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RESEARCH ARTICLE

COMPARATIVE EVALUATION OF HARDNESS AND SURFACE ROUGHNESS OF TWO COMMERCIALLY AVAILABLE MAXILLOFACIAL SILICONES FOLLOWING DISINFECTION IMMEDIATELY AND OVER A SUSTAINED TIME PERIOD - IN VITRO STUDY

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ABSTRACT

Silicone is the most common material used to fabricate maxillofacial prosthesis but silicone suffers from a rapid deterioration. Regular cleansing of facial prostheses cans causesilicone damage. Hard and rough silicone material may cause irritation to surrounding soft tissue and may look unnatural over a period of time due to aging of the material. The purpose of this study was to evaluate the hardness and surface roughness of two maxillofacial silicones under the influence of chemical disinfection and storage.

Materials and methodology: Total 32 specimens were obtained, 16 of Technovent M511 silicone and 16 of Factor II A2186 silicone. The specimens were divided into 3 groups. Both materials were disinfected with fittydent tablet 3 times in a week for half an hour and with neutral soap daily for 60 days. Samples were stored in plastic recipient without covering. The hardness and surface roughness of the material was tested, before disinfection and 2 months after the disinfection of the specimens.

Results: Shore a hardness and surface roughness of Factor II is more than Techno vent maxillofacial silicone. The storage time factor statistically influenced the materials' properties. Regarding disinfection with fittydent there was no significant difference in any of the materials tested.

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INTRODUCTION

Maxillofacial prostheses are usually made to correct facial disfiguration or deficiencies. These can occur due to cancer surgery, severe facial trauma or congenital craniofacial anomalies. [1] Silicone is the most common material used to fabricate maxillofacial prostheses because of its properties like texture, strength, durability, it is easy to handle and comfortable for patient.[2] But physical properties of silicone deteriorates rapidly such as hardness, surface roughness and colour stability and is difficult to repair.[2] After a few months of insertion, the prosthesis becomes hard and rough, and microorganisms colonize the silicones and may promote infection of surrounding tissues.[2] longevity of silicone facial prostheses is influenced by pigments, environmental exposure, and aging of silicone. Ideally, the facial prosthesis material should maintain its colour and mechanical properties. [4] Regular cleansing of facial prostheses is indicated to patients, but improper mechanical and chemical cleansing can cause silicone damage.[4]

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It is necessary to clean facial prosthesis with chemical disinfectant.[3] Softness of maxillofacial silicone material lasts from several months to years, hard and rough silicone material may cause irritation to surrounding soft tissue and may look unnatural over a period of time due to aging of the material. The purpose of this study was to evaluate the hardness and surface roughness of two maxillofacial silicone materials, under the influence of chemical disinfection and storage of 2 months.

MATERIALS AND METHODS

Technovent maxillofacial Silicone (M511 Platinum addition silicone rubber and Factor II maxillofacial Silicone (Platinum Cure System.A-2186.was used for making the specimens. Specimens were made in cylindrical metal mould which was 3mm in height and 30 mm in diameter. (ADA specification 19).[2] (Fig-1) Part A and Part B (elastomer and crosslinker) was mixed (in 10:1 proportion by weight) in silicone cup with plastic spatula. Homogenous mass of silicone was inserted into the syringe and then it was injected into the metal mould care was taken that no voids are incorporated while injecting the material into the mould. Glass slab was placed on the top to

make even flat surface. For 16 samples of Technovent silicone metal mould with maxillofacial silicone was kept inside the hot air oven and curing was done for 1 hour at 1000c.[5]According to manufacturers instruction For 16 samples of Factor II silicone curing was done for 24 hours at room temperature, according to manufacturers instruction. After that each specimen was removed from metal mould, like wise 32 specimens were made and divided into 3 groups with 2 subgroups.

Fig. 1. Metal mould

Group A – Before disinfection (n=32)

- Sub group A1 – Technovent maxillofacial Silicone tested before disinfection. (n-16)
- Sub group A2 – Factor II maxillofacial Silicone tested before disinfection.(n-16)

Group B – Disinfection with neutral soap (n=16)

- Sub group B1- Technovent maxillofacial silicone disinfected with neutral soap and tested after 60 days. (n=8)
- Sub group B2 – Factor II maxillofacial Silicone disinfected with neutral soap and tested after 60 days. (n=8)

Group C – Disinfection with fittydent (n=16)

- Sub group C1 – Technovent maxillofacial Silicone disinfected with fittydent and tested after 60 days. (n=8)
- Sub group C2 – Factor II maxillofacial Silicone disinfected with fittydent and tested after 60 days. (n=8)

Disinfection

All the specimen were kept into plastic box, and it was kept open in order to receive direct natural sun light for 60 days.[3] The specimen of C group were disinfected with solution prepared by mixing fittydent tablet in warm water. Water was warmed in the electric kettle. Temperature of water checked with the thermometer at 500 C 1 fittydent tablet was put in to the water.[9]Specimens was kept into the solution for 30 min.2 same procedure was repeated three times in a week for 60 days. The specimen of B group will be disinfected with solution prepared by neutral soap (dove soap) and water. Specimen were kept into the solution for 30 min. Same procedure was repeated daily for 60 days.[3]

Sample testing

Hardness test

Shore A hardness test was carried out for all 32 samples, before disinfection for both control and test group. Hardness of the material was measured at 5 different points with digital durometer. These points were 6mm away from the periphery of the disc and 6mm away from each other.[6] Hardness was calibrated according to ASTM D 2240. It is recorded as resistance to indentation at each point in shore units.

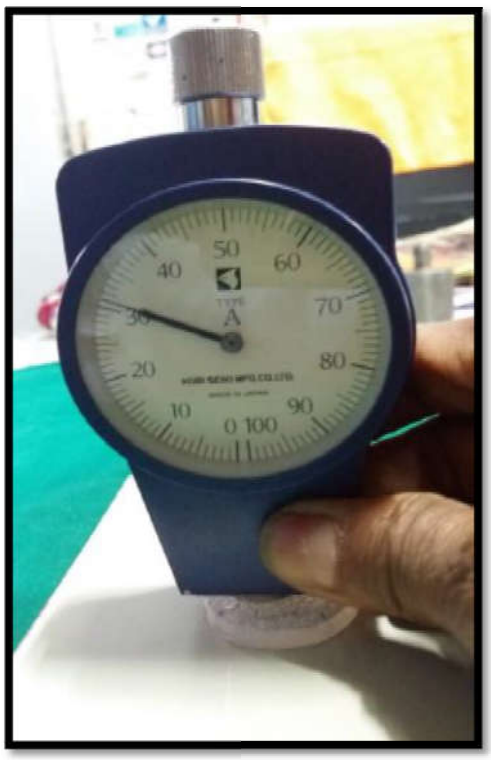

Fig. 2. Shore Aduormeter

Surface roughness test

Surface roughness test was carried out for all 32 samples, before disinfection for both control and test groups. It was checked with portable digital roughness tester. Sample was stabilized on the flat surface and stylus of the tester was moved on the surface. Surface roughness was recorded three times, and results were calculated.[3]Similar test was done after a period of 60 days of disinfection and results were calculated. Similar test was done after a period of 60 days of disinfection and results were calculated.

RESULTS

There is a significant difference in shore A hardness of Factor II and Technovent maxillofacial silicone. Technovent shows less hardness (26.81) than Factor II (29.75). (Table no1) Shore A harness of Technovent and FactorII maxillofacial silicone is increased after disinfection with neutral soap for 60 days. (Table no 2 and 3) Shore A hardness of Technovent and Factor II maxillofacial silicone remains same after disinfection with Fittydent for 60 days. (Table no 4 and 5)

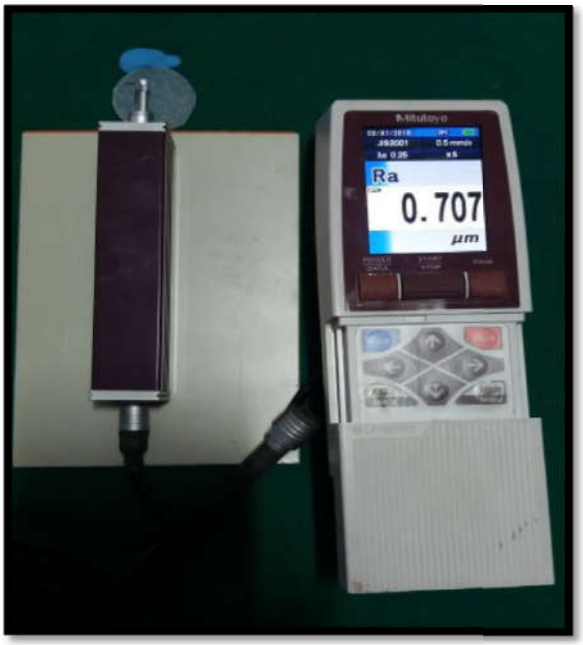

Fig. 3. Digital portable roughness tester.

Parameter	A2		A1		Z Value	P Value
	Mean	SD	Mean	SD		
Hardness	29.75	3.69	26.81	4.04	2.15	0.04

Parameter	A2		C2		Z Value	P Value
	Mean	SD	Mean	SD		
Hardness	30.00	3.665	29.75	3.919	1	0.35

Parameter	A1		B1		Z Value	P Value
	Mean	SD	Mean	SD		
Hardness	25.88	4.853	29.00	3.338	3.16	0.016

Parameter	A2		B2		Z Value	P Value
	Mean	SD	Mean	SD		
Hardness	29.50	3.964	31.13	3.563	5.02	0.002

Surface	A2		A1		Z Value	P Value
	Mean	SD	Mean	SD		
Roughness	0.69	0.55	0.31	0.14	2.67	0.012

There is a significant difference in surface roughness (before disinfection) of Factor II and Technovent maxillofacial silicone. Technovent shows less surface roughness (0.31) than Factor II (0.69). (Table no6)

Surface	A2		C2		Z Value	P Value
	Mean	SD	Mean	SD		
Roughness	0.41	0.318	0.40	0.429	0.21	0.84

Surface roughness of TechnoventandFactorIImaxillofacial silicone is decree sed after disinfection with neutral soap for 60 days. (Table no 7 and 8)

Surface	A2		C2		Z Value	P Value
	Mean	SD	Mean	SD		
Roughness	0.41	0.318	0.40	0.429	0.21	0.84

Parameter	A1		C1		Z Value	P Value
	Mean	SD	Mean	SD		
Hardness	27.75	3.059	28.00	2.619	1	0.35

Surface roughness of Technovent and Factor II maxillofacial silicone material remains same after disinfection with fittydent for 60 days. (Table no 9 and 10)

Surface	A1		B1		Z Value	P Value
	Mean	SD	Mean	SD		
Roughness	0.39	0.146	0.25	0.118	2.39	0.048

Surface	A2		B2		Z Value	P Value
	Mean	SD	Mean	SD		
Roughness	0.96	0.616	0.55	0.424	3.49	0.01

Surface	A1		C1		Z Value	P Value
	Mean	SD	Mean	SD		
Roughness	0.23	0.089	0.20	0.055	1.26	0.25

DISCUSSION

Several factors including shape, volume, position, texture and translucency of the patient's features must be precisely reproduced during maxillofacial prostheses fabrication. Silicone is the most common material used to fabricate maxillofacial prostheses because of its properties like texture, strength, durability, it is easy to handle and comfortable for patient.[2] Technovent liquid silicone rubbers (LSRs). M511 Addition (Platinum) silicone is designed and manufactured specifically for facial prosthesis. Factor II A-2186 platinum silicone is regular cure elastomer. A-2186, which is made by modification of the polymer chain has greater tear resistance, tensile strength, a larger percentage of elongation and also proved to be softer at the surface than HTV silicones and many other RTV silicones.

But physical properties of silicone deteriorates rapidly such as hardness, surface roughness and colour stability and is difficult to repair.[2] After a few months of insertion, the prosthesis becomes hard and rough, and microorganisms colonize the silicones and may promote infection of surrounding tissues.[2]In the current study Fittydent super cleansing tablets and dove soap (neutral soap) were used as disinfectant. Fittydent super cleansing tablets keep dentures and orthodontic appliances clean and fresh. In the current study, for 60 days samples were kept in plastic recipient without covering in natural sunlight. These are the conditions in which patient uses the prosthesis, in other words, in contact with the environment.[3] To compare harness and surface roughness tests were done immediately after making samples and after 60 days of disinfection and storage. Materials texture and flexibility is measured in shore A hardness. In the current study surface roughness was measured by digital portable roughness tester.[3]

Shore A hardness before disinfection

Soft materials are like human skin and they may show low values of modulus of elasticity and hardness. According to Lewis, Castleberry (1980), May (1978) and William T (1985) ideally shore A hardness has to be between 25 and 35 units.[8,11,12] There is a significant difference in shore A hardness of Factor II and Technovent maxillofacial silicone. Technovent shows less hardness (26.81) than Factor II (29.75). (Table no.1) According to 2011 product catalogue of Factroll Inc. and Technovent shore A hardness of Factor ll (2186) is 30 and Technovent (M511) is 25 unit. Technovent (M511) can be used in conjunction with M513 softening agent and M510 gel catalyst to reduce the hardness (Shore A 15-20).[7]

Shore A hardness after disinfection with neutral soap for 60 days

Shore A hardness of Technovent and Factor II maxillofacial silicone increased after disinfection with neutral soap for 60 days. According to Marcelo Coelho Goiato et al. (2009) – After the storage period, Shore hardness was increased this shows that for both maxillofacial silicones, the storage time produced a significant increase in the hardness of the specimens.[3] This may be due to the continuous condensation polymerization of maxillofacial silicone materials. Acetic acid and formaldehyde by products are formed and because of its evaporation hardness of the specimen increases. Marcelo Coelho Goiato et al. (2010) – did a study in which, an increase in hardness was observed in the maxillofacial material both after disinfection and accelerated aging. The increases were only statistically significant after disinfection with neutral soap and accelerated aging and could be the result of ongoing silicone polymerization with volatilization of formaldehyde, which occurs during the aging process. The cross-linking system used in maxillofacial material produces high temperatures, increasing the conversion rate, cross-linking density, and molecular weight of the silicone polymer to increase the hardness of the material.[2]

Shore hardness after disinfection with fiftydent for 60 days

Shore A hardness of Factor II and Technovent before and after disinfection with Fittydent for 60 days remains almost same. Chemical soaking is the primary method of choice to disinfect maxillofacial elastomers. The methods used in the present study included fittydent tablets that employ saturation and oxidation using peroxides, neutral soap that acts through digital friction and is chemically inert. Thus disinfectant used in current study did not statistically affect the hardness value. Marcelo Coelho Goiato et al in (2009) did a study regarding the influence of chemical disinfection, it was noticed that this factor did not produce a significant difference in the hardness values of the specimens when compared to the groups without disinfection.[3]

Surface roughness before disinfection

There is a significant difference in surface roughness (before disinfection) of Factor II and Technovent maxillofacial silicone. This is probably because factor II has a higher filler concentration in its composition, which promotes a higher roughness than Technovent maxillofacial silicone.[11]

Surface roughness after disinfection with neutral soap for 60 days

There is a significant difference in surface roughness of Technovent and Factor II maxillofacial silicone before and after disinfection with neutral soap for 60 days. Surface roughness of Technovent maxillofacial silicone decreased after disinfection with neutral soap for 60 days. Marcelo Coelho Goiato et al in (2009) did a study which shows that initially roughness was high but it decreases after the storage of 60 days, the roughness values decreased, irrespective of the material and the chemical disinfection.[3] According to PhillipsAnusavice10thed – this may be explained by the continuous polymerization process, which promotes a more complete polymeric chain, making the silicone surface smoother with time.[11]

Surface roughness after disinfection with fittydentfor 60 days

There is no significant difference in surface roughness of Technovent and Factor II maxillofacial silicone before and after disinfection with Fittydent for 60 days. According to current study Technovent (M511) showed better results than Factor II (2186) in terms of shore a hardness and surface roughness. All values obtained in the present study were within the acceptable range as described in the literature. And both the materials can be used to make facial silicone prosthesis.

Conclusion

Within limitations of current study following conclusion can be drawn

1. Shore a hardness of Factor II is more than Technovent maxillofacial silicone.
2. Shore a hardness of Technovent and Factor II maxillofacial silicone increases after disinfection with neutral soap for 60 days.
3. Shore a hardness of Technovent and Factor II maxillofacial silicone material remains same after disinfection with Fittydent for 60 days.
4. Surface roughness of Factor II is more than Technovent maxillofacial silicone.
5. Surface roughness of Technovent and factor II maxillofacial silicone decreases after disinfection with neutral soap for 60 days.
6. Surface roughness of Technovent and Factor II maxillofacial silicone remains same after disinfection with Fittydent.

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