Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies ***NLM ID:*** *101716117*

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr Indian Citation Index (ICI) Index Copernicus value = 91.86

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Original Research

Evaluation of retention in complete dentures using different border moulding materials: A comparative study

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ABSTRACT:
Background: Good retention and stability of denture base is the primary concern while recording of tissue movements. Hence, an appropriate dental material is required for establishing good denture borders. **Aim**: The aim of present study was to evaluate the retention of complete dentures by comparing different materials that are used for border moulding technique. **Materials and methods**: This prospective study was conducted on 100 randomly selected completely edentulous elderly patients between 60 - 70 years. Patients identified for this study were categorized into four groups a) Group A: Patients with border moulding using green stick impression compound b) Group B: Patients with border moulding using polysulphide elastomer c) Group C: Patients with border moulding with poly-ether impression material and d) Group D: Border moulding done by making use of polysiloxane impression material. With low fusion impression compound, sectional technique while with elastomer materials, single step procedure was used. For each of the patient, primary upper arch impressions were prepared using suitably selected impression stock tray. The recorded impression was poured using dental plaster for getting a primary impression cast. After this, the impression cast was properly outlined and relief was given for fabrication of individualized and customized impression trays by means of auto-polymerizing acrylic resin material. Customized trays with spacers were then prepared for each of patient. Following completion of final impression procedure, master cast was prepared by pouring obtained impressions using 'type III' dental stone then permanent denture bases were prepared using heat cure acrylic material. All clinical along with laboratory based procedures were completed by one operator for avoiding any bias. All study observations were recorded and collected data was then tabulated. All the recorded study observations were subjected to statistical analysis for evaluating differences in retentions of different denture bases. **Results and observations**: Mean ± SD values in Group A was found to be 4.61 ± 0.88 kg; in group B it was 4.69 ± 0.73 kg; in Group C, it was noted as 6.81 ± 0.89 and in group D, it was 7.12 ± 0.91. Intra-group comparisons showed no statistically significant difference between Green stick compound and polysulphide elastomer. Statistical significance was observed in retention values between Green stick compound and polyether elastomer. Extremely significant difference was observed between Green stick compound and polysiloxane elastomer. Statistically significant differences were seen between polysulphide and polyether elastomers and poly-ether and polysiloxane elastomer. Extremely significant statistical difference was observed between polysulphide with polysiloxane elastomer. **Conclusion**: Polysiloxane is a superior material for border moulding compared to other materials used I this study.
Keywords: Retention, complete, denture, polysilxane, polyether, green stick, polysulphide, elastomer.

Received: 12 May, 2022 Accepted: 15 June, 2022

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This article may be cited as: DSouza RD, Verma S. Evaluation of retention in complete dentures using different border moulding materials: A comparative study. J Adv Med Dent Scie Res 2022;10(7):63-67.

INTRODUCTION

During 1950s, performing border moulding using low fusion impression compound was an acceptable standardized procedure opted by most of the Prosthodontists due to physical and chemical properties like decrease in total setting time, easy and wide-spread availability as well as cost efficacy. With time newer impression dental materials such as various elastomers like poly-ether and poly vinyl siloxanes were introduced. These materials demonstrated greater accurateness towards recording denture borders. Various important properties that are exhibited by such impression materials include homogenous type of consistency, ease in manipulating the material, lesser time spent at chair side and more correct placement of the borders of impression trays while recording the functional depth and width of vestibular sulcus. Also, the option of

single step border moulding using newer elastomer based impression materials was a more attractive option. [1]

Proper function related to complete dentures is dependent extensively over technique of making impressions. Variety of impression techniques are described within scientific literature since the beginning of present century. Greene brothers first introduced scientific method for recording of dental impressions. [2]

Border molding is very important procedure that is followed for fabricating complete dentures. A variety of factors have been associated with retention of complete dentures. These causative factors have been broadly categorized into a) biological, b) physical and c) mechanical factors. All peripheral denture margins must be formed in a manner such that all adjacent tissues either during rest position or whether under muscle stress remain under close contact with denture margins so that air ingress is prevented between denture and underlying tissues. [3]

The technique that helps in obtaining a peripheral denture seal is termed as 'border molding'. By means of this process, shape of tray border is fabricated in accurate conformation that ensures an optimum peripheral seal. These retention factors are achieved by using an accurate method of border molding procedure which is followed by a perfect final impression.[4]

The procedure for making a final impression for fabrication of a complete denture encompasses recording of depth of vestibule by means of procedure of border molding and then making an impression of edentulous arches.

Performing a border molding procedure by using a customized tray for means of close adaptation to vestibular tissues prior to making a final impression is a procedure followed for a long time in complete denture prosthodontics. [5]

In ideal condition, any dental material which is used in process of border molding must be in 'plastic' state and should be contacting entire vestibular sulcular area during single insertion. [5] A particular border molding material allows molding of all the borders in a simultaneous manner. This possesses two distinct advantages: (A) The total numbers of tray insertions for doing border molding can decrease and (B) Simultaneous development of denture borders does not allow further continuity in errors that are due to any particular error in one particular section which may affect contours of borders in any other tray section. [6]

Incremental variety of border molding while using a low fusing impression compound doesn't fulfill this particular criteria as only small part of functional depth of intended portion of vestibule sulcus and its associated muscles will mold the periphery area of impression tray during each of the insertion. Another significant factor is short time available for manipulating low fusing impression compound that does not give sufficient duration of activity for vestibular soft tissues to perform activity as well as cause molding of borders of particular customized impression tray. Additionally, with low fusion impression material, there is a fear of burning of soft intra-oral tissues as a result of exposure to heat used for softening this compound, specially when it is being manipulated by an lesser experienced person. [6]

Above limitations led towards usage of elastomeric dental materials for making impressions for complete dentures. Elastomeric impression materials exhibit material properties that allow them to be used as appropriate alternative of low fusing impression compound. These elastomers have several properties such as higher degree of accurateness, dimensional stabilization, ease of material manipulation and adequate amount of working as well as setting times. Examples of these elastomeric impression material for border molding are polysulfide, polyether and//or vinyl polysiloxane putty impression dental materials for customized impression. [7,8,9,10] Various drawbacks of elastomeric impression materials include a) odour and staining which is seen with polysulfide material, b) inadequate time required for manipulating polyether and c) formation of thickened and over-extended impression borders with putty consistency of poly-vinyl siloxane. [11]

Hence, keeping these facts in view this study was planned with an aim of comparative evaluation of retention in complete dentures using different border moulding materials.

MATERIALS AND METHODS

This study was conducted in Department of Prosthodontics after obtaining appropriate ethical approval from Institutional Ethical Committee. Written informed consent was obtained from selected individuals following purpose of the study. The study was conducted on 100 randomly chosen patients aged between 60 to 70 years who reported to the Department for fabrication of complete dentures. Inclusion criteria were a) Patients with good preservation of complete edentulous alveolar bone ridges b) No undercuts or presence of bony exostosis c) Firm attachment of oral mucosal tissues d) Absence of inflammation as well as oral ulceration and e) Patients with normal functioning of TMJ. Exclusion criteria were a) Those having high arch palatal vaults b) Excessive resorption of alveolar bone ridges c) Fibrous type of anterior portion of alveolar ridge d) Hyperplasia of incisive papillary region e) Poor control and coordination of neuro-muscular activities and f) Rigidity of muscle attachments and muscle tissues. Patients chosen for the study were divided into four categories- a) Group A: Patients in whom border moulding was performed with green stick impression compound; b) Group B: Patients with border moulding procedure performed using polysulphide elastomer; c) Group C: Patients

with border moulding done with polyether impression material and d) Group D: in this groups, border moulding was done using polysiloxane impression material. For border moulding using low fusion impression compound, sectional procedure was done while with elastomeric materials, single step procedure was performed.

METHODOLOGY

For each of the selected patient, primary upper arch impression was prepared in suitable sized impression stock tray. The recorded impression was then poured using dental plaster for obtaining primary impression cast. Following this, obtained cast was then outlined properly and relief was provided for fabricating customized impression trays by utilizing auto-polymerizing acrylic resinous material. Customized trays with spacers were prepared for each of the selected patient. Following final impression, master casts were prepared by pouring these impressions using 'type III' dental stone over permanent denture bases were prepared using heat cure acrylic material.

A loop was then prepared by using a '19-gauge' stainless steel wire which was attached to anterior palatal area of waxed-up denture bases which was approximately corresponding with the line joining distal canine surfaces.

A digital force measurement gauge was then used for recording retention of each of the denture base by inserting inside patient's oral cavity. During this procedure, the patient was made to stand in an upright position while the position was standardized using a cephalostat in a way that maxilla was in parallel position to floor while force was applied in a perpendicular direction for evaluating retention of denture bases. The force measuring gauge was then engaged within the hook attached to the denture base and a force was then applied by downward pulling force.

Entire clinical as well as laboratory procedures were then completed by same operator to avoid individual bias. All observations were then recorded and data collected was tabulated. All recorded observations were then statistically analyzed for evaluation of difference in retention of different denture bases which were fabricated by making use of studied dental impression materials.

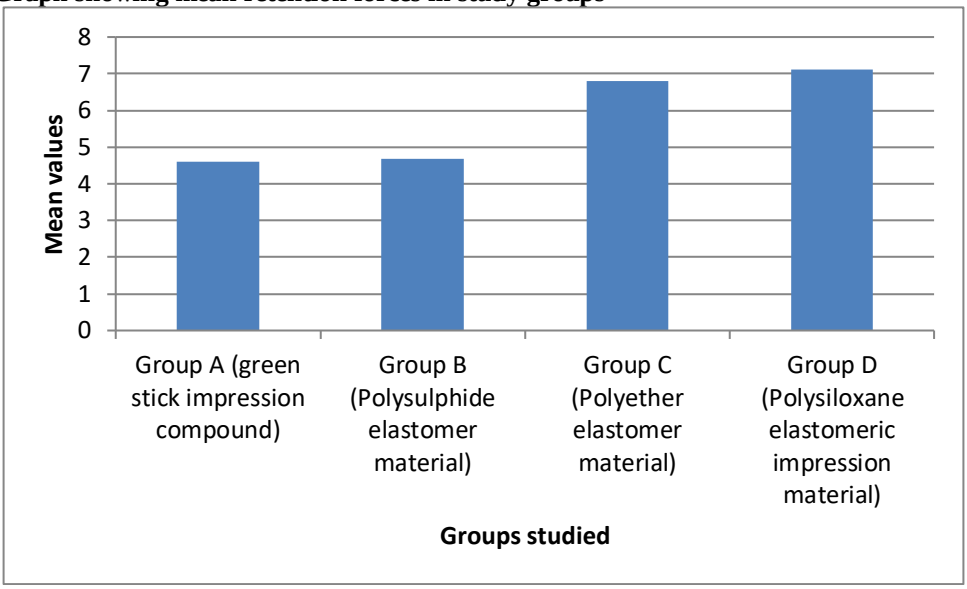
RESULTS AND OBSERVATIONS

On observation of retentive forces, mean ± SD values in Group A was found to be 4.61 ± 0.88 kg; in group B it was observed as 4.69 ± 0.73 kg; in Group C, it was noted to be 6.81 ± 0.89 while in group D, it was observed to be 7.12 ± 0.91 (table 1).

Table 1: Table showing mean ± standard deviation (S.D.) retentive force values in four study groups (in kg)

Group A (Green stick impression compound)	Group B (Polysulphide elastomer material)	Group C (Polyether elastomer material)	Group D (Polysiloxane elastomeric impression material)
4.61 ± 0.88 kg	4.69 ± 0.73	6.81 ± 0.89	7.12 ± 0.91

Graph 1: Graph showing mean retention forces in study groups



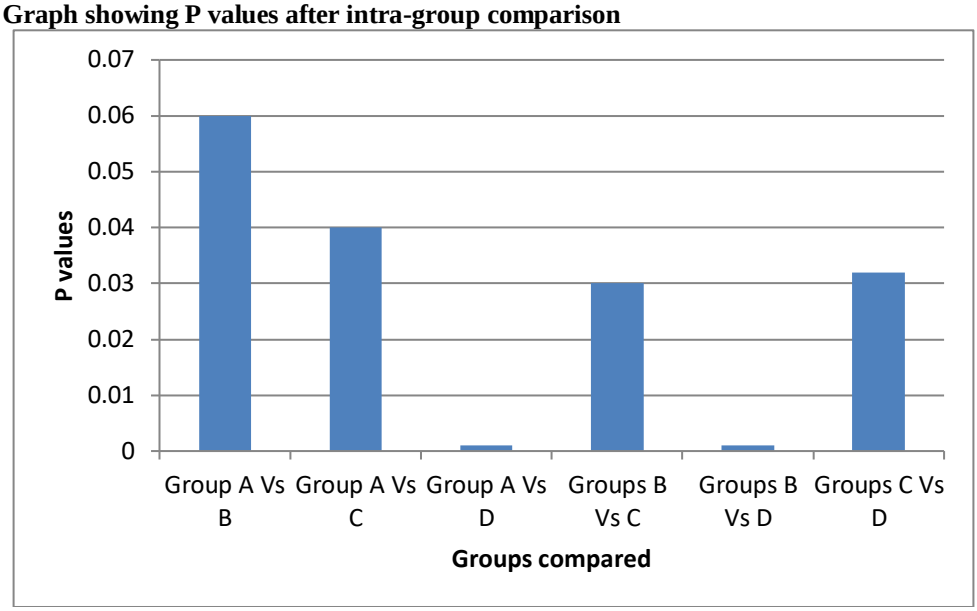
Intra-group comparisons between mean retention values showed no statistical significant difference (P >0.05) between Green stick compound and polysulphide elastomer border moulding. Statistically significant difference (P <0.05) was observed in retention values between Green stick compound and polyether elastomer based border moulding while extremely significant (P < 0.001) difference was

observed between Green stick impression compound and polysiloxane based elastomeric impression material. Statistically significant differences (P <0.05) were obtained between retention forces measured with polysulphide and polyether elastomer impression materials as well as poly ether and polysiloxane elastomer impression compound. Extremely significant statistical difference in retentive forces (< 0.001) was observed on comparing polysulphide with polysiloxane elastomeric impression materials (table 2).

Table 2: Table showing inter-group comparison between mean retentive values

Group A Vs B	Group A Vs C	Group A Vs D	Groups B Vs C	Groups B Vs D	Groups C Vs D
0.06	0.04	0.001	0.03	0.001	0.032

Graph 2: Graph showing P values after intra-group comparison



DISCUSSION

Border moulding process involves shaping of border areas of a customized impression tray by means of functional and/or manually manipulating of tissues which are adjacent to tray borders for the purpose of duplicating exact contours as well as size of labial and buccal vestibule. Termination of borders of denture over soft and resilient tissues allows movement of mucosa along with denture bases during function that helps in maintenance of peripheral seal of denture bases. This process and method of acquiring peripheral denture seal has been termed as 'border moulding'. By means of this process, shape of tray borders is recorded for accurately conforming with contours of buccal as well as labial vestibule. This is an essential requirement for ensuring the fitting of a customized impression tray that produces an optimum peripheral border seal. Hence, the ultimate goal of border moulding procedure is producing flange of a denture that can accurately support the soft tissues without producing any distortion in contact while sealing of denture border with tissues at the denture boundary without causing any impingement. Adequate resistance towards horizontal muscle forces and lateral torquing of maxillary denture may be resisted by adequate sealing of denture borders. [12, 13]

Kumar et al (2019) compared two border molding procedures as well as dental materials viz., low fusing impression compound for sectional border moulding and heavy viscosity poly vinyl silicone material for border molding in single-step. They observed that sectional type of border moulding using low fusion impression material had higher retention of complete denture in comparison with single step border moulding using polyvinyl (heavy viscous) material. [14]

Quanungo et al (2016) also compared these two dental materials i.e., low fusion impression compound and heavy viscosity addition silicone material in sectional and single type of border moulding, respectively. They also reported superiority of sectional technique of border molding over single step technique. [15]

Yarapatineni et al (2013) and Rizk (2008) investigated different types of techniques along with impression materials used for border molding for example, low fusing impression compound, putty Polyvinyl Siloxane, putty type of condensation silicone and medium viscosity Polyvinyl siloxane . They 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. [16, 17]

In present study, polyvinyl siloxane elastomer impression material was found to have superior properties in recording of denture flanges for recording of peripheral seal while doing border moulding.

In conformance to our findings, Arora et al (2015) in their comparative analysis of different impression materials i.e., low fusing green stick compound, heavy body (putty) silicone, pattern resin and peripheral wax found that polyether elastomer material was superior to other dental materials used. [18] Similarly, Sharma et al (2018) reported that polyvinyl siloxane was superior to green stick impression compound for recording peripheral border seal. [19]

Also, Shreya et al (2019) observed that putty material had greater capability of producing superior retention in denture bases when compared with green stick impression compound. [20]

CONCLUSION

There are variations in the existing studies in comparison of various impression materials that are used for recording peripheral seal of denture bases. In present study, statistically significant differences were observed on comparing green stick impression compound with other elastomeric compounds. Polyvinyl siloxane was found to be superior to other materials for border moulding.

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