Original Study

A COMPARATIVE STUDY OF USING WALNUT OIL AND BIOFILM AS A SEPARATING MEDIUM ON TRANSVERSE STRENGTH OF ACRYLIC RESIN

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ABSTRACT

Aim: The purpose of this study is to evaluate walnut oil as a separating medium and compare its effect on transverse strength of acrylic resin with biofilm.

Materials & Method: Twenty heat cure acrylic resin samples with standard dimension of 70×15×3 mm were prepared falling in two main groups (n=10 in each) according to the separating medium and effect of this materials on adhesion of stone or plaster to surfaces of acrylic resin samples and transversal strength of acrylic resin cured were determined. In the first group biofilm (cold mold seal) used and the second group walnut oil used as separating medium.

Results: According to the results adhesion for pixels with stone adhesion for first group and second groups were 32.9±23.19 and 103.7±65.18, respectively ($p>0.05$). Significant differences observed on average transversal strength in the biofilm group was 106.65±18.2 N/mm^2 and in walnut oil second group was 128.03±18.4 N/mm^2 ($p<0.05$).

Conclusion: Transversal strength of acrylic resin constructed by walnut oil was higher while the adhesion of stone or plaster to acrylic resin surfaces of the samples in the walnut oil group was higher. Since walnut oil improves acrylic resin transversal strength, failure in separating medium function, leads to use biofilm still better separating medium in protection of acrylic resin.

Key words: Acrylic resin, Biofilm, Dental materials, Dental prosthesis, Transverse strength, Walnut oil.

Introduction

Separating media are materials used for filling porous surface to effect easy separation of other materials which are later poured against them.[1] Therefore the acrylic resin must be carefully protected during processing from the gypsum surface in the mould spaces for no water incorporate in to the resin from the gypsum during processing will defined affect the polymerization rate and the cold of the resin the denture procedure will craze readily of water after the processing particularly if the resin is not cross-linked.[2] Also dissolved polymer and free monomer must be prevented from soaking in to the investing medium, portions of gypsum material will be joined to the denture after polymerization: with result that it will be virtually impossible to separate the investing material from the resin.[3]

Use of separating medium to separate dental stone or plaster from the acrylic resin or other plastic materials is well established in the construction of prosthetics such as crowns, pontics, dentures, impression try and cleft palate obturator. The separating media are either sheets, such as tin foil, rubber dam and cellophane and this type was laid over the surface of the mould to provide the required protection, or liquids such as the alginates which are painted on to the empty mould to seal the pores of the investment.[4] The different dimensional behavior of resin processed in tin-foil and tin-foil substitute was caused by adsorption of water through the substitute film during processing. The acrylic resin specimens that processed against the tin-foil substitute showed blanching and fogging and in some cases adherence of plaster particles.[5] Researchers classified the separating medium as alcoholic, ethereal or aqueous solutions and oils, but the most popular separating agent are water – soluble alginates which produce a very fine film on the applied surface.[6]

However, oils such as vaseline was used as a separating medium for acrylic work and glycerin oil was also used as a separating medium.[6] The presence of surface and sub-surface voids may compromise the physical and, aesthetic and hygienic properties of a processed denture base, porosity is likely to develop in thicker portions of a denture base.[7] Recently, Al-Taie AZ *et al*, studied olive oil as a separating medium and reported olive oil may be used as a substitute for tin foil and cold – mold seal separating medium in processing both heat and cold – cure acrylic resin denture base. However, there is no report on effect of the walnut oil as a separating medium on transverse strength of acrylic resin with biofilm.[8]

So, the purpose of this study is to evaluate walnut oil as a separating medium and compare its effect on transverse strength of acrylic resin with biofilm.

Materials & Method

Twenty heat cure acrylic resin samples with standard dimension of 70×15×3 mm are prepared falling in two main groups (ten samples of each group). In the first group biofilm (cold mold seal) and the second group used walnut oil were used as separating medium. During the molding procedure, regular flasking method was used. The plaster of paris mixed with water using a vibrator for 25 seconds based on the manufacture instruction and filled in muffles. During the setting of the plaster of paris, 3 aluminum muffles inserted into the plaster of paris. The distal section of the muffles was filed with dental stone. After setting of the plaster of paris, Vaseline rubbed on it and upper section allocated on muffle lower section and pressed using 1.5 Bass pressure. After setting of the plaster of paris, the aluminum samples were taken out safely. Then plaster of paris smoothly rubbed with separating medium of biofilm or Walnut oil. The monomer liquid and acrylic resin powder was heated and forced under 1.5 Barr pressure for

20 minutes. Then muffles allocated into the clamp in water bath at 70 °C for 90 minutes, at 90 °C for 30 minutes and cooled at room temperature for 24 hours. After processing, acrylic samples was taken out from the muffles safely. The adhesion of stone or plaster to surfaces of acrylic resin samples were determined by (i) visual observation and (ii) Measuring Titan, Buffalo, NY, USA ,Microscope at ×40 magnification. On the surface of the each sample, a domain of 1×1mm shade plate was applied on the samples and existence of the adhesion was determined by summation of the 1×1 squares. The transversal strength of acrylic resin was cured by conventional method. In this method, universal testing method was used to insert force on the middle of the samples (N/mm^2). The obtained results of transverse strength was analyzed using $S = \frac{3.W.L}{2.b.d^2}$ formula and presented N.

Figure 1: Domain of 1 x1 mm shade plate

Statistical Analysis

Data was analyzed using SPSS statistical software (Ver. 20). Before the analysis, normality of the adhesion pixels controlled using Shapiro-wilk. Then data was analyzed and comparison mean between groups was done using Independent t-test. $p<0.05$ was considered as significant differences between treatments.

Results

The adhesion of stone or plaster to surfaces on each domain is presented in table 1. According to the data, no significant differences observed on adhesion for pixels with stone among biofilm and walnut oil groups ($p>0.05$).

Adhesion of Stone or Plaster to Surfaces		Separating Medium				p *
		Biofilm	N (%)	Walnut Oil	N (%)	
D1	+	58.8	10	10	7	0.105
	-	0	0	0	3	
D2	+	42.9	6	6	8	0.314
	-	66.7	4	4	2	
D3	+	47.1	8	8	9	0.5
	-	66.7	2	2	1	
D4	+	46.7	7	7	8	0.5
	-	60	3	3	2	
D5	+	40	6	6	9	0.152
	-	80	4	4	1	
D6	+	41.12	7	7	10	0.105
	-	100	6	6	0	

Table 1: Adhesion of stone or plaster to surfaces on each domain using Fisher's Exact Test

A significant difference observed on number of the pixels attached to the acrylic resin which was higher in walnut oil compared to the biofilm ($p>0.05$). [Table 2]

Significant differences observed on average transversal strength in the biofilm group was 106.65±18.2 N/mm^2 and in walnut oil second group was 128.03±18.4 N/mm^2 ($p<0.05$). [Figure 2]

No. of Pixels	Separating Medium	Mean	Standard Deviation	95% Lower CL	95% Upper CL	p*
P1	Walnut Oil	53.8	52.44	16.28	91.23	0.33
	Biofilm	11.8	10.34	4.41	19.19	
P2	Walnut Oil	14.1	13.92	4.15	24.05	0.037
	Biofilm	3.10	4.36	-0.02	6.22	
P3	Walnut Oil	4.90	5.38	1.05	8.75	0.524
	Biofilm	7.10	9.26	0.48	13.72	
P4	Walnut Oil	10.7	15.70	-0.53	21.93	0.251
	Biofilm	4.40	5.93	0.16	8.64	
P5	Walnut Oil	5.40	3.34	3.01	7.79	0.067
	Biofilm	2.60	3.06	0.41	4.79	
P6	Walnut Oil	14.80	8.93	8.41	2.19	0.004
	Biofilm	3.90	4.15	0.93	6.87	
p Total	Walnut Oil	103.70	65.18	22.27	118.83	0.008
	Biofilm	32.90	23.19	21.02	40.23	

Table 2: Number of pixels attached to the acrylic resin using Independent t test.

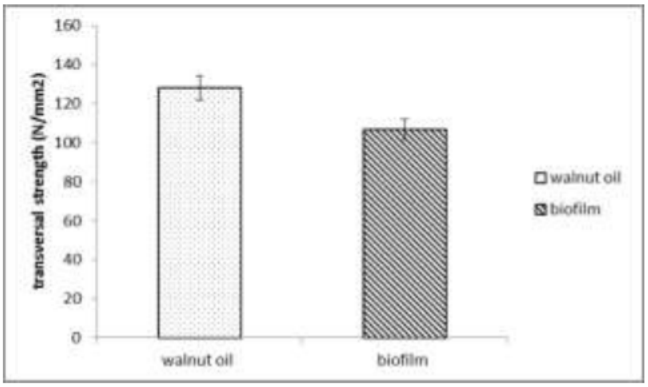

Figure 2: Transversal strength (N/mm2) of transversal strength of acrylic resin with different separating medium.

Discussion

During acrylic resin processing, the mold must be separated from the surface of the gypsum to prevent liquid resin from penetrating into the gypsum, and water from the gypsum seeping into the acrylic resin. Also, the relatively rough surface of gypsum mould may be penetrated by acrylic denture base resin and adhere to it, to prevent this, a separating medium must be employed.[9] It is reported that olive oil can be considered as a satisfactory separating medium of clear heat cured acrylic denture base resins, especially because it is easy to get, easy to use and cheap. Also the results have shown that tin foil is still the best separating medium.[9]

The surface properties of denture base material are important as they affect the oral health of tissues in direct contact with the dentures. Since the initial adhesion of microorganisms is directly influenced by the surface roughness and can increase or decrease microbial adhesion, colonization, and biofilm maturation.[10] Lower surface

roughness is important to prevent stain catching.[11] According to the results adhesion for pixels with stone adhesion for first group and second groups were 32.9 ± 23.19 and 103.7 ± 65.18, respectively. The choice of separating medium is the most important factor influencing the fairness of the resin. The cured denture resin may show some opacity, depending upon the type of resin used because of the alginate mold seal film is not completely water-eliminator.[9] Significant difference was found between tin foil and cold-mold seal separating media on one hand, tin foil and olive oil separating media on the other hand for both heat and cold-cured acrylic resins denture base. This could be due to the bleaching or the clouding which is related to the penetration of the outer layers of resin by molecules of water. This finding is in agreement with many findings.[4] They stated that examination of the specimens revealed that acrylic resin when processed against tin foil substitute showed blanching and fogging and in some cases adherence of plaster particles.[4] Hardness is term used to describe the resistance of the material to indentation and also it is a measure of the resistance to wear or scratching and it is one of the physical properties of dental material that had been chosen in this study because the major factor that affects the dental prosthesis is that it suffers wear during its function or cleaning as wear due to abrasion of the surface.[12] That causes the microporous surface of an acrylic denture which is provided a wide range of the environment to support the microorganisms that threaten the health of the patient.[13] Differences observed on average transversal strength in the biofilm group was 106.65 ± 18.2 N/mm^2 and in walnut oil second group was 128.03 ± 18.4 N/mm^2. It is reported that many different factors affected physical properties of acrylic resin dentures. Factors such as size and shape, denture thickness, different types of denture base materials and presence of an influence the physical and mechanical characteristics of bases during denture processing. Many studies have evaluated the physical properties of denture bases by production of different specimens with various shapes.[14] Therefore, it is better to use specimens with simple shapes for comparison of properties instead of dentures and denture-shaped specimens.[14] The denture base may fracture due to different reasons such as improper fitting, anatomical notches, and lack of adequate design. The fracture takes place due to flexure fatigue when the denture base is loaded and the maximum mechanical capacity of the material is exceeded.[15] The flexural strength is one of most important mechanical properties of resin materials and it has been reported that acrylic resins with incomplete polymerization have lower mechanical properties compared to those with complete polymerization.[16] Thus, by measuring the flexural strength, the quality of polymerization might be evaluated to some extent in addition to determination of denture base resistance to force and trauma.[17]

Conclusion

In conclusion, transversal strength of acrylic resin constructed by walnut oil was higher while the adhesion of stone or plaster to acrylic resin surfaces of the samples in the walnut oil group was higher. Since walnut oil improves acrylic resin transversal strength, failure in separating medium function, leads to use biofilm still better separating medium in protection of acrylic resin.

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