



Comparative Evaluation for Changes in Colour on Maxillofacial Prosthetic Silicones Following Investment in Molds of Different Materials: An In-Vitro Study

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Abstract

Purpose: The authors have noted that the colour of silicone elastomer after curing in gypsum Molds varies slightly from the shade that was matched with the patient before packing. They propose that the materials used for investing could impact the silicone's colour during its polymerization.

Materials and Methods: This study assesses the color change of two types of silicone elastomer when packed in three different investing materials: dental stone (white color), dental stone (green color), and die stone (orange colour). Samples of pigmented silicone elastomer were prepared in molds made of these materials using a separating agent, forming the test groups. The control group consisted of similar pigmented elastomer packed into stainless steel molds. A spectrophotometer was used

to measure the L*, a*, and b* values of both test and control samples, and the color difference (Delta E) between the groups was calculated.

Results: Mean value of Group A Silicone elastomer in dental plaster, dental stone and die stone were 1.80, 0.77, 2.58 and standard deviations were 0.70, 0.32, 0.83. Mean value of Group B Silicone elastomer in dental plaster, dental stone and die stone were 2.54, 1.46, 3.50 and standard deviations were 0.61, 0.32, 0.42.

Conclusion: Dental Plaster, Dental stone and die stone shows significantly higher color change in Group B Silicone as compared to Group A Silicone.

Keywords: Maxillofacial silicone, Colour, Polymerisation

Introduction

Maxillofacial deformities are distressing for patients and can adversely impact their physical and mental well-being, leading to significant psychiatric, familial, and social issues. These deformities may be congenital, resulting from malformations or developmental issues, or acquired due to conditions like necrotizing diseases, oncological surgeries, or trauma.¹ Patients with maxillofacial disfigurements often have altered appearances that prevent them from living a normal life. They experience diminished social acceptance, which profoundly affects their mental state, often shattering their hopes of resuming a normal life.²

Most people agree that having a facial deformity corrected greatly lessens emotions of anxiety, guilt, self-consciousness, inferiority, and social inadequacy. The fundamental idea is that making a patient less noticeable has a major positive societal impact.

Given his background in materials science, anatomy, art, and tissues, it is the Maxillofacial prosthetist's ability to create facial prosthesis for rehabilitation people who have these flaws.³ The major goals of maxillofacial prosthetics include things like tissue protection, function restoration, psychological treatment, therapeutics or healing impact, and restoration of esthetics, or the patient's cosmetic appearance.² The spectral properties of the material and colorants determine a prosthesis's color. Because inorganic pigments are opaque, have high chroma, low value, and are far from the spectrophotometric values of normal skin, they simulate skin that is flat and dull-looking.⁴

The materials used to separate media and fabricate molds may have a noticeable effect on silicone color.⁵ The materials of choice for creating facial prosthetics are now silicone polymers, surpassing traditional acrylic resins in this regard. However, because of deterioration

of their color and physical characteristics, these prostheses must be changed on a regular basis. attributes.⁶⁻¹¹

It has been studied and documented how silicone elastomers change color as they weather. According to these researchers, exposure to UV light, variations in humidity and temperature, the use of adhesives, cosmetics, cleaning products, and bodily fluids are the primary causes of the elastomer's color change.¹²⁻¹⁴

The authors, who work in several Maxillofacial Prosthetic Rehabilitation clinics, have observed that the color of the mixture changes slightly to significantly as the silicone sets, starting from the point at which it is packed. until it is fully extracted from the mold. The kind of investment material (gypsum product) that can have a major impact on how the elastomer changes color as it cures. This might be caused by some of the colorants that were added to the dental stones, the stone's microstructure after it was manufactured, or a mix of the two. It can also be caused by separating media. When prosthetics are manufactured for people with darker skin tones, the impact is especially more noticeable when the pigment loading in the mix is larger. The authors speculate that this impact might result from the application of heat during the process of curing or as a result of some investment material elements leaching & dividing the media within the silicone.¹⁵

A well-fitting and anatomically perfect prosthesis loses value and is less successful if the color does not blend in with the surrounding tissue. Therefore, a prosthesis with a solid, flat color will look fake and is not realistic. The best way to create a base tone is by intrinsic coloring. In the past, coloring agents have been made from various pigments and dyes.¹⁶

Objective

The objective of this study is to evaluate the effect of different investing materials on maxillofacial silicones and to evaluate the color changes of different type of maxillofacial silicone during polymerisation.

Materials and Methods

Two distinct varieties of medical-grade silicone that vulcanize at room temperature were obtained (Figs. no. 1 and 2). Ferric oxide granules that are safe for cosmetic usage were utilized as dry pigments (Fig. no. 3). They mixed in nicely with the silicon and were non-allergic.⁵

1. There were three steps in the entire process.

Making molds

2. Packaging silicones

3. Examining sample colors



Figure 1: Room temperature vulcanising medical grade silicone (Group A)



Figure 2: Room temperature vulcanising medical grade silicone (Group B)



Figure 3: Powder pigments



Figure 4: Investing material mold

A silicone packing mold was made using a variety of investing materials, such as die stone, dental plaster, and dental stone (Fig. no.4). The investment material was molded into a rectangular base, and wax strips were used to make a box. After applying eight wax strips and coating them with a separating medium, more investing material was added to the box to fill it up and make notches for a secure lock.

Before the silicone elastomer mold was ready for packaging, the outside wax strips were taken off and the mold was placed in a dewaxing unit for fifteen minutes to allow the wax to boil out readily. Three pairs of molds were made in total, each with a different investing materials.

Each mold was prepared by applying a separating media, letting it dry for half an hour, and then filled it with silicone. After combining 200g of catalyst and 20g of base, pigment was added to create the color of Asian skin (Fig. no.5). The control group samples were fabricated by packing silicone from the same mix, in a stainless steel mold (Fig. no.6).

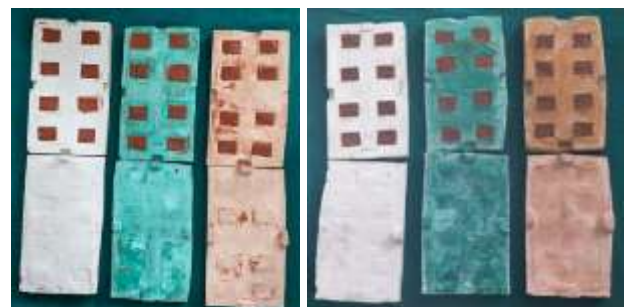


Figure 5: Packing of Silicone for group A and B (Test group)

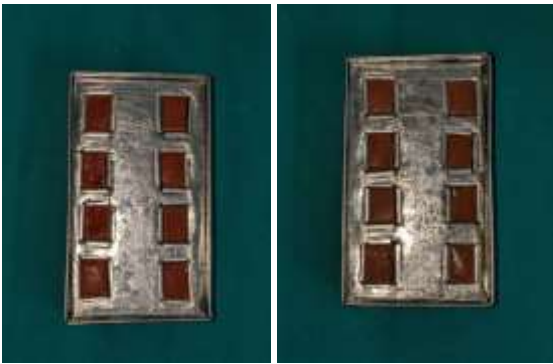


Figure 6: Packing of group A and B silicone in stainless steel mold (control group)

After being evenly packed into the molds, the silicone was allowed to polymerize at room temperature at pressures as high as 30 psi. After a day, the samples were taken out and cleaned of contaminants using acetone.

Distribution of samples were done as Group A and Group B (Table 1). To compare the color changes between the control group, Group A and Group B samples, a spectrophotometer was used.

Table 1: Distribution of Samples

Groups	Sub-Groups	N
Group A (Factor II Inc. A-2186 platinum silicone elastomer, Lakeside, AZ, USA)	Control	16
	Dental Plaster (A1)	16
	Dental Stone (A2)	16
	Die Stone (A3)	16
Group B (MP Sai Enterprise Thane, India)	Control	16
	Dental Plaster (B1)	16
	Dental Stone (B2)	16
	Die Stone (B3)	16

N= no. of samples

Result

Mean value for A1, A2, A3 were 1.80, 0.77 and 2.58 whereas the mean value for B1, B2, B3 were 2.54, 1.46 and 3.5 respectively.

Changes in Colour on Maxillofacial Prosthetic Silicones Following Investment in Molds of Different Materials in Group A and Group B are presented in graph I and II.

Graph 1: Changes in Colour on Maxillofacial Prosthetic Silicones Following Investment in Molds of Different Materials: Group A



Graph 2: Changes in Colour on Maxillofacial Prosthetic Silicones following Investment in Molds of Different Materials: Group B



On comparing group A and group B; Dental Plaster, Dental stone and die stone shows significantly higher color change in Group B as compared to Group A.

Discussion

Colour matching of orofacial prostheses to human skin has long been a challenge to the clinician. Many different materials and methods have been used to get close to the human skin shades. Earlier extrinsic colouring was done to achieve a desired skin tone Barnhart achieved a more natural, deeper, and long

lasting skin tone by intrinsically colouring of silicone rubber.¹⁷

The color change following weathering of silicone elastomers has been investigated and documented. These investigators have stated that the main factors contributing to the change in color of the elastomer is exposure to ultraviolet radiation, temperature changes, humidity, the use of adhesives, cosmetics, cleansing agents, and exposure to body fluids.¹²⁻¹⁴

It is the experience of the authors, working in different Maxillofacial Prosthetic Rehabilitation centers, that during the setting of the silicone, there is a slight-to-significant change in the color of the mix, from the point when it is packed into the mold till it is divested. The type of investing material (gypsum product) can have a significant effect on the color change of the elastomer during its curing.⁵

The results of this study indicate that there is a definite change in the color of the silicone following curing when each mold material is used, the maximum color change of the pigmented silicone occurs when die stone was used. Least color change of the pigmented silicone occurs when dental stone was used.

The mean values for Subgroup A1(Dental plaster), A2(Dental stone), A3(Die stone) were 1.80, 0.77 and 2.58 where as the mean value for Subgroup B1(Dental plaster), B2(Dental stone), B3(Die stone) were 2.54, 1.46 and 3.5 respectively.

Conclusion

It can be concluded that the maximum change in color was seen in die stone, followed by dental plaster and least in dental stone for both the groups (Group A and B). By Comparing Group A and B, Higher color change was seen in group B as compared to group A,

This study was carried using the commonly used investing materials and mold release agents in India. The

same results may or may not be obtained by other materials used in different countries. Thus keeping in mind the type of investing material and maxillofacial silicone material gives same shade to the patient before shade matching and after curing.

As esthetics, is prime factor for a patient acceptance, this study will help prosthodontists who fabricate facial prosthetics for patients.

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