Discoloration of aesthetic bracket by mouth washes

Ali Mohammed Al-Attar, B.D.S., M.Sc. [(1)]

ABSTRACT

Background: The present study aimed to determine the influence of the different types of mouth wash on discoloration of different orthodontic ceramic, sapphire brackets and adhesives.

Materials and methods: The sample composed of 120 ceramic brackets and 120 sapphire brackets, the brackets were divided according to bond material into three groups of 40 brackets include unbounded brackets, chemically cured (no-mix) bonded brackets and Light cured bonded brackets all these groups were further subdivided according to mouth wash type into three groups with 10 brackets each which include; Listerine, cetrimide, chlorhexidine 0.2%, and one control group which immersed in artificial saliva; then Staining measurements were performed with UV-Visible spectrophotometer .

Results and conclusions: all types of mouth wash cause staining, this effect was higher in ceramic than sapphire bracket and for no-mix than light cure bond bracket complex; the amount of staining low in Listerine, intermediate in cetrimide, high in chlorhexidine for all bracket-bond complex.

Key words: Discoloration, aesthetic bracket, mouth wash. (J Bagh Coll Dentistry 2014; 26(2): 125-130).

الخلاصة

الخلفية: هدف هذه الدراسة تحديد تأثير انواع مختلفة من غسول الفم على تلون الحاصرات التقومية الخزفية والياقوتية وكذلك اللواصق0

المواد والطرق: تم أستخدام 120 حاصرة تقومية خزفية و 120 حاصرة تقومية ياقوتية، قسمت هذه الحاصرات أعتمادا على نوع اللاصق الى ثلاث مجموعات تضم كل مجموعة40 حاصرة تقومية وهي مجموعة الحاصرات التقومية غير المرتبطة بلاصق، مجموعة الحاصرات التقومية المرتبطة باللاصق غير المعتمد على المزج ، مجموعة الحاصرات التقومية المرتبطة باللاصق الضوئي التصلب،ثم قسمت كل مجوعة من هذة المجاميع الثلاثة الى ثلاث مجاميع اعتمادا نوع غسول الفم(لسترين،سترمايد،كلورهكسيدين) ومجموعة رابعة حاكمة غمرت في اللعاب الصناعي ، أستخدم جهاز المطياف الضوئي لقياس تلون الحاصرات التقومية.

النتائج والاستنتاجات:جميع انواع غسول الفم سبب تلون الحاصرات التقومية،هذا التأثير اعلى في الحاصرات التقومية الخزفية من الياقوتية وفي اللاصق غير المعتمد على المزج من اللاصق الضوئي التصلب .التلون كان قليلا بسب غسول اللسترين متوسط في السترمايد،عاليا في الكلورهكسيدين.

الكلمات المفتاحية: التلون، الحاصرات التجملية، غسول الفم.

INTRODUCTION

As the numbers of adults seeking orthodontic treatment has increased, tooth-colored brackets were introduced to meet the demand for more esthetic appliances.[(1)] Optical properties such as color stability of esthetic brackets has clinical implications for long-term color matching with the underlying teeth. The early plastic brackets were made of polycarbonate and plastic molding powder, which take up water and change color during service. Therefore, these brackets did not last long because of discoloration, fragility, and breaking under stress. [(2-5)] Advanced types of reinforced plastic brackets such as stainless steel slot inserts and composite resin brackets have been introduced since then.[(6)] Brackets made of polycrystalline ceramic and monocrystalline sapphire became widely available in the mid 1980s.[(7-9)] Ceramic brackets combined the esthetics of plastic brackets and the reliability of metal brackets. These brackets provide excellent color fidelity, and resist staining and discoloration.[(10)]

There are internal and external causes for the discoloration of aesthetic brackets; External discoloration can be caused by food dyes and colored mouth rinses, material, e.g. the polymeric structure or filler content, and surface roughness play a decisive role in the extent of discoloration caused by diverse substances. [(11)]

(1)Lecturer. Department of Orthodontics. College of Dentistry, University of Baghdad.

The amount of color change can be influenced by a number of factors including oral hygiene, water sorption, and incomplete polymerization. The reason for internal discoloration can be found in UV irradiation and thermal energy. UV light is able to induce physico-chemical reactions in the polymer, which cause irreversible color changes of the brackets. Heat, acids, alkalis, oxygen, abrasion, enzymes, and radiation can all cause the chemical breakdown of esthetic brackets.[(12)]

As to the color stability of ceramic brackets, it has been reported that monocrystalline and polycrystalline ceramic brackets resist staining or discoloration from any chemical substance likely to be encountered in the mouth; [(10)] However, ceramic brackets in the oral environment can be affected by color pigments in tea, coffee, and mouth wash.[(13)]

One of the measures that help to ensure self maintenance of good oral hygiene is the use of mouthwashes. These mouthwashes may be fluoridated or non-fluoridated. The use of fluoridated mouth washes aims mainly to reduce the effects of enamel demineralization, while the other non fluoridated mouthwashes –the subject of this study- act in a major way as an anti-plaque agents [(14,15)].

The aim of the present study was to determine the influence of the different types of mouth wash on discoloration of different orthodontic ceramic, sapphire brackets and adhesives.

MATERIALS AND METHODS

Two types of orthodontic bracket were used; ceramic brackets (Reflection©) and sapphire (Pure©), also two types orthodontic bonding system were used chemically cure (no-mix) and light cure, all above materials supplied from Ortho Technology/USA. Mouthwashes include Listerine (Pfizer, USA), cetrimide (Pharcopharmaceuticals, Egypt) and chlorhexidine 0.2%, (GlaxoSmithKline (gsk), UK).

Bonding procedure

The sample composed of 120 ceramic brackets (Reflection©) and 120 sapphire brackets (pure©), the brackets were divided according to bond material into three groups of 40 brackets:

- Unbounded brackets which were not bonded to any bond materials.
- Chemically cured (no-mix) bonded brackets in which the brackets were bonded using chemically cured adhesive resin (no-mix).
- Light cured bonded brackets in which the brackets were bonded using light cured adhesive resin.

The ceramic and sapphire brackets were bonded with a chemically cured (no-mix), light-cured orthodontic adhesive as follow:

- Resilience Primer® was applied by brush on each bracket base or Resilience light cure Primer® used with Resilience® Light-Cure orthodontic adhesive.
- A small amount of the adhesive paste was applied onto the bracket base, and then by using a clamping tweezers the bracket was placed lightly onto a horizontal flat plastic plate mounted on the table of surveyor (Dent aurum, Germany) covered by a celluloid strip to facilitate detachment of the bracket–adhesive complex with a recovery of the set material .
- A constant load of two hundred grams was placed on the bracket to ensure a uniform thickness of the adhesive, the load fixed to the upper part of the vertical arm of the surveyor, a surveyor rod was fixed in the lower part of the vertical arm of the surveyor and put it in contact with the bonded bracket, excess adhesive was removed from around the bracket base with a sharp scalar.
- The visible light-cured adhesive specimens were photopolymerized with a light-curing unit (woodpecker Co., China); the light guide of curing light unit was directed toward the bracket, the light shined through the bracket for 20 second.

The bonded brackets were allowed to bench set for 24 hr to ensure complete polymerization of adhesive material, then after setting; the celluloid strips were removed and the resultant bracket-bonded adhesive were flat.

Immersion in mouth wash

Unbonded and bonded brackets were further subdivided according to mouth wash type into three groups with 10 brackets each which include Listerine, cetrimide, chlorhexidine 0.2%, and one control group which immersed in artificial saliva fig. (1). The immersion procedure was done by positioned each bracket on a black rectangular cardboard (30×11×0.2 mm) with central window, the cardboards were numbered and using the number of the card as a reference ,The specimens then immersed in mouth wash contained in inert plastic containers for one hours at 37˚C in the incubator [16].

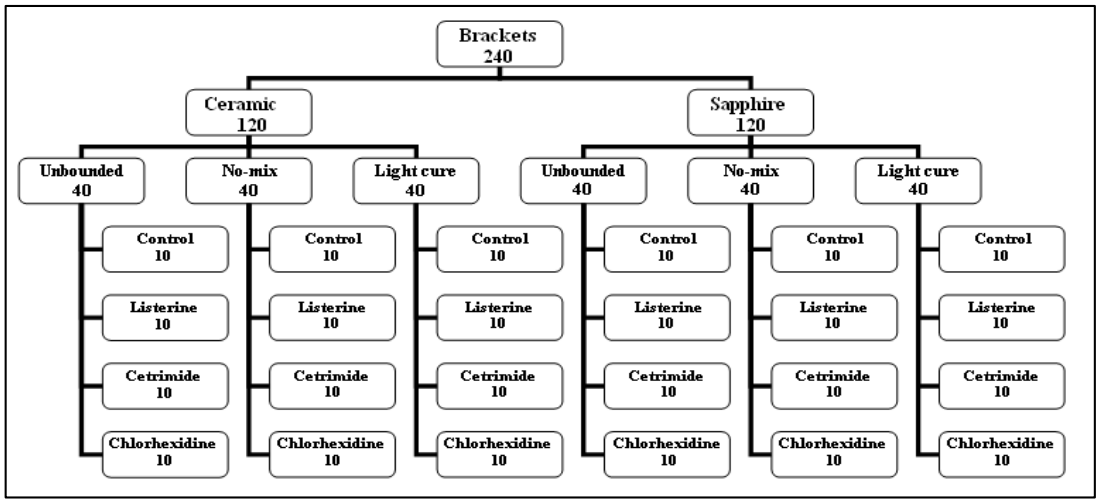

Figure 1: Organization of sample

Assessment of staining

The samples were taken out of the immersion media; then Staining measurements were performed over the 800 to 200 ŋm visible wavelength range with UV-Visible spectrophotometer (T6UV, Korea) fig. (2). The chamber of the spectrophotometer was opened, and then the black rectangular cardboard with bracket positioned in central window put inside cubit of the spectrophotometer fig. (3), then the chamber was closed and the machine was given the order to start scanning starting from 800ŋm wavelength in the infra-red zone to 200ŋm wavelength in the UV zone passing through the entire visible spectrum.

The light passes through the sample; then the intensity of the remaining light was measured with a light sensor, the results appeared as a graph from which the amount of light absorption was plotted and the amount of absorbed light at a 345ŋm wavelength visible light was obtained and used in the later statistical analysis.

Figure 2: UV-Visiblespectrophotometer *(T6UV, KOREA).*

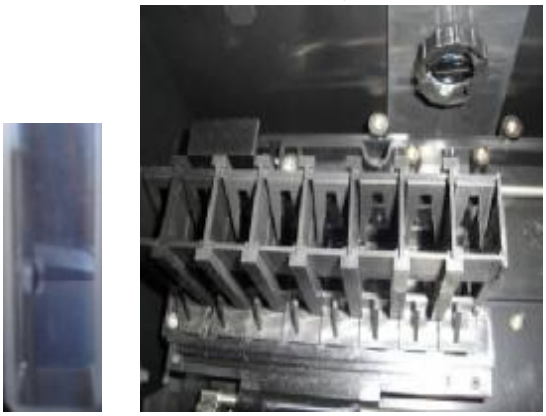

Figure 3: Black rectangular cardboard with bracket positioned in central window put inside cubit of the spectrophotometer.

Statistical analysis

1. **Descriptive statistics**: including mean, standard deviation, and standard error.
2. **Inferential statistics:** including: One way analysis of variance (ANOVA) to test any statistically significant difference among the light absorption of groups and least significant difference (LSD) to test any statistically significant differences between each two subgroups when ANOVA showed a statistical significant difference within the same group.

Significance for all statistical tests was predetermined at $P \leq 0.05$.

RESULTS

Descriptive statistics show that light absorption increase when immersed bracket in mouth wash, light absorption was higher in ceramic than sapphire bracket and for no-mix than light cure bond bracket complex; the amount of light absorption low in Listerine, intermediate in cetrimide, high in chlorhexidine for all bracket-bond complex types (table 1)

Table 1: Descriptive statistics of the amount of light absorption by different bracket groups in different mouth washes

Bracket		Control		Listerine		Cetrimide		Chlorhexidine	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Ceramic	Unbounded	2.080	0.0043	2.088	0.0044	2.121	0.012	2.251	0.0461
	+No-mix	2.143	0.0280	2.238	0.525	2.347	0.042	2.519	0.0463
	+Light cure	2.123	0.0127	2.199	0.049	2.328	0.069	2.449	0.0631
Sapphire	Unbounded	2.073	0.0064	2.081	0.0077	2.119	0.0129	2.193	0.0300
	+No-mix	2.1336	0.0279	2.211	0.494	2.300	0.0411	2.503	0.0486
	+Light cure	2.1134	0.1333	2.185	0.0487	2.292	0.0727	2.439	0.0599

Ceramic brackets

There was significant difference among all group of ceramic brackets immersed in different types of mouth wash except unbounded control – Listerine and Listerine- cetrimide groups show non- significant difference by LSD test (table 2).

Table 2: Difference in the amounts of light absorption of ceramic brackets immersed in different mouth washes

Brackets	ANOVA(df=39)		LSD			
	F-test	p-value	Mouth wash		Mean difference	p-value
Unbounded	108.72	0.000 *	Control	Listerine	-0.0060	0.746
				Cetrimide	-0.041	0.028*
				Chlorhexidine	-0.1702	0.000*
			Listerine	Cetrimide	-0.035	0.060
				Chlorhexidine	-0.164	0.000*
			Cetrimide	Chlorhexidine	-0.129	0.000*
Ceramic +No-mix	138.04	0.000 *	Control	Listerine	-0.046	0.000*
				Cetrimide	-0.203	0.000*
				Chlorhexidine	-0.375	0.000*
			Listerine	Cetrimide	-0.108	0.000*
				Chlorhexidine	-0.281	0.000*
			Cetrimide	Chlorhexidine	-0.172	0.000*
Ceramic +Light cure	72.48	0.000 *	Control	Listerine	-0.076	0.000*
				Cetrimide	-0.205	0.000*
				Chlorhexidine	-0.326	0.000*
			Listerine	Cetrimide	-0.128	0.000*
				Chlorhexidine	-0.249	0.000*
			Cetrimide	Chlorhexidine	-0.121	0.000*

***significant**

Sapphire brackets

There was significant difference among all group of sapphire brackets immersed in different types of mouth wash except unbounded control – Listerine group show non- significant difference by LSD test (table 3).

Table 3: Difference in the amounts of light absorption of sapphire brackets immersed in different mouth washes

Brackets	ANOVA(df=39)		LSD			
	F-test	p-value	Mouth wash		Mean difference	p-value
Unbounded	101.37	0.000 *	Control	Listerine	-0.0076	0.679
				Cetrimide	-0.0459	0.014*
				Chlorhexidine	-0.1192	0.000*
			Listerine	Cetrimide	-0.0382	0.04*
				Chlorhexidine	-0.1115	0.000*
			Cetrimide	Chlorhexidine	-0.0733	0.000*
Sapphire +No-mix	139.50	0.000 *	Control	Listerine	-0.0776	0.000*
				Cetrimide	-0.1669	0.000*
				Chlorhexidine	-0.3698	0.000*
			Listerine	Cetrimide	-0.0893	0.000*
				Chlorhexidine	-0.2922	0.000*
			Cetrimide	Chlorhexidine	-0.2029	0.000*
Sapphire +Light cure	70.27	0.000 *	Control	Listerine	-0.0722	0.000*
				Cetrimide	-0.179	0.000*
				Chlorhexidine	-0.326	0.000*
			Listerine	Cetrimide	-0.1068	0.000*
				Chlorhexidine	-0.2538	0.000*
			Cetrimide	Chlorhexidine	-0.147	0.000*

Effect of adhesive

The amount of light absorption significant differ when compare unbounded bracket versus nomix and light cure bond bracket complex except sapphire brackets immersed in Listerine there was non- significant difference between unbounded and light cure bond bracket.

There was non- significant difference between no-mix and light cure bond bracket except for Listerine and chlorhexidine there was significant difference (table 4).

Table 4: Difference between the different adhesives for light absorption after immersion in different mouth washes

Brackets		ANOVA Df=29		LSD		
		F-test	p-value	1Vs2	1Vs3	2Vs3
Ceramic	Control	31.852	0.000*	0.001*	0.023*	0.272
	Listerine	41.415	0.000*	0.000*	0.000*	0.040*
	Cetrimide	68.988	0.000*	0.000*	0.000*	0.316
	Chlorhexidine	70.013	0.000*	0.000*	0.000*	0.000*
Sapphire	Control	27.675	0.000*	0.001*	0.034*	0.277
	Listerine	28.985	0.000*	0.000*	0.087	0.000*
	Cetrimide	43.629	0.000*	0.000*	0.000*	0.662
	Chlorhexidine	117.331	0.000*	0.000*	0.000*	0.001*

(1 Vs 2) Unbonded bracket versus bracket bonded with no mix
(1 Vs 3) Unbonded bracket versus bracket bonded with light cure
(2 Vs 3) bracket bonded with no mix versus bracket bonded with light cure

DISCUSSION

The test bracket in this study were ceramic and sapphire bracket because they are the most esthetic bracket now use.

The use of listerine, cetrimide and chlorhexidine mouth washes because they widely use during orthodontic treatment as antiseptic agent ; but the side effects of reversible staining affect its wide spread; therefore study of this effect was done in this study. The immersion time intervals 60 minutes corresponded to an accumulative effect of daily use of the mouthwash for one month, considering that mouthwashes are usually used for one minute twice daily, the same time interval was used by other researchers [17,18]

The increase stain of bracket when immerse in the mouth wash due to diffusion and adsorption of mouth wash molecule to the surface of bracket, sapphire bracket is more glazed surface and the bond between molecules are more stronger since its monocrystaline, so reduce overall surface roughness and adsorption of mouth wash on bracket surface than ceramic bracket.

The stronger staining effect of chlorhexidine mouth wash due to probable electrostatic interaction between the positively charged (cationic) Chlorhexidine molecules and the negatively charged ceramic surface, also chlorhexidine contain alcohol(15%) in its composition which increase surface degradation of bracket. The effect of cetrimide due to cationic nature of cetrimide and the negatively charged ceramic surface (electrostatic interaction), while Listerine has slight acidic nature make effect less than other mouth wash (table 1).

The lowest staining effect of Listerine makes the difference between control-Listerine group in both unbounded ceramic and sapphire brackets insignificant (table2 and 3).

The significant difference between unbounded and bonded bracket (table 4) is due effect of adhesive, chemical cure resin(nomix)absorbed water molecules (physisorption), water is a softener of plastics and increases the deterioration of the resin matrix, which increase the monomer release from composite and increase the surface degradation of adhesive; produce rough surface which increase mouth wash deposition leading to increase stain[19], while the effect of light adhesive may be due to the ‘‘incomplete polymerization’’ phenomenon of light cure adhesive which occur due to number of factors that affect the depth of photo activated cures, including factors of illumination from the edges of bracket and critical total transmittance value of bracket in which duration and intensity of light exposure may be attenuated by the bracket structure, incomplete polymerization increase monomer leaching and cause alteration in light absorption values indicating a decreased color stability of light cure composite. Since sapphire bracket more transparent than ceramic bracket so light transmission is more leading to more complete polymerization and since Listerine less staining effect than other mouth wash making the difference between unbounded sapphire bracket and light cure bonded insignificant in Listerine group (table 4).

The significant difference in light absorption between no-mix and light cure in Listerine and chlorhexidine mouth wash group may be due to acidic content of Listerine and alcohol content of chlorhexidine which effect more in no-mix than light cure this agree with Sargison *et al* [20] and Sanders *et al* [21]

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