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Short Communication

Comparison of the Tensile Strength and Elongation Percentage of Medical Graded and Industrial Graded Silicone - An In Vitro Study

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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.

Key words: Silicone, Maxillofacial prosthesis, Polyvinyl chloride, 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. [1] Polyurethane is a soft material with good aesthetic and adheophilic properties.

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. [2] 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.,

Aim of the Study: Compare the physical properties such as tensile strength and elongation percentage of the medical grade and industrial grade silicone.

MATERIALS AND METHODS

The medical grades silicone used in this study was RTV-MDX-4-4210(Fig1) and the industrial use silicon e RTV-732, addition silicone impression material, modelling wax, dies stone and separating medium. [3] The instruments used are Silicone injecting gun, Dental flask, carer, knife, B.P blade, brush bench press, die mould, Teflon wheels, and metal shaft.

Fig.1 Medical Grade Silicone

Equipments used to test the physical properties: Lloyds Testing machine, 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, Designation D413-65 for tensile strength. [4]

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 MetalDies 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. 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 30 hours to facilitate curing.

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.

Fig.2 Industrial Grade silicone

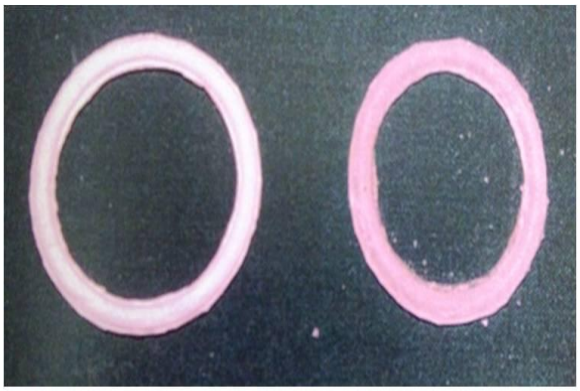

Fig:3 SAMPLES FOR TENSILE STRENGTH TEST

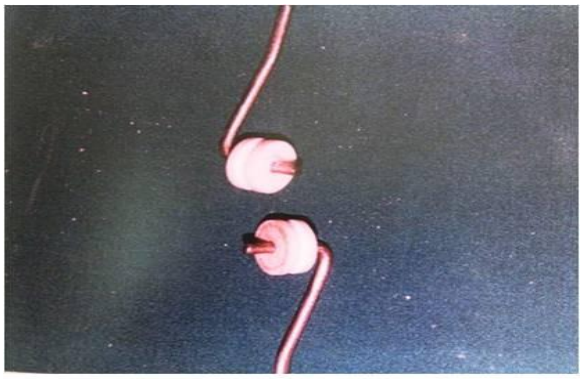

Fig:4 TEFLON WHEELS WITH SHAFT

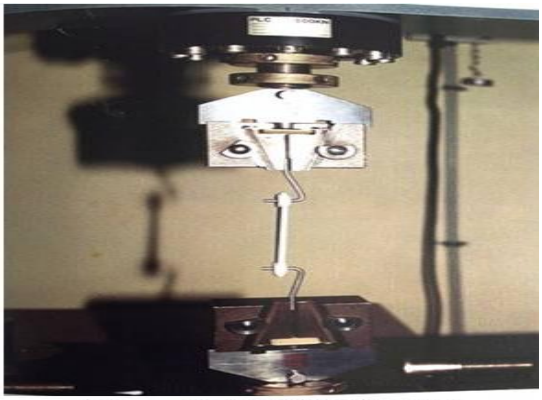

Fig:5 TENSILE STRENGTH TEST

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. Preparation of Teflon wheels and metal shaft to engage the test samples for tensile strength. Teflon wheels of diameter 21mm and 10mm width (Fig4) were prepared by using commercially available pre-fabricated Teflon rods. A shaft having 60mm length Made up of cast metal is attached to the centre of Teflon wheel to act as axis.

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 by Lloyd's machine for tensile strength of medical and industrial graded silicone. Table II: shows the Percentage of elongation between medical and industrial graded silicone. Table III shows the comparative values of tensile strength between medical and industrial graded silicone. Table IV shows the comparison of the percentage of elongation between the medical and industrial graded silicon.

RESULTS

The tensile strength of groups between medical graded and industrial silicones are 710 and 350.00 respectively. The standard deviation of groups between medical graded silicone and industrial silicone are 37.25 and 29.05 respectively.

According to statistical analysis T-value shows 18.20 and P value less than 0.001 which is highly significant. Table II shows that the tensile strength of medical graded silicone is much higher than silicone used for industrial purpose. The mean percentage elongation of groups between Medical and industrial graded silicones are 480 and 520 respectively. The standard deviation of groups between medical and industrial graded silicone are 8.30 and 8.32 respectively. The T- values shows the 13.54 and P value is less than 0.001 and which is highly significant. The percentage of elongation of medical graded silicone is slightly lower than silicone used industrial purpose.

Table-I Tensile Strength (PSI)

S.No	MEDICAL GRADE SILICONE	INDUSTRIAL GRADE SILICONE
1	705	365
2	715	335
3	710	370
4	710	330
5	710	355
6	710	345
7	705	345
8	715	355
9	715	350
10	705	350
MEAN	710	350

Table –II Percentage Elongation

S.No	MEDICAL GRADE SILICONE		INDUSTRIAL GRADE SILICONE	
	Elongation at Breakdown	% Elongation	Elongation at Breakdown	% Elongation
1	65	500	72	530
2	55	460	68	510
3	63	520	71	535
4	57	440	69	505
5	59	480	69	520
6	61	480	74	510
7	59	490	66	530
8	66	470	73	520
9	54	485	67	520
10	61	475	71	520
MEAN	60	480	70	520

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

GROUP	MEAN	STANDARD DEVIATION	T- VALUE	P-VALUE
MEDICAL	710	33.23		
INDUSTRIAL	350	27.78	18.18	P<0.001**

****** Denotes significant P-VALUE

Table –IV Comparison Of Percentage Elongation Between Medical Graded And Industrial Silicone

GROUP	MEAN	STANDARD DEVIATION	T- VALUE	P-VALUE
MEDICAL	445.9	7.31		
INDUSTRIAL	499.1	7.35	12.56	P<0.001**

****** Denotes significance P-VALUE

DISSCUSSION

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. [5,6] These materials must have significant strength flexibility and resilience to synchronize the facial movements. In this study tensile strength and Percentage of elongation are two types of silicones of industrial and medical graded are used and they analysed and statistical data were obtained.

Tensile strength is indicative of general measure of all the strength of a facial prosthetic material. [7] The tensile strength of medical graded silicone found to be much higher than the industrial graded silicone. Elongation is a measure of flexibility and is a vital factor to synchronize with facial movements. In this study the medical grade silicone is superior to the industrial grade silicone in all the physical properties.

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 tensile strength and percentage of elongation than the industrial graded silicone.

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