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RESEARCH ARTICLE

A Comparative Evaluation of the Retention of Denture Bases fabricated using Selective Pressure, Massad's and Functional Impression Techniques: A Clinical Study

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ABSTRACT

Background: Impression techniques have evolved considerably during the last decade. However, it needs to be assessed whether the retention achieved with these techniques is adequate enough to establish them as an alternative to the conventional techniques.

Purpose: This study was planned to evaluate the retention of denture bases fabricated using the selective pressure, functional and Massad's impression techniques.

Materials and methods: Twenty completely edentulous patients were selected and each of them was subjected to three definitive impression techniques: selective pressure, functional and Massad's techniques. The permanent bases were fabricated and checked for retention with a custom made retention checking apparatus. The load required to dislodge the denture base fabricated using each technique, from the maxillary foundation was recorded and this data was subjected to statistical analysis.

Results: The statistical analysis shows that the difference between the selective pressure and the functional impression technique is statistically significant (p = 0.046) However, this result needs verification by collecting more data or designing another study, since the observed p-value is closer to the significance level (i.e. 0.05). Though the difference between the means of Massad's and functional techniques is of 39 gm, it is statistically not significant (p = 0.09). The difference between means load to dislodge denture bases for selective pressure and Massad's techniques (5.5 gm) is not statistically significant (p = 0.95).

Conclusion: The three impression techniques yielded adequately retentive permanent denture bases. However, retention of the denture bases obtained from the selective pressure impression technique was best, followed by the Massad's and functional techniques.

Clinical implication: The results of this study indicated that the denture bases fabricated using selective pressure impression technique were more retentive than the Massad's and the Functional impression technique.

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INTRODUCTION

The evolution of dentistry and increased dental awareness has made the patient more demanding. The loss of teeth and supporting tissues by disease or accident is still a cause of concern, which demands replacement by artificial substitutes. Complete denture is a removable prosthesis that replaces the entire dentition and associated structures of the maxillae or mandible.[1] The fabrication of complete denture requires a number of steps, the first, being impression making. A complete denture impression is a negative registration of the entire denture bearing, stabilizing and border seal areas present in the edentulous mouth.[1] The objectives of an impression are to provide retention, stability, comfort and support to the denture. An impression also acts as a foundation for improved appearance of the patient and at the same time maintains the health of the oral tissues.[2] The impression techniques are numerous, but may be generally classified according to jaw position and the degree of pressure used when making the impression, that is, open or closed mouth, pressure, nonpressure or negative pressure, or selective pressure.

The selective pressure impression technique was proposed by Boucher in 1950. It combined the principles of both pressure and minimal pressure techniques. It confined the forces acting on denture to the stress bearing areas. These tissues were recorded under slight pressure while other tissues were relieved with minimal pressure.[3] Functional impression materials were those which, when applied to the tissue surface of a denture base or impression tray, recorded the topography and position of the basal seat and border tissues as they existed in a functional state.[4] Tissue-conditioning materials had been

found useful as functional impression materials.[4] The functional impression technique utilized the property of the tissue conditioners to allow time for the tissues to reposition themselves as they had an ability of getting compressed under pressure but rebound when pressure was released. Elastomeric impression materials are being used in recent times for impression making in complete denture fabrication. Joseph Massad in 2007 proposed a modified impression technique which included building or layering method of impression making, maintaining the integrity between layers of the impression materials of varying viscosities depending on the compressibility of the tissues.[5] It provided detailed and customized impression of the edentulous patient using both the static and functional concepts of impression making in one application.[5]

The introduction of new impression materials and techniques has made it necessary to evaluate whether these are efficient and accurate enough to substitute the conventional techniques and materials being used since decades. The retention achieved in a denture is an important criteria to check the accuracy and efficacy of an impression material or technique. Hence, this study was planned to evaluate the selective pressure, functional and Massad's impression techniques and correlate the retention achieved for the denture bases fabricated using these techniques.

MATERIALS AND METHODS

Twenty completely edentulous patients were selected based on the inclusion and exclusion criteria (Fig. 1). The selected patient's history, examination, both intraoral and extraoral were carried out to assess the patient's tissues. Special emphasis in the examination was given to the maxillary arch and variation in the compressibility of the overlying tissues were assessed with a T- burnisher and marked on a cast which was used as a reference for special tray fabrication for selective pressure, functional impression technique and to determine the areas where different viscosities of elastomeric impression materials will be placed during the Massad's impression technique. An appropriate maxillary edentulous stock metal tray with 5 mm clearance between the tray and maxillary ridge was selected and primary impression was made with impression compound (Y Dents). The impression was poured in dental plaster Type II (Kaldent) to obtain a primary cast for each patient. The primary cast was duplicated in putty (Aquasil) to achieve two primary casts for each patient which were numbered as No. 1 and 2. On the cast No. 1 auto polymerizing acrylic resin special tray (DPI) was fabricated for selective pressure impression technique, with a spacer design by referring to the chart on which the compressibility was marked and also the stress bearing and relief areas. The tray was fabricated using by dough technique. The tray for selective pressure impression technique was kept 2 mm short of the sulcus. On cast No. 2 auto polymerizing acrylic resin special tray (DPI) was fabricated for functional impression technique. The tray was made extending to the sulcus and without handle so that the patient could perform the functional movements easily. The definitive impression techniques were grouped as following:

Selective pressure impression technique.[6-9]
Massad's impression technique.[5,10-14]
Functional impression technique.[15-17]

Selective Pressure Impression Technique

The special tray fabricated on cast No. 1 was checked for adaptation and extension and modified whenever required. The border molding was done with low fusing impression compound (DPI Pinnacle) by sectional method. The definitive impression was made with zinc oxide eugenol impression paste (DPI) standardizing the manipulation of materials (Fig. 2).

Massad's Impression Technique

The second definitive impression technique was the Massad's technique. Specially designed trays which could be molded in hot water were selected for individual patients taking into consideration size of the arch. The tray size selection was done by measuring the distance between the tuberosities using a caliper and relating it to the chart given with the trays. The tray was modified wherever required. In this technique depending on the resiliency of the tissues, the elastomeric impression materials of various viscosities were used. High viscosity polyvinylsiloxane material (Aquasil) was used for making tissue stops, ensuring a uniform distance of approximately 2 to 3 mm from the vestibular sulcus. Single step border molding was then performed with high viscosity polyvinylsiloxane material (Aquasil). The light viscosity polyvinylsiloxane impression material (Aquasil) was loaded corresponding to the areas to be relieved over the tray and medium viscosity polyvinylsiloxane (Aquasil) was loaded in the other areas. The loaded tray was placed in the oral cavity and impression was made (Figs 3 and 4).

Functional Impression Technique

The special tray fabricated on cast No. 2 was checked for adaptation and extensions. Any necessary corrections were made. The spacer was removed. The powder and liquid of the tissue conditioner (D-soft) were mixed according to manufacturer's instructions and loaded onto the tray and impression was made. The patient

Fig. 1: Preoperative intraoral

Fig. 2: Final impression with selective pressure impression technique

Fig. 3: Border molding for Massad's technique

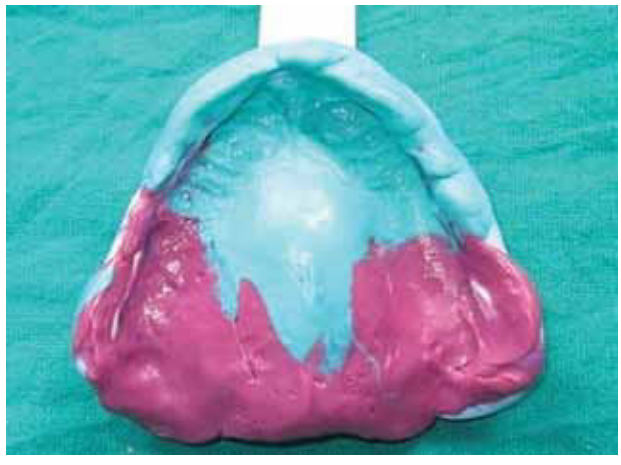

Fig. 4: Final impression using Massad's impression technique

Fig. 5: Final impression with functional impression technique

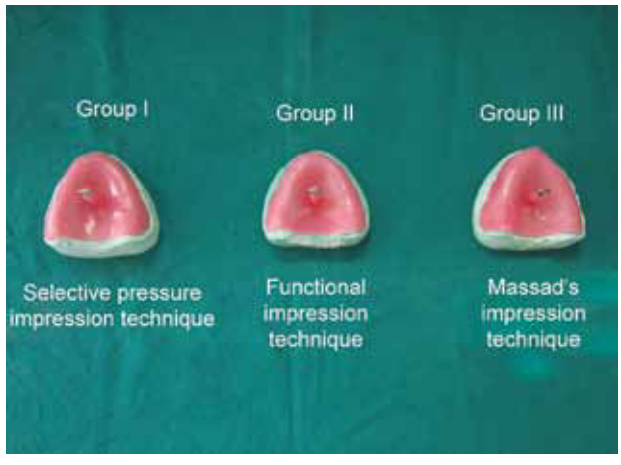

Fig. 6: Permanent bases with metal hooks

was instructed to make functional movements like swallowing, speech and pursing of lips. After three minutes the tray was removed and impression was checked for any voids. Impression material was added if required. The tray was placed in the oral cavity again for 30 minutes (Fig. 5).

The three definitive impressions were poured in Type III dental stone (Kaldent). The tissue conditioner impression was coated with dental stone using a paint brush taking care, not to disturb the tissue conditioner material. After this layer of stone was set, the second layer of stone poured followed by the base. Other impressions were poured using the conventional technique. The casts were retrieved and permanent bases were fabricated with heat polymerizing acrylic resin. The bases were then retrieved, finished and polished. The bases were

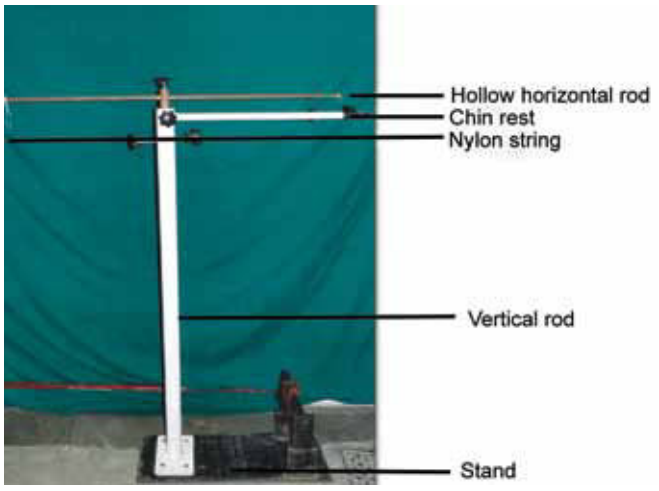

Fig. 7: Retention measuring apparatus

Fig. 8: Bases loaded with weights to check for retention

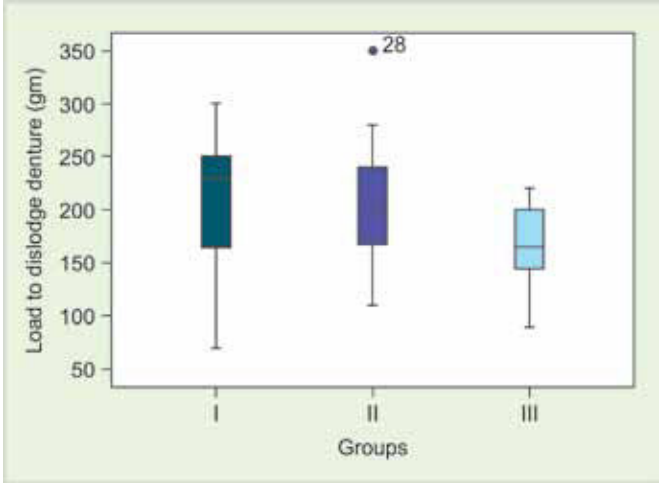

Fig. 9: Boxplots for load to dislodge denture bases

then placed in cold water till further use. A hook was attached at the center of the denture base with self polymerizing acrylic resin keeping it perpendicular to the occlusal plane of the edentulous ridge (Fig. 6). The components of the retention measuring apparatus were secured in position. The selected patient was made to stand in a cephalostat (Figs 7 and 8). The patient was made comfortable, the maxillary denture base fabricated using selective pressure technique was placed on the maxillary foundation. The nylon string on one end was attached to the hook of the denture base. The other end had the weighing pan on which weights were added very slowly taking care not to disturb the assembly. The weight used to dislodge the denture base was recorded. Three such readings were taken and the average of three readings was considered the definitive reading for that base. After an interval of 48 hours, the next base fabricated using Massad's impression technique and again after 48 hours the base fabricated using functional impression technique was checked for retention. In a similar manner all the 20 patients' denture bases were checked for retention and the weights which dislodged the bases were recorded (Table 1).

The readings were then subjected to statistical analysis:

- One-way ANOVA (Table 2) and
- Post hoc tests: Multiple comparisons by using Scheffe test for subjects (Tables 3 and 4).
- The level of significance was set at 0.05.

RESULTS

The statistical analysis shows that the difference between the selective pressure and the functional impression technique is statistically significant (p = 0.046) However, this result needs verification by collecting more data or designing another study, since the observed p-value

Table 1: Load required to dislodge the denture bases

Patient	*Group I (gm)*	*Group II (gm)*	*Group III (gm)*
P1	150	120	110
P2	140	190	160
P3	70	200	90
P4	250	110	150
P5	95	110	90
P6	250	200	170
P7	240	200	180
P8	300	350	150
P9	245	240	190
P10	180	190	150
P11	260	230	220
P12	220	240	200
P13	200	180	160
P14	160	150	120
P15	300	280	210
P16	250	240	220
P17	240	230	200
P18	260	265	210
P19	210	200	180
P20	170	155	140
Total	4190	4080	3300

Table 2: Result of one-way ANOVA test for load to dislodge denture base

Source of variance	*Sum of squares*	*DF*	*Mean square*	*F*	*p-value*
Between groups	23543.33	2	11771.67	3.86	0.03
Within groups	173975	57	3052.193	–	–
Total	197518.3	59			

Table 3: Results of Scheffe's multiple comparisons

Pairs of groups compared	*Mean difference*	*Std. Error*	*p-value*	*95% confidence interval*	
				Lower bound	*Upper bound*
Group I-II	5.5	17.47	0.95	–38.41	49.41
Group I-III	44.50	17.47	0.046	0.59	88.41
Group II-III	39	17.47	0.09	–4.91	82.91

Table 4: Homogeneous subsets in terms of mean load to dislodge denture base

Groups	*n*	*Subset for alpha = 0.05*	
		1	*2*
III	20	165	–
II	20	204	204
I	20	–	209.5
p-value	–	0.09	0.95

is closer to the significance level (i.e. 0.05). Though the difference between the means of Massad's and functional techniques is of 39 gm, it is statistically not significant (p = 0.09). The difference between means load to dislodge denture bases for selective pressure and Massad's techniques (5.5 gm) is not statistically significant (p = 0.95) (Fig. 9).

DISCUSSION

The result of the study emphasizes that all three impression techniques yield adequately retentive permanent denture bases. However, the retention of the denture bases obtained from the selective pressure impression technique was better than the Massad's and functional technique. This is in accordance with Sharry, Wang and Khlevnoy who recommended definitive impressions with a spaced custom tray and zinc oxide eugenol impression paste. The difference measured though is not of a significant value to imply an alternate hypothesis. Williams, Zarb, Gilbert and Blandin, Chee and Donovan[18] stated that greater accuracy is obtained in custom made trays than with impressions made in stock trays. The denture base fabricated by the Massad's impression technique did not show much difference as compared to the selective pressure impression technique though the bases were less retentive. This may have been due to lack of a special or custom tray in the Massad's technique. The specialized stock trays designed by Massad were used. They did not fit as well as the special tray for the respective individual. The varying viscosity of elastomeric impression materials did have an advantage because low viscosity was used for applying light pressure in relief areas, medium body for other areas of the palate and high viscosity for border molding. This was a single step impression technique. It used contemporary materials having more accuracy and dimensional stability. It may however be expensive as the trays are technique specific and elastomeric impression materials are more costly than the zinc oxide eugenol impression paste. The functional impression technique in which the tissue conditioner material was used for making the impression showed the least retentive denture bases as compared to the Massad's and selective pressure technique. The lower retention of the bases fabricated by the functional impression technique may have been due to the fact that the material had a property to flow and did not exert any pressure on the peripheral tissues which is achieved by low fusing compound and the high viscosity impression material.

CONCLUSION

Within the limitations of the study the following conclusion were drawn:

1. The permanent denture bases fabricated using selective pressure definitive impression technique were the most retentive among the three definitive impression techniques.
2. The permanent denture bases fabricated using Massad's definitive impression technique were more retentive than the functional impression technique, but less retentive than the selective pressure impression technique.
3. The permanent denture bases fabricated using functional impression technique were the least retentive among the three impression techniques.
4. All the three definitive impression techniques-selective pressure, Massad's and functional impression technique yielded denture bases with adequate retention.

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