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The effect of glycerin-painted wax pattern on surface quality of dental stone mold

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Abstract

Aim: The aim of this study was to examine the effects of glycerin-coated wax pattern on dental stone surface quality in terms of surface roughness and micro air bubble formation.

Method: In this study, a total of 20 modeling wax samples were used for the hydrophilicity test (the contact angle test) divided into 2 groups (control and glycerin-painted). A total of 20 dental stone samples were also prepared for visual and microscopic analysis divided into 2 groups (control and glycerin-painted).

Results and conclusion: The contact angle data showed a significant decrease in surface hydrophilicity for the glycerin-painted group (P-value < 0.05). However, the visual and microscopical analysis did not show a prominent distinction in surface quality between the two groups, so there is no noticeable effect on dental stone surface caused by glycerin-modified wax pattern.

Key words: Dental stone mold; dental stone surface properties; modeling wax surface treatment

Introduction

Dental restorations have gained extensive use by people since the last century. The basic factors for a successful dental prosthesis is to achieve proper function and esthetics. During manufacturing of dentures care must be taken for each individual step as any defect in any step would affect the following. When it comes to esthetics, carving the perfect form of the denture that mimics the natural oral tissues is critical. It requires high individual artistic skill and technical knowledge to copy the correct shape and to produce a fine mold for the wax pattern by dental stone. When making the master casts, dental stone is the most commonly used material for preparation of them [1]. It also facilitates the diagnosis, treatment plan and the manufacturing design of the prosthesis [2]. There are many types of dental stone materials available in the market used for dental casts and molds preparation [3]. However, they are selected for the specific purpose based on their mechanical properties such as surface roughness, diametric compressive strength and other properties [4,5]. Dental stone surface quality after flasking procedure is critical for the finished acrylic dentures. There are several studies on the dental stone surface properties change in relation to impression materials [6], and with facilitated setting time [7,8]. However, it was poorly reported whether there is any

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approach to improve surface quality during flasking and after wax elimination procedures. Glycerol (commercial name glycerin) is a sugar-alcoholic compound that is colorless, odorless, and nontoxic. It is featured by three carbon backbone and the three hydroxide side chains. It can be synthesized as an industrial byproduct or produced from epichlorohydrin obtained from propylene [9]. The aim of this study was to examine the effects of adding glycerin coating layer to the wax pattern on dental stone surface quality in terms of surface roughness and micro air bubble formation.

Materials and methods

Materials

Dental modeling wax (Bmsdental, Italy), was used in this experiment with elite dental stone (Zhermack, Italy). Pure glycerin (Dano, Syria) was selected for this experiment as a coating on the modeling wax samples. Distilled water was used for the contact angle measurement and cotton swaps were used for glycerin painting. Two groups of modeling wax samples were prepared for this study. Each group consisted of 10 samples with the dimensions of (10X10X2mm).

Contact angle measurements

Water contact angle measurements were taken for the modeling wax samples using a digital microscope (Digimicro / China) with 200X magnification power (Figures 1 and 2). The measurements were taken for the control group and the glycerin-painted group. The method was done by placing a drop of distilled water on the acrylic surface by a stainless steel needle followed by taking an immediate image, and then the contact angle was measured electronically by ImageJ software. The average time from drop placement to measurement was 5 seconds.

Stone samples preparation

Two groups of modeling wax molds were prepared, the control and the glycerin-pained molds. Each group consisted of 10 molds. A mix of dental stone was prepared by mixing 200g of the stone powder with 50ml of distilled water. The mix was poured into the wax molds gently. The resulting dental stone sample surface area was 1cm².

Microscopic inspection

After setting, the stone samples that were poured onto the wax samples were inspected under the Digimicro (200X) microscope for surface quality and porosity. The visual inspection of the sample images was aided by the ImageJ software for surface irregularities and cavities.

Results

Contact angle data

As illustrated in the tables 2 and 3 as well as figure 3, the water contact angle measurement showed a significant difference in the surface hydrophilicity (P-value <0.05). The wax surface of the control group was more hydrophilic than the glycerin painted samples.

Microscopic inspection

The dental stone samples images were inspected visually by using the imageJ software. Both groups' results did not show a significant difference in dental stone surface quality attributed to the glycerin painting on the wax samples (Pictures 1 and 2).

Discussion

It was poorly reported in the literature on how to conserve the dental stone mold surface details and

quality when doing the flasking and wax elimination procedures. According to Cilingir A. and his associate [10], steaming technique used for dental stone cast and molds cleaning affected the surface properties of the stone based on its exposure to steam

This study was conducted to examine and evaluate the effect of adding glycerin layer to the wax pattern surface prior to flasking procedure on the surface quality of dental stone mold. A pure glycerin was used in this experiment and applied to the wax sample surfaces followed by contact angle measurements and then dental stone was poured on the samples. The set stone surfaces were analyzed visually and microscopically for surface irregularities.

The water contact angle measurements and statistical data shown in Table (1 through 3) showed a measurable decrease in surface hydrophilicity of the dental wax surface when adding glycerin layer. This results was interpreted as the glycerin film could possibly interfere with water spreading on the surface despite the fact that the chemical structure of the glycerin is a sugar-alcohol.

Surface visual analysis was achieved by analyzing all dental stone samples carefully under 200 times magnification for any air bubbles, air gabs, surface roughness, and any form of surface irregularities. Although there were some surface defects in some samples from both groups, there was no significant deference that could be attributed to the addition of glycerin layer to the wax pattern.

Conclusion

Within the limitations of the study, the results showed that the glycerin-coated wax surface did not significantly affect or change the dental stone surface quality poured onto it even though the glycerin coating did decrease the hydrophilicity of the wax surface.

References

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Tables

Table (1): Contact angle data

Control group	Glycerin-painted group
47.88	53.58
46.64	62.77
48.50	61.00
51.27	57.28
50.64	59.75
47.23	59.07
44.61	51.73
50.30	60.21
49.58	58.24
47.82	50.04

Table (2): descriptive statistics of the contact angle data

	Groups	N	Mean	Std. Deviation	Std. Error Mean
Contact angle	Control	10	48.4470	2.04619	.64706
	Glycerin-painted	10	57.3670	4.21142	1.33177

Table (3): independent sample t-test results

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Contact angle	Equal variances assumed	4.793	.042	-6.024	18	.000	-8.92000	1.48064	-12.03071	-5.80929
	Equal variances not assumed			-6.024	13.025	.000	-8.92000	1.48064	-12.11811	-5.72189

Figures

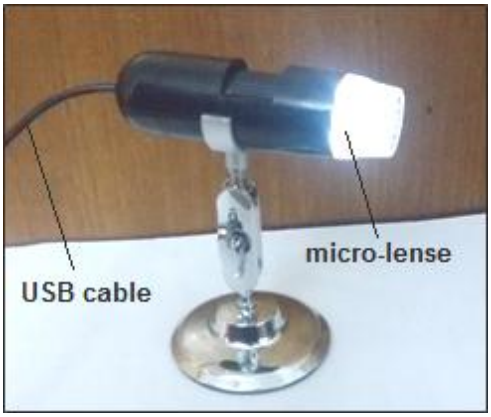

Figure (1): Digimicro Microscope

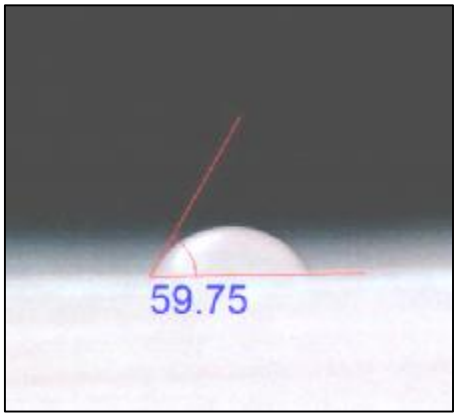

Figure (2): Contact angle measuring

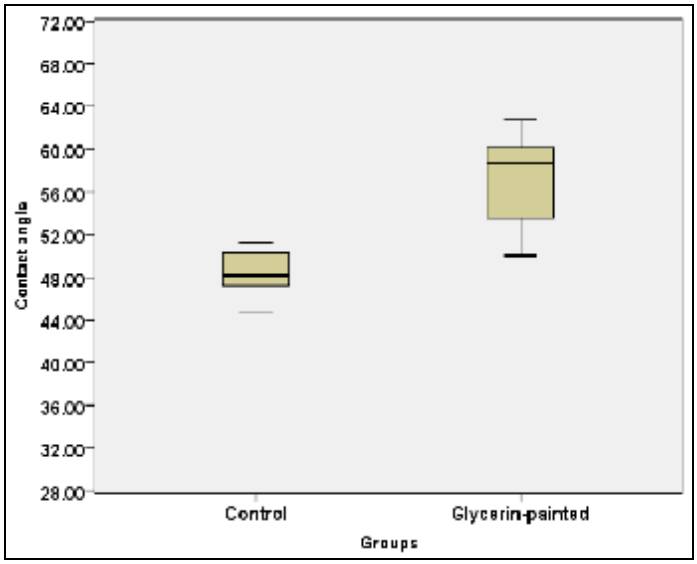

Figure (3): Contact angle results chart

Picture (1): A sample from the control group

Picture (2): a sample from glycerin-painted group