



Comparative Evaluation of Retention of Heat Cure Denture Bases Fabricated Using Different Border Molding Materials; An In-Vivo Study.

(Retention of heat cure denture bases)

¹Dr. Kanica Gandhi, ²Dr. Sandeep Garg, ³Dr. Nidhi Mangtani Kalra,

¹Post graduate student, Department of Prosthodontics, Maharishi Markandeshwar College of Dental Sciences and Research, Mullana, Ambala

²Professor and Head, Department of Prosthodontics, Maharishi Markandeshwar College of Dental Sciences and Research, Mullana, Ambala

³Reader, Department of Prosthodontics, Maharishi Markandeshwar College of Dental Sciences and Research, Mullana, Ambala

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KEYWORDS

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ABSTRACT:

AIM: To evaluate and compare the retention of heat cure denture bases fabricated using different border molding materials.

Material and Method: Ten completely edentulous patients were included in the present study. Three border moldings were done for each patients using different border molding materials i.e. green stick impression compound, polyether and tissue conditioner. Then three permanent denture bases were fabricated for each patient and retention was evaluated using pulley system. Data obtained was tabulated and subjected to statistical analysis using one way ANOVA and post hoc tukey's test.

Results: A statistically significant difference was seen in retention of denture bases fabricated using tissue conditioner and polyether in comparison to green stick, whereas no significant difference was found between tissue conditioner and polyether.

Conclusion: within the limitations of the study, it was concluded that though denture bases fabricated using polyether and tissue conditioner exhibited superior retention, results were favorable with all three materials clinically.

INTRODUCTION

Dental diseases, particularly affecting the elderly population, continue to be a significant public health concern, often resulting in complete edentulism. It not only leads to the loss of natural teeth but also contributes to the resorption of the alveolar bone.¹ This condition adversely impacts essential oral functions such as chewing, speech and overall stomatognathic functionality, subsequently affecting the individual's social life. A range of treatment options exists for

rehabilitating such patients, including complete dentures, overdentures and implant-supported prostheses². While overdentures offer necessary retention and alveolar bone preservation, challenges may arise in preserving existing teeth. Similarly, implant-supported dentures, considered a standard care in complete denture therapy, face limitations such as high costs, surgical fears, bone availability and treatment accessibility.³ Consequently, conventional dentures remain a fundamental treatment option in most of the patients.



The success of complete denture therapy depends on a well-fitted prosthesis, judged by its ability to provide retention, stability, and support. Among these, retention of denture is of utmost importance in achieving patient satisfaction. Though various factors influence the denture retention, precisely recording the peripheral seal area with adequate clearance for muscular movements holds paramount importance.

Traditionally, Green stick has been employed for border molding since its introduction by Green Brothers in 1907.⁴ Border molding using this low fusing compound is time consuming and has certain disadvantages. To address these challenges newer materials like polyvinyl siloxane (PVS), polyether and tissue conditioner are being used for border molding. With PVS and polyether simultaneous molding of all borders can be done.^{5, 6, 7} These materials are easy to manipulate, dimensionally stable, have good accuracy and easy to trim and shape. Similarly tissue conditioner is being used as a functional impression material and poses certain advantages.^{8, 9, 10} These newer materials though offer advantages; their impact on prosthesis retention requires further investigation. Therefore present study was planned to evaluate and compare the retention of heat-cure denture bases fabricated using three different border molding materials i.e. low fusing impression compound, polyether, and tissue conditioner.

METHOD

The present in vivo study was carried out after taking Ethical clearance from the institutional ethical committee (No.IEC-2258/ Dated- 27-05-2022). Ten completely edentulous patients irrespective of their age and gender were selected for the study according to following inclusion and exclusion criteria.

Inclusion Criteria:

1. Patients having well-formed ridges with overlying healthy and firm mucosa.
2. Patients without any bilateral posterior or anterior undercut or bony exostosis with respect to maxillary arch.
3. Patients that were fully compliant with the study and were willing to participate in it.

Exclusion Criteria:

1. Patients with hyperplastic or abused denture bearing tissues.
2. Patients with atrophic ridges.
3. Patients with poor neuromuscular control.
4. Patients with maxillo facial defects.
5. Patients suffering from Xerostomia.

After patient selection, each patient was explained about the study and a written consent was obtained. For all patients, three heat cure denture bases were fabricated using three different border molding materials and testing was done. For this, a maxillary primary impression was made for each patient with impression compound using non perforated edentulous stock tray. The impression was then poured and three special trays were fabricated on each cast using cold cure resin.

First border molding was done using green stick impression compound and final impression was made using zinc oxide eugenol impression paste. Second border molding was done using polyether impression material. Border molding was done in single step by performing various movements of lips and cheeks and definitive impression was made in polyether itself. Third border molding was done using Tissue conditioner as a functional impression material. Tissue conditioner material was mixed as per manufacturer's recommendations and loaded into the tray. The tray was then placed in patient's mouth and borders were molded in a conventional manner. After achieving initial set, the impression was removed and checked for its accuracy. All three impressions were then poured with type 3 dental stone to obtain master casts. Same procedures were repeated for all ten patients. All master casts thus obtained were marked and grouped as given in table 1.

Table: 1. Grouping of stone casts as per materials used for border molding.

Group	Border Molding Material Used	Casts
A	Green stick impression compound	10
B	Polyether	10
C	Tissue conditioner	10
TOTAL		30



On all the master casts, permanent denture bases were fabricated using heat cure acrylic resin. A total of 30 heat cure denture bases were fabricated, three for each patient. After this geometric centre of denture bases was located and a stainless wire loop was incorporated at this centre using self cure resin (fig.1). This loop was used for engaging the Digital force gauge to apply dislodging force.

The testing apparatus used in the present study was modification of apparatus designed by Skinner and chug (1953).¹¹ This apparatus worked by applying forces perpendicular to denture base. In the present study, testing apparatus used consisted of three parallel horizontal rods supported by one vertical rod resting on a flat wooden block (fig. 2). This Vertical rod could be adjusted according to the patient's height. Uppermost horizontal rod was fitted with facebow which helped in positioning the head of the patient. Middle horizontal rod had a pulley on each end. These pulleys engaged a nylon fishing line with one end attached to the digital force gauge and the other end attached to the metal hook of denture base. Digital force gauge was attached to a spindle handle by nylon fishing line. The spindle handle was used to apply accurate dislodging force by rotating the handle in clockwise direction. Lowermost horizontal rod had a adjustable chin rest to support the patient's chin.

Retention of denture bases was checked with existing apparatus (fig.3). For this, patient was asked to sit in an upright position and a wet denture base was seated firmly in patient's mouth. The instrument was then adjusted vertically at required height and horizontally to engage the hook of nylon fishing line perpendicular to the loop fixed at the centre of maxillary denture base. The chin of the patient was supported by chin rest whereas face bow assembly was used to stabilize the head of the patient. The patient was instructed to relax and not to put any pressure on the palatal side of the denture base with tongue. The mouth of the patient was kept in half open position. A steady Continuous force was applied on denture base by rotating the spindle handle which was attached to the loop on denture base with a nylon fishing line. Force applied was in caudal direction and the value at which denture base dislodged, as recorded by digital force gauge, was noted as retentive force value. Three values were recorded with

each denture base. The same procedure was repeated with each denture base for each patient and values were recorded.

RESULTS

These values obtained were tabulated and statistically analyzed using SPSS software version 25. Intergroup comparison was done using one way ANOVA followed by post hoc tukey's test and P value <0.05 was considered significant. The results showed that the mean retentive value of maxillary denture bases was maximum with tissue conditioner followed by polyether, whereas minimum value was obtained with green stick impression compound. Results were found to be statistically significant difference ($p < 0.05$) using green stick impression compound as a border molding material with tissue conditioner and polyether, whereas no statistical significant difference was found between denture bases fabricated using polyether and tissue conditioner material.



Figure 1



Figure 2



Figure 3

DISCUSSION

Success of a complete denture depends primarily on achieving adequate retention and stability by accurately recording the peripheral seal areas and the denture bearing surfaces. Commonly used materials for recording peripheral seal area are Green stick compound, Elastomeric Impression material, Tissue Conditioner, Impression Waxes and Pattern Resin. Each material has its own advantages and disadvantages but the retention achieved by using any of them is debatable.

Green stick used in the present study is a material of choice for practitioners as well as students. Its advantage includes ease of manipulation and good results. Sectional technique can be used for border molding with green stick.¹² Polyether was included because of its advantages like high degree of accuracy, dimensional stability, ease of manipulation, single step border molding and decrease in chair-side time. Kheur et al stated in their study that single step border molding was more valuable as it was less time consuming and more comfortable to the patient than sectional border molding.¹³ According to Smith, polyether impression material meets all the requirements of border molding

material⁵. It can be easily manipulated in mouth and excess can be cut easily with scalpel. Tissue conditioners are used as a functional impression material. They record the denture bearing area and peripheral seal areas in functional state. Technique by using tissue conditioner as functional impression material offered many advantages over conventional method of border molding.¹⁴ Borders can be molded by single insertion, the material used is hydrophilic, easier to handle and impression obtained are accurate and dimensionally stable. Zarir R et al also used this material as a border molding material in their study and found similar results.¹⁵

In the Present study, 10 completely edentulous patients with well formed ridges were included. For each patient three border moldings were done using different border molding materials. After final impression, three denture bases were fabricated for each patient using same denture base material and retention was checked.

Retention of denture can be evaluated by subjective assessment or objective assessment. Subjective measures include a questionnaire pertaining to retention and result depends on the patient's interpretation and their psychology. Objective assessment of retention includes measurement of force required to dislodge the denture base using various equipment. In 1950, Skinner designed a laboratory balance for application of dislodging force¹¹, whereas Avant used a modified testing machine having dial type push pull dynamometer for the same¹⁶. The instruments used in different studies for measuring force were dynamometer¹⁶, gnathometer¹⁷, Gnatho-dynamometer, spring balance, dial type push pull dynamometer, hydraulic electronic system and electronic system using extra-oral transducer. Objective measures are free from the influence of interpretations of the patients.

In present study, retention of maxillary denture was checked objectively by measuring dislodging force using a pulley type testing appliance. The apparatus used in this study is similar to the one given by Skinner with some modification.¹¹ Kumar et al¹⁸ and Chhabra et al¹⁹ have also used similar apparatus in their study. The apparatus measures the retention force with the help of Digital Force Gauge and uses a spindle handle attached to the hook placed in the denture base by nylon fishing



line. In addition to the design used by Kumar et al, a facebow was used to stabilize the head position so to achieve more accuracy and precision.

Result of the present study showed that denture bases fabricated by using tissue conditioner as a border molding material exhibited the highest mean retentive value (3.2 ± 0.50 Kg) followed by polyether (3.2 ± 0.29 kg), while denture base fabricated using green stick had the lowest mean retentive value (2.4 ± 0.19 kg). A statistical significant difference in retention of denture bases fabricated using green stick compound was found in comparison to tissue conditioner and polyether, whereas no statistical significant difference was seen between tissue conditioner and polyether.

Similar results were found by Patel JR et al who conducted a study to compare border morphology using tissue conditioner, low fusing compound and putty addition silicone as a border molding material and found statistically significant difference among three materials with tissue conditioner being the best material.¹⁰ Pachar R et al in their study found that denture bases fabricated using polyether as a border molding and final impression material in a single step had the highest mean values of retention compared to those made using Green stick, Impression compound and putty consistency addition silicone.²⁰ Similarly, Roy KC et al conducted a study to compare the retention of denture bases fabricated using green stick, condensation silicone and polyether as a border molding materials. They used a digital weighing meter to evaluate retention by applying force at geometrical centre. The mean value of polyether material was found to higher and statistically significant. Hence they concluded polyether to be the best material in comparison to other two materials as a border molding and final impression material.²¹

Contrary to present study, Jone et al compared the clinical results of border molding done using putty addition silicone, low fusing compound and impression waxes followed by final impression with light body and concluded that border molded using low fusing compound & addition silicone showed similar clinical results.²² Qanungo A et al, also compared the single-step border molding technique with sectional border molding by evaluating the retention of heat cure

denture bases.²³ The retention obtained in sectional border molding using green stick was significantly higher than that of single step technique. The probable reason may be the difference in consistencies of material used, since they used Light viscosity elastomers as final impression material. Also this study used stainless steel loop in more anterior location in maxillary denture bases compared to geometrical centre used in present study and force was applied using the force gauge held in operators hand rather than use of pulley system. Variation in the present study different from other studies is may be due to difference in testing apparatus, difference in different label, study designs of border molding materials.

There were certain limitations in present study ie. only Maxillary denture bases were checked for the retention by testing apparatus., also equipment used to evaluate retention could apply force only perpendicular to denture base which is not the case in actual clinical condition.

CONCLUSION

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

1. Denture bases fabricated using Tissue conditioner as a border molding material had the highest mean retentive value followed by Polyether and green stick.
2. Statistically significant difference ($p < 0.05$) was seen in retention of denture bases fabricated using polyether and tissue conditioner in comparison to green stick.
3. Difference in retention of denture bases fabricated using Polyether and tissue conditioner as a border molding material was statistically insignificant.

So, from the present study it could be suggested that though denture bases fabricated using polyether and tissue conditioner as a border molding material exhibited superior retention compared to green stick, results were favorable with all three materials clinically.

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