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Modification of some denture cleaning agents employed with mechanical cleansing methods

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Abstract

The present study was carried out to investigate the effect of 5 cleaning agents (dettol soap, whitening tooth paste, sodium bicarbonate powder, and ethanol hand sanitizer gel and siwak powder) on color alteration of heat-polymerized acrylic resin and to compare it with that of distilled water. 60 specimen strips of heat-polymerized acrylic resin material were prepared measuring 5mm width, 40mm length and 2mm thickness; five specimens were used for each group. After two weeks of immersion in tea solution, the light transmission percent value for each specimen was determined at 400nm and 700nm wave lengths by a spectrophotometer device.

Then the half of the stained specimens were cleaned by the cleaning agents by brushing with a hand brush, and rest specimens were cleaned by the same cleaning agents by an electrical dental brush and again measure the light transmission percent value for each specimen by the spectrophotometer device.

The result obtained in this study showed that ethanol gel specimen group has the highest mean value for light transmission among all the specimen groups of hand and motor brush at the two wave lengths, followed by tooth paste, siwak powder, sodium bicarbonate powder & dettol soap groups but distal water group has the lowest one. Furthermore, there were no measurable differences between the hand brush and the electric tooth brush with respect to staining removal from the acrylic resin specimens for all cleaning agents groups used in this study.

Key words: denture cleaning agents, denture mechanical cleansing, heat-polymerized acrylic resin, color alteration, electric tooth brush.

Introduction

Since the introduction of acrylic resin in the late 1930s it has remained the principle denture base material. Complete and partial dentures are very susceptible to the formation and accumulation of dental calculus and a variety of different stains and pigments⁽¹⁾.

The accumulation of deposits such as food debris, stains, and microbial

plaque on denture surface may result in inflammatory changes to the oral mucosa⁽²⁾.

Polymethylmethacrylate absorbs water slowly overtime and there is evidence that beverages such as tea, coffee and wine significantly increase the development of stain on enamel & acrylic resin. Tea is the most widely

consumed beverage in the world, aside from water ⁽³⁾.

Denture cleanliness is essential to prevent malodour, poor aesthetic and the accumulation of plaque and calculus with its effect on the denture ⁽²⁾, also it prevents fungi growing on denture surfaces and candida species that cause denture stomatitis ⁽⁴⁾.

Knowledge of constituents of denture cleaners, their efficiency adverse effect and safety would aid in dispensing appropriate information to the patients.

Previous investigations into the relative efficiency of denture cleaners are numerous but these investigations are always need to be made continuously every year to assess the newly forms of denture cleaning agents and techniques used by the patients.

The most common method of routine denture cleansing is brushing with tap water and either soap or tooth paste or sodium bicarbonate ⁽⁵⁾. There is antibacterial soaps like (dettol soap) that can be used in cleaning dentures for the best protection from germs.

It has also been reported that ethanol may be used for occasional disinfection and cleaning of dentures ⁽⁵⁾.

These days, alcohol-based hand rub are used instead of soap & water for cleaning of the hands as it is easier, less costly and less time consuming than traditional hand washing ⁽⁶⁾. Shay ⁽⁷⁾ showed that the brushing method is an ineffective method of denture disinfection so it is intended in this study to investigate ethanol gel with brushing in cleaning dentures.

A variety of oral hygiene measures have been performed since the dawn of time like tree twigs. Siwak or miswak is the most widely used tree twig, it is fortified with natural minerals that help to clean the natural teeth and kill microbes and germs ^(8,9), the stick is obtained from a plant called Salvadore

Persica that grows around Mecca and the Middle East area in general. it is widely used among Moslems after Prophet Mohammed (pbuh) realized its value as a device which should be used by Moslems to clean their teeth. In this respect our Prophet (pbuh) is considered the first dental educator in proper oral hygiene ⁽⁹⁾. For this reason it is interesting to study the mechanical ability of siwak as a denture cleaning agent.

Message, rotary and counter rotational electric brushes are used these days as the manual brush in removing plaque ⁽¹⁰⁾, that can be used by geriatric patients, mentally retarded or handicapped denture wearers in cleaning their dentures.

In the present study the effect of several types of cleaning agents that are used by the patients on color alteration of heat-polymerized acrylic denture base material has been evaluated.

Therefore, laboratory tests to simulate the cleaning procedures that can be used by the patients were carried out on specimen strips of heat-cured acrylic denture base material and examine their light transmission by spectrophotometer.

Materials and Methods

In this study, 60 specimen strips of heat-polymerized acrylic resin material (Q.D, England) measuring 5mm width, 40mm length and 2mm thickness to meet the demands of the measuring instrument, were formed in a form of wax patterns and were allowed to undergo short-time polymerization in a water bath at 74°C for 1.5 hour, followed by 30 minutes boiling in 100°C water to ensure adequate processing (ADA,1999). After being processed, these specimens were finished & polished on both sides using acrylic bur, stone bur, sandpaper of

medium grit, pumice and roach to a final thickness of 2 ± 0.1 mm.

The specimens were divided into 12 groups, each group contain 5 coded specimens that were coded with a small round bur on their periphery, these specimens were stored in a staining solution of black tea for two weeks and the specimen's color changes were measured by using an ultraviolet-visible recording spectrophotometer.

To prepare a standard staining solution, 12.5g of black tea (Lipton tea, England) was dissolved in a jar of 750ml boiling distilled water, after 10min of stirring, the tea was decanted from the leaves then the solution was poured into 5 cups. The solution was cooled to room temperature before each specimen was immersed completely in one cup.

For carefully avoiding specimen to specimen contact within the staining solution, each specimen was stored individually in a cup of 150ml of the tested solution.

To prevent fungal growth, the solutions were changed every day. Before any color measurements were obtained, all specimens were removed from the staining solutions and rinsed with distilled water, dried with tissue paper and allowed to dry.

Specimens were centered on the measuring head of a spectrophotometer (CARY 100 Conc. UV-visible spectrophotometer, UARIAN, Australia), the amount of light transmission at the 400 & 700 nm wave length of the visible spectrum was measured & recorded.

After that the 60 stained specimens were divided into two groups, and each group is divided into 6 groups, the specimens of the first 6 groups were cleaned thoroughly by 6 types of cleaning agents; distal water, soap (Dettol, Indonesia), tooth paste (Procter & Gamble, Germany),

sodium bicarbonate powder (Al-Mansur Co., Iraq), ethanol hand sanitizer gel (Households & toiletries Co., Jordan) and siwak powder by brushing with a hand brush (Smart soft brush, Indonesia) for a period of 2 min., and the specimens of the other 6 groups were cleaned by the same cleaning agents but by aid of a message tooth brush (battery-operated brush LS-01338, China). The specimens were rinsed in tap water after each of the treatments.

Siwak powder was prepared according to Al-Nidawi⁽¹¹⁾, sticks of siwak (Salvadora Persica, Saudi Arabia) were removed from its package and left to dry in the hot air oven at 37°C for 24hr. The weight of each stick was 10-11 gm. Each was cut using sharp knife to small pieces, and they were ground to powder using commercially food (meat) grinder (National Super Grinder Matsushita elec. IND. Co. LTD. Japan). It is worth to mention that this food grinder was cleaned thoroughly before use by deionized water, then left to dry. Siwak powder was collected and kept in a closed glass container till use.

Then, Specimens after cleaning procedures were examined again on the spectrophotometer, and the amount of light transmission at the 400 & 700 nm wave length of the visible spectrum was measured & recorded.

The recordings were analyzed statistically by the use of descriptive analysis including mean values & standard deviations, statistical analysis was conducted. The significance of color changes exhibited by the acrylic resin specimens at 400 & 700nm wave lengths were compared for equal length of time with the student t-test. Statistical significance was set at the 0.05 probability level.

Results

The means and the standard deviation of the values of light transmission in percent for all specimen groups before and after cleaning with hand and motor brush are presented in table (1&2) and figure (1&2) .

For hand brush specimen groups at 400nm wave length, there was a statistically significant difference between the means of light transmission values of the control group and all the other specimen groups as shown in the student t- test table (3).

Also , it was shown in this table at 700nm wave length that there was a statistically no significant difference between the means of light transmission values of the control group and the specimen group that were cleaned by dettol soap, and there is a significant difference between the control group and specimen groups that were cleaned by tooth paste & siwak powder , also there is a high significant difference between the control group and specimen groups that were cleaned by sodium bicarbonate powder & ethanol hand gel .

Table (4) at 400nm wave length showed no significant difference between the control group and the specimen group of dettol soap, there is a significant difference between the control group & tooth paste & sodium bicarbonate powder & siwak powder groups, also there is a high significant difference between the control group and ethanol hand gel group.

We can also see in table(4) at 700nm wave length no significant difference between the control group and the specimen group of dettol soap, there is a significant difference between the control group & sodium bicarbonate powder group , also there is a high significant difference between the control group and tooth paste ,

ethanol hand gel & siwak powder groups .

In comparison between the specimen groups that were cleaned by hand brush & motor brush, it was shown in table (5&6) that there was a non significant difference between them at 400 & 700 wave lengths respectively.

Table (7&8) showed a significant difference between the means values of the light transmission of all the specimen groups at 400nm and that at 700nm wave lengths of the hand brush & motor brush groups respectively.

In general, ethanol hand gel specimen group has the highest mean value for light transmission among all the specimen groups of hand and motor brush at the two wave lengths , but distal water(control) group has the lowest mean value for light transmission at both wave lengths (figure 1&2).

It is shown clearly in Figure (1& 2) that the better cleaning agent for heat-cure acrylic resin specimens is ethanol hand wash gel, then tooth paste, siwak powder, sodium bicarbonate powder, dettol soap & distal water consequently at the two wave lengths for both hand & motor brush groups.

Discussion

A five denture cleaning agents(dettol soap, tooth paste, sodium bicarbonate powder, ethanol hand sanitizer gel & siwak powder) of mechanical cleansing type have been studied & compared with distilled water by using of hand brush & message brush. The effect of these cleansers on mean color stability of the stained acrylic resin was evaluated in the present study. The light transmission percent for all the specimen groups at 400 and 700nm wave lengths was measured by spectrophotometer device & this

represents the color stability of the specimens.

The result of the spectrophotometer digital study showed that all of the heat-polymerized acrylic resin specimens had nearly the same values of light transmission when exposed to tea staining solution in this study. This implies that extrinsic stains played a major role in the discoloration of the investigated materials ⁽³⁾.

For the two wave lengths, the investigated acrylic resin specimens that were cleaned by distilled water (control group) with both types of brushes revealed significantly the least mean values of light transmission than those obtained by the other cleansing agents (figure 1&2) i.e. it is a poor cleaning agent in respect to the other studied agents. This finding is in agree with ⁽¹²⁾ who studied ultrasonic cleaning method with various denture cleansing solutions and demonstrated that the device apparently has little cleansing effect when employed with water only and concluded that the cleaning of the dentures is related to the chemical activity of the solutions and has little relationship to vibratory activity of cleaning devices, this result also may explain what is shown in table (3) of this study that there was a statistically significant difference between the means of light transmission values of the control group and all the other specimen groups at 400nm wave length for hand brush.

However, figure (1&2) of this study showed that distilled water have an accepted cleaning action which may be related to the mechanical effect of the brushes as in principle, it is known that the mechanical cleansing is an effective means of improving denture cleanliness and maintaining a healthy mucosa beneath dentures ⁽⁹⁾. This is also explained in ⁽¹²⁾ study who reported that some brushing of dentures is necessary to remove all

deposits since the cleaning agents seem only to soften and loosen them but not to remove them completely.

In this study at 700nm wave length, The investigated cleaning agents displayed varying degrees of cleaning efficiency when used in mechanical cleaning of acrylic specimens by hand brush (table 3), as there was a statistically no significant difference between the means of light transmission values of control group and dettol soap group, and there is a significant difference between the control group and specimen groups that were cleaned by tooth paste & siwak powder, also there is a high significant difference between the control group and specimen groups that were cleaned by sodium bicarbonate powder & ethanol hand gel. This indicates that soap is not a favorable cleaning agent even if contain antibacterial material like dettol.

This finding is in agree with Osborne ⁽¹³⁾ & Eduardo et al. ⁽¹⁴⁾ studies of denture cleaning methods in which they concluded that soap and water were inadequate for cleaning dentures and that brushing with paste was more effective than soap.

The soiling of dentures occurs in three phases. In the 1st phase, mucin and food debris may accumulate upon the surface which offers a little resistance to the simplest cleaning process and may be removed by a light brushing with soap while in the 2nd phase of plaque and the 3rd phase of tartar the denture need a chemical or a physical method of cleaning with a better proprietary cleansers ^(3,15).

The simple effect of soap in cleaning dentures is showed also in table(4), in which there is no significant difference between the control specimen group and the dettol soap specimen group that were cleaned

by message brush at both wave lengths.

This finding is in conflict with Budtz-Jorgensen⁽⁵⁾ who stated that brushing with soap or tooth paste is effective when used meticulously in removing artificial discolorations and plaque from acrylic resin dentures, they also clarify that there is no experimental evidence that brushing with a tooth paste or polishing paste is more efficient than using soap but most patients prefer to use tooth paste, this fact is mentioned in many surveys of denture cleansing habits like which were published in Polyzois⁽²⁾ and Neill⁽¹⁵⁾ surveys.

In the current study, sodium bicarbonate powder revealed a better staining removal effect than water and soap (figure 1&2) for the two types of brushes and at both wave lengths and this is may be because that it is regarded as a mild abrasive that can remove plaque and stains from acrylic resin by aid of mechanical brushing means, it is reported that all powders and pastes increase the amount of wear on dentures like products containing insoluble calcium carbonate are highly abrasive where as dentifrices containing soluble sodium bicarbonate is less abrasive⁽¹⁶⁾. For instance, the American Dental Association considers sodium bicarbonate to be a preferred ingredient in tooth paste⁽⁸⁾.

Table (3&4) at both wave lengths showed a significant difference between the control group & siwak powder group, this is in agree with El-Mostehy et al study⁽⁹⁾ which indicated that siwak and powdered siwak if used with a mechanically proper device i.e. tooth brush will give a great deal of oral cleanliness, and also agreed with Hardie and Ahmed⁽¹⁷⁾ whom found that the beneficial effects of the siwak may depend less upon the mechanical efficiency of its bristles and more upon its chemical constituents.

Deposits that form on the acrylic resin denture bases and on the teeth are assumed to be caused by the same mechanisms and substances that cause deposits on natural teeth, of which salivary calculus and tobacco tars are most common and most difficult to remove⁽¹²⁾ therefore, its removing can be done in the same way from natural teeth and from denture base.

Recently researchers have postulated that chewing sticks help in cleaning the teeth in two ways, the mechanical action of chewing stick fibers, which removes dental plaque from the teeth and some type of chemical effect on the teeth and/or dental plaque^(18,19). El-Samarrai et al.⁽¹⁹⁾ reported that tooth brush was found to be more effective compared to Siwak stick in reducing plaque concluding that the chemical constituents of Siwak might affect the microbial composition of dental plaque.

In this study the high staining removal action of siwak in respect to water, soap and sodium bicarbonate powder might result from the contents of siwak, this result is in agree with Al-Bagieh et al⁽²⁰⁾ and Almas⁽²¹⁾, like silicon and silica which help in cleaning the teeth by acting as an abrasive material to remove stain. Also, minerals such as sodium chloride, potassium chloride, sodium bicarbonate and calcium oxides, these remove stains from teeth. Trimethylamine is useful for losing tartar and other stain from the teeth. Siwak also have antibacterial, antimicrobial and antimycotic effect especially with candida albicans which may be related to sulphate, sulphur, alkaloid & trimethylamine content of siwak⁽⁸⁾.

In this study, when tooth paste studied in cleaning dentures with both types of brushes, it was shown that it have a more significant effect in stain

removal than the above mentioned studied agents (table 3&4), this might be attributed to the abrasive action of its components like silica and mica, this mild abrasive assists the mechanical removal of plaque and stain by brushing, in addition perfume agents (limonene) and other ingredients such as surfactants (sodium lauryl sulfate in low concentration) which are included to increase the effectiveness of the abrasive. It is written on the cover of the investigated tooth paste of this study that it contains whitening particles and lemon extract which surrounds teeth surfaces helping to restore natural whiteness. There are other ingredients that may have an important influence on the results such as trisodium phosphate is regarded as a cleaning agent and stain remover and tetrasodium pyrophosphate acts as a tartar control agent serving to remove calcium and magnesium from saliva and thus preventing them from being deposited on teeth⁽²⁵⁾.

It was noted from the result of the study given in figures (1&2) and tables (3&4) that the specimen groups that were cleaned by ethanol hand gel by the two types of brushes and at both wave lengths revealed significantly a greater mean values of light transmission than those obtained by the other specimen groups, i.e. that this ethanol was as effective and superior to the other tested cleansing agents. This might be because of its physical properties whereas ethanol is regarded as a versatile solvent, miscible with water and with many organic solvents⁽²³⁾. The polar nature of its hydroxyl group causes ethanol to dissolve many polar and ionic compounds like calcium chloride, this compound is one of the components of inorganic portion of denture deposit forming about 70%, the rest 30% of deposits is organic portion (tartar) formed by saliva and is mostly not formed in the

tested specimens because this study was conducted in a saliva free medium and this may explain the high value of staining removal effect of ethanol in the present study. In addition, the tannin which is yellow colorants of the staining solution of this study (tea) is a high polar substance⁽³⁾.

Furthermore, because the ethanol molecule also has a no polar end, it will also dissolve no polar substances, including most essential oils and numerous flavoring, coloring, and medicinal agents. Therefore ethanol is able to dissolve both polar and non-polar substances, which makes it an excellent solvent⁽²³⁾.

It has been reported that ethanol may be used for occasional disinfection of dentures and to avoid contamination from the operatory to the dental laboratory and vice versa, it has been found that ethanol is superior to hypochlorite⁽⁵⁾. Ethanol is used in medical wipes and in most common antibacterial hand sanitizer gels as an antiseptic. Ethanol kills organisms by denaturing their proteins and reduction of surface tension and dissolving their lipids and is effective against most bacteria and fungi, and many viruses, but is ineffective against bacterial spores⁽²³⁾.

The studies that were conducted to assess the effect of cleansers on acrylic resin⁽²⁴⁾ clarified that ethanol has a harmful effect on the surface of hot cure denture base material appeared immediately after 30min immersion in ethanol solution, this is because of their distraction effect on the surface, so it was preferred in this study to use ethanol gel employed with a brush for 2min to decrease this harmful effect; however, ethanol gel effect on surface of acrylic resin material need to be evaluated. Moreover, the dentures can keep their surfaces smooth and polished as the gel didn't contain abrasive substances like pastes⁽²⁵⁾.

Ethanol also has limited residual activity due to evaporation, which results in brief contact times. Hand sanitizers containing alcohol are more effective at killing germs than soaps. To have maximum antimicrobial effectiveness an alcohol rub should contain 70% to 95% alcohol ⁽²⁶⁾.

The result of this study is similar to that of shan & nutan ⁽²⁷⁾ who invent a method of cleaning dentures using aerated foams, they used ethanol as a main component of this foam so as to benefit from its solvent and antibacterial effects. The alcoholic component also helps impart a pleasant fresh-tasting feel to the cleansed denture when replaced in the mouth.

It is clearly shown in this study that both of the hand brush and message brush have the same cleaning effect on the acrylic resin specimens with all types of cleaning agents and at both wave lengths (table 5&6), this indicates that the cleaning of acrylic resin specimens is related to the chemical activity of the cleaning agents and has little relationship to vibratory activity of cleansing devices, this is in agree with Nicholson et al. ⁽¹²⁾ & Also, Dills et al ⁽¹⁾ who showed that the brushing alone is not sufficient to remove denture plaque and the paste brushings method was consistently the more effective procedure for removal of denture plaque. This result is implied in Hickman et al ⁽¹⁰⁾ study who stated that powered tooth brush is as effective as a manual tooth in removing plaque & cleaning the teeth. However, Pizzo et al ⁽²⁸⁾ indicated that powered toothbrush is better in plaque removal efficacy compared with the manual brush.

Cronina et al. ⁽²⁹⁾ & Sharma et al. ⁽³⁰⁾ investigated another type of tooth brushes and indicated that a rechargeable oscillating / pulsating tooth brush demonstrated significantly

greater reduction in plaque compared to a battery- operated tooth brush.

It is reported that if brushing is performed correctly, the accumulated plaque will be removed efficiently. However, effective plaque removal requires a degree of manual dexterity that is often lacking, especially among elderly or handicapped individuals ⁽²⁾. So electric tooth brushes is preferred by most patients nowadays.

Table (7&8) showed a significant difference between the means values of the light transmission of all the specimen groups at 400nm and that at 700nm wave lengths of the hand brush & motor brush groups respectively. This data variability might be attributed to the variability of the technical factors.

For this study the spectrophotometer was well suited by use of a computer program for measuring the color alteration of the heat-polymerized acrylic resin caused by the stain and after cleaning the stain, very small changes in color could be detected by this instrumentation especially at short wave lengths which may introduce a more accurate data than other wave length ⁽³¹⁾. However, Crawford et al ⁽³²⁾ believed that 690nm wave length is the most sensitive for the material under test.

Although, ethanol gel showed the highest cleansing action (figure 1&2) but the other tested agents appeared suitable for clinical uses as they demonstrated high light transmission values measured by the spectrophotometer.

Conclusions

1. The acrylic resin specimen group that was cleaned mechanically by ethanol gel revealed the higher staining removal effect values among the tested groups.

2. The soap cleaning agent had the lowest mean value of light transmission percent among the studied cleaning agents.
3. Distilled water revealed a less cleansing effect on acrylic resin specimens in comparison to all the other cleaning agents of this study.
4. Tooth paste, siwak powder and sodium bicarbonate powder had a high stain removal effect consequently after ethanol.
5. Statically no significant differences found between the hand brush and motor brush groups i.e both of the tooth brushes had the same mechanical cleansing effect on acrylic resin material.
6. The heat-polymerized acrylic resin specimens had clinically acceptable color stability.
7. It was seemed in this study that all the investigated cleaning agents had a good cleansing action on the acrylic resin materials by using of a hand brush or a motor brush.

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Table(1): Mean No. and Standard deviation for light transmission values in % of all the specimen groups at 400 & 700 nm wave lengths that were cleaned by hand brush before & after specimens cleaning & the difference between them .

		400			700		
		Before	after	Diff.	Before	after	Diff.
Control	Mean	4.406	6.92	2.514	12.216	19.228	7.012
	SD	1.382	2.1079	1.292	2.485	4.775	3.620
SO.	Mean	4.564	9.726	5.162	12.636	23.134	10.498
	SD	1.1295	3.292	2.7041	2.610	3.466	1.725
T.P	Mean	3.732	11.876	8.144	11.588	27.182	15.594
	SD	1.392	3.164	3.082	1.808	2.013	3.146
S.B	Mean	4.17	11.358	7.188	12.48	26.064	13.584
	SD	1.545	3.122	2.313	1.356	2.957	2.709
Eth	Mean	4.172	13.71	9.538	11.358	29.188	17.83
	SD	1.727	3.390	3.361	2.436	0.703	1.747
Si	Mean	4.54	12.102	7.562	12.424	26.934	14.51
	SD	1.299	3.860	3.568	1.411	2.773	2.184

Table(2): Mean No. and Standard deviation for light transmission values in % of all the specimen groups at 400 & 700 nm wave lengths that were cleaned by motor brush before & after specimens cleaning & the difference between them .

		400			700		
		Before	after	Diff.	Before	after	Diff.
Control	Mean	4.014	6.19	2.176	12.51	18.65	6.146
	SD	0.933	1.952	1.1901	1.717	3.372	2.913
SO.	Mean	4.518	9.244	4.726	12.78	22.53	9.758
	SD	1.375	2.764	2.3718	1.669	4.098	2.61
T.P	Mean	4.694	12.35	7.654	12.22	26.96	14.74
	SD	1.498	3.897	2.65	1.936	2.164	3.363
S.B	Mean	4.5	11.04	6.538	11.04	23.05	12.02
	SD	1.453	1.68	1.8847	1.899	1.814	2.696
Eth	Mean	4.134	13.84	9.706	11.32	29.52	18.2
	SD	0.598	2.715	2.8826	0.473	0.547	0.795
Si	Mean	3.664	10.46	6.8	11.09	24.15	13.05
	SD	0.979	2.355	2.3082	2.132	3.04	2.702

Table(3): student t-test between the mean No. of light transmission values of control group and the other specimen groups cleaned by hand brush.

	400			700		
	t-test	P-value	Sig	t-test	P-value	Sig
S.O	3.038	0.038	S	2.003	0.116	NS
T.P	2.451	0.049	S	3.006	0.048	S
S.B	6.663	0.003	S	3.942	0.011	HS
Eth	3.621	0.022	S	7.25	0.001	HS
Si	6.811	0.002	S	3.985	0.021	S

P>0.05 No. Significant P<0.05 Significant P<0.01 High significant

Table(4): student t-test between the mean No. of light transmission values of control group and the other specimen groups cleaned by motor brush.

	400			700		
	t-test	P-value	Sig	t-test	P-value	Sig
S.O	1.99	0.113	NS	1.782	0.149	NS
T.P	3.353	0.028	S	11.843	0.000	HS
S.B	5.736	0.005	S	3.459	0.026	S
Eth	8.870	0.001	HS	10.187	0.000	HS
Si	4.221	0.013	S	13.745	0.000	HS

P>0.05 No. Significant P<0.05 Significant P<0.01 High significant

Table(5): student t-test between the mean No. of light transmission values of hand brush and motor brush specimen groups at 400nm wave length.

	t-test	P-value	Sig
Control	0.71	0.517	NS
S.O	0.212	0.843	NS
T.P	0.259	0.809	NS
S.B	0.580	0.593	NS
Eth	0.061	0.954	NS
Si	0.544	0.615	NS

P>0.05 Non Significant

Table(6): student t-test between the mean No. of light transmission values of hand brush and motor brush specimen groups at 700nm wave length.

	t-test	P-value	Sig
Control	0.758	0.491	NS
S.O	0.615	0.572	NS
T.P	0.387	0.718	NS
S.B	0.667	0.541	NS
Eth	0.424	0.694	NS
Si	0.811	0.463	NS

P>0.05 Non Significant

Table(7): student t-test between the mean No. of light transmission values of all specimen groups cleaned by hand brush at 400nm & that at 700nm wave lengths

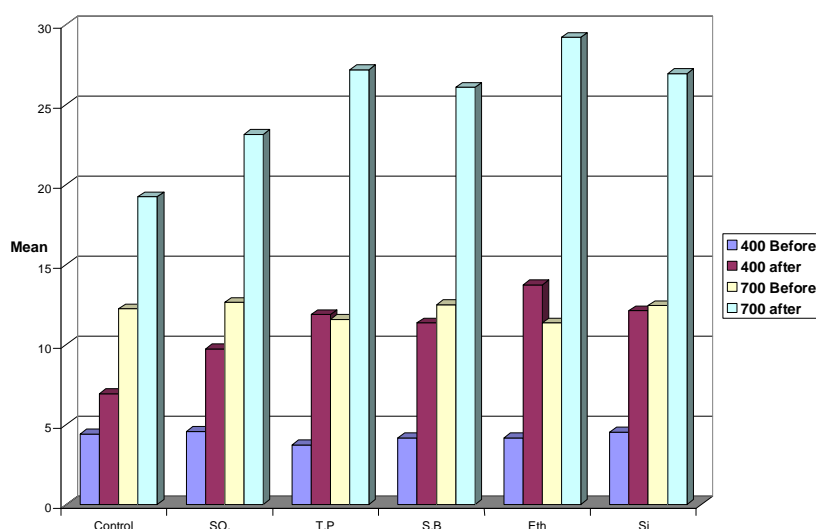
	t-test	P-value	Sig
Control	2.61	0.047	S
S.O	3.72	0.009	S
T.P	3.78	0.007	S
S.B	4.01	0.005	S
Eth	4.89	0.002	S
Si	3.71	0.009	S

P<0.05 Significant

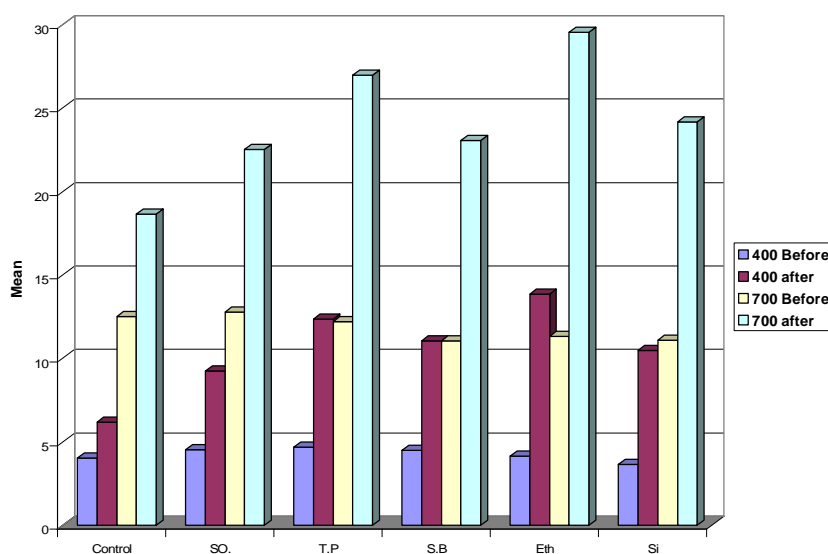
Table(8): student t-test between the mean No. of light transmission values of all specimen groups cleaned by motor brush at 400nm & that at 700nm wave lengths

	t-test	P-value	Sig
Control	2.82	0.037	S
S.O	3.19	0.015	S
T.P	3.70	0.007	S
S.B	3.73	0.0075	S
Eth	6.35	0.003	S
Si	3.93	0.005	S

P<0.05 Significant



Figure(1): histogram for the mean No. of light transmission values in % of all the specimen groups at 400 & 700 nm wave lengths that were cleaned by hand brush before & after specimens cleaning .



Figure(2): histogram for the mean No. of light transmission values in % of all the specimen groups at 400 & 700 nm wave lengths that were cleaned by message brush before & after specimens cleaning .