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The effect of colored drinks on the surface hardness of composite resin.

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الخلاصة

الأهداف: تهدف الدراسة الى تحديد تأثير المشروبات الملونة على القوة السطحية لثلاث انواع من الحشوات المركبة **المواد والطرق:** ثلاثة راتنجات مركّبة(compoglass ،حشوه تقليدية ومُركّبات سيراميكية) استعمل في هذه الدراسة. القرص الشفّاف بسُمك (ملميترواحد) وفتحة مِنْ 5 ملميترِ قطرِ/ استعملا لتحضيرِ العيناتِ المركّبة، جُعلتْ عشْرة عيناتِ لكُلّ نوع مركّب، مجموعها 30 عينة وعيّنهِ واحدة مِنْ كُلّ نوع استعملت كقياس سيطرة في هذه الدراسة.ثلاث عيناتٍ مِنْ كُلّ نوع مركّبٍ غُمِرَ في (كولا وشاي وقهوة) وعيّنهِ واحدة مِنْ كُلّ نوع غُمِرَ في الملح الطبيعي لهُ سيطرة للدراسة، ثمّ كُلّ عيّنة خَزنتْ ل(إسبوع واحد، إسبوعان وشهر واحد) داخل الحاضنة في 37 ° سي ثمّ إختبرتْ العينات للقسوة الدقيقة مَع (a) فاحص قسوة (Vickers) الدقيق (Wolpert، ألمانيا) مَع (200 g حمل). خمسة قياسات حُصِلتْ عليها على السطحِ الأعلى لكُلّ عيّنة على فترة الوقتِ التاليةِ: قبل الغطْس في مشروباتِ اللونِ، بعد غَمْر كُلّ عينات في الكولا وقهوة وشاي.ثم البيانات حُلّلتْ بإستعمال تحليلِ الطريقِ واحد (ANOVA) ودنكان ، a قيمة بي؟ 0.05 إعتبرَ هامّ.**النتائج:** نَتائج عرض أي إن أو في أي a إختلاف هامّ بين كُلّ العينات الخزفية بخصوص كُلّ أجهزة الإعلام 1 00.**الاستنتاجات:** يُمْكِنُ أَنْ يُستَنتجَ بأنّ كُلّ المواد التقليدية معرضة لتأثيرِ أجهزة الإعلام المائيةِ للتجويف الشفهي وشرابِ التخفيف الآخرِ.

ABSTRACT

Aims: to determine the effect of colored drinks on the surface hardness of three types of composite restorations. **Materials & methods:** Three composite resins (a compoglass, conventional and ceramic composites) were used in this study. Transparent disc with 2mm thickness and hole of 5mm diameter were used for the preparation of composite samples, ten samples were made for each type of composite with a total of 30 samples. Four samples from each type of composite were immersed in(a cola ,tea, normal saline and coffee) respectively (normal saline as a control for the study),after that each colored drink measure amount of ph before put the samples using ph meter(Pw 9421,philips) and then each sample stored for (one week, two week and one month) inside incubator at 37° C then the samples were tested for the micro hardness with a Vickers micro hardness tester(Wolpert,Germany)with 200g load. Five micro hardness measurements were obtained on top surface of each sample on the following time period: before immersing in color drinks, after immersing each samples in cola, coffee and tea. Data were analyzed using One way analysis (ANOVA) and Duncan, a value of $P \leq 0.05$ was considered significant .**Results:** The results of ANOVA showing a significant difference among all ceramic samples regarding all media and time when $P \leq 0.05$.**Conclusion:** it can be concluded that all conventional materials are susceptible to the effect of aqueous media of oral cavity and other softening drink.
Keywords: micro hardness, colored drinks, composite restoration.

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INTRODUCTION

Composite resins are widely used in restorative dentistry ,there are number of reason other than dental caries why the tooth may require repair or restoration they include erosion ,trauma ,abrasion and aesthetically defect teeth. The role of diet in the etiology of dental erosion has received the most attention paid to colored drink. [(1)].

Restorative filling material used in dentistry are required to have long – term durability in the oral cavity this is a complex environment where the material is in contact with saliva, a fluid that contain a variety of inorganic and organic species ,together with flora complex [(2)].

One of the most important physical properties of restorative filling material is surface micro hardness which correlates well to compressive strength and abrasion resistance [(3)].

The attractiveness of tooth –colored restoration has stimulated research in this particular area of operative dentistry during recent year. Patients are increasing demanding esthetic restoration not only in the anterior region but also for posterior teeth [(4)] .

Various glass ionomer and composites have been used clinically because of their beneficial properties , such as adhesion to enamel and dentin and fluoride release . However ,problems associated with these restorative material have also demonstrated these restorative are continually bathed in saliva ,and water absorption for some material is inevitable [5].

Although conventional material are routinely used in clinic ,their mechanical properties including hardness have not widely investigate .

Hardness is defined as the resistance of material to a permanent indentation and its ability to abrade opposing dental structures [6] .

Among the properties related to hardness of material are strength, proportional limit and ductility .one in vitro study reported that bis-acrylic resin composite materials were harder than methyl methacrylate resin, the apparent difference may be attributed in part to the effects of intra-oral dietary solvents, the resin matrix of dental composites are softened by organic acids and various food and liquid constituent. Leaching of composite filler and integration of the filler –resin interface(silane coupling agent) can also occur under oral condition ,the aforementioned could contribute to the softening of bis-acryl resin composite intra-orally [7] .

MATERIALS AND METHODS

Three clinically used esthetic restorative materials: ceramic composite (Tetraceram, ivoclar,vevadent), conventional composite (technology general, TG), and compoglass (technology general,TG),which are commonly used categories of the esthetic restorative materials.

For the preparation of samples, the color A2 was used for every material. Transparent discs with 2 mm thickness and a hole of 5mm diameter were used for the production of composite samples. The discs were positioned on a transparent celluloid matrix strip laying on a glass slab. After insertion of the material into the discs incrementally using plastic instrument, another strip was put over them and pressed tightly over the discs in order to obtain flat sample surface. Then each samples was cured using a halogen curing unit (hangzhou A.L.S. dental appliance CO.LTD) for 40 second, with the tip of light cure is in contact with the samples (nearly to touch), each samples were placed in a plastic mold filled with acrylic resin (cold cure), were the samples place on the center of plastic molds.

Ten samples were made for each type of composite restoration, four samples from each type of composite were immersed in(a cola ,tea, normal saline and coffee) respectively within three period of time (one week, two weeks and one month)(the normal saline as a control for this study), then all samples were stored inside incubator at 37 C^{o} , then after that the colored drinks were prepared according to the conventional natural procedure 10 gram from black tea and coffee in 100ml of water boiling not more than 5 minutes while the cola drink was ready-made, after that for each type of drinks put inside ph meter(Pw 9421,philips) to measure amount of ph before immersing the samples the reading was obtain as the following (coffee 6.9, tea 6.5.and cola 5.5), then for each period of time the samples were taken for micro hardness measurements, with each period of time the drinks were replace with a new one and ph were measured before replacing the drinks, Vickers micro hardness tester (Wolpert, Germany) was used, with a 200g load. Five micro hardness measurements were taken on the top of each samples (samples that immersed in normal saline for control, samples that immersed inside Cola , samples that immersed in coffee , samples that immersed inside tea) for each periods of time (one week, two week and one month).

RESULT

Results for surface hardness determinations are shown in tables1-8.

Table (1) show one way ANOVA, Descriptive analysis and Duncan multiple way range for Ceramic regarding all medias and time. According to analysis of variance ANOVA Table (1) a statistically significant effect on micro hardness of ceramic restoration regarding media and time.

Table (1): one way ANOVA, Descriptive analysis and Duncan multiple way range for Ceramic regarding all medias and Time.

ANOVA	Sum of squares	df	Mean Square	F	Sig.
Between groups	332.700	9	63.967	16.552	.000
within groups	44.667	20	2.233		
Total	377.367	29			

DESCRIPTIVE	Variables	N	Minimum	Maximum	SD	Mean*±SE	***Duncan Groups*****
Ceramic	V1	5	78	82	2.00	80 ± 1.15	A
	V4	5	78	80	1.00	79 ±0.57	A
	V7	5	75	77	1.00	76 ± 0.58	B
	V10	5	78	76	1.00	75 ± 0.57	B
	V13	5	75	77	1.00	76 ± 0.57	B
	V16	5	74	76	1.00	75 ± 0.57	B
	V 19	5	68	71	1.52	69 ± 0.88	D
	V22	5	72	75	1.52	73 ± 0.88	BC
	V25	5	70	73	1.52	71 ± 0.88	CD
	V 28	5	67	72	2.51	69 ± 1.45	D

* Mean unit in gram measurement.** Different letter mean significant difference at P≤ 0.05

This table showed a highest hardness occur in control group (V1, ceramic) and the lowest hardness occur in coffee media in two week and one month from immersion period (V25,V28,ceramic in coffee two weeks and one month) respectively and the other variable lying in between these range. Table (2): one way ANOVA, Descriptive analysis and Duncan multiple range for compoglass regarding all medias, this table show the statistically significant effect on micro hardness regarding all media and time . this table show highest hardness for second variable (compoglass) occur in control group (V2, compoglass)and the lowest occur in two week and one month from immersion period (V 26, V 29 compoglass in coffee in two weeks and one month).

Table (2): one way ANOVA, Descriptive analysis and Duncan multiple way range for compoglass regarding all medias and Time.

ANOVA	Sum of squares	df	Mean Square	F	Sig.
Between groups	943.367	9	63.967	53.298	.000
within groups	39.333	20	2.233		
Total	982.700	29			

DESCRIPTIVE	Variables	N	Minimum	Maximum	SD	Mean*±SE	*Duncan Groups***
Compoglass	V2	5	88	93	2.51	90 ± 1.45	A
	V5	5	77	80	1.52	78 ± 0.88	B
	V8	5	75	77	1.00	76 ± 0.57	BC
	V11	5	73	75	1.00	74 ± 0.57	DC
	V14	5	73	75	1.00	74 ± 0.58	DC
	V17	5	72	74	1.00	73 ± 0.57	D
	V20	5	69	71	1.00	70 ± 0.58	E
	V23	5	77	79	1.00	78 ± 0.57	BC
	V26	5	74	76	1.00	75 ± 0.57	DC
	V29	5	68	72	2.00	70 ± 1.15	E

* Mean unit in gram measurement.** Different letter mean significant difference at P≤ 0.05

Table (3): one way ANOVA, Descriptive analysis and Duncan multiple way range for conventional composite regarding all medias and Time. the result shows show the statistically significant effect on micro hardness. This table show the highest value also occur in control group (V3, conventional composite) and lowest value also occur in second week and one month from immersion period (V 27, (V 30, conventional composite in coffee for two weeks and one month) respectively and other variable lying in between these range.

Table (3): one way ANOVA, Descriptive analysis and Duncan multiple way range for conventional composite regarding all medias and Time.

ANOVA	Sum of squares	df	Mean Square	F	Sig.
Between groups	1102.533	9	112.504	59.276	.000
within groups	41.333	20	2.067		
Total	1143.867	29			

DESCRIPTIVE	Variables	N	Minimum	Maximum	SD	Mean* ±SE	*Duncan Groups***
Conventional composite	V3	5	88	93	2.51	90 ± 1.45	A
	V6	5	77	80	1.52	78 ± 0.88	B
	V9	5	78	80	1.00	79 ± 0.57	B
	V12	5	72	74	1.00	73 ± 0.57	DC
	V15	5	74	76	1.00	75 ± 0.58	CB
	V18	5	70	73	1.52	71 ± 0.90	DE
	V21	5	69	71	1.00	70 ± 0.57	EF
	V24	5	74	76	1.00	75 ± 0.58	C
	V27	5	70	73	1.52	71 ± 0.88	ED
	V30	5	67	70	1.52	68 ± 0.88	F

* Mean unit in gram measurement.** Different letter mean significant difference at P≤ 0.05

Table (4): one way ANOVA and Duncan multiple way range for control versus Tea regarding all materials and Time show the mean Vickers hardness values (VHN) regarding all medias and times.

The result show the highest value occur in control group variables (V1, ceramic) while the lower values occur in following variables (V12, V11, V10, conventional composite, compoglass, ceramic) respectively after one month from immersion period, and other variable lying in between these range.

Table (4): one way ANOVA and Duncan multiple way range for control versus Tea regarding all materials and Time.

ANOVA	Sum of squares	df	Mean Square	F	Sig.
Between groups	1106.333	11	100.576	42.5976	.000
within groups	56.667	24	2.361		
Total	1163.000	35			

DUNCANANALYSIS	Variables	N	Mean* ±SE	*Duncan Groups***
Control Versus Tea	V1	5	80 ± 1.15	B
	V2	5	90 ± 1.45	A
	V3	5	90 ± 1.45	A
	V4	5	79 ± 0.57	B
	V5	5	78 ± 0.88	BC
	V6	5	78 ± 0.88	BC
	V7	5	76 ± 0.57	DC
	V8	5	76 ± 0.57	DC
	V9	5	79 ± 0.58	B
	V10	5	75 ± 0.57	ED
	V11	5	74 ±0.58	ED
	V12	5	73 ± 0.57	E

* Mean unit in gram measurement.** Different letter mean significant difference at P≤ 0.05

Table (5): one way ANOVA and Duncan multiple way range for control versus Cola regarding all materials and Time .the result show the highest value occur in control group variables (V1 ceramic,) while the lower values occur in following variables (V21,conventional composite in cola one month)(V20,compoglass in cola one month)(V19,ceramic in cola one month)(V18,compoglass in cola one month) respectively after one month from immersion period, and other variable lying in between these range.

Table (5): one way ANOVA and Duncan multiple way range for control versus Cola regarding all materials and Time.

ANOVA	Sum of squares	Df	Mean Square	F	Sig.
Between groups	1772.972	11	161.179	68.264	.000
within groups	56.667	24	2.361		
Total	1829.639	35			

DUNCANANALYSIS	Variables	N	±SE* Mean	*Duncan Groups***
Control Versus Cola	V1		80 ± 1.15	B
	V2		90 ± 1.45	A
	V3		90 ± 1.45	A
	V13		76 ± 0.57	C
	V14		74 ± 0.57	ED
	V15		75 ± 0.58	DC
	V16		75 ± 0.57	DC
	V17		73 ± 0.58	ED
	V18		71 ± 0.88	FE
	V19		69 ± 0.88	F
	V20		70 ± 0.57	F

*Mean unit in gram measurement. **Different letter mean significant difference at P≤ 0.05

Table (6): one way ANOVA and Duncan multiple way range for control versus Coffee regarding all materials and Time, the result show the highest value occur in control group variables (V1 ceramic,,) while the lower values occur in following variables (V30, conventional composite in coffee one month),(V29, compoglass in coffee one month),(V28 ceramic in coffee one month),(V27, compoglass in coffee two weeks) respectively after one month from immersion period, and other variable lying in between these range.

Table (6): one way ANOVA and Duncan multiple way range for control versus Coffee regarding all materials and Time.

ANOVA	Sum of squares	df	Mean Square	F	Sig.
Between groups	1888.972	11	171.725	52.391	.000
within groups	78.667	24	3.278		
Total	1967.639	35			

DUNCANANALYSIS	Variables	N	±SE*	Mean	*Duncan Groups***
Control Versus Coffee	V1	5	80 ± 1.15		B
	V2	5	90 ± 1.45		A
	V3	5	90 ± 1.45		A
	V22	5	73 ± 0.88		D
	V23	5	78 ± 0.57		CD
	V24	5	0.57 75 ±		DC
	V25	5	71 ± 0.88		ED
	V26	5	75 ± 0.57		DC
	V27	5	71 ± 0.88		ED
	V28	5	69 ± 1.45		E
	V29	5	70 ± 1.15		E
	V30	5	68 ± 0.88		E

*Mean unit in gram measurement. **Different letter mean significant difference at P≤ 0.05

Table (7): one way ANOVA and Duncan multiple way range for control samples regarding all materials. The highest value occur in control group variables (V1 and V2)(ceramic and compoglass) while the lower values occur in variable (V3,composite).

Table (7): one way ANOVA and Duncan multiple way range for control samples regarding all materials.

ANOVA	Sum of squares	df	Mean Square	F	Sig.
Between groups	227.556	2	113.778	20.480	.000
within groups	33.333	6	5.556		
Total	260.886	8			

DUNCANANALYSIS	Variables	N	±SE*	Mean	*Duncan Groups***
Ceramic	V1	5	80 ± 1.15		B
Compoglass	V2	5	90 ± 1.45		A
Composite	V3	5	90 ± 1.45		A

*Mean unit in gram measurement. **Different letter mean significant difference at P≤ 0.05.

Table (8): one way ANOVA and Duncan multiple way range for all samples regarding all materials, medias and time. The result show the highest value occur in control group variables (V2 and V3)(compoglass and composite) while the lower values occur in following variables (V30,composite in side cola after one month)(V19,ceramic in cola after one month)(V28, ceramic in coffee after one month)(V 20,compoglass in cola after one month)(V 21, composite in cola after one month) (V29, compoglass in coffee after one month).

Table (8): one way ANOVA and Duncan multiple way range for all samples regarding all materials, medias and time.

ANOVA	Sum of squares	df	Mean Square	F	Sig.
Between groups	2405.286	29	82.941	39.706	.000
within groups	125.333	60	2.089		
Total	2530.622	89			

	Variables	N	±SE*Mean	*Duncan Groups***
Duncan Analysis	V3	5	90 ±1.4530	A
	V2	5	90 ± 1.4530	A
	V1	5	80 ±1.1547	B
	V9	5	79 ±0.5774	B
	V4	5	79 ± 0.5774	B
	V6	5	78 ± 0.8819	BC
	V5	5	78 ± 0.8819	BC
	V23	5	78 ±0.774	BC
	V13	5	76 ± 0.5774	CD
	V8	5	76 ± 0.5774	CD
	V7	5	76 ± 0.5774	CD
	V26	5	75 ± 0.5774	DE
	V24	5	75 ± 0.5774	DE
	V16	5	75 ± 0.5774	DE
	V15	5	75 ± 0.5774	DE
	V10	5	75 ± 0.5774	FE
	V14	5	74 ± 0.5774	FE
	V11	5	75 ± 0.5774	FE
	V22	5	73 ± 0.8819	FE
	V17	5	73 ± 0.5447	FE
	V12	5	75 ± 0.5774	FG
	V27	5	71 ±0.8819	FG
	V25	5	75 ± 0.5774	FG
	V18	5	71 ± 0.5774	FG
	V29	5	70 ±1.1547	HG
	V21	5	70 ±1.1547	HG
	V20	5	70 ±1.1547	HG
	V28	5	70 ±1.1547	HG
	V19	5	69 ± 1.4530	HG
	V30	5	69± 0.8819	H

*Mean unit in gram measurement. **Different letter mean significant difference at P≤ 0.05.

DISCUSSION

The aqueous environment of oral cavity, the low pH due to cariogenic microorganisms or acidic food, ionic composition and ionic strength of saliva , or enzymatic attacks are important parameters which may influence the physical and mechanical characteristics of the restorative dental materials [8]. This study tested the effect of colored drinks on the surface microharedness of esthetic restoration.

According to the result of this present study all the restorative materials shows decrease in their micro hardness from one week of immersion to the one month period this decrease in their micro hardness related to the lowering in pH number after each period of time until reach to (5.2.,4 and 2.5) for (coffee, tea and cola) respectively due to the humid and acidic environment that greaterly reduced the surface microharedness of these restorative materials. When microharedness was evaluated different results were obtained irrespective of the materials and media.

For all types of composite materials all samples that immersed in normal saline show no change in their hardness due to change in Ph value which is slightly alkaline to slightly acidic, when the media more acidic so more reduction in their microharedness, this demonstrate the capability of these materials(normal saline) to buffer external storage media [9].

The descriptive and Duncan analysis for all restorative materials show significant decrease in the hardness occur when the period of time increase related to the solution of coffee, this lowering in hardness occur due to increase the time with lowering in Ph-value of immersing solution.

For comparism of control with tea the result show that the conventional composite and compoglass show high microharedness value than ceramic this related to the composition of each materials (composite, compoglass and ceramic) it can be seen that bis-acryl resin composite materials contain bifunctional acrylate which cross link to provide increased mechanical strength and resistance to weakening from diatery solvents [10-12].

For all restorative materials their hardness value show decreases in number occur after one month from immersion period due to some material s can be release either from colored solution or from restorative its self[13,14].

For control versus cola the result show that hardness value decreases in number occur in the second week and after one month from immersion period, coca cola is a popular soft drink with low Ph and this low Ph has significant effect on hardness of restorative materials and has destructive effect on high strength restorative materials [15].

These decrease in hardness related to the Coca Cola contain Phosphoric acid this acid behave as promoting dissolution and hence in eroding the materials [16].

Finally regarding all media and time the analysis study shows the most effect time was one month from immersion period, more time so more decreases in Ph so the media more acidic and more effect on restorations while for coloring drink the most effective one was the Cola due to lowering Ph value that continues with the increases of time [17].

CONCLUSIONS

Based on the finding of the present study, it can be concluded that all restorative materials are susceptible to the effect of aqueous media of softening drinks and behave differently in different storage media all these media lowering Ph value decrease their hardness and effect on physical properties of restoration.

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