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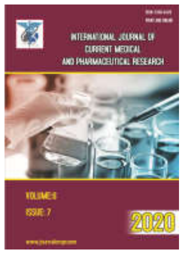

Research Article

A COMPARATIVE EVALUATION OF FRACTURE STRENGTH OF SINGLE MAXILLARY COMPLETE DENTURES REINFORCED WITH THREE DIFFERENT MATERIALS: AN IN-VITRO STUDY WITH A CLINICAL COMPONENT

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ABSTRACT

Context- Many in vitro studies described methods to reinforce single maxillary complete dentures. No study have yet compared and evaluated the reinforcing effects of fibre and metal reinforced denture with simulated oral conditions to fracture these dentures and also to compare these meshes in clinical cases of maxillary edentulous arches.

Purpose-The purpose of this study was to see better strengthening options for single maxillary reinforced dentures using three different reinforcements in ideally fabricated dentures and in different clinical cases of maxillary edentulous arches.

Materials and Methodology-Ideal maxillary dentures were reinforced with SES (Group-A), Glass cloth, GC2 (Group-B) and Metal mesh (Group-C). These groups along with Non reinforced control group (Group-D) with a sample size of 10 per group, were compared to assess mechanical properties of dentures and results were analyzed using ANOVA and Post Hoc Tukey Test. Ten reinforced dentures per group were also delivered to the patients.

Results- Fracture load of Group A was significantly higher than Group B [p=0.017] and D [p<.001] but not significantly higher than Group C [p=0.977]. Elastic modulus of Group A and B were found to be nearly same (p=0.183) but was greater than that of Group C and D (p=0.12 and 0.21, respectively). Toughness of Group A was found to be highest amongst all groups.

Conclusions- All reinforced groups showed greater fracture resistance, elastic modulus and toughness than control group. In clinical scenarios, SES mesh showed ease of manipulation, adaption in deep palatal cases, light weight and good esthetics followed by GC 2 mesh.

INTRODUCTION

Polymethylmethacrylate (PMMA) has been successfully used for fabrication of denture bases, artificial teeth and impression trays[1]. Currently it is the material of choice for denture fabrication because of its favorable working characteristics, ease of processing & repair, accurate fit, stability in the oral environment, superior esthetics and cost effectiveness[2]. Despite of its excellent properties, denture fracture is one of the most common clinical problem encountered with this material[3].

Fracture in dentures is mainly seen due to fatigue failure or impact failure[4]. It is desirable to have a denture base material with greater flexural strength. The flexural strength is a combination of tensile, compressive, and shear strength. The primary problem of PMMA is its poor strength characteristics, including relatively low flexural strength, low impact strength and low fatigue resistance. This material shows brittle nature under its glass transition temperature (T_g) of approximately 110ºC and is susceptible to cyclic loading.[5] Repeated flexing of PMMA occurs when it is subjected to loads. This leads to

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development of microcracks at the areas of stress concentration[6].

Factors that can cause denture fractures can be clinical or technical factors, material or processing factors, accidental damage and previously repaired dentures[7].

Methods to strengthen the denture base material includes reinforcement with metal[8], carbon fibers[9], glass fibers (fiberglass)[10], and ultrahigh modulus polyethylene fibers[11] ; the chemical modification of a denture base material such as co-polymerization with a rubber graft copolymer[12] or the addition of cross-linking agents.[13]

Most studies regarding the effect of fiber reinforcement have been conducted by using rectangular-shaped specimens made of denture base resin[2, 14]. As complete dentures have complicated 3-dimensional structures composed of artificial teeth and denture base, the results with these specimens cannot represent those of dentures as the forces have not been applied simulating clinical conditions.

The purpose of this study was to evaluate the reinforcing effects of glass fiber mesh with different content, structures and metal mesh on single maxillary complete dentures using total fiber reinforcement (TFR) placed over artificially mimicked mucosa and reduced cast and application of load on the posterior teeth and to compare the effects with non-reinforced maxillary denture. This study included both in vivo and in vitro component.

METHODOLOGY

Samples in this study were divided into four main groups: Group 1-SES mesh, Group 2-GC2 mesh, Group 3- Metal mesh and Group 4-Control (Non reinforced maxillary dentures). Sample size was 10 for each group for both in vivo and in vitro component of the study. (Fig 1)

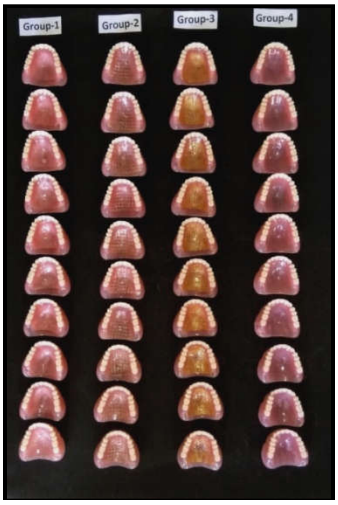


Figure 1 Forty dentures (In vitro component)

Patients for clinical component of this study were selected from outpatient department attending the Department of Prosthodontics and Implantology at Himachal Institute of Dental Sciences, Paonta Sahib, Distt. Sirmour, Himachal Pradesh from year 2016-2018. The inclusion criterion for selection is given in Table 1. All the patients were well informed about their participation in clinical trial of this study, their consent was obtained and a prior approval was taken from the ethical committee of institution to conduct this study.

Table 1 The inclusion criteria for selection of cases was maxillary complete edentulous ridges against-

Cases	*Occlusion*
Mandibular natural remaining teeth	Canine guided/ Groupfunction
Partially edentulous mandibular teeth	Canine guided/ Groupfunction
Fixed mandibularteeth	Canine guided/ Groupfunction
Implant supported mandibular overdenture,	Bilateralbalanced
Tooth supported mandibular overdenture.	Bilateralbalanced

In vitro component of the study

Forty maxillary edentulous casts were made by pouring high-strength dental stone into an edentulous rubber mold (EDE 1001, Nissin Dental Product Inc). An ideal occlusal rim was fabricated, and teeth's setting was done according to glass plate relation. Processing of the denture was done using compression molding technique. The processed denture was finished and polished in such a way that the thickness of the denture was 3 mm overall and this completed denture was duplicated with the help of Vinylpolysiloxane putty (Kerr Take 1 Advanced putty) to form a mold (Fig 2). Forty ideal wax dentures of same thickness and ideal teeth setting were made using this mold. To maintain even thickness a weighing block of 2kgs was placed over the cast during duplication for 1hour. These forty dentures were processed in the similar manner till dewaxing stage.

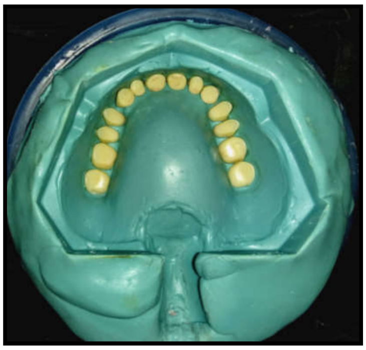


Figure 2 Putty mold to duplicate ideal teeth setting

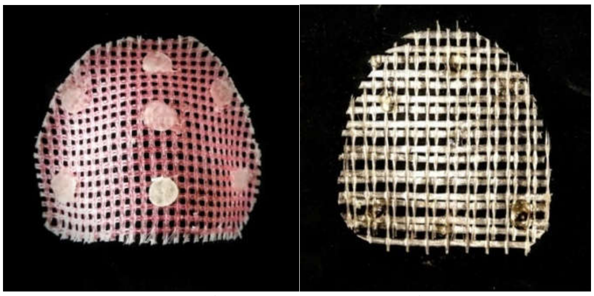
One sheet of (1 mm thick) molding wax was pressed on the edentulous cast, and stops were formed bilaterally at canine region, the first molar area, and three at the midline of the palate by removing a 2 mm diameter of the wax and were filled with self cure denture base resin (DPI). The mesh was then placed over the edentulous cast covered with the wax sheet.

Group 1- SES mesh (INNO Dental Corp Limited, Seoul, Korea) was adhered to cover the entire palate of the cast and was polymerized with a light-polymerization unit (Liwa Light, Willman and Pein, Germany) according to the manufacturer's recommendations.

Group 2- Two layers of Glass cloth (GC2) [Chinmmay enterprises, Bhosari, Pune] were placed over each other and was cut in shape adapting entire palate. The GC2 was treated with silane coupling agent (Silano, Anglus, Balaji Dental Supplies, Bahadurgarh) and dried, then bonding agent (One coat bond SL, Coltene, Mumbai) was applied and cured with a light-polymerization unit (Liwa Light).

Group 3-The metal mesh (Maarc, Darya Ganj, New Delhi) was placed on the edentulous cast and hammered to form the shape of the palate and residual ridge crest of the cast.

Wax spacer was removed and meshes were cut finally adapting the cast (Fig 3).



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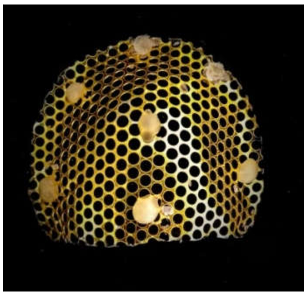


(iii)

Figure 3 Trimmed meshes with tissue stops. i) SES mesh, ii) Glass cloth 2, iii) Metal mesh.

Heat cure acrylic resin (Meliodent, **Heraeus Kulzer**) was mixed (3:1, polymer & monomer) and packed in dough stage; the mesh was placed on the lower half of flask at this stage and packed under compression. Tissue stops ensured that the mesh was placed in between the intaglio and cameo surface of denture. Final finishing of processed denture was done maintaining same thickness all over i.e. 3mm. (Fig 4)

Figure 4 Finished and polished dentures.

Fabrication of edentulous mold simulating oral soft tissue

A special tray was fabricated over the maxillary edentulous cast with full spacer. Vinylpolysiloxane light body impression of intact cast was made using this special tray. (Light-Bodied Permlastic; Kerr Corp) (Fig 5).

To simulate the oral mucosa, the edentulous cast was reduced in between 1.6 and 5.5 mm for each region according to the results of Uchida *et al*[15]. The labial and buccal frenum of the cast were also removed (Fig 6). The reduced edentulous cast was duplicated using heat cured clear acrylic resin (DPI, Heat cure clear acrylic) (Fig 7). A separator (Vaseline petroleum jelly) was applied on the inner surface of the light body impression and it was then loaded with monophase (Aquasil Ultra) and placed over reduced acrylic cast. Impression was separated from the tray once it was set, i.e.; after 15 minutes. Any excess material was cut and placed over reduced cast to simulate oral mucosa (Fig 8). Four reduced acrylic casts (one per group) with eight simulated mucosa (2 per group) were made.

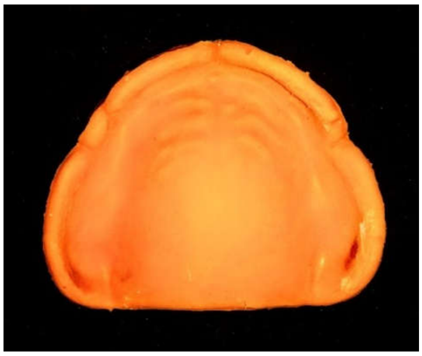


Figure 5 Light body impression of

Figure 6 Reduced edentulous cast master model

Figure 7 Reduced acrylic cast

Figure 8 Reduced cast with simulated oral mucosa

Testing of the specimens

To measure the compressive properties, complete denture was placed on the fabricated model and load was applied over the teeth region using universal testing machine at a crosshead speed of 5 mm/min. To apply bilaterally equal force over the denture, two metal cylindrical rods (2mm in diameter, 30 mm in length) were placed over the posterior teeth region i.e. from first premolar to second molar and a metal rectangular slab (70mm in length, 32 mm in width and 10 mm in thickness) was placed over them (Fig 9). A cylindrical screw (M16, 12.9 bolt; ANSI/ISO Metric hex cap screw, Grade steel) was placed in between the slab and the cross head of universal testing machine (Fig 10). The maximum force before fracture was recorded as fracture resistance in kilonewton (kN). The compressive test data was evaluated using Digital Universal testing machine (BCS/E/01, WDW series, Banbros). The end of the test was determined either by fracture or when the load dropped 30% from the maximum load. Elastic modulus and toughness was also calculated using the data obtained from load and displacement curve. Since there was a screw placed in between the metal slab and UTM mandrel, the energy absorbed by the screw was reduced from the values of elastic modulus and toughness for each sample.

Fracture resistance, elastic modulus, and toughness were analyzed by the ANOVA and Post Hoc Tukey Test to identify differences among groups. The level of significance chosen in all statistical test was $p<0.05$.

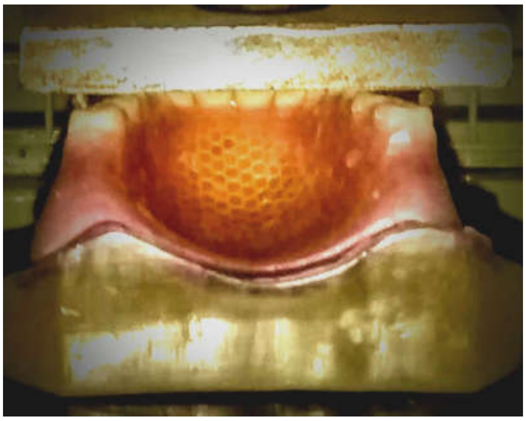


Figure 9 Rectangular slab and rods placed over posterior teeth

Figure 10 Model palced on UTM table with screw in between the slab and mandrel.

RESULTS

The results comparing the mechanical properties of the all samples are represented in Table 2. The fracture pattern of all specimens is given in Table 3 (Fig 11). Failure mode was classified according to the location of fracture lines and involvement of reinforcement (Fig 12, a-d). It was observed that in most of the dentures the fracture lines initiated at both labial and buccal notches.

Table 2 Mechanical properties of all samples with average of four groups

Fracture load (kN)				
S.No	*Group A SES Mesh*	*Group B GC2 Mesh*	*Group C Metal mesh*	*Group D Control*
1	10.004	6.061	9.252	5.011
2	10.510	6.127	7.418	6.695
3	12.611	8.245	8.031	5.100
4	6.351	8.002	8.867	5.727
5	8.343	6.311	9.361	5.363
6	7.604	8.395	8.509	4.109
7	8.974	7.126	9.607	5.977
8	10.499	8.81	9.847	6.813
9	8.47	8.474	9.074	6.723
10	8.063	6.951	9.255	4.311
Av.	**9.143**	**7.450**	**8.922**	**5.583**
Elastic Modulus (kN/mm)				
1	2.896	3.081	1.966	3.033
2	4.030	3.233	2.362	3.005
3	4.154	4.271	2.062	3.612
4	4.342	4.087	1.641	2.426
5	4.163	4.270	1.938	1.594
6	2.875	3.815	1.937	1.319
7	2.242	3.753	3.179	2.600
8	2.748	4.239	2.464	1.892
9	2.633	3.988	2.331	2.450
10	2.181	3.573	2.790	1.373
Av.	**3.226**	**3.831**	**2.267**	**2.330**
Toughness (Nm/J)				
1	7.488	6.468	14.738	2.864
2	16.109	6.626	9.717	5.928
3	21.859	5.380	6.443	3.44
4	4.213	5.729	16.489	5.645
5	8.926	5.127	13.199	5.789
6	8.014	7.869	11.052	4.450
7	17.898	10.682	7.222	4.486
8	18.508	8.683	12.246	8.724
9	12.773	8.469	8.823	7.176
10	15.304	12.24	9.220	4.134
Av.	**13.109**	**7.728**	**10.915**	**5.263**

Table 3 Fracture pattern seen in different groups of maxillary complete dentures

Fracture Pattern Types	**Group A (SES)**	**Group B (GC2)**	**Group C (Metal)**	**Group D (Control)**
1.Complete fracture of Denture. (Fig-30)	0	0	0	10
2.Partial fracture of teeth or denture base/Incomplete fracture. (Fig-31)	8	7	5	0
3.Fracture of denture base involving fracture of reinforcement. (Fig-32)	0	1	4	0
4.Fracture of teeth or denture base accompanying delamination between denture base and reinforcement. (Fig-33)	2	2	1	0

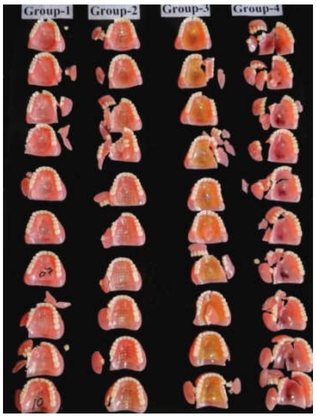
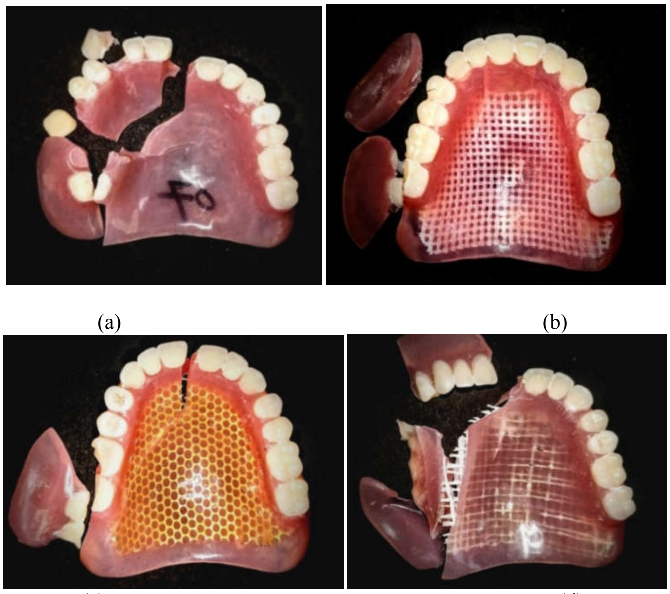


Figure 11 Fractured dentures all four groups



(a) (b)

(c) (d)

Figure 12 (a)Type 1-Complete fracture of denture, (b)Type 2-Partial fracture of teeth or denture base, (c)Type 3- Fracture of denture base base involving fracture of reinforcement, (d) Type 4-Fracture of teeth or denture accompanying delamination between denture base and reinforcement

Samples in Group A (SES Mesh) showed either partial fracture (80%) or fracture of teeth and/or denture base with delamination of mesh (20%). In Group B (GC2 Mesh) majority of dentures showed incomplete fracture (70%), followed by delamination of mesh along with teeth or denture base fracture (20%), only one denture showed material fracture (10%). Group C (Metal Mesh) showed all modes of failure except complete fracture (Type 2 mode of fracture -50%, Type 3-10%, Type 4-20%). All samples of Group D (Control) fractured in 2 or 3 pieces showing 100 %complete fracture failure mode.

Table 4 is showing descriptive statistics, which includes mean and standard deviation of each group. One way ANOVA test was used to analyse the fracture load, elastic modulus and toughness, significant difference was found in the properties of groups (Table 5). Post Hoc Tukey (HSD) Test was used to identify differences among groups (Table 6). In inter group comparison, the fracture load of Group A (SES mesh) was significantly higher than Group D (Control) [p<.001] and Group B (GC 2 mesh) [p=0.017]. The fracture load of Group B was higher than Group D (p=0.007). [Graph 1]

Significant difference was observed in elastic modulus of Group A when compared to Group C and D (p=0.12 and 0.21, respectively) and Group B when compared to Group C and D (p<0.001 for both Group C and D [Graph 2] .The toughness of Group A was found to be highest amongst all groups. Significant difference was seen in comparison to Group B and D (p=0.010 and <0.001, respectively). Toughness of Group C was significantly higher than that of Group D (p=.007) [Graph 3]

Table 4 Descriptive Data of all the properties

Mechanical Properties		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
						Lower Bound	Upper Bound
Fracture load (kN)	A	10	9.1433	1.79283	.56694	7.8607	10.4258
	B	10	7.4504	1.05705	.33427	6.6943	8.2066
	C	10	8.9223	.74450	.23543	8.3897	9.4549
	D	10	5.5831	.97894	.30957	4.8829	6.2834
Elastic Modulus (kN/mm)	A	10	3.2268	.84993	.26877	2.6188	3.8348
	B	10	3.8316	.42637	.13483	3.5266	4.1366
	C	10	2.2676	.45903	.14516	1.9392	2.5959
	D	10	2.3309	.77198	.24412	1.7786	2.8831
Toughness (Nm/J)	A	10	13.1096	5.74231	1.81588	9.0018	17.2174
	B	10	7.7285	2.35028	.74322	6.0472	9.4098
	C	10	10.9159	3.24835	1.02722	8.5922	13.2396
	D	10	5.2639	1.76765	.55898	3.9994	6.5284

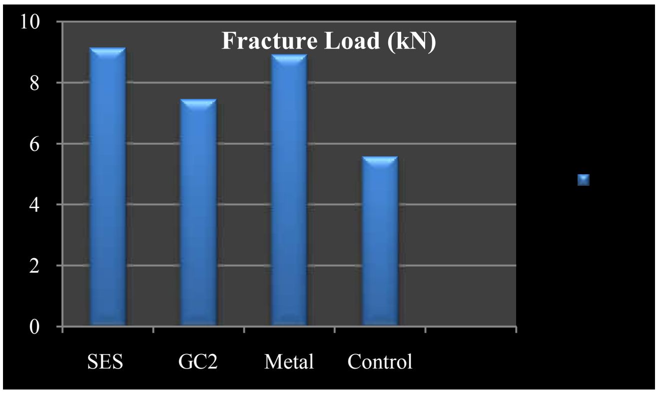
Table 5 ANOVA – Significant difference was seen in between groups (p<0.05)*

		Sum of Squares	df	Mean Square	F	Sig.
Fracture load (kN)	Between Groups	80.980	3	26.993	18.475	<.001**
	Within Groups	52.598	36	1.461		
	Total	133.577	39			
Elastic Modulus (kN/mm)	Between Groups	16.977	3	5.659	13.231	<.001**
	Within Groups	15.397	36	.428		
	Total	32.375	39			
Toughness (Nm/J)	Between Groups	358.752	3	119.584	9.168	<.001**
	Within Groups	469.569	36	13.044		
	Total	828.320	39			

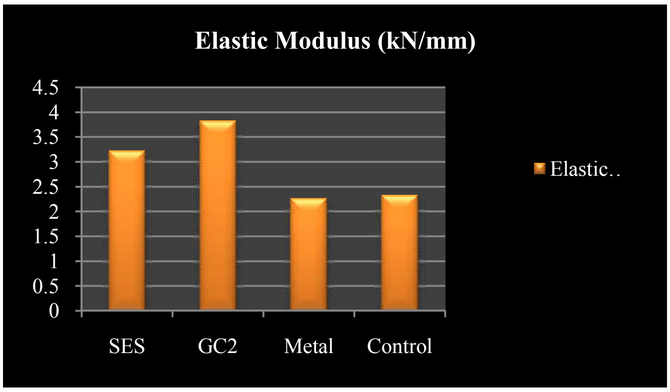
Table 6 Post Hoc Tukey (HSD) Test used for multiple comparison of data

Dependent Variable	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
Fracture load (kN)	A	B	1.69280	.54056	**.017***
		C	.22095	.54056	.977
		D	3.56011	.54056	**<.001****
	B	A	-1.69280	.54056	**.017***
		C	-1.47185	.54056	**.047***
		D	1.86731	.54056	**.007****
	C	A	-.22095	.54056	.977
		B	1.47185	.54056	**.047***
		D	3.33916	.54056	**<.001****
	D	A	-3.56011	.54056	**<.001****
		B	-1.86731	.54056	**.007****
		C	-3.33916	.54056	**<.001****
Elastic Modulus (kN/mm)	A	B	-.60475	.29247	.183
		C	.95926	.29247	**.012***
		D	.89597	.29247	**.021***
	B	A	.60475	.29247	.183
		C	1.56401	.29247	**<.001****
		D	1.50072	.29247	**<.001****
	C	A	-.95926	.29247	**.012***
		B	-1.56401	.29247	**<.001****
		D	-.06329	.29247	.996
	D	A	-.89597	.29247	**.021***

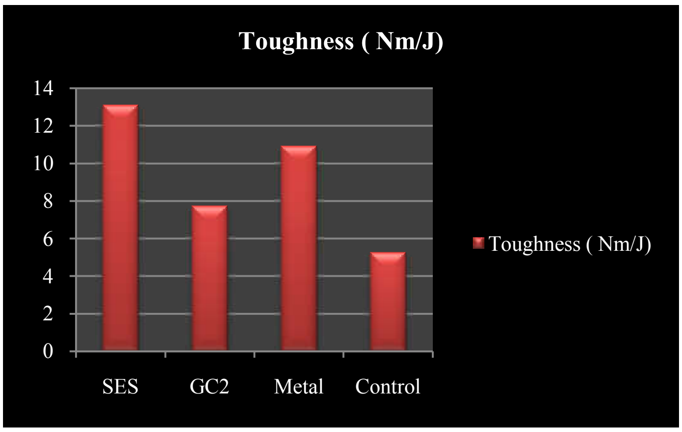
		B	-1.50072	.29247	**<.001****
		C	.06329	.29247	.996
Toughness (Nm/J)	A	B	5.38107	1.61515	**.010****
		C	2.19371	1.61515	.533
		D	7.84566	1.61515	**<.001****
	B	A	-5.38107	1.61515	**.010****
		C	-3.18737	1.61515	.217
		D	2.46458	1.61515	.433
	C	A	-2.19371	1.61515	.533
		B	3.18737	1.61515	.217
		D	5.65195	1.61515	**.007****
	D	A	-7.84566	1.61515	**<.001****
		B	-2.46458	1.61515	.433
		C	-5.65195	1.61515	**.007****



Graph 1 Fracture load of different groups



Graph 2 Elastic modulus comparison in different groups



Graph 3 Comparison between Toughness in four groups

DISCUSSION

Many authors have suggested different methods to reinforce denture base acrylic resin. Jennings & Wuebbenhorst, 1968; Ruffino, 1985 have used different types of metal wire for denture reinforcement.[16] In many studies, carbon fibres have been used for strengthening the acrylic denture based material[16, 17]. The use of carbon fibres might pose an aesthetic problem because of black colour of the fibres.[16] Glass or aramid fibres might be aesthetically better suited materials for this purpose. The strengthening properties of glass and aramid fibres have also been studied by many researchers.[17]

In this study, all the reinforced groups showed higher resistance to fracture load as compared to control group. SES mesh dentures showed highest resistance to fracture against the compression load followed by Metal mesh. The SES mesh increased the fracture load of control group by 63.7 %, followed by metal mesh 59.8% and GC2 mesh 33.4%. This may be attributed to the fact that chemical bonds form more easily between prepolymerised SES mesh fibers and the denture base resin than between the metal and resin[17, 18]. Further studies are required to evaluate whether the fracture load of dentures can be increased by the surface treatment of metal mesh with a metal primer. The fracture load of SES mesh was significantly higher than GC 2 mesh (p=0.017) and Control group (p<.001) but not significantly higher than Metal mesh (p=0.977). Similarly, significant difference was seen in toughness of SES mesh in comparison to GC2 (p=0.010) and control group (p<.001). No significant difference was seen in between SES and Metal mesh groups (p=0.533). SES mesh increased the toughness of control group by 149%, followed by metal mesh 107.3 %. GC 2 mesh increased the toughness of control group by 46.8%. GC2 mesh showed better properties than the control group as significant difference was seen on comparison of fracture load and toughness (p=0.007 and 0.433, respectively). Metal mesh shows superior properties than GC2 and control group. This can be explained on the basis of number of layers used for glass cloth mesh. In our study two layers of glass cloth were used. In the similarly conducted previous study by Sang-Hui Yu *et al* (2015, 2017) three and four layers of glass cloth fibre was used, which showed better results than metal reinforced group.[19, 20]

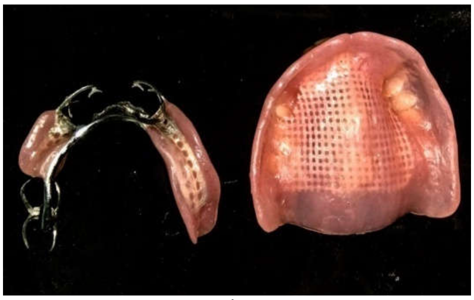
There are many studies in which the mechanical properties of single maxillary complete dentures were evaluated experimentally on study models or on ideal dentures.[8, 21, 22, 23, 24] Only few studies have evaluated the effects of reinforced dentures given in actual clinical cases.[23, 25] The purpose of adding in vivo component in this study was to see working properties of meshes in various clinical scenarios and to look for any incidence of fracture, fracture pattern, exposure and subsequent discoloration of mesh over a follow up period of more than one year. (Fig 13-16)

A

b

Figure 13 – Intraoral view, a) Pre treatment b) Post treatment

a



b

Figure 14 Clinical case – Maxillary tooth supported overdenture w.r.t 13,14,24,25 against lower cast partial denture kennedy's class 2 modification 1, reinforced with SES mesh, (a) Cameo surface, (b) Intaglio surface.

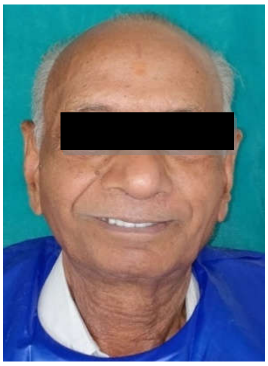


Figure 15 Extra oral view

Figure 16 Follow up after one year-cameo surface

It was found that the SES mesh not only showed superior results in terms of mechanical properties, it was easy to manipulate and showed better working properties. In clinical cases SES mesh was easier to adapt followed by GC2, especially in cases with deep palatal vault where metal mesh was difficult to adapt. During the study period two fractured maxillary dentures were reported in the department. One case reported incidence of maxillary complete denture from the midline against remaining natural lower teeth after 2 years, with multiple attempts to repair the fractured denture. Another case was maxillary complete denture against mandibular overdenture and the history of wearing was 3 years. The type of fracture noted in this case was midline fracture with fracture line extending to the posteriolateral area of palate. Both the cases were reinforced with different materials (SES and metal mesh, respectively) and followed up over a period of more than one year. None of the mesh was exposed as seen in one year follow up period. No incidence of fracture of reinforced denture was seen.

There are numerous studies that have evaluated the flexural strength of different reinforced heat cured acrylic resin materials in rectangular bar shaped specimen using 3-point bending test.[2,5,14,26,27,28] Some studies have used maxillary mold to evaluate impact and/or flexural strength of maxillary reinforced dentures. [21, 22, 23] Very few studies have used a reduced cast with simulated oral mucosa to evaluate fracture resistance of reinforced maxillary dentures.[8, 20]To make the experimental conditions close to the denture in mouth, a reduced cast with simulated oral mucosa was used in the in vitro part of this study. To produce realeff effect, the cast was reduced 1.5-5mm according to the test results of Udicha *et al*.[15]

In order to minimize error in the values of fracture loading, a pilot study was done using twelve (three per group) reinforced dentures to see any changes in the simulated mucosa of test model. It was found that the silicon material used to simulate mucosa was torn and crack lines were observed in study model after applying compression load over eight reinforced dentures. Therefore, four reduced acrylic casts and eight simulated mucosa fabricated with elastomeric material were used in this study. One reduced cast and two fabricated mucosa were used per group and the reduced mucosa of each group was changed after fracture of five samples while testing, as elastomeric material would also undergo elastomeric strain and fatigue after application of compressive load.

The conventionally used methods for evaluating the fracture resistance of dentures applied direct force on the palatal area of the maxillary denture without any support of underlying structure.[19, 29] However, this method is completely opposite to the direction of forces applied intraorally on dentures. The results of such tests have low clinical applicability. [8, 19]In this study, point of application of force was on the posterior region of teeth as this region is used for chewing. A screw was placed in between slab and mandrel to ensure that equal force was applied bilaterally to avoid any high point of contact incorporated during fabrication of denture and/or oral mucosa simulated model.

It has been established that maxillary dentures are subjected to bending deformation, with tensile stresses occurring at the labial aspect and lingually to the incisors on the polished surfaces. According to M.S. Beyli, J. A. von Fraunhofer, [30] Matthews and Wain [31], the area lingual to the incisors is the most heavily stressed and, clearly, the incisal notch (relief for incisive papilla) represents a point of weakness in that it might act as a stress raiser and so contribute to midline fracture of maxillary dentures. In a 3-D FEA analysis done by Yi Y Cheng *et al* in 2010, highest tensile and compressive strains were found at the incisal and labial frenal notches, respectively. Strains on the intaglio surface of the denture were primarily compressive[21].

Fracture of dentures have been reported in patients when the fiber reinforcements are placed too close to the oral mucosa that corresponds to the compression side during mastication.[32] Many studies suggested that the mesh should be located on the tensile side of the specimen to increase the flexural strength and flexural modulus.[5, 22, 23] In this study, the mesh was covered in the entire palatal region and was placed in between the polished and tissue surface with even thickness of 3 mm.

CONCLUSION

Within the limitations of this study, the following conclusions were drawn

1. All the three reinforced groups showed greater fracture resistance, elastic modulus and toughness than control group.
2. The fracture load and toughness of the SES group were higher than those of the metal mesh and GC2 mesh group.
3. Single maxillary complete dentures fabricated with fiber reinforcement were lighter in weight and more esthetic in comparison to metal mesh dentures.
4. In clinical scenarios, SES mesh showed better working properties with ease of manipulation and adaption in deep palatal cases, followed by GC 2 mesh.

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