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Original Research

Assessment of tensile strength, water absorption, hardness and colour stability of three maxillofacial silicone materials

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ABSTRACT:
Background: Among the various contributing factors, properties of the maxillofacial prosthetic material play a crucial role in the final result of the prosthetic rehabilitation. The present study was conducted to compare three maxillofacial silicone materials with respect to tensile strength, water absorption, hardness and colour stability.
Materials & Methods: Three silicone materials which were divided into three groups. Group I consisted of A-2186 silicone maxillofacial material, group II consisted of MDX4-4210 silicone maxillofacial material and group III consisted of MP Sai Biomed silicone maxillofacial material. Parameters such as tensile strength, water absorption, hardness and colour stability was assessed. **Results:** The mean tensile strength in group I was 3.62 Mpa, in group II was 6.07 Mpa and in group III was 2.81 Mpa. The difference was significant (P< 0.05). The mean hardness value in group I was 31.7, in group II was 46.02 and in group III was 28.1. The difference was significant (P< 0.05). The mean water absorption value in group I was 0.43, in group II was 0.45 and in group III was 0.60. The difference was significant (P< 0.05). **Conclusion:** A-2186 maxillofacial Silicone possess all round better properties with respect to colour stability and water absorption. MDX4- 4210 was found to be the best material followed by A-2186 and MP SAI BIOMED silicone material in terms of hardness and tensile strength.
Key words: Colour stability, Maxillofacial Silicone, MP SAI BIOMED

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INTRODUCTION

The speciality of maxillofacial prosthetics is currently finding itself changing and evolving more than at any other specialty over the past few decades.[1] Traditional prosthodontic principles are still used for the management of many patients which require special skill eg - treatment of patients with head and neck malignancy, postsurgical therapy, surgical reconstruction and congenital, developmental defects.[2]

Among the various contributing factors, properties of the maxillofacial prosthetic material play a crucial role in the final result of the prosthetic rehabilitation.[3] The main challenge encountered in the performance of an ideal facial prosthesis is the degradation in appearance, either due to changes in color or deterioration of physical properties. The average service life of facial prosthesis is still only 1–1.5 years, mainly due to color degradation.[4]

Rehabilitation of patients with disabilities of the craniofacial region due to either congenital or acquired defects is a difficult task. These defects may be minor in nature (aesthetics) or major discrepancies (functional limitations).[5] The Prosthodontic management of these patients should aim at restoring the functional and aesthetic features as well as also ensure complete psychological wellbeing. Since the sixteenth century, various surgical defects or trauma to the craniofacial region has been treated by maxillofacial prosthetic replacements which had been constructed from a variety of materials.[6]The present study was conducted to compare three maxillofacial silicone materials with respect to tensile strength, water absorption, hardness and colour stability.

MATERIALS & METHODS

The present invitro study was conducted in the department of Prosthodontics. It comprised of three silicone materials which were divided into three groups. Group I consisted of A-2186 silicone maxillofacial material, group II consisted of MDX4-4210 silicone maxillofacial material and group III consisted of MP Sai Biomed silicone maxillofacial material. 30 Metal dies were fabricated according to American Society for Testing and Materials (ASTM) specifications. The specimens were submitted to the reading process with a sphere spectrophotometer at intervals of 6, 12 and 24 hours. Parameters such as tensile strength, water absorption, hardness and colour stability was assessed. Data thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

RESULTS

Table I: Assessment of tensile strength

Groups	Mean	P value
Group I	3.62	0.05
Group II	6.07	
Group III	2.81	

Table I shows that mean tensile strength in group I was 3.62 Mpa, in group II was 6.07 Mpa and in group III was 2.81 Mpa. The difference was significant (P< 0.05).

Table II: Assessment of hardness

Groups	Mean	P value
Group I	31.7	0.02
Group II	46.02	
Group III	28.1	

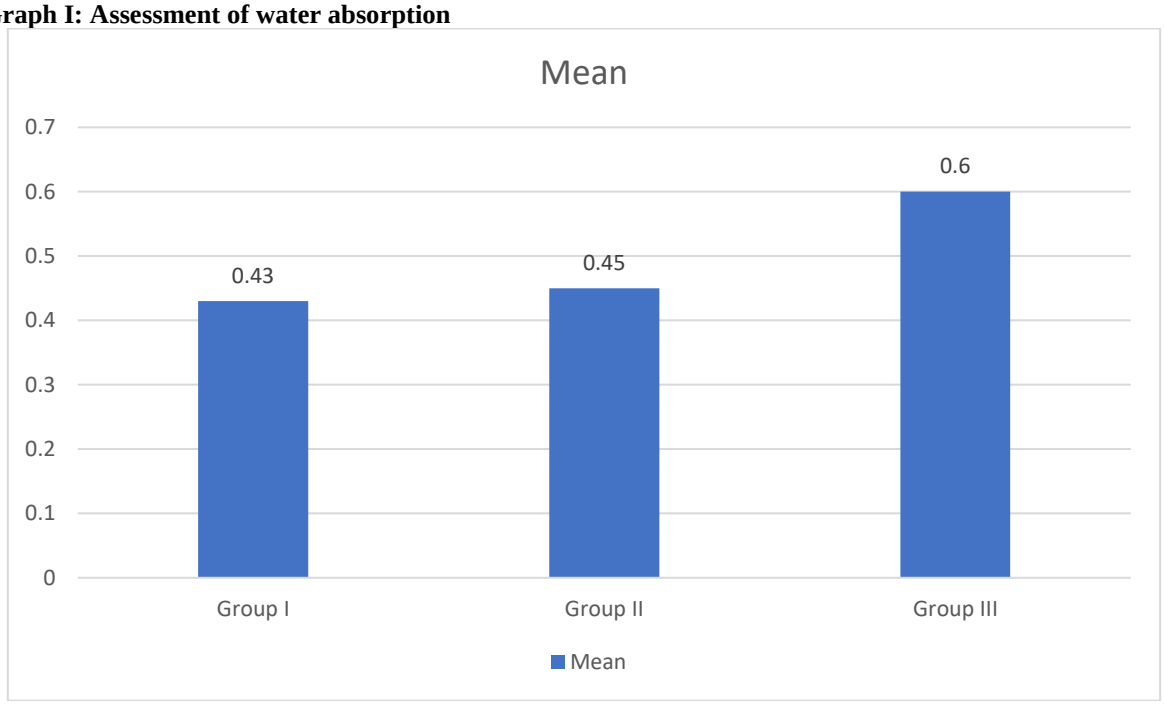
Table II shows that mean hardness value in group I was 31.7, in group II was 46.02 and in group III was 28.1. The difference was significant (P< 0.05).

Table III: Assessment of water absorption

Groups	Mean	P value
Group I	0.43	0.05
Group II	0.45	
Group III	0.60	

Table III, graph I shows that mean water absorption value in group I was 0.43, in group II was 0.45 and in group III was 0.60. The difference was significant (P< 0.05).

Graph I: Assessment of water absorption



DISCUSSION

An ideal elastomer-colourant combination should not only have satisfactory aesthetics but should also provide above average physical properties.[7] The addition of the colourant should enhance the physical properties of the elastomer, but it should be made sure that the ideal colorant added should not degrade any of its properties.[8]Wear and tear along with environmental factors cause a high degradation of polymers, colour changes of the silicone elastomer itself.[9] The weathering of polymers can cause changes in physical and chemical characteristics, which can result in an actual alteration of their tensile strength and hardness.[10]The present study was conducted to compare three maxillofacial silicone materials with respect to tensile strength, water absorption, hardness and colour stability.

We found that mean tensile strength in group I was 3.62 Mpa, in group II was 6.07 Mpa and in group III was 2.81 Mpa. Sengupta et al[11]evaluated and compared three maxillofacial silicone materials with respect to tensile strength, water absorption, hardness and colour stability. ANOVA test was used followed by Bonferroni (post hoc) multiple comparison test. Statistical analysis showed significant difference between A-2186, MDX4-4210, MP SAI BIOMED with respect to tensile strength, water absorption, hardness and colour stability. Based on the data, none of the three maxillofacial silicones possessed all the ideal properties required by a maxillofacial elastomeric material.

We found that mean hardness value in group I was 31.7, in group II was 46.02 and in group III was 28.1. Gupta et al[12]identified and interpret results of studies that evaluated the changes in the color stability of maxillofacial prosthetic materials due to chemical instability of silicones and pigments and the effect of exposure to environmental conditions and aging factors on the same.A fixed-effect model indicated a statistically significant ($P < 0.001$) decline in the mean ΔE (standardized mean difference [SMD] – 0.989) values in the study group as compared to that of the control group. However, a random-effects model indicated a statistically nonsignificant ($P = 0.125$) decline in the mean ΔE (SMD – 0.787) values in the study group as compared to that of the control group.

We observed that mean water absorption value in group I was 0.43, in group II was 0.45 and in group III was 0.60.Han et al[13] conducted a study to assess the effect of different nano-oxide concentrations of three compositions (Ti, Zn, and Ce) on the mechanical properties of a maxillofacial silicone elastomer and concluded that incorporation of Ti, Zn, or Ce nano-oxides at concentrations of 2.0% improved the overall mechanical properties of the silicone. When the concentrations of all three nano-oxides were 2%, the particle size in general, although irregular, seemed to be at the upper limit of the nano-scale classification of 0.100 μm; however, when the concentrations of nano-oxides were 3%, the SEM images showed that the nano-oxide particles had partly agglomerated. It was also concluded that the recommended concentration of nano-oxide should not exceed 2%–2.5%.

Reddy et al[14] stated that physical properties of A-2186 are better than MDX4-4210.3 According to this study, A-2186 maxillofacial Silicone possess all round better properties with respect to colour stability and water absorption than the other two commercially available materials that were used in this study. With respect to hardness and tensile strength, MDX4-4210 was found to be the best material followed by A-2186 and MP SAI BIOMED silicone material.

The limitation the study is small sample size.

CONCLUSION

A-2186 maxillofacial Silicone possess all round better properties with respect to colour stability and water absorption. MDX4- 4210 was found to be the best material followed by A-2186 and MP SAI BIOMED silicone material in terms of hardness and tensile strength.

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