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RESEARCH ARTICLE

COMPARATIVE EVALUATION OF THE EFFECT ON THE RETENTION OF MAXILLARY DENTURE BASE BY USING TWO DIFFERENT BORDER MOLDING TECHNIQUES AND TWO DIFFERENT MATERIALS- AN IN VIVO STUDY

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Abstract

Purpose: This study was undertaken to compare the retention between sectional border molding using low fusing greenstick compound and single step border molding using condensation silicone (putty) impression material in two stages- A. After final impression and B. With the temporary denture base.

Materials & Methods: In this study evaluation of retentive values of sectional border molding (Group I) (custom impression trays border molded with green stick compound) and single step border molding (Group II) (border molding with condensation silicone (putty) impression material). In both techniques definitive wash impression were made with light body condensation silicone and denture base with auto- polymerization resin.

Results: Group 1B was significantly higher (mean- 2.176) than Group 1A (mean- 1.798) in test-1. The t-value (6.023) infers that there was significant difference between Group 1A and Group 1B (p =0.001). Group 2B was significantly higher (mean- 2.344) than Group 2A (mean-2.111) in test -2. The t-value (2.852) infers that there was significant difference between Group 2A and Group 2B (p=0.001).

Conclusion: Within the limitations of this clinical study border molding using custom tray with low fusing green stick compound provided significant difference for retention as compared to condensation silicone at border moulding and denture base stage.

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Introduction:-

Treatment of edentulous patients with complete dentures is a technically demanding task.¹ During fabrication of complete denture, the border molding and final impression stage plays a vital role for the success of a complete denture. The objective of the definitive impression of complete denture is to accurately record the entire denture-bearing area so as to produce a stable and retentive prosthesis while maintaining patient comfort and esthetics and preserving the remaining tissues.²

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The accuracy of the final impression stage is of crucial in obtaining a complete denture. It involves an initial step of determining the vestibule with the use of the border molding technique, and then making the final impression of the target edentulous arch.³ In denture fabrication, depending on the condition of the oral cavity and the dentist's perspective on impression material, the impression techniques and materials used may vary.⁴

Low fusing impression compound was introduced as the material of choice for border molding in the year 1907 by Green Brothers.⁵ Since then, many efforts have been taken to simplify the procedure without compromising the treatment. There are many materials and techniques that are employed for border molding. Two techniques that are commonly followed for border molding are sectional and single-step.

The conventional technique (sectional) of border molding with low fusing material has certain limitations. Incremental border molding leaves much to be desired since only a part of the functional depth of the vestibular sulcus and associated musculature molds the periphery of the tray during each insertion.⁶

The aim of the present study was to compare low fusing impression compound by sectional technique and putty consistency polyvinyl siloxane by single step, along with light-body poly vinyl siloxane as final impression in both the techniques to determine the retention of the acrylic complete maxillary denture base.

Materials And Methods:-

Twenty completely edentulous patients seeking prosthodontic rehabilitation were randomly selected as test subjects from the Prosthodontic Department of the institution with ages ranging from 40 to 70 years. The exclusion criteria comprised a fibrous ridge, ridge resorption, tissue undercut, bony exostoses, and tori. The protocol of the study was approved by the Institutional Review Board. All participants were fully informed about all the methodologies used in the study, and consent was attained from all participants following their approval. A single operator performed all the procedure.

Each patient was mainly categorized under two groups which were further sub-divided into two subgroups:

Group 1(n=20) Retention measured at border moulding stage

1. Subgroup 1A: Measurement of retention of custom tray obtained from sectional method of border moulding.
2. Subgroup 1B: Measurement of retention of custom tray obtained from single step method of border moulding.

Group 2 (n=20) Retention measured at denture base stage

1. Subgroup 2A: Measurement of retention of denture base obtained from sectional method of border moulding.
2. Subgroup 2B: Measurement of retention of denture base obtained from single step method of border moulding.

For each patient, two primary impression of the upper arch were made using an impression compound (Y-Dents) and poured in dental plaster (DPI) 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.



Fig 1:- Border molding performed using low fusing impression compound & polyvinyl siloxane.

After the border molding was done (Fig 1), spacer wax was removed, tray adhesive (Coltene Whaledent) was applied provided by the manufacturing company with a brush on both the custom trays. The tray adhesive was dried as instructed by the manufacturer. Final impression was made using light-body elastomeric impression material in custom trays of both the subgroup 1A and subgroup 1B(Fig 2). Master cast of both the subgroups were generated by pouring the final impressions with type III dental stone (Neelkanth Dental Stone Plaster). A auto-polymerizing acrylic resin material was used for the denture base of each master cast.



Fig 2:- Final wash impression was made using light bodied polyvinyl siloxane.

Retention was measured using digital force gauge at two stages, group 1- Border molding stage and group 2- Denture base stage (Fig 3). Retention was measured at both the stages using digital force gauge. For this purpose, a 17 gauge (1.2mm diameter), stainless steel V-shaped wire embedded at the anterior portion of the palatal surface on the imaginary line corresponding to the line intersecting the midline and canine eminence, for both the custom trays (1A and 1B) and denture bases (2A And 2B).



Fig 3:- Digital force gauge was used to measure the retention.

To link the V-shaped triangular loop into the denture base with the digital force gauge, a stainless steel wire (Smith) of gauge 23 was used between them (Fig 4). Next, downward pulling force was applied to each custom trays and denture bases until it is displaced from the mouth. This step was repeated 4 additional times for a total of 5 times. A average of these 5 data was calculated for each patient. To eliminate the bias caused by variations in the technique, all clinical and laboratory procedures were carried out by the same individual.



Fig 4:- Orthodontic wire assembly attachment to the denture base.

The data for the present study was analyzed using the SPSS statistical software 19.0 Version. The descriptive statistics included mean, standard deviation. The intragroup comparison for the different time intervals was done using paired t test to find the difference between the individual time intervals. The level of the significance for the present study was fixed at 5%.

The intergroup comparison for the difference of mean scores between two independent groups was done using the unpaired/independent t test.

The Shapiro–Wilk test was used to investigate the distribution of the data and Levene’s test to explore the homogeneity of the variables. The data were found to be homogeneous and normally distributed. Mean and standard deviation (SD) were computed for each variable.

Results:-

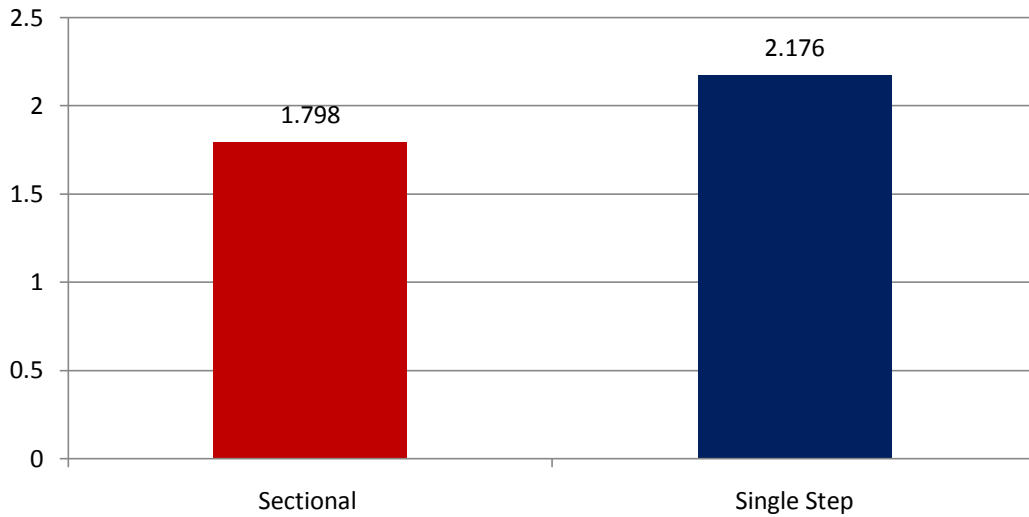
In the present study, evaluation of the retentive values was done at 2 stages: Border molding stage (group 1) and denture base stage (group 2). In each group/stage, two different techniques were used i.e. sectional border molding (Subgroup A) and single step border molding (Subgroup B) to evaluate and compare for the retention in maxillary arch.

	N	Mean	Std. Deviation	Std. Error Mean	T value	P value
Sectional (subgroup 1A)	20	1.798	0.468	0.046	6.023	0.001 (Sig)
Single Step (subgroup 1B)	20	2.176	0.615	0.060		

Table 1:- Intergroup Comparison Of Retention Values Between The Two Techniques (Sectional And Single Step) Using Independent T Test At Border Molding Stage (Group 1).

Independent t test at p value less than 0.05 is significant

This table illustrates the mean retentive values for group 1 i.e. at border molding stage for two subgroups (Subgroup 1A) sectional- border moulding and (Subgroup 1B) single-step border moulding. The retentive values for single step border molding i.e. subgroup 1B (mean= 2.176) was significantly higher than sectional border molding i.e. subgroup 1A (mean=1.798). The t-value (6.023) infers that there was significant difference between Subgroup 1A and Subgroup 1B (p =0.001).



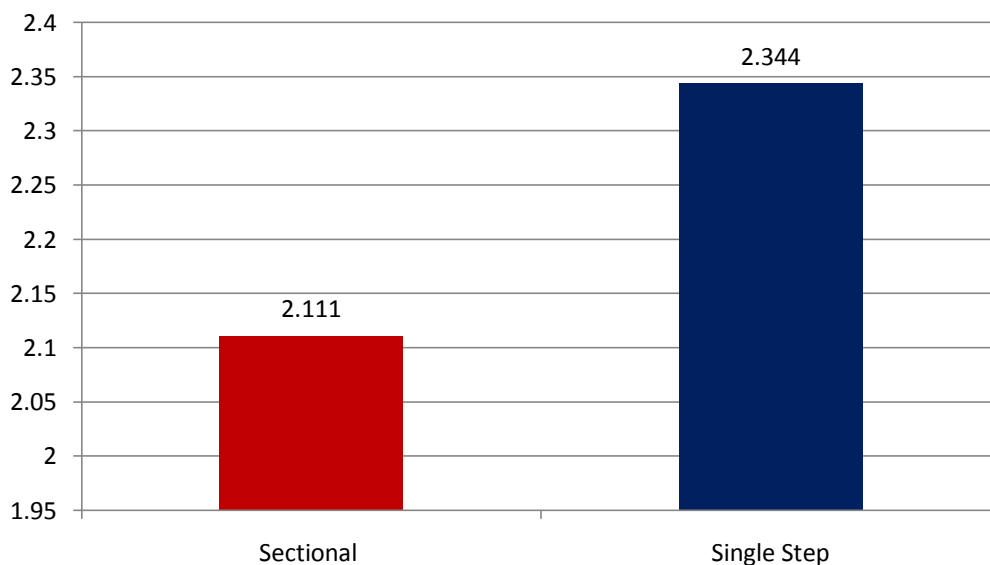
Graph 1:- Illustrates the comparison of retention values between two techniques at border molding stage.

	N	Mean	Std. Deviation	Std. Error Mean	T value	P value
Sectional (subgroup 2A)	20	2.111	0.531	0.053	2.852	0.001 (Sig)
Single Step (subgroup 2B)	20	2.344	0.620	0.062		

Table 2:- Intergroup Comparison Of Retention Values Between The Two Techniques (Sectional And Single Step) Using Independent T Test At Denture Base Stage (Group 2).

Independent t test at p value less than 0.05 is significant

This table illustrates the mean retentive values for group 2 i.e. at denture base stage for two subgroups (Subgroup 2A) sectional- border molding and (Subgroup 2B) single-step border molding. The retentive values for single step border molding i.e. subgroup 2B (mean= 2.344) was significantly higher than sectional border molding i.e. subgroup 2A (mean=2.111). The t-value (2.852) infers that there was significant difference between Subgroup 2A and Subgroup 2B (p =0.001).



Graph 2:- Illustrates the comparison of retention values between two techniques at denture base stage.

Discussion:-

Materials used for border molding other than low fusing compound are autopolymerising resins, polyether, putty elastomeric impression materials, mouth temperature waxes and soft liners. The type of impression material used and the selected border molding technique plays a great role in the retention force of a CD.⁸

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.^{2,9} Various studies have attempted to evaluate and compare the efficacies of these techniques.

The choice of material for single step border molding in this study was polyvinyl siloxane putty material, because of its excellent manipulative consistency, adequate working time, dimensional stability and ability of being molded with finger pressure prior to and after insertion in to the oral cavity.¹⁰

Among the various studies,^{9,12} comparing the retention of two border molding techniques, the common choice for a definitive impression was zinc oxide eugenol in conjunction with sectional border molding. Mostly, light viscosity addition silicone is used along with putty elastomer for 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, light viscosity addition silicone was used for definitive impression in both the techniques to overcome the problem as well as to maintain standardization. Light body siloxane was used for final impression as it is biocompatible, has good flow properties, adequate working time, and dimensional accuracy and stability and has pleasant colour and odour.

All the final impressions were recorded using selective pressure technique, which combines the principles of mucostatic and mucocompressive techniques. The advantage of this technique is that the non-stress bearing areas are recorded with the least amount of pressure and selective pressure is applied to certain areas that are capable of withstanding the force of occlusion suggested by Boucher.¹³

In this study, stainless steel orthodontic wire was modified into V-shaped of dimension 1cm*1cm*1cm to maintain the uniformity, also the diameter of the wire chosen was thicker which is 1.1 mm so as to give minimum flex while pulling of the digital gauge. In all the samples we have used the same dimension and diameter of stainless steel wire to maintain standardization.

The results of the present study statistically proved that single-step border molding technique was more retentive than sectional border molding technique in both the groups.

The findings of the present study contradict Quanungo et al (2016)¹⁴ where they reported superiority of sectional technique of border molding over single step technique. Again, this discrepancy may be attributed to the nature of the impression material used. In their study, irreversible hydrocolloid was used as the primary impression material, whereas in the present study, an impression compound was used as the primary impression material.

Yarapatneni et al (2013) and Rizk (2008) reported no statistical significance in retentivity of complete dentures with elastomer impression materials (using a single step technique) and border molding done in sections by use of low fusion impression material.^{12,15}

Appelbaum(1984) concluded polyvinyl siloxane putty and light-body impression material are well suited for making complete denture impressions. Obviously, good results are obtained with less expenditure of time as well as less discomfort and inconvenience to the patient.⁹

The findings of this study supports the research done by Jassim TK et al (2020)⁷, Pacher et al (2018)¹⁶ where the green stick compound with light-body final impressions yielded the lowest mean CD retention value. Yarapatneni et al (2013)¹⁵ and Al-Judy HJ (2015)¹⁷ also observed the higher retention forces were detected in the denture bases produced by putty silicone full tracing a combined by light body silicone final impression material as it was compared with other tracing procedure and materials.. Similarly, Sharma et al (2018)¹⁸, Shreya et al (2019) and DSouza RD et al (2022)⁸ reported that polyvinyl siloxane was superior to green stick impression compound for recording peripheral border seal.

In single step border-molding technique a better retention was observed than the sectional border molding in this study. This may be because - the entire peripheral seal was recorded simultaneously in single insertion, borders of uniform thickness with smooth continuity, the elasticity of the material also helped in accurate adaptation of the border tissues, the simultaneous muscle movement resulted in a uniform recording of periphery, bilaterally which helped in achieving allround peripheral seal.¹⁹

The results of this study vary in agreement with previous studies which could be attributed to differences in materials and methodology as well as operator's skill and experience.

The design of the present study has certain limitations, such as the retention being evaluated only for trial denture bases and not in the final dentures. Another 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, only one form of polyvinyl siloxane impression material was assessed in this study, even though various different forms are available on the market. This study did not evaluate the time involved in completing the impression procedure. Furthermore, the study did not consider the retention force of the denture base for the lower arch. Our study concentrated solely on assessing the denture base retention force for the upper arch, so further research is proposed for assessing these other factors. Other areas of investigation would be evaluation of patient satisfaction score and number of post-insertion adjustment appointments required for both border molding technique.

Conclusion:-

Following conclusions can be drawn from the study:

1. Border moulding using polyvinyl siloxane by single-step molding technique using light body elastomer wash impression proved to produce more retentive impression as compared to sectional border border molding in maxillary arch.
2. Maxillary denture base using single- step border moulding technique has higher retentive values compared to sectional moulding using low fusing impression compound.
3. Single-step border molding could be a viable and advantageous alternative to conventional border molding and can be accomplished using heavy viscosity addition silicone.

The choice of a particular border molding technique should be based on clinical indications, operator skill, and convenience. Consequently, it could possibly provide some future innovative means in achieving optimal denture retention.

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