International Journal of Health Sciences and Research
www.ijhsr.org ISSN: 2249-9571

Short Communication

Evaluation of the Tear Strength and Shore Hardness of Medical Graded and Industrial Graded Silicone - An In Vitro Study

C.Sabarigirinathan[1], K.Vinayagavel[2], P.Rupkumar[3], G.Sriramaprabu[3], T.Jeyanthikumari[4], J.Baranikrishnan[5], S.Sivasakthikumar[6], Preethychandran[6], S.Bhuvaneswari[7]

[1]Professor & HOD, [2]Professor, [3]Associate Professor, [4]Senior Assistant Professor, [6]Assistant Professor, [7]Resident, Department of Prosthodontics Tamil Nadu Government Dental College & Hospital, Chennai.
[5]Associate Professor, Government Vellore Medical College, Tamil Nadu.

Corresponding Author: K.Vinayagavel

Received: 14/07/2015 *Revised: 11/08/2015* *Accepted: 25/08/2015*

ABSTRACT

Maxillofacial prosthesis is a branch of prosthetic dentistry in which the rehabilitation and reconstruction done with materials such as polyvinyl chloride, polyurethane acetic resin, various types of silicones. In this study the room temperature silicone RTV and heat vulcanising silicone are used and to Compare their physical properties such as tensile strength and elongation percentage of the medical grade and industrial grade silicone. In this study medical graded silicone has better physical properties like tear strength, shore hardness and tensile strength and higher percentage of elongation than the industrial graded silicone.

Keywords; Silicone, Maxillofacial prosthesis, Polyvinylchloride, Polyurethane acetic resin.

INTRODUCTION

Maxillofacial prosthesis is an important branch of prosthetic dentistry which received lot of significance in the rehabilitation procedures. Materials such as polyvinyl chloride, polyurethane acetic resin, various types of silicones and other material are being used in fabricate facial prostheses. Selection of the materials for prostheses depends on defects technician skill provision for retention cost and biocompatibility. Polyurethane is a soft material with good aesthetic and adheophilic properties. Silicone molecule exhibits weather resistance over a wide range of temperature. [1]

In this study the room temperature silicone RTV and heat vulcanising silicone are used. In the heat activated silicone the two polymers are cross-linked with the release of benzoic acid as a by-product. Silicones are very widely used in the field of medicine and in the dentistry as they fulfill most of the clinical demands silicones are extensively used in industry for the fabrication rubber gaskets, sealants etc. [2]

Aim Of The Study: Evaluation of the tear strength and shore a hardness of both industrial and medical grade silicones.

MATERIALS AND METHODS

The medical grade silicone used in this study were RTV-MDX-4-4210(Fig:1) and the industrial grade silicone RTV-732(Fig: 2), addition silicone impression material, modelling wax, dies stone and

separating medium., The instruments used are Silicone injecting gun, Dental flask, carer, knife, B.P blade, brush, bench press, die mould, Teflon wheels, metal shaft.

Equipments used to test the physical properties: Lloyd's Shear strength machine (Fig:3), Shore durometer, calibrated scale, vacuum chamber

Fabrication of samples: The standards are established by American Society for testing materials D 1938-85 for tear strength D2240-65 for surface hardness

Preparing Metal DIE for O- rings: A two piece square metal mold was made with mold space for O-ring cut into it. The inner diameter of mold for O ring is 50 mm ant the outer diameter is 60mm. The dies are cut in such way that O, has a depth of 6mm (2mm for upper and lower dies respectively) The centre of one die has a shaft and the other has a recess to accept the shaft which aids seating off the dies together.

Preparation of Metal Dies to fabricate the samples for tear strength: A mild steal sheet of 0.6mm thickness is taken and cut into a rectangular piece measures 30mm and width ad 80mm length.

Preparation of Metal Dies to fabricate the samples for Shore A Hardness test.: Prepare 12mm of thickness of metal with 24mm diameter to test the hardness of the material. Paraffin oil was applied as the separating medium the surface on the dies mould, industrial silicone injected into the mould space with the help of silicone injecting gun and packed tightly under bench press and left for 24 hours to facilitate curing. [3]

The mix is packed tightly by closing the upper and lower parts of the stone dies with the help of bench press and left for 30 hours to complete the curing process. After 30 hours the mould was opened and O-ring was removed for it and checked excess material trimmed. Ten samples were prepared for each material and total number 20 samples were prepared.

Preparation of samples for tear strength: Impression of metal sheet dies having dimensions of 80mm length 30 mm width and 0.6mm thickness were made with the help of addition silicone. After curing the 20 samples were prepared (Fig:4).

Preparation of samples for C: Dies dimensions of 24mm diameter and 12mm thickness. 10 samples were prepared for each material and total no of 20 samples (Fig:5). The samples are subjected to SHORE A HARDNESS TEST (Fig: 6)

Fig.1 Medical Grade Silicone

Fig.2 Industrial Grade silicone

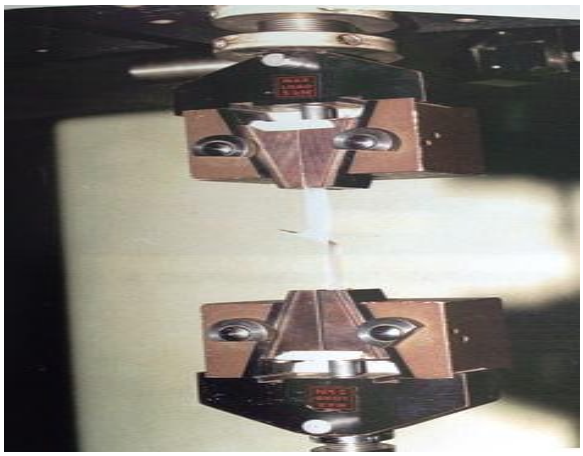

Fig.3. Lloyd's Shear strength machine

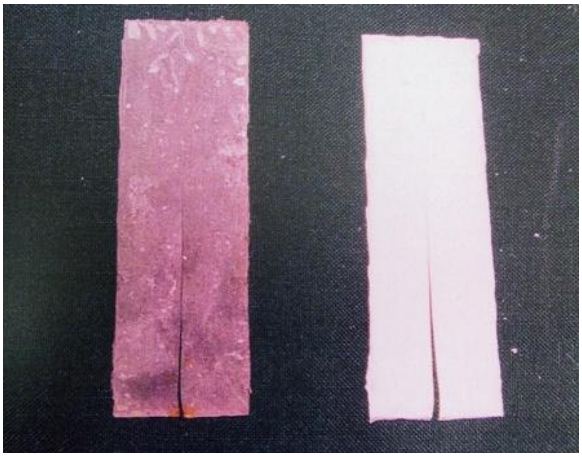

Fig.4 Samples for Tear Strength

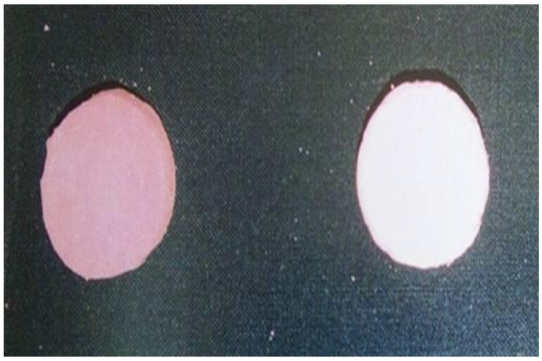

Fig:5 SAMPLES FOR SHORE A HARDNESS TEST

Fig:6
HORE A DURAMETER
HARDNESS TEST

Table-I: Tear Strength (Ppi)

S.No	MEDICAL GRADE SILICONE	INDUSTRIAL GRADE SILICONE
1	89	72
2	91	73
3	89	71
4	90	71
5	90	69
6	89	71
7	91`	73
8	89	71
9	90	69
10	90	71
MEAN	89.8	71.1

Table – II: Shore Hardness Number

S.No	MEDICAL GRADE SILICONE	INDUSTRIAL GRADE SILICONE
1	31	30
2	31	30
3	34	29
4	31	29
5	32	31
6	33	31
7	31	30
8	34	30
9	32	29
10	33	29
MEAN	32.1	29.8

Table –III: Comparison Of Tear Strength Between Medical Graded And Industrial Silicone

GROUP	MEAN	STANDARD DEVIATION	T-VALUE	P-VALUE
MEDICAL	89.80	0.82	29.05	P<0.001
INDUSTRIAL	71.10	1.33		

** Denotes significant P-VALUE

Table –IV: Comparison Of Shore Hardness Between Medical Graded And Industrial Silicone

GROUP	MEAN	STANDARD DEVIATION	T-VALUE	P-VALUE
MEDICAL	32.1	1.3	3.16	P<0.01
INDUSTRIAL	29.8	0.89		

** Denotes significant P-VALUE

Statistical analysis: The collected samples are analysed by calculating the mean, standard deviation and student's independent t-test.

The table I. shows the values of samples tested Lloyd's machine for tear strength of medical graded silicone and industrial graded silicone. Table II shows shore hardness test for medical grade silicone and for industrial grade silicone. Table III shows the comparative values of tear strength between medical graded and industrial silicone. Table IV shows the shore A hardness levels. According to statistical analysis t-values shows 29.10 and P-values less than .001 and it is statistically significant. The standard deviations of groups between medical graded and industrial graded silicone are 1.5 and .91 respectively and the t- value is statistically significant.

DISCUSSION

Maxillofacial prostheses have to fulfill the several clinical demands such as functional, aesthetics, and longevity. Among the silicones available in the market RTV silicones MDX-4-4210 was found to have better physical properties than other types of RTV silicones. [4] These materials must have significant strength flexibility and resilience to synchronize the facial movements. In this study tear strength and shore A hardness of two types of silicones of industrial and medical graded are used and they analysed and statistical data were obtained.

Tear strength is indicative of marginal integrity and durability of the clinical and that a high elongation at break and a high tear strength produced the most desirable combination. Shore hardness is another measure of flexibility and is indicative of life like feel. [5] In this study the medical grade silicone is superior than the industrial grade silicone in all the physical properties and also with the bio-compatibility.

SUMMARY AND CONCLUSION

Recently resins are replaced by various silicones. In this study the properties of the both industrial and medical graded silicones samples are tested and found that medical graded silicone has better physical properties like tear strength, shore hardness and tensile strength and higher percentage of elongation than the industrial graded silicone.

REFERENCES

1. Andreopoulos AG, Theophanides T. Related articles design ad properties of maxillofacial prosthetic materials. Med device technol. 1993 Nov; 4 (9) 20-5.Review.
2. Conroy, B.F.Haylock Report of 4 year research and development programme involving the institute of maxillofacial technology,

international facial prosthetic workshop PP 218-215, 1979.
3. Firtell DN,Donnan ML, Anderson CR; related articles light weight RTV silicone for maxillofacial prosthesis, JPD 1976 Nov;36 (5); 544-99.
4. Koran A, Craig RG: Related Dynamic mechanical properties of MFP JPD res 1975 Nov-Dec 54(6);1216-21.
5. Haug SP,Moore BK Andres CJ; Related Articles color stability and colorant effect on MFP elastomers, Part III Colorant whether effect on physical properties JPD 1999 Apr;81 (4) 431-38.

How to cite this article: Sabarigirinathan C, Vinayagavel K, Rupkumar P et al. Evaluation of the tear strength and shore hardness of medical graded and industrial graded silicone - an in vitro study. Int J Health Sci Res. 2015; 5(9):502-506.

****