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Comparative evaluation of tear resistance of two rubber base bite registration pastes: An *in -vitro* study

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Abstract
Introduction: Any alteration in the interocclusal recording material before mounting the cast on the articulator would lead to change in maxillomandibular relationship, causing improper restoration with defective occlusal contacts. For an accurate replication, the interocclusal recording material must not deform or tear while being removed from oral cavity. Among various interocclusal record materials available, two recently introduced elastomeric bite registration pastes namely polyether and addition silicone are gaining popularity.
Aims and Objectives: Since no much study are available regarding the tear resistance of bite registration materials, the present study was conducted to evaluate and compare the tear strength of polyether and addition silicone bite registration pastes.
Materials and Method: Twenty specimens each of polyether and addition silicone bite registration pastes were made using metallic die according to dimensions as in ASTN D624 Type C mould. Tear resistance of both the materials were measured using Shimadzu Autograph Universal testing machine. The values obtained were tabulated and analysed statistically.
Results and Conclusion: The mean tear resistance for polyether was 4.4456 N/mm and that for addition silicone bite registration pastes was 3.4943 N/mm. The tear resistance of polyether bite registration paste is significantly higher than the tear resistance of addition silicone bite registration paste. As the p value obtained was 0.000 (p value < 0.05) the result obtained is statistically significant.

Keywords: addition silicone, polyether, bite registration paste, tear strength

Introduction
Successful prosthetic rehabilitation of a patient depends on an accurate detailed reproduction of intra oral structures and precise record of its relation to structures in its opposing arches. In cases where the number of teeth present are satisfactory and will provide cast stability, the casts can be mounted by manual articulation. On the other hand, when large edentulous spaces are present, cast mounting is considerably more complex requiring accurate transfer of the interocclusal relationship and vertical dimension. As the dental prosthesis is fabricated extra orally on master casts, it is necessary to record maxilla-mandibular relationship and accurately transfer it to the articulator. Accurate mountings can lead to final prosthetic restorations that require minimal occlusal modifications intraorally, thus reducing the chair side time during insertion. Historically, various materials used for registration of occlusal relationships were rigid like plaster, impression compound, wax, zinc oxide-eugenol paste, eugenol free zinc oxide paste, acrylic resin. While using rigid registration materials errors were observed with the flow of the material over axial surfaces of teeth and soft tissues, resulting in difficulty with re-positioning working casts within the bite registration and abrasion of the working cast during mounting. Recently, addition silicones and polyether impression materials have been modified by adding plasticisers and catalysts in order to be used as interocclusal records. Among various critical requirements of interocclusal materials like limited initial resistance to closure, dimensional stability, resistance to compression, ease of manipulation, biocompatibility, accurate recording and ease of verification, tear strength is an important factor which measures how well a material can withstand the effects of tearing. Bite registration materials should resist tearing when tensile stresses are applied during removal of the record and mounted cast separation. They are most susceptible to tearing in the interproximal areas. Tear in the bite record causes defects, will affect the accuracy of the final restoration. Additionally, some record material remnants in the interdental area may precipitate inflammation.

Therefore, impression materials must have maximum tear Strength at the time of removal. The present study was conducted to compare the tear strength of two recently introduced interocclusal record materials, polyether and addition silicone bite registration paste.

Materials and Method

There were two groups of specimen for comparison of tear strength.

A total of 40 specimens were made which were divided equally into 2 groups:

Group 1: 20 specimens made from Polyether Bite Registration Paste (Ramitec).

Group 2: 20 specimens made of Addition Silicone Bite Registration Paste (O Bite)

Fabrication of metal die

For measuring the tear strength a metal die with an upper and lower half was fabricated. Left bottom and top right portion of the lower half of the die was having two holes. Likewise there were two projections on the upper half of the die corresponding to the holes in the lower half which helps in the proper orientation of the die during closure. Lower half of the die was having depression of 2mm depth with a well-defined V shaped tear guide along its median made according to dimensions as in ASTM D624 Type C Mould. (Figure 1).

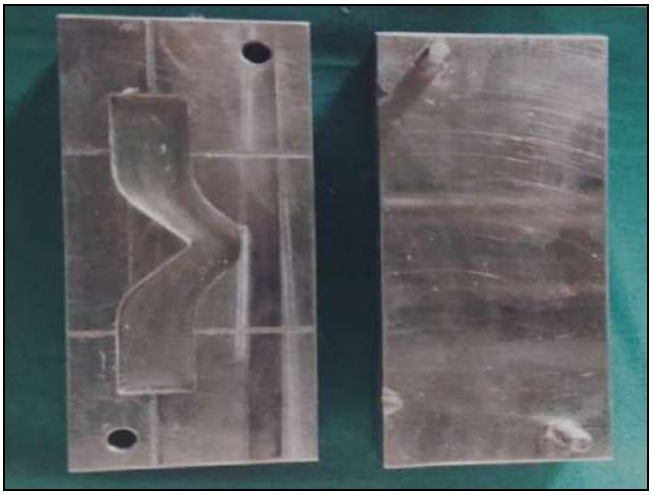

Fig 1: Metallic die for fabrication of specimen

Fabrication of test specimen

The test specimen were fabricated using the metallic die (Figure 2).

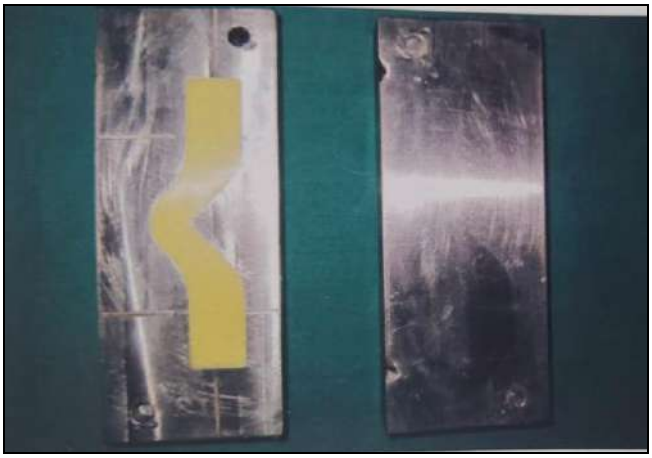

Fig 2: Test specimen in metallic die

For Polyether Bite Registration Paste, required amount of equal length of base and catalyst pastes were dispensed on the mixing pad and mixed using stainless steel mixing spatula to get a homogenous streak free mix according to manufacturer's instruction. For Addition Silicone Bite Registration Paste, a cartridge of the registration paste was fixed to the auto mixing gun with spiral mixing tip and mixed according to manufacturer's instruction. The mixed registration paste were loaded to the lower half of the die and then compressed with the upper half of the die, so that the excess material was squeezed out. After the manufacturer's recommended setting time was completed, the die was opened and excess material in the specimen was removed using Bard Parker blade. The specimens of uniform thickness without air bubbles or defects were selected for the study (Figure 3 and 4)

Fig 3: Polyether test specimen

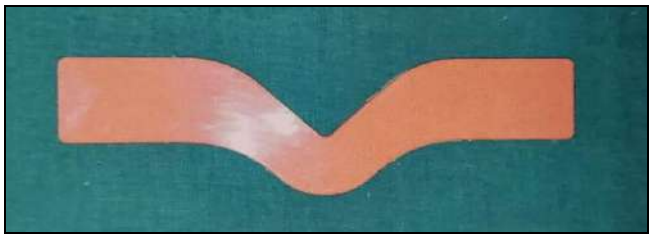

Fig 4: Addition silicone test specimen

Testing of the specimen

The instrument used for the study was Shimadzu Autograph Universal Testing Machine. The machine was connected to

a computer for operating the machine, and for analysing and printing of the data obtained. The test speed given to the computer was 5mm/minute. One end of the test specimen was attached to upper screw type flat grip and the other end to the lower one (Figure 5).

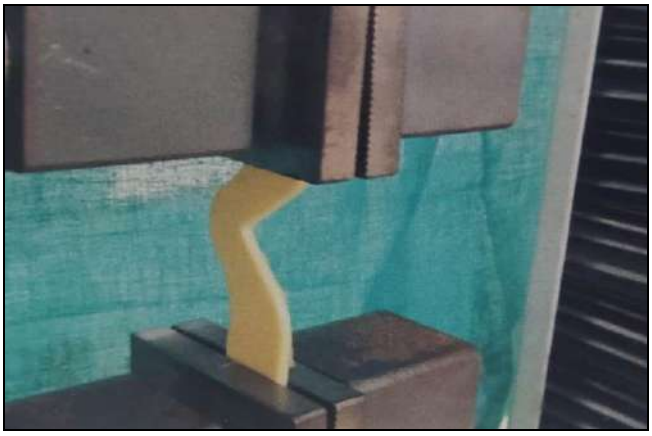

Fig 5: Test specimen loaded in Universal Testing Machine

On start command, a uniform pulling force moved apart the upper and lower grips at a speed of 5mm/minute. When it reaches a point that exceeds the tear strength of the specimen, the specimen was torn (Figure 6).

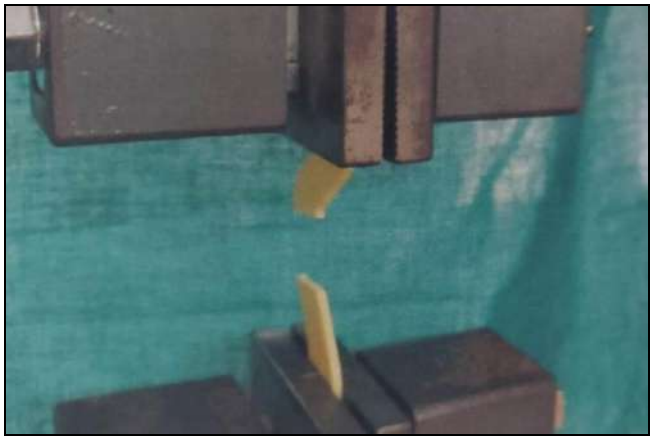

Fig 6: Test specimen after testing

The tearing force was then divided by its thickness of the sample to find the tear resistance for that particular specimen and the value was displayed on the computer screen. Total 40 specimens 20 from each group were tested and value obtained for each specimen were tabulated and statistically analysed.

Results

Tear strength of total 40 specimens – 20 specimens each of polyether and addition silicone bite registration pastes were tested and values obtained are given below.

Table 1: Tear Resistance of polyether bite registration paste

Sl. No	Tear resistance (N/mm)	Mean Value (N/mm)
1	4.54072	4.4456
2	4.54170	
3	4,45081	
4	4.16406	
5	4.25058	
6	4.45060	
7	4.51320	
8	4.43720	
9	4.50130	
10	4.49580	
11	4.54070	
12	4.50350	
13	4.42970	
14	4.52350	
15	4.46351	
16	4.58340	
17	4.45060	
18	4.35210	
19	4.25084	
20	4.46820	

Tear resistance of polyether specimens ranges between 4.16406 and 4.58340 with a mean value of 4.4456 N/mm (Table 1 and Figure 7)

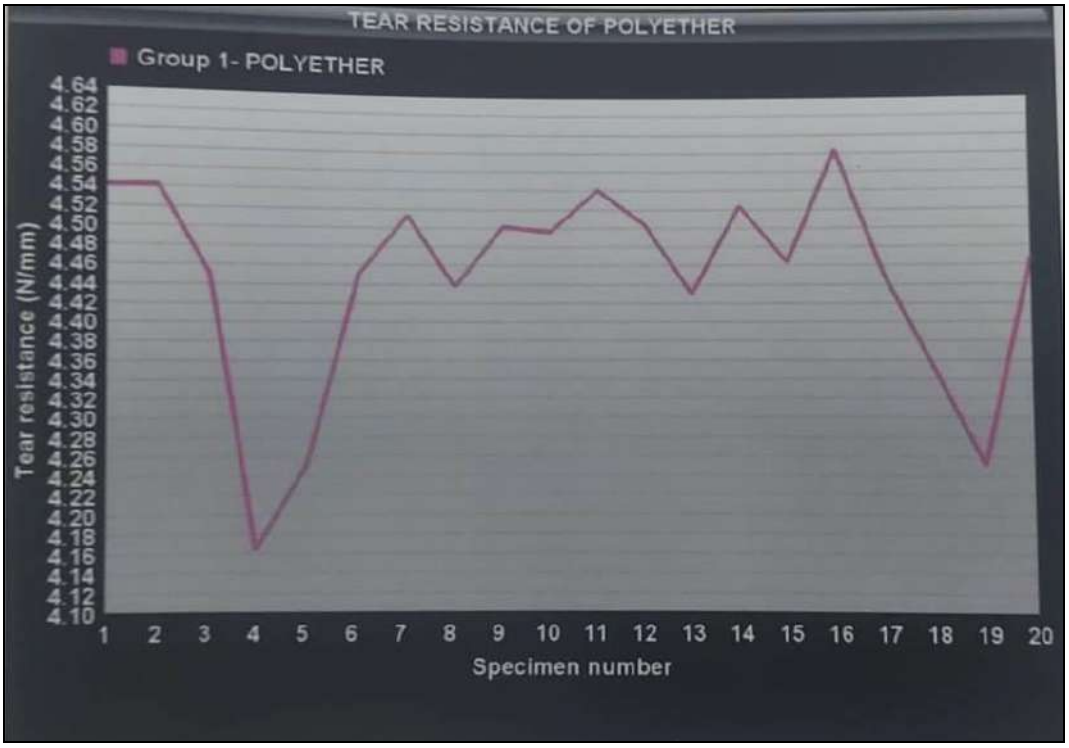

Fig 7: Tear resistance of Polyether

Tear Resistance of addition silicone specimens ranges between 3.35642 and 3.59730 with a mean value of 3.4943 N/mm. (Table 2 and Figure 8)

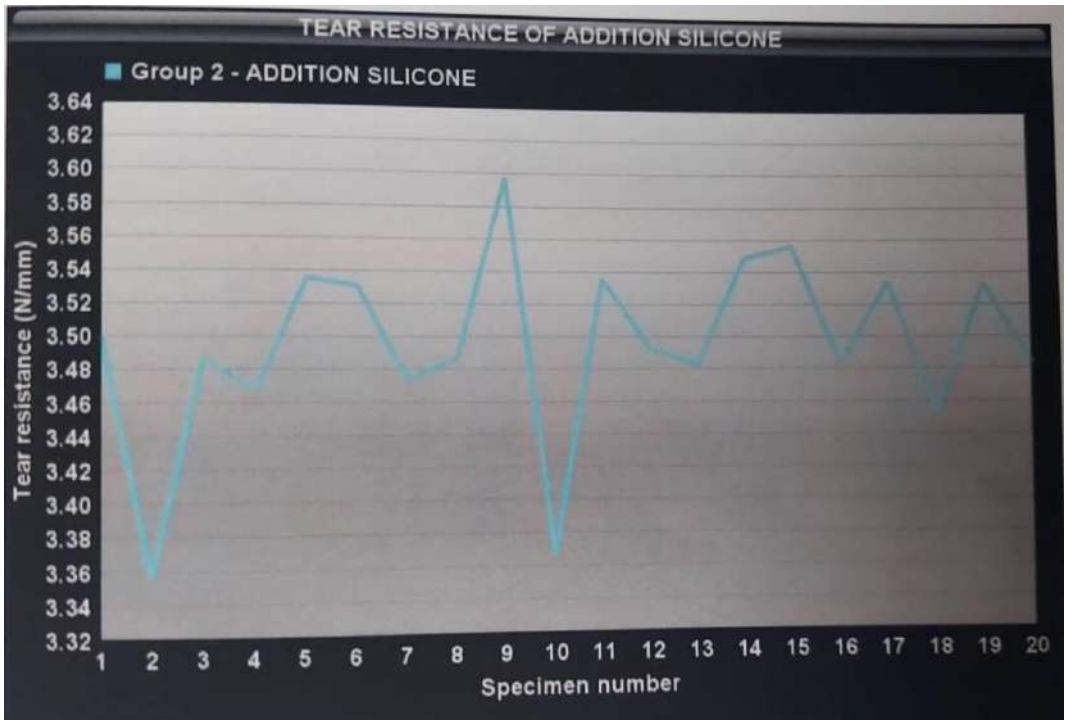

Fig 8: Tear resistance of Addition silicone

Statistical Analysis

The results obtained for tear resistance were statistically analysed using student t test (Table 3 and Figure 9). The tear resistance of polyether was more compared to addition silicone and the difference was statistically significant as the p value is 0.000 (p value < 0.05). (Table 4)

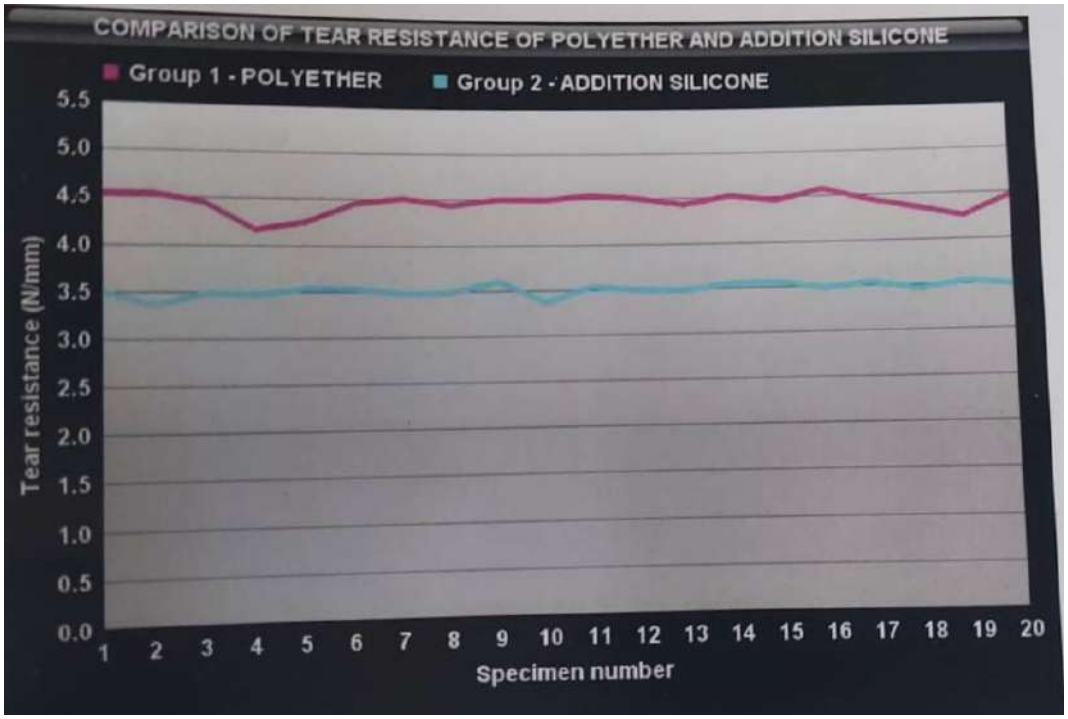

Fig 9: Comparison of tear resistance of Polyether and Addition silicone

Table 3: Mean and Standard Deviation for Polyether and Addition silicone bite registration paste

	Group	N	Mean	Standard Deviation
Tear Resistance	Polyether	20	4.4456	0.11029
	Addition silicone	20	3.4953	0.05810

Table 4: t test for equality of means for measuring tear resistance

	t test for equality of mean		
Tear Resistance (Equal variance assumed)	t	df	P value
	-34.090	38	0.000

Discussion

An interocclusal record is the registration of the positional relationship of the opposing teeth or the jaws to each other. Accurate interocclusal record minimise the time needed for intraoral adjustments during delivery of the prosthesis and can provide high quality fixed restoration. It reduces overall treatment time and cost.

Tear strength is an in important property that an interocclusal bite registration paste should possess. The material must be capable not only of flowing and forming thin films, but also be withdrawn from undercuts without tearing after the material has set. Tear energy is influenced by flow characteristics of the material, adhesion to teeth and soft tissues, and the presence of internal and surface defects. Some materials can readily flow resulting in formation of thinner film and tear strength is directly related to film thickness. Materials which show greater adhesion to tooth structure would require higher force to remove from the mouth; this also can increase the probability of tearing.

The propagation of a tear must be preceded by initiation. Sometimes incorporation of saliva or other tissue fluid during setting of material could result in defects which can act as initiators, may ultimately reduce the tear strength of the set material. The results obtained from the study showed that polyether possess statistically significant higher tear strength compared to addition silicone bite registration paste. This may be due to the difference in the filler materials contained in the two pastes. The shear modulus of polyether is more compared to addition silicone, which can also be a reason for the increased tear strength of polyether bite registration paste.

Thomas *et al.* compared the tear strength of elastomeric impression materials and he concluded that polyether showed higher tear resistance compared to addition silicone which is in accordance with the result obtained from the present study. Keck *et al*. tested the tear resistance of non-aqueous elastomers which also concluded that polyether possess higher tear strength compared to addition silicone.

Conclusion

The clinical tear performance of a given material has a complex relationship between polymer and filler types, flow to a particular film thickness, adhesive property, rate of withdrawal etc. A material which exhibit good tear strength in laboratory conditions may not exhibit the same performance during clinical use. However within the limitations of the study, results of the present study showed that among the two most commonly used bite registration pastes, polyether shows higher tear resistance compared to addition silicone material.

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