturized scale fillers" dental therapeutic fabric in which materials composed of nanometric and micrometric inorganic particles as strengthening filers e.g. Esthex-Dentsply.

Materials and Methods

The Study was carried out in the Department of Dental Basic Sciences and Conservative Dentistry, College of Dentistry, University of Mosul.

A add up to of thirty-six examples (bars) at the measurement of (3 x 8 x 15) mm were arranged from three diverse sorts of light-activated composite tar as appeared in table 1 and figure 1 incorporate three groups:

- Group I: Twelve examples were arranged from light-activated nanohybrid composite gum (Tetric N-Ceram, Ivoclar - Vivadent-Liechtenstein).
- Group II: Twelve specimens were prepared from light-activated microhybride composite material (Arabesk, Voco - Germany).
- Group III: Twelve specimens where prepared from light-activated poly-glass hybrid composite (Soltaire-2) composite, Heraus, Kulzer, Germany company source.

Type of composite resin	composition	Particle size	Manf.
Tetric N-ceram	Dimethacrylates (19 - 20 wt%) barium glass ytterbium trifluoride mixed oxide, copolymer (80 - 81) wt% catalysts, stabilizer and pigments (< 1 wt% inorganic filler 55 - 57 vol %)	40 nm - 3000 nm	Ivoclar vivadent
Arabesk	60% by volume (76.5% by weight) inorganic fillers micro fliers 0.05 µ n small particle fillers 0.5 - 2 µn	0.05 µn 0.5-2 µn	Voco-Germauy
Soltaire -2	Multicross-linking urethane (meth) acrylate monomers *BaAF-Silicate glass *Porous-Silic on dioxide	0.02-23 µn Ø 0.7 µn Max < 2 µn Ø 8 µn, max (23) µn	Heraeus-kulzer

Table 1: *Composition of three different type of light curing composite resin.*

Figure 1: *Three different types of dental composite used in this study.*

Specimens for each tested materials (3 x 8 x 15) mm were fabricated from larger bars with dimensions of (3 x 8 x 30) mm the composite materials were polymerized in a silicon mold made from acrylic bars to produce the larger bars after that they were cut in two part to produce the specimens, the specimens were produced in horizontal layers and pressed with spatula to prepare the bars two layers were necessary due to their thickness [11] materials were manipulated according to manufacturer's instructions.

Specimens were polymerized under a light-curing unit (Monitex- Tawan-08H0153) inside the silicon mold sample, individually layer was photo-polymerized through forty second, replication the recommended time to ensure complete polymerization, the remoteness between the light source and samples was standardized (1.35 mm).

The light intensity (500 nm) of the curing light was checked regularly, during specimen's preparation and after wards. Specimens were polished to remove the imperfection as shown in figure 2.

Figure 2: *Dental composite specimens used in this study.*

In each group, samples kept in (3) different types of artificial saliva (Table 2), three samples from each composite kept in a different type of artificial saliva medium, the last three samples kept in deionized water (control group) 37°C [12].

The heaviness of every example was estimated at a systematic electronic Balance when capacity at various time interims 1, 2, 7, 21, 35, 60 days to gauge the measure of retained of artificial salivation.

Artificial saliva composition (12) type (1) Components	**Concentration G/L**
NaCl	0.40
KCl	0.40
$CaCL_2.2H_2O$	0.79
$NaH_2PO_4.2H_2O$	0.78
$NaS_9.H_2O$	0.005
$CO(NH_2)_2$Urea	1.0
Distilled water	1000ml
Artificial saliva composition (11) type (2) Components	**Concentration G/L**
NaCL	125.6
KCL	963.9
KSCN	189.2
KH_2PO_4	654.5
Ureia	200.0
$Na_2SO_410H_2O$	763.2
NH_4Cl	178.0
$CaCl_2,2H_2O$	227.8
$NaHCO_3$	630.8
Artificial saliva composition (1) type (3) Component	**Concentration G/L**
Zanthangum	0.92
Potassium chloride	1.2
Sodium chloride	0.85
Magnesium chloride	0.05
Calcium chloride Di-potassium	0.13
Sodium di –hydrogen phosphate	0.13
Methyl- polyhydroxy Benzoate	0.35

Table 2: *Chemical composition of three different artificial saliva mediums.*

Results

Statistical analysis of one-way ANOVA and Duncan Multiple Range Test for artificial saliva sorption showed a significant difference ($P < 0.05$) among three different types of light activated composite resin. The results showed (gain and loss) in their weight as a result of being immersed in three different types of artificial saliva medium and deionized water.

Tetric N-ceram (nano composite) showed gain and loss in their weight (0.014 gram) interact actively compared to Arabesk (0.027 gram) and Soltaire-2 (0.032 gram) composite resin which showed minor loss in their weight as shown in table 3.

Composite resin	Number of Specimens	Mean (gram)	Standard deviation	P-value	Duncan's group
Tetric N - Ceram	12	0.014	0.006	0.000	A
Arabesk	12	0.027	0.018	0.000	B
Soltaire-2	12	0.032	0.020	0.000	C

Table 3: *ANOV and Duncan's Multiple range tests for the artificial saliva sorption (gram) for three different types of dental composite resin.Different letters mean significant difference at P< 0.05.*

There are importance contrast (P < 0.05) within the arranged counterfeit saliva sorption for three diverse bunches compare to control gather in which minor pick up in weight for three distinctive sorts of composite fabric (0.01) in deionized water compared to saliva sort (3), (1) and (2) which vary in chemical composition (Table 4).

Medium	Number of specimens	Mean (gram)	Standard deviation	P-value	Duncan's group
Saliva 1	12	0.027	0.015	0.000	C
Saliva 2	12	0.034	0.023	0.000	D
Saliva 3	12	0.020	0.013	0.000	B
Deionized	12	0.010	0.004	0.000	A

Table 4: *ANOVA and Duncan's Multiple Range Tests for three different types of artificial saliva and deionized water. Different letters mean significant difference at P < 0.05.*

The first day of storage in artificial saliva medium showed significant difference (p < 0.05) about gain in weight, (rise in weight until 7 days). After 21 days of storage, there are lessening in weight (loss of weight) for the three types of composite specially with Tetric N - Ceram, Arabesk and Soltaire-2 composite resin as shown in table 5.

Time	Number of specimens	Mean (gram)	Standard deviation	P-value	Duncan's group
1 day	12	0.019	0.011	0.000	B
2 days	12	0.026	0.018	0.000	E
7 days	12	0.038	0.026	0.000	F
21 days	12	0.025	0.017	0.000	D
35 days	12	0.021	0.009	0.000	C
60 days	12	0.015	0.008	0.000	A

Table 5: *ANOVA and Duncan's Multiple Range Tests for artificial saliva sorption (gram) for three different types of composite resin at different time intervals.Different letters mean significant difference at P< 0.05.*

Discussion

Artificial saliva sorption and water sorption may cause some undesirable effect such as softening of the resin matrix, resin degradation, reduction of stain - resistance and leakage of filler elements by degradation of silane present in the interface between matrix and particles [13,14].

Dental composite (nano, micro particles) are sensitive to the three different type of artificial saliva medium at different time intervals.

The gain and loss of weight for nano composite (Tetric N-cream) was significantly differ from than micro (Arabesk) and (Soltaire-2) composite resin. This due to its diffusion coefficient was higher than other (Arabesk and Solitarine-2) composite resin.

Nano composite gain and loss more components (particles) than micro composites because it is particles are smaller than other types. A number of factors will determine the diffusion coefficient for this type of materials (nano, micro composite) these include, the type of resin filer fraction, filler size reactivity of the glass and the presence of silane and nano silane coupling agents [13,15].

The diffusion coefficient of nano composite was higher than micro composite. This is due to higher exchange of substance between artificial saliva and composite material (nano particle). Tetric N - Ceram (nano composite) has more interaction with artificial saliva medium (gaining and loss of weight) compared to other nano composite which has highest loss of components. It also justified its final smallest gain of weight. Nano composite has smaller particles than micro composite. Nano composite have higher specific surface area than micro composite, the nano-composites may lose filler elements by degradation of the silane present in the interface between matrix

and particles, nano composite loss of weight (lost more particles) because it has more interface area covered with silane to be degraded [13,14]. or three diverse sorts of composite the weight increment due to retention of counterfeit saliva at time from to begin with day of submersion in counterfeit saliva medium until 7th day, after 21th day of capacity in fake saliva, the interaction between fake saliva and composite materials ended up littler extra ordinarily (picking up of water), and misfortune more sum of weight and particles uncommonly for nano composite. Water sorption by composite put away in deionized water amid diverse periods of capacity are most reduced than counterfeit saliva medium since counterfeit saliva put away medium advances more interaction of materials with counterfeit saliva than deionized water [6,16].

Conclusion

Dental composites are sensitive to artificial saliva medium, gain and loss of weight of Tertric N - ceram (nano - composite) may interact actively followed by Arabesk and Soltaire-2 composite for three different types of artificial saliva at different time intervals.

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