Comparative analysis of the retention of maxillary denture base with and without border molding using zinc oxide eugenol impression paste

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Abstract

Aims and Objectives: The purpose of the study was to determine the effect of border molding on the retention of the maxillary denture base. Materials and Methods: Two special trays, one with full extensions to the periphery and one 2 mm short from the borders were made on the cast obtained from the preliminary impression. Border molding was done on the tray which was short from borders. On both trays, the final impression was made with zinc oxide eugenol impression paste. Heat cure denture bases were fabricated on the prepared casts and retention was measured using specially designed instrument. Observations and Results: Mean force with border molding (2765.0 g) was larger than mean force without border molding (1805.0 g) at \( P < 0.01 \) level. In terms of percentage, too, the mean improvement (59.4%) in force of dislodgement was statistically highly significant (i.e. \( P < 0.01 \)). Clinical Significance: The results of the present study suggest that the dentures made with border molding will provide better retentive force than the dentures made without border molding.

Key words: Border molding, peripheral seal, retention

INTRODUCTION

Retention in prosthetic dentistry is a force, which resists the displacement of a denture in an occlusal direction. The retention of the denture is of utmost interest to the patient and a matter of great satisfaction to the dentist. The retention is dependent upon many factors as the forces of adhesion, cohesion, interfacial surface tension, gravity, intimate tissue contact, peripheral (border seal), atmospheric pressure, and neuromuscular control. The most important single factor on which retention depends is the border seal. The glossary of prosthodontic termsinecrafted the border seal as the contact of the denture border with the underlying or adjacent tissues to prevent the passage of air or other substances. The peripheral borders of the denture are so formed that the tissues, when at rest or under muscular tension, will remain in close contact with the margins, thus preventing the ingress of air between the denture and tissues. The method of obtaining such peripheral seal is border molding by which the shape of the border of the tray is made to conform accurately to the contour of buccal and labial vestibules. This essential requirement of the tray’s fit ensures an optimal peripheral seal. The goal is to provide a denture flange that correctly supports, but does not distort the tissues while also creating a border sealing contact with the boundary tissues without impingement. Horizontal forces and lateral torquing of the maxillary denture can be resisted only by adequate border seal. Hence, border molding procedures are used for two purposes, first to establish correct flange length and border

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thickness and second, to achieve retention through border seal.

**Review of literature**

Schlosser [2] studied that the retention is governed by three major factors: Uniform bearing hard and soft areas, a good border seal, and a well-balanced functional occlusion.

Landa [3] stated that under certain circumstances the force of atmospheric pressure will become a great aid to retention of dentures.

Skinner et al. [4] showed that the retention of base plates was greatly reduced when there was no peripheral seal.

Gehl et al. [5] acknowledged that atmospheric pressure acts only if the peripheral seal is correctly formed.

Roydhouse [6] supplied the key to the relationship between the peripheral seal, the fluid forces in the saliva film and retention of complete dentures.

Fish [7] was the first to discuss the determinants of retention and differentiate between tissue, polished, and occlusal surface of the complete denture.

Tyson [8] concluded from a series of laboratory tests that retention is obtained primarily through the effect of soft tissue impaction against denture base, creating a seal which prevents air getting between the denture and the mucosa.

Avant [9] compared the retention of complete denture bases having different types of posterior palatal seal. He concluded that a posterior palatal seal is necessary for the optimum retention of the maxillary complete denture.

**MATERIALS AND METHODS**

The study was conducted *in vivo* on 20 edentulous patients with firm and normal ridges without undercuts, irrespective of the arch form and shape of the palatal vaults. The preliminary impression of the maxillary denture bearing area was made with impression compound in a stock tray [Figure 1]. The impression was poured in dental stone. Two customized trays of chemically activated resin were made on the cast as follows: Markings for the resin tray to be border molded were 2 mm short and 3 mm short for the wax spacer from the sulcus. Baseplate wax of 1 mm thickness was adapted on the cast to act as a spacer. The posterior palatal seal area on the cast was not covered with wax spacer [Figure 2a]. The resin tray was extended to the complete depth of the sulcus and wax spacer was kept 1 mm short of the sulcus for the tray on which border molding would not be carried out [Figure 2b].

In the region of cuspids and first molars, 2 mm wide strip of wax was cut and extended over the labio/buccopalatal aspect of the ridge to provide four stops in the resin tray for proper orientation of the tray in the mouth. The special trays of about 2–3 mm thickness were constructed over the cast by sprinkle method using an autopolymerizing acrylic resin [Figure 3a and b]. Resin handles were made in
The tray with full extensions was checked and adjusted in the patient's mouth till it did not dislodge during various muscle movements. Wax spacers were removed from both the trays and final impressions were made with zinc oxide eugenol impression paste [Figure 4a and b]. The impressions were poured in dental stone. The posterior palatal seal area was scraped on the cast obtained after border molding.

Heat cure acrylic resin bases were fabricated on both the casts with two raised horizontal platforms in the region of the second premolar and first molar. The denture bases were finished and polished. Holes were drilled in the raised platforms, and a straightened wire of 26 gauge was passed through the holes and tied on one side [Figure 5a and b]. The denture bases were distributed into two groups of 20 specimens each and retention was compared.

- **Group 1:** Denture bases made without border molding
- **Group 2:** Denture bases made with border molding.

### Measuring the retention of denture bases

For measuring the retention, a specially designed testing device was used. The device assembly had an adjustable forehead support and chin rest to obtain the stable patient position. It had a horizontal rod with a metal rod on one end and a wire tied on the other end which passed over the pulley and attached to a plate for carrying the weights. The metal rod had a notch which fitted on the wire of the denture base. The retention of both the sets of denture bases was tested after they had been left in the mouth for 20 min. Patient was seated in front of the testing device in a comfortable position. The chin was placed quite firmly in the chin rest with forehead leaning solidly against the forehead support. The notch on the steel rod was fitted on the wire of the denture base [Figure 6]. Patient was instructed to relax and not to exert any pressure on the denture base with the tongue. Weights were placed on the plate till the denture base dislodged.

### RESULTS

**Group I denture bases** [Table 1] showed the minimum value, in the range of measurement of dislodging force, to be 600 g and the maximum value to be 2700 g, averaging to a group mean of 1805.0 g.

**Group 2 denture bases** [Table 1] showed the minimum value, in the range of measurement of dislodging force, to be 1300 g and the maximum value to be 4500 g, averaging to a group mean of 2765.0 g.
Further, values of percentage increase in force of dislodgement with border molding over such a force without border molding were computed in respect of each of the twenty patients and have been presented again in Table 1.

Statistical analysis

With a view to draw valid conclusions from the experimental data, the measurements on dislodging force in respect of Group 1 and Group 2 were subjected to statistical evaluation.

Various statistical measures such as standard deviation, coefficient of variation (%), standard error of mean were computed for the two groups. Besides, 95% and 99% confidence intervals for both the groups were also worked out. These computations have been presented in Table 2.

“Paired t-test” was applied to test whether the mean dislodging force of the two groups is statistically different from each other.

As per the computations, value of the “Paired t-test” statistic turned out to be 12.226 at 19° of freedom. This value was much higher than the 5% and 1% critical values of “t” (being 2.093 and 2.861 respectively) at the corresponding number of degrees of freedom. Thus, the computed value of “paired t-test” was highly significant implying, thereby, that means of the two study groups were highly different from each other. In other words, mean force with border molding (2765.0 g) was larger than mean force without border molding (1805.0 g) at \( P < 0.01 \) level.

Further, values of percentage increase in dislodging force [Table 1] were also subjected to “t-test” in order to ascertain whether their mean was significantly different from zero or not. As per the computations, the “t” value (10.328 at 19 degrees of freedom) again turned out to be much higher than the critical values at both 5% and 1% levels. This led to the conclusion that in terms of percentage, too, the mean improvement (59.4%) in force of dislodgement was statistically highly significant (i.e. \( P < 0.01 \)).

Finally, variations among the observations on force of dislodgement in respect of the two study groups have been depicted diagrammatically in the graphs [Graphs 1 and 2].

DISCUSSION

The fundamental principles underlying retention of the complete denture are physical, mechanical, and biological. Atmospheric pressure, vacuum, adhesion, cohesion, surface tension, viscosity, base adaptation, border seal, seating force, and muscular control have all been cited as major or contributory factors which aid in retention.

**Table 1: Values of mean dislodging force and range among the experimental observations in the two study groups**

| Group                              | Number of observations | Range        | Mean       |
|------------------------------------|------------------------|--------------|------------|
| 1 (Without border molding)         | 20                     | 600-2700 g   | 1805.0 g   |
| 2 (With border molding)            | 20                     | 1300-4500 g  | 2765.0 g   |
| Percentage increase in dislodging force | 20               | 28.0-116.7 | 59.4%      |

**Table 2: Values of basic statistical computations on force of dislodgement for the two study groups**

| Group                              | Number of observations | Mean (g) | SD (g)  | CV (%) | SEM | 95%               | 99%               |
|------------------------------------|------------------------|----------|---------|--------|-----|-------------------|-------------------|
| 1 (Without border molding)         | 20                     | 1805.0   | 618.24  | 34.3   | 141.8 | 1508.1-2101.9 g   | 1399.2-2210.8 g   |
| 2 (With border molding)            | 20                     | 2765.0   | 774.13  | 28.0   | 177.6 | 2393.3-3136.7 g   | 2256.9-3273.1 g   |

SD: Standard deviation, CV: Coefficient of variation, SEM: Standard error of mean
Surface tension forces at the periphery contribute to retention, but the most important concerns are good base adaptation and border seal. These must be achieved if full advantage is to be taken of the salivary flow related effects as reported by Darvell and Clark.[10]

According to Landa[11] by creating a partial vacuum. In order to secure atmospheric, however, it is necessary to have the peripheral denture borders in intimate contact with the soft tissues so as to form a valve seal. This will prevent the air from penetrating between the denture and the supporting tissues even during the functioning of the dentures.

When a displacing force at right angles to the occlusal surface is applied to a denture that has a peripheral seal, a negative pressure develops between the denture and the tissues. The best position for the peripheral seal around the denture is on the buccal surface of the upper and buccal and lingual surfaces of the lower, rather than only at depth of the sulcus as reported by Watt and MacGregor.[12]

The correctly placed posterior palatal seal will create a partial vacuum beneath the maxillary denture, which is activated only when horizontal or tipping forces are directed against the denture base as advocated by Winkler.[13]

The results show the force of dislodgement ranged from 600 to 2700 g with a group mean of 1805.0 g in Group 1 (denture bases made without border molding) 1300–4500 g with a group mean of 2765.0 g in Group 2 (denture bases made with border molding).

It shows 53.18% increase in the retentive force of the denture bases made with border molding as compared to those made without border molding, which emphasizes the need for border molding.

The results of the present study suggest that the dentures made with border molding will provide better retentive force than the dentures made without border molding as advocated by Skinner et al.[4]

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.

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