Original Article

Comparative evaluation of border molding using two different techniques in maxillary edentulous arches: A clinical study

Anchal Qanungo, Meena Ajay Aras, Vidya Chitre, Ivy Coutinho, Praveen Rajagopal, Ashwin Mysore

Department of Prosthodontics, Goa Dental College and Hospital, Bambolim, Goa, India

Abstract

Purpose: The aim of this *in vivo* study was to compare the single-step border molding technique using injectable heavy viscosity addition silicone with sectional border molding technique using low fusing impression compound by evaluating the retention of heat cure trial denture bases.

Materials and Methods: Ten completely edentulous patients in need of prostheses were included in this study. Two border molding techniques, single-step (Group 1) and sectional (Group 2), were compared for retention. Both border molding techniques were performed in each patient. In both techniques, definitive wash impression was made with light viscosity addition silicone. The final results were analyzed using paired *t*-test to determine whether significant differences existed between the groups.

Results: The *t*-value (3.031) infers that there was a significant difference between Group 1 and Group 2 ($P = 0.014$). The retention obtained in Group 2 (mean = 9.05 kgf) was significantly higher than that of Group 1 (mean = 8.26 kgf).

Conclusion: Sectional border molding technique proved to be more retentive as compared to single-step border molding although clinically the retention appeared comparable.

Key Words: Heavy viscosity addition silicone, low fusing impression compound, retention, sectional border molding, single-step border molding

Address for correspondence:
Dr. Anchal Qanungo, Room Number S-114, Goa Dental College and Hospital Girls' Hostel, Bambolim - 403 202, Goa, India.
E-mail: anchal.qanungo@gmail.com

Received: 23rd February, 2016, **Accepted:** 25th May, 2016

INTRODUCTION

In complete denture prosthodontics, the final impression stage plays a pivotal role in the success of a complete denture. The final impression procedure for a complete denture entails capturing the vestibule through border molding procedure and then making an impression of the edentulous arch.[1] Border molding a custom tray to adapt it closely to the tissues of the vestibule before making the final impression is a time-honored procedure in complete denture prosthodontics. The original material used for border molding was low fusing impression

Access this article online	
Quick Response Code:	Website: www.j-ips.org
	DOI: 10.4103/0972-4052.191291

How to cite this article: Qanungo A, Aras MA, Chitre V, Coutinho I, Rajagopal P, Mysore A. Comparative evaluation of border molding using two different techniques in maxillary edentulous arches: A clinical study. J Indian Prosthodont Soc 2016;16:340-5.

compound, introduced in 1907 by the Green brothers.[2] The technique for border molding using low fusing impression compound is usually divided into steps where sections of tray borders are molded in separate applications.

Woelfel *et al*.[3] have determined that seven dentists required an average of 17 insertions when utilizing low fusing impression compound for border molding in the same patient. Accurate impressions were achieved, but border molding with low fusing impression compound is time-consuming and tedious.

Ideally, the material used for border molding when it is in plastic state should contact the entire vestibular sulcus area at one insertion.[4] A material which will allow simultaneous molding of all borders has two general advantages: (1) The number of insertions of the trays for border molding could be reduced and (2) development of all borders simultaneously avoids propagation of errors caused by a mistake in one section affecting the border contours in another section. Incremental border molding using low fusing compound does not meet this prerequisite since only a part of the functional depth of the vestibular sulcus and associated musculature molds the periphery of the tray during each insertion. Another limitation is the short manipulation time of low fusing compound which does not allow sufficient time for vestibular tissues to act and mold the borders of the custom tray.

Finally, with this material, there is a fear of burning the soft intraoral tissues due to the heat used to soften the compound, especially by an inexperienced operator.

These limitations led to the use of elastomers for complete denture impressions. Elastomers exhibit the properties which make them a viable alternative to low fusing impression compound. These include a high degree of accuracy, dimensional stability, ease of manipulation, and adequate working and setting times. The use of polysulfide,[5] polyether,[4,6,7] or vinyl polysiloxane putty[8,9] impression materials for custom tray border molding has been described. The drawbacks of these materials are odor and staining associated with polysulfide, inadequate manipulation time of polyether, and thick and over extended borders[10] obtained with putty viscosity of polyvinyl siloxane (PVS).

Recent studies[8,11,12] investigated different techniques and materials of border molding such as low fusing impression compound, putty PVS, putty condensation silicone, and medium viscosity PVS. There was no statistically significant difference in the retention of complete denture bases in which border molding was accomplished in a single-step using elastomeric impression materials than those in which the border molding was performed in sections using low fusing impression compound.

The purpose of this *in vivo* study was to compare the single-step border molding technique using injectable heavy viscosity addition silicone with sectional border molding technique using low fusing impression compound by evaluating the retention of heat polymerized trial denture bases.

The null hypothesis was that the retention of the heat polymerized trial denture bases fabricated with single-step border molding technique using injectable heavy viscosity addition silicone will be similar to the retention of heat polymerized trial denture bases fabricated with sectional border molding technique using low fusing impression compound.

MATERIALS AND METHODS

Ten completely edentulous patients seeking prosthodontic rehabilitation were randomly selected as test subjects from the Prosthodontic Department of the institution with ages ranging from 50 to 60 years. Inclusion criteria were as follows: Well-formed residual alveolar ridges, no severe undercuts or bony exostosis, firm mucosa all over the denture bearing area with no signs of inflammation, ulceration or hyperplasia, absence of systemic disease, average quantity and consistency of saliva and normal temporomandibular joint function. Extremely high palatal vaults were excluded from the study. The protocol of the study was approved by the Institutional Review Board. An informed consent was obtained from all the patients and a single operator performed all the procedures.

For each patient, primary impression of the upper arch was made using an irreversible hydrocolloid impression material (Tropicalgin, Zhermack, Italy) in a suitable sized perforated stock tray and poured in dental stone (Kalstone, Kalabhai Pvt. Ltd., Mumbai, Maharashtra, India) to obtain the primary cast. The cast was properly outlined and relieved for fabrication of custom impression trays using autopolymerizing acrylic resin (DPI-RR Cold Cure, The Bombay Burmah Trading Corporation Ltd., Mumbai, Maharashtra, India). Two identical trays were made for each patient. Each tray was tried in the mouth and peripheries reduced so that they were 2 to 3 mm short of the tissue reflection. It was ensured that the distal end contained both the hamular notches and extended 2 mm beyond the vibrating line.

Technique 1: Sectional border molding

Using one of the custom trays, border molding was completed by the operator with the conventional method with low fusing impression compound (DPI Pinnacle, The Bombay Burmah Trading Corporation Ltd., Mumbai, Maharashtra, India). Buccal and labial molding was carried out by adding softened low fusing impression compound in sections to the tray borders and moving the lips and cheeks upward, forward, and downward.

Posterior palatal seal was functionally recorded by applying the softened compound from one hamular notch to other and instructing the patient in valsalva maneuver[13] [Figure 1a]. Any excess material flowing onto the ridge area was scrapped using a Bard-Parker blade (Aspen Surgical Products, Caledonia, USA). After the wax spacer was removed, holes were made in the tray over the median palatal raphe, anterolateral and posterolateral regions of the hard palate[1] for relief as well as to aid in the retention of the impression material. A tray adhesive (Universal Tray Adhesive, Zhermack, Italy) was applied to the inner surface of the tray. This was followed by making a definitive impression using light viscosity addition silicone (Aquasil Ultra LV, Dentsply, USA) [Figure 1b].

Technique 2: Single-step border molding

The second tray was used for border molding with an injectable heavy viscosity PVS (Aquasil Ultra Heavy, Dentsply, USA). The tray border was painted with a tray adhesive (Universal Tray Adhesive, Zhermack, Italy) and allowed to dry. The heavy viscosity addition silicone was injected onto the tray borders and across the posterior palatal seal area. Labial/buccal borders and posterior palatal seal were molded in a manner similar to sectional border molding technique. The tray was removed after the impression material had completely polymerized and the borders were examined for accuracy [Figure 2a]. Excess material was trimmed off using a sharp Bard-Parker blade (Aspen Surgical Products, Caledonia, USA). Holes were made following removal of the wax spacer. A tray adhesive (Universal Tray Adhesive, Zhermack, Italy) was also applied to the inner surface of the tray. After the adhesive had dried up, the tray was loaded with light viscosity addition silicone (Aquasil Ultra LV, Dentsply, USA) to complete the definitive impression [Figure 2b].

The impressions were boxed, and the casts were poured. Denture bases were waxed on each cast and coded. Prefabricated stainless steel hooks were attached to anterior palatal region of the waxed up bases approximately corresponding to a line joining the distal surfaces of cuspids. The casts with waxed-up bases were flasked, placed in the same flask compress, and processed in a curing unit. The same mix of acrylic resin (DPI Heat cure, The Bombay Burmah Trading Corporation Ltd., Mumbai, Maharashtra, India) was used for both maxillary heat polymerized trial denture bases. After they had been processed, deflasked, and decast, the bases were carefully finished and only excess acrylic resin flash was removed from the borders. The finished bases were inserted, checked in the mouth with pressure-indicating paste, and adjusted as necessary [Figure 3a].

Measuring the retention of two denture bases

A digital force meter (Extech Instruments Corporation, MA, USA) was used to record the retention of the denture base [Figure 3b]. The device was prepared to display the readings in kgf. 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 [Figure 4]. Force meter is a spring-loaded device that 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. The retention of the denture base was determined by the force value that was displayed on the force meter screen at the moment the denture base got dislodged. Three readings were taken for each border molding technique and an average was calculated. The data were tabulated and statistically analyzed to evaluate the difference

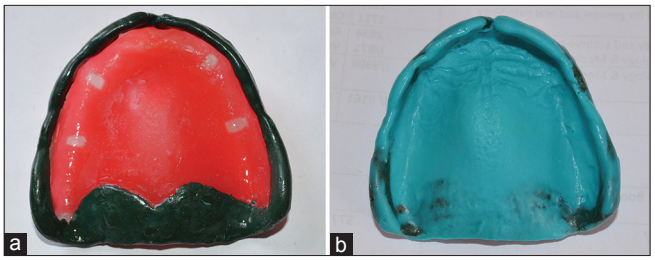


Figure 1: (a) Sectional border molding technique using low fusing impression compound, (b) Definitive impression using light viscosity addition silicone

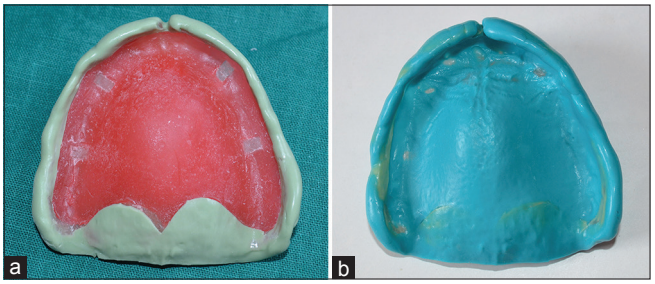


Figure 2: (a) Single-step border molding using injectable heavy viscosity addition silicone, (b) Definitive impression using light viscosity addition silicone

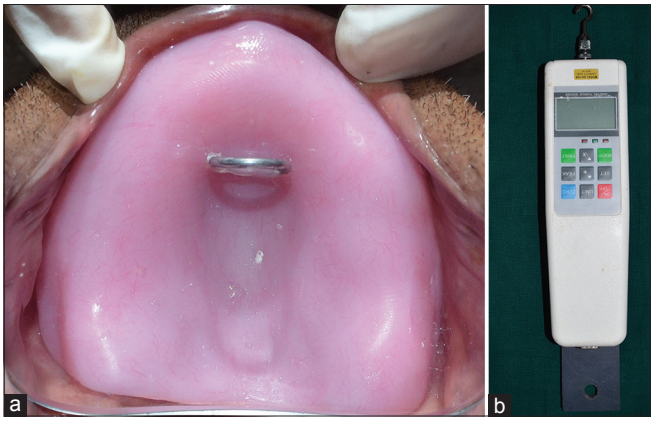
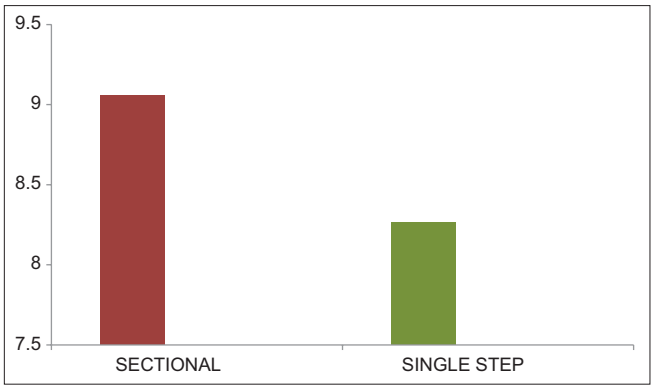


Figure 3: (a) Heat polymerized trial denture base with prefabricated stainless steel loop incorporated into it, (b) Force meter for evaluation of retention of heat polymerized trial denture bases

Figure 4: Application of vertically downward force to dislodge the heat polymerized trial denture base



Graph 1: The mean retentive values (kgf) of single-step and sectional border molding groups

Table 1: The mean retentive values (kgf) of single-step and sectional border molding groups

Patient number	Single-step border molding (kgf)	Sectional border molding (kgf)
1	5.60	6.19
2	8.61	10.22
3	10.25	10
4	7.60	8.19
5	7.22	9.22
6	8.66	10.16
7	7.20	8.75
8	9.97	9.82
9	7.06	7.65
10	10.48	10.36
Mean	8.2650	9.0560

in retention of the dentures bases obtained from two border molding techniques. For each patient, the retention of the two denture bases was also evaluated clinically by directing the patient to perform functional movements such as opening the mouth wide, side to side movement of mandible, making moderate lip and cheek movements, and checking for any dislodgement of the denture bases.[14] The denture bases were also subjected to a dislodgement test by the operator, evaluating the seal on the opposite side by a rolling pressure of the index finger away from the side being checked. The effect of posterior palatal seal was checked in the same manner by applying pressure in the anterior region of the denture bases.[15]

RESULTS

In this study, evaluation of the retention offered by single-step border molding (Group 1) and sectional border molding (Group 2) of ten subjects were compared. The mean retentive values (kgf) of two groups are illustrated in Table 1 and Graph 1. For comparison of the data, Student's *t*-test was employed with the help of SPSS software (IBM SPSS statistic 20). The data shown in Table 2 represent the inferential statistics for comparing the two groups. The *t* value (3.031) infers that there is a significant difference between sectional and single-step border molding ($P = 0.014$). However, on clinical evaluation, the retention of the heat polymerized trial denture bases fabricated with both techniques was acceptable.

DISCUSSION

An accurate impression will always ensure satisfactory retention, stability, and comfort in a complete denture patient. There are numerous factors associated with the retention of complete dentures which can be achieved by means of meticulous border molding. There are two techniques documented in literature, the sectional and the single-step border molding. Studies[8,11,12] have attempted to evaluate and compare the efficacies of these techniques. However, the literature is still equivocal about the efficacy of the two techniques. This study was conducted to investigate the difference in retention resulting from these techniques using methods that ensured precise evaluation of the techniques.

The low fusing impression compound was used for sectional border molding because of its ease of manipulation, availability, popularity, and cost-effectiveness. There have been studies[8,11,12] in literature comparing low fusing impression compound with putty consistency of elastomeric impression material with varying results. The problems faced with putty consistency of elastomeric impression materials are overextended, thick borders,[10] and short manipulation time to shape it into a rope and placement over the tray borders. In this study, an injectable heavy viscosity PVS was chosen over putty due to its excellent manipulative consistency, adequate flow, dimensional stability and adequate working time.[16] Furthermore, there have been no reports in literature comparing retention of single-step border molding using injectable heavy viscosity PVS with sectional border molding using low fusing impression compound.

Among the various studies,[8,12] comparing the retention of two border molding techniques, the common choice for a definitive

Table 2: The mean, standard deviation, and *t*-test for the measured retentive forces of both border molding techniques

	n	Mean	SD	SE	*t*-test	95% CI of the difference		df	*P**
						Lower	Upper		
Single-step + sectional	20	0.79100	0.52539	0.26101	3.031	1.38145	0.20055	9	0.014

*Paired *t*-test. SD: Standard deviation, SE: Standard error, CI: Confidence interval

impression was zinc oxide eugenol in conjunction with sectional border molding and light viscosity addition silicone with single-step border molding. This difference in wash impression materials could contribute to the difference in retention values obtained with two techniques. In this study, this problem was overcome by using light viscosity addition silicone for definitive impression in both techniques to maintain standardization.

Most authors[11,12] have attached 0.9 mm stainless steel orthodontic wire loops to the heat polymerized trial denture bases using autopolymerizing acrylic resin. The orthodontic wire of 0.9 mm could flex due to the force applied by the force meter and give inaccurate retention values. This study used a more rigid 1.5 mm prefabricated stainless steel loops that were incorporated into the waxed up trial denture bases leading to a stronger union. Likewise, the position of the loops was shifted to a more anterior location as opposed to the geometrical center used by earlier studies.[11,12] The rationale for this alteration was that a more anterior positioning would ensure a force that was directed perpendicular to the denture base as opposed to oblique forces generated when the geometrical center was used for attachment of loop. This was to ensure adherence to the principles/definition of retention.[17]

The instrument of choice for evaluation of retention was a digital force meter as advocated by Burns *et al*.[18] for a more objective assessment.

The results of this study statistically proved that sectional border molding technique was more retentive than single-step border molding technique although clinically the retention appeared to be comparable. This could be attributed to the operator experience with the material. Also, there is more control as well as scope for evaluation and correction with sectional border molding technique. On the other hand, single-step border molding is more technique sensitive as the entire vestibular sulcus and posterior palatal seal area need to be recorded accurately in a single insertion. Rizk[12] demonstrated superior retention with single-step border molding using putty rubber base material. Yarapatineni *et al*.[11] obtained comparable retention with two techniques. The results of this study are not in agreement with previous studies which could be attributed to differences in materials and methodology as well as operator skill and experience.

The design of the present study has certain limitations. The retention was evaluated for heat polymerized trial denture bases and not the final dentures. Other limitation of the study is that patient satisfaction score and number of post insertion adjustment appointments required for each border molding technique have not been taken into consideration. Also, a larger sample size could be considered for better extrapolation of results to a clinical scenario.

There are few aspects of complete denture impressions which can be further investigated. Comparing various elastomeric impression materials such as polyether, putty PVS, heavy viscosity PVS, and monophase PVS for accuracy of border molding could be considered for future research. Furthermore, a comparison of retention of mandibular denture bases fabricated with sectional and single-step border molding could be considered. The third area of investigation would be evaluation of patient satisfaction score and number of post insertion adjustment appointments required for both border molding techniques.

CONCLUSION

Following conclusions can be drawn from the study:

- Sectional border molding technique proved to be more retentive as compared to single-step border molding although clinically the retention appeared comparable
- Single-step border molding could be a viable and advantageous alternative to conventional border molding and can be accomplished using injectable heavy viscosity addition silicone. The choice of a particular border molding technique should be based on clinical indications, operator skill, and convenience.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Davis DM. Developing an analogue/substitute for the maxillary denture-bearing area. In: Boucher's Prosthodontic Treatment for Edentulous Patients. 11th ed. St. Louis, MO: Mosby; 1998. p. 141-61.
2. Green JW. Green Brothers' Clinical Course in Dental Prosthesis. 5th ed. Detroit: Detroit Dental Mfg. Co.; 1910. p. 1.
3. Woelfel JB, Hickey JC, Berg T Jr. Contour variations in one patient's impressions made by seven dentists. J Am Dent Assoc 1963;67:1-9.
4. Smith DE, Toolson LB, Bolender CL, Lord JL. One-step border molding of complete denture impressions using a polyether impression material. J Prosthet Dent 1979;41:347-51.
5. Firtell DN, Koumjian JH. Mandibular complete denture impressions with fluid wax or polysulfide rubber: A comparative study. J Prosthet Dent 1992;67:801-4.
6. Felton DA, Cooper LF, Scurria MS. Predictable impression procedures for complete dentures. Dent Clin North Am 1996;40:39-51.
7. Tan HK, Hooper PM, Baergen CG. Variability in the shape of maxillary vestibular impressions recorded with modeling plastic and a polyether impression material. Int J Prosthodont 1996;9:282-9.
8. Appelbaum EM, Mehra RV. Clinical evaluation of polyvinylsiloxane for complete denture impressions. J Prosthet Dent 1984;52:537-9.
9. Solomon EG. Single stage silicone border molded closed mouth impression technique-part II. J Indian Prosthodont Soc 2011;11:183-8.
10. Patel JR, Sethuraman R, Chaudhari J. Comparative evaluation of border morphology produced by three different border molding materials. Int J Contemp Dent 2010;1:82-8.
11. Yarapatineni R, Vilekar A, Kumar JP, Kumar GA, Aravind P, Kumar PA. Comparative evaluation of border molding, using two different techniques in maxillary edentulous arches – An *in vivo* study. J Int Oral Health 2013;5:82-7.
12. Rizk FN. Effect of different border molding materials on complete denture retention. Cairo Dent J 2008;24:415-20.
13. Massad JJ. Vinyl polysiloxane impression material in removable prosthodontics. Part 1: Edentulous impressions. Compendium 2007;28:452-9.
14. Levin B. The maxillary impression. In: Impressions for Complete Dentures. Chicago, Illinois: Quintessence Publishing Co, Inc.; 1984. p. 122.
15. Smutko GE. Making edentulous impressions. In: Essentials of Complete Denture Prosthodontics. 2nd ed. Delhi, India: AITBS Publishers; 1996. p. 93.
16. Hayakawa I, Watanabe I. Impressions for complete dentures using new silicone impression materials. Quintessence Int 2003;34:177-80.
17. Rahn AO, Heartwell CM. Complete denture impressions. In: Textbook of Complete Dentures. 5th ed. Canada: BC Decker, Inc.; 2002. p. 221.
18. Burns DR, Unger JW, Elswick RK Jr., Beck DA. Prospective clinical evaluation of mandibular implant overdentures: Part I – Retention, stability, and tissue response. J Prosthet Dent 1995;73:354-63.