Comparative study on the fit of Maxillary Complete Denture Bases at the Posterior Palatal Border Made by Heat Cure Acrylic Resin Processed on High Expansion Stone and Type III Dental Stone
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Abstract
Background: The advent of acrylic resins in 1937 was a major breakthrough in the annals of modern dentistry. Their recognition and acceptance in prosthodontics was indeed incredible as they were found to be more aesthetic, easy to manipulate both in the clinic as well as in the laboratory. Aims: To determine the effect of high expansion stone (type V) in compensating the acrylic resin shrinkage compared to type III dental stone. Materials and Methods: A total of 30 edentulous maxillary casts were made from this master mold, out of which 15 were made with type-V high expansion dental stone and another 15 were made from type-III dental stone. These 30 edentulous casts were used for processing the maxillary denture bases. Each acrylized denture base was recovered, trimmed, polished and numbered before its adaptation on the master cast for reading. Results: Analysis of the data revealed that the maxillary denture bases processed on high expansion dental stone casts produced openings along the posterior palatal border that were substantially 39% smaller compared with the denture bases processed on type-III dental stone. Conclusion: The use of high expansion dental stone can be recommended to compensate for the acrylic shrinkage.

Key Words: Type III Dental Stone; Maxillary Denture Base; Type V Expansion Stone.

Introduction
The advent of acrylic resins in 1937 was a major breakthrough in the annals of modern dentistry. (1) Their recognition and acceptance in prosthodontics was indeed incredible as they were found to be more aesthetic, easy to manipulate, both in the clinic as well as in the laboratory and required less capital expenditure for processing. (2) However, later research and investigations revealed that, regardless of the curing technique or type of acrylic resin selected, the processing deformation that is apparent when the cured dentures are removed from the cast is universally recognized as major disadvantage of this material. (3)

Although relatively well fitting dentures are produced at low cost and with easy manipulation, current denture base materials are not ideal in every aspect. This was acknowledged in 1943 itself by Skinner and Cooper, (4) who noted at least two unavoidable dimensional changes which are active in every acrylic denture; namely, shrinkage, which occurs during processing, and subsequently expansion, which occurs upon immersion in water. Results of several workers including Skinner, (4, 5) have shown that, in general, heat cured acrylic resin dentures have a processing linear shrinkage of 0.3%-0.5% which when immersed in water show a linear expansion of 0.1%-0.2%. The net linear shrinkage therefore amounts to 0.1% to 0.4%.

One of the clinical criteria for a successful prosthesis is its accurate adaptation the denture bearing area. Efforts have been made to improve the physical properties of the material by modifying the acrylic polymer, for example, through copolymerization. Investing and processing procedures were developed, such as direct and trial pack techniques, dry and wet curing, pour techniques and injection techniques. However little research has been conducted on the influence on the type of dental stone used to fabricate the cast. The present study compared the accuracy of fit of maxillary complete denture bases made by heat cure acrylic resin at the posterior palatal border processed on high expansion dental stone (type V) and on type III dental stone and assess the role of water sorption by acrylic resin on the fit of maxillary complete denture bases. The present study was conducted to determine the effect of high expansion stone (type V) in compensating the acrylic resin shrinkage compared to type III dental stone.

Materials and Methods
The materials used in this study were, a) High expansion dental stone (type V) (Whipmix corporation, USA), b) Type III dental stone (Hinrizit, Germany), c) Heat cure acrylic resin (Trevalon, Dentsply, India), and d) Scheu-dental mold material (Bioplast, Germany). The
instruments used were, Stereomicroscope and Biostar vacuum adaptation machine.

Procedure

An ideal maxillary cast was prepared from a standard edentulous mold which was devoid of any undercuts or surface irregularities and had a smooth U-shaped, well-formed arch. A master mold was prepared from this cast using Schau-dental mold material, which was 2mm thick and clear. The bioplast sheet was adapted on the maxillary cast using vacuum adaptation machine. A total of 30 edentulous maxillary casts were made from this master mold, out of which 15 were made with type-V high expansion dental stone and another 15 were made from type-III dental stone. The setting expansion of type-V dental stone was 0.28% and that of type-III was 0.13%-0.14%. These 30 edentulous casts were used for processing the maxillary denture bases.

An additional master cast was made with type-III dental stone from the same master mold, which represent as the standard model and on which all the measurements were made. All the maxillary denture bases were acrylized following the instructions of the manufacturer. Each acrylized denture base was recovered, trimmed, polished and numbered before its adaptation on the master cast for reading. The gap between the inner (palatal) surface of the maxillary denture base and the tissue surface of the master cast was measured with a stereomicroscope. The midline was determined by drawing a line from the labial frenum to incisive papilla along the mid palatine raphe to the posterior border of the cast. Measurements were made at the midline and at 5 and 10 mm on each side from the midline. Three measurements were made, a) First immediately after trimming and polishing, b) Second after 24 hours immersion of denture base in tap water at room temperature and c) third after one week immersion of denture base in water at room temperature.

Results

Statistical analysis revealed that, at each measurement period and at each location the mean posterior palatal border openings were significantly different for the denture bases processed on type-V dental stone versus type-III dental stone. When the measurements were made immediately after trimming and polishing, although the range of posterior palatal border opening varied from 31-50%, at each measurement location the mean openings for the high expansion dental stone were consistently 39% smaller than those for type-III dental stone.

Little or no reduction in gap was observed when the denture bases were immersed in water for 24 hours, which were not statistically significant. However, 7 days immersion of denture bases in water showed significant smaller openings for both the denture bases processed on either stone.

Discussion

The accuracy of fit of a denture base was an important factor in the retention of the denture base. The better apposition of the denture base was attained better the retention of the denture in the mouth and greater would be the comfort experienced by the patient.

Among the various properties of heat cure denture base resins, two unavoidable dimensional changes are shrinkage, which occurs during processing, and subsequently expansion, which occurs upon immersion in water. The net processing shrinkage for heat activated resin has been measured as 0.53% and linear shrinkage generally is observed to be less than 1%.

According to ADA specification no. 12, the weight gain following immersion of a test specimen in distilled water for 7 days must not be higher than 0.8mg/cm. Several investigators have used a variety of methods to determine the dimensional change occurring in acrylic resin denture base materials during processing and subsequent usage by patients.

Various methods have been used to assess the dimensional changes or discrepancies occurring along the posterior palatal border. But, of the all, the simplest method of evaluating the fit of the dentures is to place them lightly on a master cast and observe the fit, by Anthony and Peyton.(5) Skinner(4) found that the shrinkage due to curing is not confined to one region alone, instead it would be distributed uniformly over all the surfaces of the denture.

Johnson 1987(6) stated that the diminution of intimate tissue contact, resulting from the acrylic shrinkage, by the buccal flange in the tuberosity region generally possess no monumental clinical problems as close proximity of vestibular tissues combines with the buccal palisades of the cheeks to maintain the denture seal in this area. But it is necessary to compensate for the distortion of heat activated resin, in order to secure positive contact with palatal mucosa at the posterior border of a maxillary denture. Based on the above facts, in the present study, the influence of high
expansion dental stone was tested to compensate for the acrylic resin shrinkage.

Earlier studies by O. Sykora and E.J. Sutow (2, 7) on the use of high expansion dental stone to compensate for the acrylic shrinkage have demonstrated 50% reduction in the size of posterior palatal border openings of the maxillary dentures. The high expansion dental stone tested in their study had a setting expansion of 0.55% which was almost 4.5 times greater than that of the type-III dental stone used (0.12%). In the present study, the type-III dental stone used had a setting expansion of 0.14% and that of type-V dental stone was 0.28%, which nearly equalizes the amount of setting expansion required for type-V dental stone (0.3%) as specified by ADA no. 25.

Analysis of the data revealed that the maxillary denture bases processed on high expansion dental stone casts produced openings along the posterior palatal border that were substantially 39% smaller compared with the denture bases processed on type-III dental stone.

Theoretically, sorption of water or oral fluids by the acrylic resin can help to compensate for processing shrinkage by expanding the denture. It has been determined that a typical acrylic resin denture base may require a period of almost 17 days to become fully saturated when immersed in water at room temperature. Analysis of five measurement locations showed no statistical differences caused by 24 hours immersion of the denture bases, processed on either stone casts. However, one week immersion in water produced significant dimensional change for both types of denture bases processed on either stone casts.

**Conclusion**

The study concluded that there was an improvement in the fit of maxillary complete denture bases at the posterior palatal border when processed on type-V high expansion dental stone, compared to type-III dental stone, and immersion of denture bases of both types in water for one week produces significant expansion to improve the fit of maxillary complete denture bases. From the present study, the use of high expansion dental stone can be recommended to compensate for the acrylic shrinkage. With the high expansion dental stone, it is theoretically possible that it could result in a complete maxillary denture that is too tight in some other area. Since the study was restricted to laboratory investigation only, further research would be required for clinical acceptance of the findings.

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