



## Evaluation and Comparison of the Effect of Different Border Molding Materials on Complete Denture Retention: An *in vivo* Study

<sup>1</sup>Renu B Pachar, <sup>2</sup>Younginder Singla, <sup>3</sup>Prince Kumar

### ABSTRACT

**Aim:** Different border molding materials have different qualities which help in recording fine details of tissues. The present study was conducted to evaluate and compare the effect of different border molding materials on complete denture retention.

**Materials and methods:** The present study was conducted on 10 completely edentulous patients in the age group of 50 to 70 years. On each patient, three different border moldings were completed. In group I, border molding was done with green stick impression compound. In group II, border molding was done with putty consistency addition silicone. In group III, border molding and final impression were done by polyether impression material in a single step. Permanent denture bases were fabricated with wire loop at the center. Retention was assessed in all three groups using a digital force gauge.

**Results:** Upon data compilation and preparation of spread sheets for concerned groups, it was subjected to statistical analysis using Statistical Package for the Social Sciences (SPSS) software version 21.0 for Windows. Mean age  $\pm$  standard deviation (SD) was  $57.40 \pm 8.46$  in group I,  $57.40 \pm 8.46$  in group II, and  $57.40 \pm 8.46$  in group III. The difference was nonsignificant ( $p > 0.05$ ). The overall mean value for the group I was  $4.59 \pm 0.81$ . For group II, it was  $4.7 \pm 0.81$ . For group III, it was  $6.72 \pm 0.81$ . The difference was significant ( $p < 0.05$ ).

**Conclusion:** Green stick compound with light body final wash showed the lowest mean values of complete denture retention. Dentures made using polyether final impression material showed the highest mean values of complete denture retention followed by putty rubber base border molding with light body final wash.

**Clinical significance:** In this study, polyether showed the highest mean retentive value compared with other tested materials; therefore, it could possibly provide some future innovative means in achieving optimal denture retention.

**Keywords:** Complete denture, Green stick compound, Impression, Polyether.

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### INTRODUCTION

As a proven fact, the denture retention is one of the most difficult problems confronting the prosthodontist. Successful denture therapy can be judged by its ability to withstand the occlusal forces, retention, and stability. The satisfaction level of patients is difficult to achieve. Even complete dentures with all the desired properties may fail to fulfill all the required criteria for the patient. Complete denture retention plays the most important role in patient satisfaction and long-term success denture success. Usually, denture retention is governed by (1) the size of denture base area, (2) quality and quantity of saliva (thick ropy/thin watery), (3) adhesive and cohesive forces, (4) interfacial surface tension and capillarity, (5) presence and amount of bony undercut, and (6) height/width and shapes of remaining alveolar ridge. Perfect retention is anyway desirable and deemed for every denture seeker. It could be logically and precisely achieved by clinical procedures, such as border molding, accurate final impression and occlusion.<sup>1</sup> Border molding should cover the vestibular area effectively so that the final impression of good quality is obtained. Material for

<sup>1-3</sup>Department of Prosthodontics, Maharaja Ganga Singh Dental College & Research Centre, Sri Ganganagar, Rajasthan, India

**Corresponding Author:** Prince Kumar, Department of Prosthodontics, Maharaja Ganga Singh Dental College & Research Centre, Sri Ganganagar, Rajasthan, India, Phone: +919999564962, e-mail: princekumaronline@gmail.com

border molding should have ideal properties. It should be able to flow to all areas; it should be nontoxic and nonirritant. It should be used when in plastic state. The material should be capable of reproducing the tissues in limited number of attempts.<sup>2</sup> Border molding with green stick compound, followed by impression with zinc oxide eugenol impression paste is the universally used impression material in complete dentures because of its simplicity in handling, fast setting, ability to capture minute details, easy handling, and no significant dimensional changes. Low fusing impression compounds have been used since the 1900s. It is used for border molding technique but the process is time consuming. Moreover, the short manipulation time makes it difficult in achieving the desired results. This material is softened by heating it and thus recording the borders which also carries the risk of tissue charring of the patients.<sup>3</sup> Elastomers, such as polyethers, polysulfide, and polyvinylsiloxane (PVS) were other useful materials in prosthodontics which succeeded in overcoming limitations of low fusing impression compound up to a certain extent. Putty condensation silicone has been used nowadays with better outcomes.<sup>4</sup> Additionally, several other studies have advocated the use of polyether base impression material for border molding of complete denture impression. With this technique, there is simultaneous border molding of all the borders of impression with a single insertion of the tray. The present study was aimed to compare the retention of denture base when border molding is done with low fusing compound, putty addition silicone, and without border molding secondary impression made with polyether impression material.

## MATERIALS AND METHODS

The present study was conducted in the Department of Prosthodontics in Maharaja Ganga Singh Dental College & Research Centre, Sriganganagar (Rajasthan) from 2016 to 2017. Ten completely edentulous patients seeking prosthodontic rehabilitation were randomly selected as test subjects in the age group of 50 to 70 years. The exclusion criteria for patient selection were (1) excessive ridge resorption, (2) fibrous anterior ridge, (3) papillary hyperplasia, (4) poor neuromuscular control, and (5) rigid musculature and mucosal tissue (scleroderma and submucous fibrosis). All were informed regarding the study and written consent was obtained. Ethical clearance was taken from the institutional ethical committee prior to the study. A single blinded model was schemed for this study to avoid any kind of conscious/unconscious bias. For each patient, primary impression of the upper arch was made in a suitably sized stock tray and poured in dental plaster to obtain the primary cast. The cast was properly

outlined and relieved for fabrication of custom impression trays using autopolymerizing acrylic resin. Three identical trays with spacer were made for each patient. Trays were divided into three groups according to material used for border molding and final impression. In group I, border molding was done with green stick impression compound and final impression made with light body addition silicone impression material (Reprosil, Dentsply, India). In group II, border molding was done with putty consistency, and addition silicone and final impression was made with light body addition silicone impression material (Aquasil, Dentsply, India). In group III, border molding and final impression were done by polyether impression material in a single step (Impregum, 3M ESPE Inc., USA). The average shelf life of all the material ranged up to 1 to 2 years while the market prices were Rs 2,100/4,700/3,600 for Reprosil/Aquasil/Impregum respectively. Master casts were obtained by pouring impressions with type III dental stone on which heat-cured acrylic permanent denture bases were constructed. A loop made up of 19-gauge stainless steel wire was attached to the anterior palatal region of the waxed-up bases approximately corresponding to a line joining the distal surfaces of cuspids (Fig. 1). Each patient received three heat-cured permanent denture bases constructed from three master casts obtained from three groups of border molding. A digital force gauge was used to record the retention of the denture base (Fig. 2). The denture base was inserted in the patient's mouth and the patient stood upright with head position standardized with the help of a cephalostat such that the maxilla was parallel to the floor and a force was directed perpendicularly to evaluate the retention (Fig. 3). A force gauge was engaged onto the hook of the heat-polymerized trial denture base and force was applied by pulling it downward while being held in the palm of the operator. All clinical and laboratory exercises were completed by the same individual to



Fig. 1: Finished denture base with wire loop at the anterior palatal region

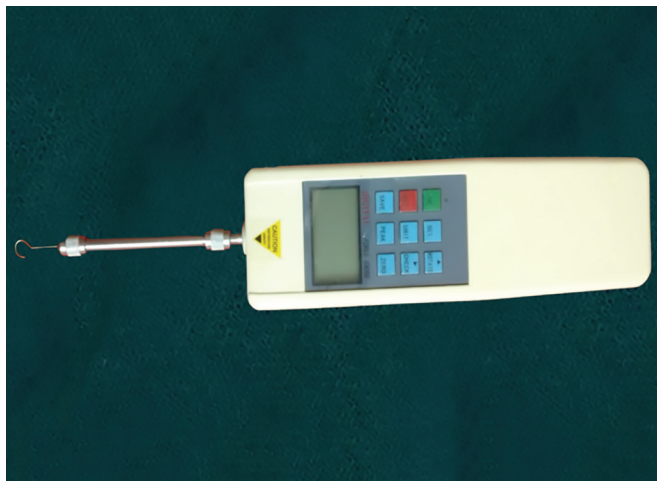


Fig. 2: Digital force gauge to quantify retentive forces



Fig. 3: Application of vertical downward force to dislodge the trial denture base (with digital quantification)

Table 1: Age- and gender-wise distribution

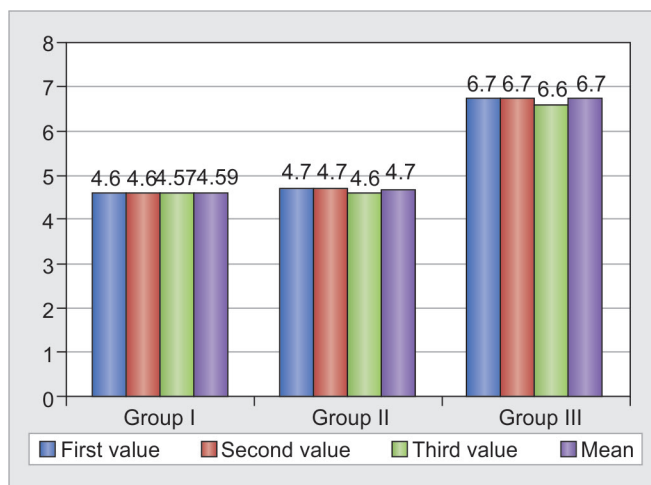
Parameters	Group I		Group II		Group III		p-value
	Male	Female	Male	Female	Male	Female	
Number	4	6	4	6	4	6	0.1
Mean age ± SD	57.40 ± 8.46		57.40 ± 8.46		57.40 ± 8.46		1

p < 0.001 (significant)

avoid any possibility of interindividual bias. Readings were recorded and the collected data were tabulated and statistically analyzed to evaluate the difference in retention of the denture bases obtained from the studied impression materials.

**STATISTICAL ANALYSIS AND RESULTS**

All the observational findings were compiled and sent for statistical evaluation using statistical software SPSS version 21 (IBM Inc., Armonk, New York, USA). Table 1 shows that groups I, II, and III had 4 males and 6 females each. The difference was nonsignificant (p = 0.1). Mean age ± SD was 57.40 ± 8.46 in group I, 57.40 ± 8.46 in group II, and 57.40 ± 8.46 in group III. The difference was nonsignificant (p > 0.05). Graph 1 shows that in group I, the mean first value was 4.6 ± 0.82 kg, while the mean second value was 4.6 ± 0.83 kg and mean third value was 4.57 ± 0.8 kg. The overall mean value for the group was 4.59 ± 0.81 kg. In group II, the mean first value was 4.71 ± 0.81 kg, while the mean second value was 4.7 ± 0.82 kg, and mean third value was 4.68 ± 0.81 kg. The overall mean value for the group was 4.7 ± 0.81 kg. In group III, the mean first value was 6.73 ± 0.81 kg, while the mean second value was 6.71 ± 0.81 kg and mean third value was 6.69 ± 0.81 kg. The overall mean value for the group was 6.72 ± 0.81 kg (Table 2). The difference was significant (p < 0.05). There was a significant difference in mean retentive values for all the three values among the three groups (p < 0.001) (Table 2).



Graph 1: Assessment of level of significance for average values of measured forces in all groups

Table 2: Mean retentive values of all three different groups

Age/sex	Mean retentive values (in kg)		
	Group I	Group II	Group III
52/M	5.30	5.50	7.73
70/F	2.90	3.00	5.12
57/M	3.90	4.10	6.60
70/M	4.71	5.43	7.02
65/M	5.10	5.90	7.23
55/F	5.30	4.57	6.55
57/F	5.50	5.43	7.10
62/M	4.95	4.90	6.23
50/F	5.13	5.10	7.60
68/M	5.10	5.17	6.29



**Table 3:** Comparison of mean first, second, and third retentive values among the three groups

	Group I Mean $\pm$ SD	Group II Mean $\pm$ SD	Group III Mean $\pm$ SD	p-value	Groups I vs II	Groups I vs III	Groups II vs III
First value for each tray (in kg)	4.6 $\pm$ 0.82	4.71 $\pm$ 0.81	6.73 $\pm$ 0.81	<0.001	0.925	<0.001	<0.001
Second value for each tray (in kg)	4.6 $\pm$ 0.83	4.7 $\pm$ 0.82	6.71 $\pm$ 0.81	<0.001	0.942	<0.001	<0.001
Third value for each tray (in kg)	4.57 $\pm$ 0.8	4.68 $\pm$ 0.81	6.69 $\pm$ 0.81	<0.001	0.927	<0.001	<0.001
Mean	4.59 $\pm$ 0.81	4.7 $\pm$ 0.81	6.72 $\pm$ 0.81	<0.001	0.932	<0.001	<0.001

p<0.001 (significant)

Furthermore, it was observed that there was a significant difference in mean values for all the three values between groups I and III (p<0.001) and between groups II and III (p<0.001) (Table 3).

## DISCUSSION

The fabrication of complete denture construction demands accurate border molding to promote the development of border seal, which is essential for the preservation of contact of the denture border with the adjacent vestibular tissues during rest as well as in functional activity.<sup>5</sup> Retention of complete denture always plays a key role in its success; hence, each and every step of denture fabrication must be given due importance. Close adaptation between mucosa and denture base usually offers optimal retention. There are numerous physical factors that significantly impart retention of a complete denture. These include adhesion between denture and mucosa, cohesion in saliva, salivary consistency and flow, surface tension, and atmospheric pressure. The greater the surface tension and thinner the fluid film, the greater will be the retention. Nevertheless, the overall recording of tissues in completely edentulous patients is a tedious process. Even a minute error can hamper the retention of the denture. Different impression materials with different properties are being used in dentistry.<sup>6</sup> Relatively insufficient data are available in the literature wherein denture base retention with polyether was measured; however, several studies have shown the comparison of retention of denture base made by addition silicone impression material and green stick compound. Elastomers are considered famous among dentists, but the only limitation is the smell of PVS material, staining, and unstable manipulation time of polyether.<sup>7</sup> Overextended and thick borders obtained by PVS are other drawbacks. Apart from different materials used for border molding, different techniques for recording it are also available which affect the retention and stability of complete dentures. Our findings are in accordance with the study results of Smith et al<sup>2</sup> and Appelbaum and Mehra<sup>5</sup> who recommend the use of elastomer as a material of choice for border molding and final wash impression procedures. Furthermore, Gupta et al<sup>8</sup> performed a study on 20 healthy edentulous subjects

to compare the retention of complete dentures made by using two different border molding materials and border molding techniques, i.e., green stick with incremental technique and heavy-bodied PVS with simultaneous technique. Study results showed mean retentive value of green stick compound as 1.497 kgf. However, in our study we found quite higher retentive values as 4.59 kgf. The differences in the results may be understood based on the difference in the methodologies as they used denture bases made up of autopolymerizing resin. Tasleem et al<sup>9</sup> and Kikuchi et al<sup>10</sup> in their study analyzed patient satisfaction in terms of stability, retention, time taken, and comfort during border molding using two different materials. Materials used in the study were PVS and green stick wax. There was no significant difference among two techniques in terms of retention, stability, and comfort; however, time taken by the conventional method was quite longer as compared with PVS. The study results were quite comparable to ours. Additionally, Yaratpatneni et al<sup>11</sup> conducted an *in vivo* study in comparative evaluation of border molding using two different techniques in maxillary edentulous arches. Patients were divided into two groups, group I in which sectional border molding with custom impression trays with green stick compounds was used and in group II, simultaneous border molding with condensation silicone impression material was used. Wash impression was obtained after border molding in both groups. Here, authors also found no significant difference in retention in both the techniques. We found that in group I, the overall mean value was 4.59  $\pm$  0.81, in group II, it was 4.7  $\pm$  0.81, and in group III, it was 6.72  $\pm$  0.81. These findings are comparable to and in agreement with the study results of Olivieri et al.<sup>12</sup> Al-Judy<sup>13</sup> conducted a study of comparison of the effect of sectional border molding using different molding and final impression materials on the retention of maxillary complete denture bases among 14 completely edentulous patients. Retention with denture bases obtained from full and posterior putty silicone border molding combined with the light body silicone was higher as compared with those obtained from other tracing procedure. Qanungo et al<sup>14</sup> in their study of comparative evaluation of border molding using two different techniques in maxillary edentulous arches included 10 completely

edentulous patients. In group I (5), simultaneous impression molding with addition silicone and in group II (5), incremental impression molding with low fusing impression material were obtained. Retention in group II was higher as compared with group I. These results were contrasting and could be attributed to differences in age and studied population. In the study conducted by Chafii et al,<sup>15</sup> the overall values were slightly lower when compared with ours. This discrepancy could be explained based on the difference in the consistencies of studied subjects. Furthermore, Rizk<sup>16</sup> also compared the retention of complete dentures made by using different border molding materials where green stick compound, medium, and putty rubber base were used. There results also show that there was a statistically significant difference in retention among the three materials wherein putty rubber base showed the highest mean value of retention followed by medium body, while green stick compound showed the lowest mean value. Our study results were in compliance with the findings of Rizk. Jone and Jain<sup>17</sup> recently studied and compared the clinical outcomes of border molding using green stick compound, putty-type addition silicone, and mouth temperature wax followed by light body wash impression. It was concluded that border molding using green stick compound and putty-type silicone exhibited similar clinical retention. Even if putty-type silicone was very user-friendly and workable, they believed that border molding with green stick compound would be more idyllic for dental undergraduate curriculum, as it requires less clinical expertise and allows easy corrections. Khajuria et al<sup>18</sup> also favored polyether material, as it is used to entrap minimum bubbles, and thus increases the accuracy in reproducing surface details. This was comparable to our study results wherein we also showed polyether material as the preferred material for a single-step technique. Kheur et al<sup>19</sup> also recommended single-step border molding, as it is a viable and valuable alternative to conventional sectional border molding. It is less time consuming, less uncomfortable for the patient, and requires less efforts for the dentist.

The design of the present study has certain limitations, such as the retention being evaluated only for heat-polymerized trial denture bases and not in the final dentures. Another limitation of the study is that patient satisfaction score and number of postinsertion adjustment appointments required for each border molding technique have not been taken into consideration. Also, a larger sample size could be considered for better exploration of results to a clinical scenario. There are also a few aspects of complete denture impressions which can be further investigated. A comparison of retention of mandibular denture bases fabricated with sectional and single-step border molding could also be considered.

Other areas of investigation would be evaluation of patient satisfaction score and number of postinsertion adjustment appointments required for both border molding techniques.

## CONCLUSION

Literature has well-evidenced lack of substantial studies and data for retention measurement with polyether impression material. In our study, we genuinely attempted to explore the outcomes of denture retention using polyether impression material for making secondary impression. Here, it showed the highest mean retentive value compared with other tested materials; therefore, it could possibly provide some future innovative means in achieving optimal denture retention. However, further studies with larger sample sizes need to be done so as to provide certain authentication and concrete guidelines for different clinical conditions.

## CLINICAL SIGNIFICANCE

Retention and stability are the factors leading to successful complete denture therapy. An impression material capable of providing all these qualities is beneficial in achieving good results. Our study result favors polyether in terms of optimal retention when compared with other routinely used materials. Consequently, it could possibly provide some future innovative means in achieving optimal denture retention.

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