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ORIGINAL ARTICLE

A Comparative Evaluation of the Denture Base Accuracy along the Posterior Palatal Seal using Different Anchorage Systems in Complete Dentures

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ABSTRACT:

Purpose: This study was designed to investigate the adaptation of maxillary denture bases to stone casts with varying palatal vault processed by the conventional, and two anchoring methods. **Material and methodology:** Fifteen maxillary casts made of shallow palatal form and another fifteen made of deep palatal form were selected for the study. Fifteen of each group were further divided into 3 subgroups consisting of five casts in each sub group.(1 conventional group,2 anchorage groups).The anchoring methods used holes drilled on the cast and a special flange extended onto the posterior aspect of the maxillary cast. Twenty-four hours after polymerization, the bases on the casts were sectioned at the posterior border at pre-determined points and evaluated for the degree of adaptation, by using a stereomicroscope. The resultant data were analyzed using two-way analysis of variance followed by post hoc multiple comparison test.
Results: The maximum gap was noted in the mid-palatine region in the conventional method. Though the anchored pegs showed better adaptation of denture bases, statistically there was no significant difference between two anchoring methods irrespective of palatal configuration. **Conclusion:** Within the limitations of the study it is concluded that, anchor hole method and strap method equally effective and these methods significantly improves the palatal adaptation of denture bases compared with conventional method.
Key words: Posterior palatal seal, palatal vault, denture base, polymerization shrinkage, anchoring holes.

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INTRODUCTION:

The retention of the denture is of at most interest to the patient and a matter of great satisfaction to the dentist as well as the patient. Adhesion, cohesion, and interfacial surface tension, gravity, intimate tissue contact reduced atmospheric pressure all contribute to the retention of complete dentures[1]. Craig etal[2] have indicated that retention of dentures is greatly dependent on capillary forces. These forces are at a maximum when the distance between the denture surface and supporting tissues is minimum. Other factors such as area of coverage and occlusion are involved, but the better the denture base conforms to the tissue surfaces automatically, the better will be the retention[3].

One of the properties examined with methyl methacrylate resins was linear and volumetric changes which occurred after curing, and consecutively two methods for measuring this change were developed and described. However, the resins were all found to shrink during the curing process. But, on immersion in water, the resins were found to expand. Due to this, most of the maxillary complete dentures do not adapt accurately to the casts because of the changes in the resin during polymerization[4]. The accuracy of the fit of the maxillary denture base is required in the posterior aspect of the palate between denture and the cast. There are literature evidences suggesting that anchoring the maxillary denture base during polymerization will improve the fit of the denture on the cast[5-8], which in turn will improve the fit and the retention of the maxillary denture base. But there is little information regarding the fact, which among the anchoring methods will help in the intimate adaptation of permanent denture bases on to the stone casts. This study also examined the comparative evaluation of permanent denture bases on different palatal vault configuration.

MATERIAL AND METHODOLOGY:

Preliminary casts were obtained from patient with shallow and deep palatal vault. Master casts were made by regular beading and boxing method. Silicone putty duplicating material was used to duplicate the master casts. From each mould 15 casts were poured with type IV dental stone. Total of 30 casts were duplicated in which 15 shallow palatal vault, remaining 15 deep palatal vault. Master casts were divided into 6 test groups based on palatal vault configuration and anchoring method. Those are Shallow conventional, shallow strap, shallow anchor hole, steep conventional, steep strap, steep anchor hole method.

Three methods were employed in the fabrication of permanent denture bases.

1. CONVENTIONAL METHOD (METHOD A)
   Without any modification of denture bases, a sheet of base plate wax (1.5-mm thick) was adapted over the stone cast to ensure uniformity.

2. STRAP METHOD(METHOD B)

A method suggested by Vig[5] was used to minimize the polymerization shrinkage in the maxillary denture by adding a special artificial flange to the posterior aspect of the maxillary cast. In this technique just like conventional method, first a sheet of base plate wax was adapted to which an additional layer of wax was extended over the posterior aspect to wrap the cast. The dimensions of this wax extension measured as 25mmin width and 8mm in height. (Figure 1)

3. ANCHOR HOLE METHOD (METHOD C)

This method was suggested by suggested by Ristau[6] and was used to enhance retention of the denture bases.
In this method mechanical anchorage was accomplished by placing holes along the posterior land area 1mm distal to the posterior border of the denture base in the casts at prescribed locations: the left vestibule area, the left ridge, midway between the left ridge and the palatal midline, the midline, midway between the right ridge and the palatal midline, the right ridge, and the right vestibule. A clear acrylic resin template was made for each type of palatal vault. This template acted as a standard guide in transferring the reference points on other sample cast(Figure2:Reference A)as well as guided in the placement of the cast on the pindex machine to drill holes with regards to the reference points. Corresponding sites were marked in the clear acrylic resin template along the posterior palatal seal area. Holes were drilled by using no 8 round bur with eccentric motion to a depth of 5 mm to make anchor extensions on the cast 1mm distal to the posterior land area (Figure 2 Reference point B).
The cast with the template was placed on the platform of the pindex machine. Laser light of Pindex was aligned with the reference points on the template, and holes were drilled underneath the cast (Figure2: Reference A). These holes serve as markers during measurement.
Then a layer of base plate wax was adapted over the cast and care should be taken wax should cover the posterior land area.
Finally all casts with temporary denture bases were heat-polymerized at 163°F for 9 hours[9].After polymerization, the flasks were allowed to bench cool and the lower compartment was separated from the flask .The specimens were then enclosed in an overlying matrix of yellow dental stone to stabilize the bases on the casts during sectioning and measurement. After bench cooling, a cut was made with reference to the previously made markings on the cast with the help of the Pindex machine. The cast along with the denture base was trimmed on the posterior aspect with dental cast trimmer. The trimming was stopped before the measurement plane was reached and the acrylic resin anchoring studs became visible and were completely trimmed away(Figure 3).Stereo microscope (MAGNUS MSZ-Bi) of 0.65x magnification with the help of image analysis software (IMACE PRO-INSIGHT VERSION 8) was used to measure the distance between each cast and its denture base(Figure 4A,Figure 4B). Each measurement was repeated five times. The average value represented the amount of discrepancy in each location.

Figure 1: Strap method showing wax extension

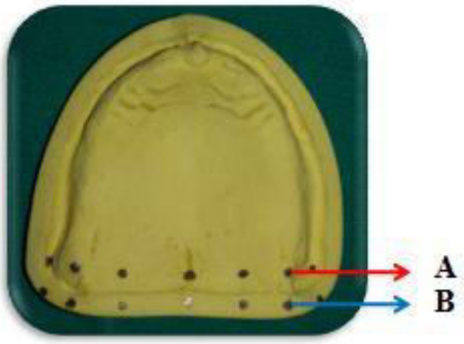


Figure 2: Showing Reference A and Reference B points

Figure 3: Anchoring pegs are exposed during trimming

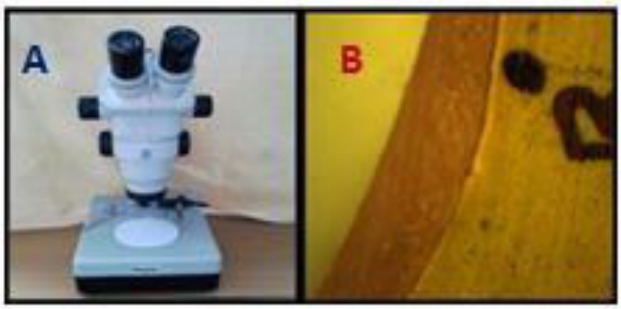


Figure4: 4A, Stereomicroscope, Figure 4B, Stereo microscope showing interface gap opening

RESULTS:

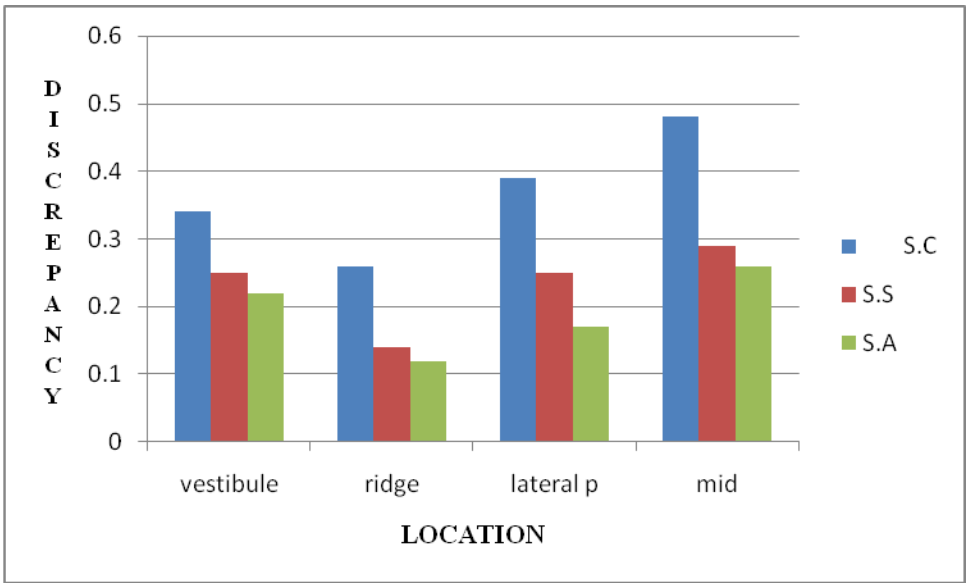
The discrepancies of fit in shallow and steep palatal vault are presented in Tables 1. Data were statistically analyzed by using two-way analysis of variance (ANOVA) and followed by post hoc multiple comparisons. (LSD-least significant difference). The same level of significance was maintained throughout the study (p = .05).Statistical analysis revealed that there was significant difference noticed between the Convention and with Anchoring methods (Table 2, Table 3).But statistically there was no significant difference among the two anchoring methods with different palatal vault configurations.

TABLE 1: EFFECT OF ANCHORING METHODS ON PALATAL VAULT CONFIGURATION

Type of method	**Palatal shape**	**Posterior palatal border opening, mean(mm), standard deviation, measurement location**			
		vestibule	**ridge**	**Lateral palate**	**Mid palate**
1.Conventional method	Shallow vault Steep vault	0.34 (0.050) 0.26 (0.057) P <0.01	0.26 (0.053) 0.17(0.050) P <0.01	0.39 (0.060) 0.44(0.099) P >0.01	0.48(0.052) 0.62(0.062) P <0.01
2.Strap method	Shallow vault Steep vault	0.25(0.018) 0.23(0.040) P > 0.05	0.14 (0.040) 0.11 (0.026) P > 0.05	0.25 (0.029) 0.20 (0.033) P > 0.05	0.29 (0.043) 0.28 (0.033) P > 0.05
3.Anchorhole Method	Shallow vault Steep vault	0.222 (0.025) 0.23 (0.040) P > 0.05	0.12 (0.028) 0.10 (0.008) P > 0.05	0.17 (0.050) 0.21 (0.023) P > 0.05	0.26 (0.042) 0.25 (0.025) P > 0.05

Mean, standard deviation, n=5,N=30

TABLE 2: COMPARISION BETWEEN 3 DIFFERENT METHODS IN SHALLOW PALATAL FORM.



SC-shallow conventional, SS-shallow strap, SA-shallow anchored

TABLE 3: COMPARISION BETWEEN 3 DIFFERENT METHODS IN STEEP PALATALFORM

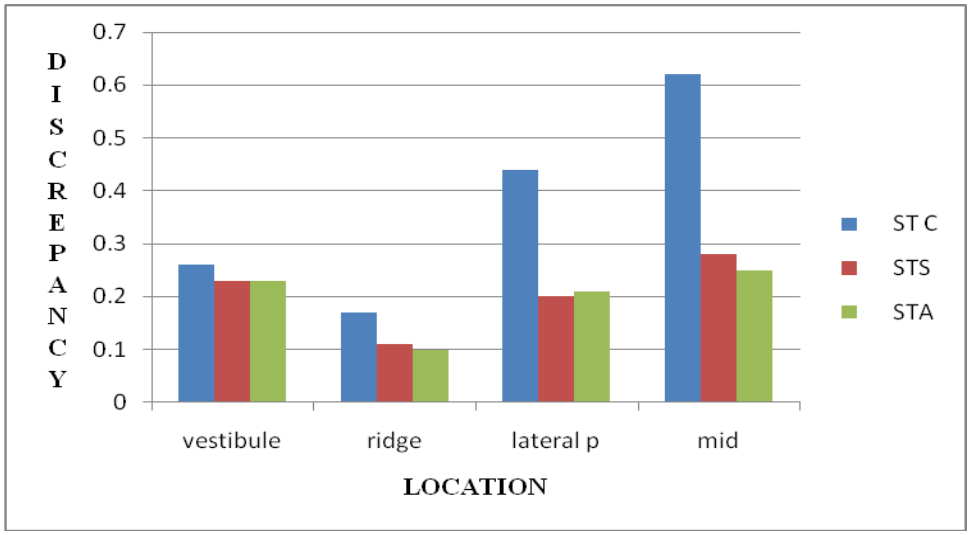
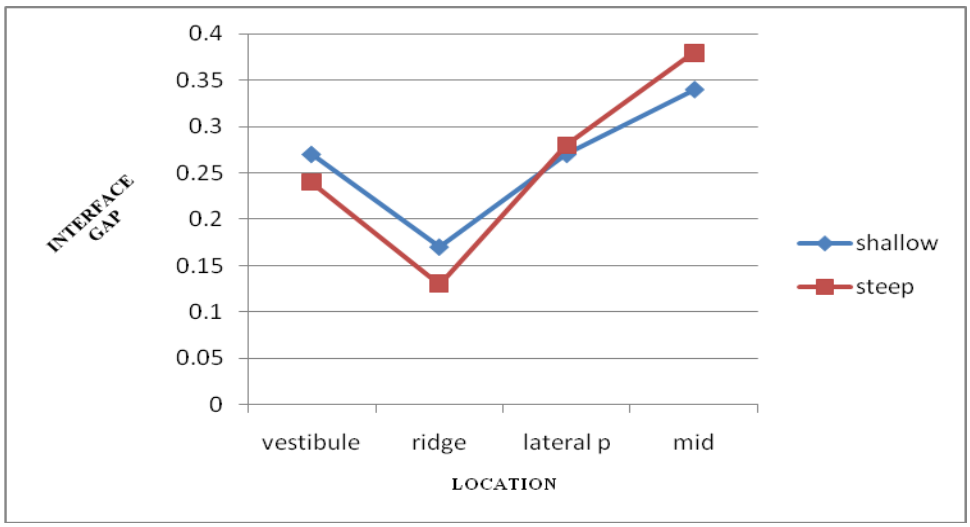


TABLE 4: COMPARISION BETWEEN CONVENTIONAL SHALLOW AND STEEP PALATAL FORM



DISCUSSION:

The accuracy of fit of a denture base is considered an important factor in the retention of the denture base. The better the adaptation of the denture base on the cast the greater will be retention of the denture in the mouth as well as provides greater comfort to the patient. But polymerization shrinkage of the denture base is unavoidable entity which would result in improper fit of the denture base after processing, tooth movement, incisal rod opening on the articulator[10-13].Literatures have suggested different anchoring methods to overcome this shrinkage[5, 6]. In the present study the effect of two anchoring methods were compared to evaluate the fit of the denture.

Reasons for the selection of anchoring methods:

A method developed by Vig R.G was followed to minimize the polymerization shrinkage. In this technique a special wax extension was provided at the posterior end of the cast extending up to the base in order to neutralize the anchoring effect of the labial residual ridge. It also helps to prevent the anterior movement of the denture base in to the labial undercut which may result in polymerization shrinkage[5].

Another anchorage method suggested by Ristau B[6]was applied to prevent polymerization shrinkage. In this method the anchor holes were placed along the post palatal seal area which provides locking of the resin into the undercuts and thus prevents polymerization shrinkage.

Literature evidences also suggested that there is a definite correlation present between the fit of the denture base and anatomic morphology of the palate[14]. Hence different anchoring methods and their effect on different palatal vault configuration were tested in the present study.

When comparing conventional method with anchoring methods in the current study revealed that, greatest mean discrepancy (0.62 mm) resulted from dentures processed with the conventional method (A) in mid palate area of steep palatal vault. This results showed similar findings to earlier studies[6, 15, 16].Statistically significant difference was observed between conventional method and anchoring methods($p < 0.01$) especially in lateral palate and mid palate location in both the types of palatal vault (Table2, Table 3). Irrespective of palatal vault it is evident that method C was superior to the conventional method in improving adaptation at the posterior palatal midpoint and lateral palate.

When the Comparison among the anchoring methods were made, the interface gap discrepancy at four specified locations such as vestibule, ridge, lateral palate and mid palate measured as0.02, 0.03, 0.05, 0.01 in strap method and 0.01, 0.02, 0.04, 0.01 in anchor hole method between shallow and steep palatal vault forms. But this discrepancy when subjected to statistical analysis showed no significant difference among the anchoring techniques ($p > 0.05$) to improve the overall fit of the denture base.

Regarding the pattern of adaptation a small change was noticed in conventional method. Steep palatal vault showed more discrepancy at the mid palate area and also showed less discrepancy at the vestibule and ridge area compared to shallow palatal vault (Table 4). Reason for this change is due to the convoluted form of the steep palate, dentures showed more shrinkage towards the central area of the cast.[14] Despite the influence of palatal vault configurations on polymerization shrinkage, there are several studies which suggest that incorporation of filler particles into polymethyl methacrylate would minimize the shrinkage to certain extent.[17]

CONCLUSION:

Anchoring methods significantly reduces interface gap opening at the lateral and mid palate location regardless of the type of palatal form compared to conventional method. Anchor hole method shows slightly superior results compared to strap method to improve the fit of the denture base but these results were not statistically significant. Both anchoring methods can be safely recommended to improve the fit of the denture base so that patient satisfaction greatly improved.

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