A comparison of the retention of complete denture bases having different types of posterior palatal seal with different palatal forms

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ABSTRACT
Background: The most common problem associated with the lack of retention of maxillary complete denture is faulty posterior palatal seal pps. The methods for achieving a pps include arbitrarily scraping the cast, selective pressure technique, and the physiologic impression technique.

Material and Method: In this study forces required to dislodge a maxillary complete denture bases were compared for different types of posterior palatal seals (PPS) with different palatal forms by using a specially designed strain gauge force transducer and strain measuring device. Nine male and female subjects are selected with age range 55-70 years. These patients with different palatal forms according to House's classification of palatal forms: Class I flat, Class II intermediate and Class III high. Using different impression technique the first ordinary impression with Zinc-oxide eugenol and scraping the cast for pps, the second physiological impression by using Korecta wax No.4.

Result: The results show very highly significant difference, between the different designs of pps and physiological impression for each group.

Conclusion: The physiological impression of pps give better retention because no over compression of tissues (within the physiological limit) and concluded that the form of palate has direct influence on the retention of complete dentures and will aid in the selection of type of posterior palatal seal needed.

Keywords: Maxillary complete denture, posterior palatal seal. (J Bagh Coll Dentistry 2012;24(2):11-17).

INTRODUCTION
A well fitting and retentive complete maxillary denture requires a well fitting surface a peripheral border compatible with the muscles and tissues which make up the muco-buccal and muco-labial spaces so that a peripheral seal is created by the soft tissues draping over them and finally, a posterior palatal seal. Avants 1 has shown that "a pps is necessary for optimum retention of maxillary complete dentures" and that of the designs he tested, none proved to be superior in all of his five test subjects1.

The pps area has been defined as an area of soft tissue along the junction of the hard and soft palate on which pressure, within the physiologic limits of the tissues, can be applied by a denture to aid in its retention. 2

The pps of a maxillary complete denture can be established during the making of the final impression by scoring the final cast, or by incorporating the seal in the finished denture base. The technique can be classified generally as being either functional or empirical 3. Regardless of the technique used or the stage of denture fabrication during which the pps is placed, the objective of its utilization is the same. It provides aperipheral seal by selectively displacing soft tissue to 4:

- Provide close tissue contact during speech and swallowing, preventing food and debris from impinging between the denture base and the underlying tissue.
- Enhance retention and stability.

The anterior vibrating line at the area of the junction of the hard and soft palate can be located by palpation of the hamular process and the fovea palatine. The anterior vibrating line serves as the anterior border of the pps area. The posterior vibrating line lies in the junction of the aponeurotic portion of the soft palate and represents the posterior extension of the pps area. They considered a two separate lines of flexion 5. The location and incorporation of the pps on the maxillary definitive cast are often done by the dentist or dental laboratory technician. However these procedures should be the responsibility of the dentist, as the tissue displacement can only be determined clinically 6. A faulty pps may cause

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poor retention and/or tissue irritation. Brian M et al.\(^6\) describe a technique for the location of the pps intraorally and accurate transfer to maxillary complete denture cast by indelible pencil. Laney and Gonzalez\(^{14}\) discussed the need for knowledge of the oral cavity's anatomy so that the static surface of the denture base can be balanced against one dynamic tissue surface. In the pps area, the tissues are displaceable and the degree of displacement can be found by palpation with a "T" burnisher\(^{15}\), by closing both nostrils of the patient and having him blow gently\(^{16}\) or by visualizing the vibrating line as the patient says "ah"\(^{3}\). Also, by placing the tissues with various impression materials, a functional or physiologic pps can be impression made as early as the maxillary final impression\(^{18}\). Another method, scraping the maxillary cast before final processing of the denture, can be used to construct a pps\(^{19}\). Therefore, the pps takes on many various shapes, size and locations. These various types of pps are discussed by winland and Young\(^{21}\), and their construction as taught in our dental schools is investigated. They discussed that no matter what type of pps is used, the important word is seal-to seal out air and food and to seal in partial pressure and they said that the determination of the posterior limit and palatal seal of the maxillary complete denture is not the technician's obligation, but the responsibility of the dentist. Abedalbaki et al.\(^{20}\) compare the retention of complete denture bases with different types of pps (bead, double bead, and bufferfly). They found no design provide superior priority than the other type of pps but a double beading and butterfly pps can improve the retention of a maxillary complete denture.

**Determinants of posterior extension:**

During the final impression appointment, the final extension of posterior border of the maxillary denture is determined. Factors to be considered include:

- The drape of the soft palate in relation to the hard palate. A more abrupt relation between the hard and soft palates generally indicates increased muscular functional activity of the soft palate, thus reducing the potential posterior extension of the palatal seal.\(^4\)

The shape of palatal vault is related to the activity of the soft palate. The flat vault has the least movable soft palate and the widest area of displaceable tissue. In contrast, the high vault or "V" shaped palate often has a soft palate virtually at right angles to the hard palate and is extremely mobile. Thus the area of tissue displaceability is very narrow. The intermediate palatal vault lies between these two extremes\(^7,21\).

Antolinocolon et al\(^8\) concluded that the form of the palate has direct influence on the retention of complete denture will aid in the selection of the type of posterior palatal seal needed.

**MATERIALS AND METHOD**

A. The testing apparatus

For the purpose of this study, retention has been expressed in term of force required to vertically dislodge a maxillary complete denture using a specially designed strain gauge force transducer. The data measured by gram\(^{25}\). The apparatus consist of many parts as shown in figure 1.

B. Selection of patients

Nine edentulous patients were selected from prosthodontic clinic, college of dentistry, Baghdad University, 6 males and 3 females, the age range between 55-70 years, the criteria used for selection were relatively smooth, firm alveolar ridge covered with healthy mucosa without any posterior under-cuts. The patients with different palatal form according to House's classification of palatal forms: Class I flat palatal vault in the hard palate and Class III a high vault and Class II intermediate between them\(^7,30\).

C. Impression techniques:

A preliminary impression with impression compound (Quayle Dental, England) was taken and 2 custom trays were fabricated on the study model. Then two impression techniques used:

1. First impression technique:
   1. Before the border molding procedure, trim and adjust the posterior border of the custom tray 1 to 2 mm distal to the vibrating line.
   2. Complete the border molding and make a final impression by using zinc oxide-eugenol (ZoE) paste.
   3. Remove the impression from the mouth.
   4. Mark the vibrating line in the mouth with indelible pencil by using "ah" sound with nose blowing and using the fovea palatinae in locating the vibrating line\(^24\).
   5. Reinsert the maxillary impression in the mouth and transfer the location of vibrating line to the ZoE impression.
   6. Poured with stone (Zeta, selensor, Industria Zingardi S.r.i, Italy). The water to powder ratio recommended by the manufacturer was used.
   7. The master cast was then duplicated once by using heavy body silicon, the
master cast marked 2 while the duplicated cast was marked 3.

II. The second impression technique (Physiological posterior palatal seal).
1. The same steps 1, 2 and 3 used in the previous technique.
2. The anterior vibrating line can be visualized by instructing the patient to say "Ah" with short vigorous bursts while the posterior vibrating line can be visualized by instructing the patient to say "Ah" in short bursts in a normal unexaggerated fashion, then mark the anterior and posterior vibrating lines in the mouth with indelible pencil and transfer the location to the ZoE impression.
3. Kerr Korecta wax No. 4 was used to record the pps area, it’s a fluid, mouth temperature wax, is preferred for this procedure. It will flow sufficiently at mouth temperature to avoid over displacement of tissues. Because the wax continues to exhibit its property of flow in the mouth, it permits the tissues in the area of the pps to rebound, establishing a degree of displacement that is physiologically acceptable. This wax is painting on pps area of impression.
4. Impression is reseated in mouth and held in place for about 3 minutes. Patient is guided and instructed to tip head forward to approximately 30° from vertical position and forcibly place tongue against tray handle or clinician's finger which is supporting tray, this maneuver allow pps area to be recorded in functional position.
5. Excess wax will be displaced and will flow posteriorly.
6. Impression is removed and examined wax that has flowed posterior to seal is removed with Bard-parker blades, intimate contact between wax and tissues is indicated by glossy appearance of wax in contrast to dull appearance where no contact exists. Wax is painted on where indicated and the impression is reseated intraorally until wax exhibits contact along entire posterior palatal area.
7. After trimming excess wax, impression is reseated for five to eight minutes. During this time, patient intermittently repeats head and tongue positions. This last seating allows tissues in area of pps to exert their displacing effect on wax, there by achieving functional depth of seal. Figure (2)
8. Impression is carefully beaded and boxed and the impression then poured with stone (Zeta, Selensor, Industria Zingardi s.r.i Italy). The water powder ratio recommended by the manufacturer was used. This cast was marked 1.

D. Scraping the casts for incorporation of pps: The casts marked 2 and 3 were scraped to carve certain designs into their posterior palatal areas. No. 4 round bur with a lacron carver were used. The patients classified into groups according to House's cassinification of palatal form.

Group A (Class I flat palatal form)
A1= physiological impression technique of pps
A2= scraping the cast 2 according to House-modified butterfly 3-4mm wide and 1mm deep was carved in the center of the palatal seal area passing through the hamular notches and flushing out on approaching the buccal sulcus.
A3= Scraping the cast 3 – a single bead design as described by boucher.

Group B (Class II intermediate palatal form)
B1= physiological impression technique of pps
B2= Scraping the cast 2 according to House-modified butterfly 2-3mm wide and 1mm deep was carved in the center of the palatal seal area passing through the hamular notches and flushing out on approaching the buccal sulcus.
B3= Scraping the cast 3 –a single bead design as described by boucher.

Group C (Class III high palatal form)
C1= physiological impression technique of pps
C2= Scraping the cast 2 according to House-single bead design 1mm width and depth made on the posterior vibrating line.
C3= scraping the cast 3–butterfly shaped configuration was carved as suggested by Hardy and Kapur. An angled groove 1.0mm deep and 1.5mm wide at the base was carved in the center of the palatal seal area passing through the hamular notches and flushing out on approaching the buccal sulcus.
E. Construction of the test denture bases: Identical denture bases for the pps were made on cast 1, 2 and 3 for each group and were designated 1, 2 and 3 respectively. Base plate was formed for each of the casts using two mm thick layers of base plate wax, the bases were processed using heat curing acrylic resin (Quayle Dental, England).

F. Clinical testing
Astringe of about 1 inch length was secured on the polished palatal surface of each of the maxillary denture bases in region relating to the second premolar and first molar teeth , with auto polymerizing acrylic assembly (Figure 4). The dislodging force that is directed to the maxillary denture bases was applied at the middle of the denture base where the middle location is considered the most reliable region for testing the retention of complete maxillary denture .

All tests for a subject were completed in one appointment; all the denture bases for that subject were stored in water for the same length of time before being tested for retention. Thus, the time of day and water sorption was not variables. The patient head was held firmly on the head rest with occlusal plane parallel to the floor. Figure (5) all measurements of retention involving in a given subject were conducted at one sitting, each test denture base was subjected to three retention tests. The force values at which the denture base was dislodged completely from the palate at a steadily increasing force was displayed on strain measuring device represented by gram, the force values in grams could be calculated.

RESULTS
The mean values of the statistical analysis for the data of group A (flat palatal form) between the three groups of A1, A2 and A3 were shown in Table 1. Where as the results of ANOVA table with LSD as shown in table 2. The results explained that there was a very highly significant differences between the groups and between (A1 and A2) and between (A1 and A3) and between (A2 and A3) groups. While the mean values of the statistical analysis for the data of group B (intermediate palatal form) between the three group B1, B2, and B3 as shown in Table (3). Where as the result of ANOVA table with LSD as shown in Table (4). The result explained that there was a very highly significant difference between groups and between groups (B1 and B3) and between (B2 and B3), while there was a non significant differences between groups (B1 and B2).

The mean values of the statistical analysis for the data of group C (deep palatal form) between the three groups C1, C2 and C3 as shown in Table (5). The results of ANOVA table with LSD as shown in Table (6). The results explained that there was a very highly significant difference between groups and between groups (C1 and C3) and between (C2 and C3) groups. While a non significant difference between (C1 and C2) groups.

DISCUSSION
An adequate seal of the posterior border of a maxillary complete denture is essential for retention. Establishing the pps at final impression stage confirm the effectiveness of the pps and allows the dentist to control its location and the amount of tissue displacement . This is agree with the result of this study which revealed that the physiological impression technique of pps area give better retention for complete denture base than the other technique of pps. Vintion stated, "where the tissues move in normal function is the area where maximum peripheral seal can be achieved with the least amount of tissue displacement. This appears to be best physiologically. It is maximum result with minimum activity .

The route of the vibrating line from one side of the palate to the other is not of a definite pattern but varies with the shape of the palate. This variation is such a constant observation that palate or throat forms have been classified as Class I, Class II and Class III. Class I indicates a low, flat vault in the hard palate which continues into a soft palate that has a minimal amount of drop and movement. This situation permits a more distal extension of the maxillary denture and provides broader pps area . This agree with the result of group A, it was found that the physiological impression technique and modified butterfly 3-4mm width for pps area give better retention than the single bead design of pps. Nikoukar and Swenson and Terkla were found that the flat palatal shape has vibrating line located farther posteriorly.

While in Class III indicates a high vault in the hard palate and an acute drop and maximal movement in the soft palate. The region where this acute drop occurs becomes extremely critical because it places greater limitations on the distal extension of the maxillary denture and will accommodate only a narrow pps . This agree with the result of group (C) which revealed that the physiological impression technique of pps and single bead design of House give better retention for complete denture base than the butterfly shape
of pps (Hardy and Kapur) found that the higher the vault the more abrupt and forward is the vibrating line. While the Class II designates those palatal forms which are intermediate between Class I and Class III. This agree with the result of group B which revealed that the physiological impression of pps and modified butterfly 2-3mm width according to House give better retention for complete denture base than the single bead design of pps (Boucher).

The mucosal tissues of the pps area vary in displaceability from patient to patient, the task of determining the shape, size and depth of the seal must be accepted by the clinician and should not be assigned to the Laboratory technician. It is quite impossible to establish the posterior limit, the width and depth of the seal in an edentulous cast alone, and it is the clinician's responsibility to make the decision based on proper procedures in the mouth.

REFERENCES


12. Vernie AF, Chitre V, Aras M. A study to determine whether the anterior and posterior vibrating lines can be distinguished as two separate lines of flexion by unbiased observer: Apilot study Indian J of Dental Research 2008; 19(4): 335-9 [IVSL].


Table 1: Means and standard deviation of Group A

<table>
<thead>
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<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
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<tr>
<td>A2</td>
<td>186.0000</td>
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Table 2: ANOVA and LSD of group A

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<tr>
<th>Group A</th>
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<td>Within groups</td>
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<td>Total</td>
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<table>
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<tr>
<th>Group A</th>
<th>Mean Difference (I-J)</th>
<th>Std. Error</th>
<th>Sig.</th>
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<tbody>
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<td>A1 A2</td>
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<tr>
<td>A3 A2</td>
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<tr>
<td>A3 A2</td>
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The mean differences is significant at the 0.05 level

Table 3: Means and SD of group B (deep palatal vault)

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<tr>
<td>B1</td>
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<td>3</td>
<td>10.00000</td>
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<tr>
<td>B2</td>
<td>480.00000</td>
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<td>B3</td>
<td>257.00000</td>
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<td>Total</td>
<td>409.00000</td>
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Table 4: ANOVA and LSD of group B

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<tr>
<td>B3</td>
<td>233.00000</td>
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</tr>
<tr>
<td>B2 B3</td>
<td>223.00000</td>
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The mean differences is significant at the 0.05 level

Table 5: Means and standard deviation of Group C

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<td>C3</td>
<td>244.3333</td>
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Table 6: ANOVA and LSD of Group C

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<td>C3</td>
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<td>C2 C3</td>
<td>148.33333</td>
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The mean differences is significant at the 0.05 level
Figure 1: Strain gauge force transducer

Figure 2: Physiological impression of pps

Figure 3: All casts of each groups

Figure 4: Astring of 1 inch in length on the polished surface

Figure 5: The patient during testing procedure