

Posterior Palatal Seal: A Literature Review

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ABSTRACT

Complete dentures may suffer from a lack of proper border extension, but most important of all is the posterior palatal extension on maxillary complete dentures. The posterior border terminates on a surface that is movable in varying degrees and not at a turn of tissue as are the other denture borders. Locating and designing of posterior palatal seal after thorough understanding of the anatomic and physiological boundaries of this dynamic region greatly enhances border seal and increases maxillary complete denture retention.

The diagnostic evaluation and placement of posterior seal are often given only minor attention in complete denture construction. This article reviews the importance of the posterior palatal seal with regard to its anatomy, location, design and placement.

Keywords: Complete denture retention, Border seal, Posterior palatal seal, Posterior palatal seal region, Vibrating line, Soft palate, Velopharyngeal closure.

INTRODUCTION

GPT-8 defines postpalatal seal (PPS) area as the soft tissue area at or beyond the junction of the hard and soft palates on which pressure, within physiologic limits, can be applied by a complete RDP to aid in its retention.¹ This soft tissue seal around the posterior border of maxillary complete denture requires special consideration during denture extension determination because the range and extent of the soft tissue activity along this border is profound, when judged with the labial and buccal sulcus tissues.²

The role of physical factors controlling retention has been studied vastly by Cox, Fry, Howland, Moses, Page and Pryor.^{1,3-9} Skinner and Chung have experimentally shown that the posterior palatal seal effectively resists rotational thrusts exerted on complete denture by utilizing the retentive function of atmospheric pressure.^{1,10-12} Presence of intact border seal is indispensable for the retentive function of atmospheric pressure. Posterior palatal seal complements the buccal and labial border seal and converts the denture to function as a sealed compartment resisting torquing forces.^{2,7,8,10,11,13-20}

Functions of the Posterior Palatal Seal^{2,21-26}

The primary function is that of completing the peripheral seal and enhancing the retention of complete denture. The other purposes served by the palatal seal are as follows:

1. Diminishes the gag reflex by making the posterior border indiscernible to the tongue.
2. Compensates for polymerization shrinkage of acrylic resin thereby blocks air and food entry beneath the denture.
3. Strengthens the maxillary denture due to the additional bulk at the posterior border.

4. Decreases the forces on the residual ridge by increasing the denture bearing area.

Silverman²² reported that the hypothesis for extending the denture border more posteriorly to contact the soft palate during function is supported by anatomic, neurophysiologic and radiographic considerations. He stated that the contour and design of the posterior border of a maxillary complete denture should allow dual valving action of soft palate, permitting uninterrupted speech and swallowing, thereby making the denture work in harmony with patient's function.

The range of soft palate movement and the degree of displaceability of the seal area differ in every individual. House²³ proposed three classes of palatal throat forms based on the angle, the soft palate makes with the hard palate and the soft palate muscle activity that will be necessary to establish velopharyngeal closure.

- In class I, the soft palate is horizontal (Fig. 1) as it extends posteriorly, requiring minimal muscular activity for velopharyngeal closure allowing more than 5 mm of seal area
- In class III, the soft palate is more acute in relation to the hard palate, (Fig. 2) necessitating marked elevation of the musculature for velopharyngeal closure permitting a narrow seal of less than 1 mm
- Class II type of soft palatal contour lies somewhere between class I and class III classes allowing 1 to 5 mm of seal area depending on the muscular activity of the soft palate (Fig. 3).

Anatomy of Posterior Palatal Seal Area

Edward, Boucher, Pendleton, Zack and Appleby^{4,27-30} have explained the general and microscopic anatomy of this area.

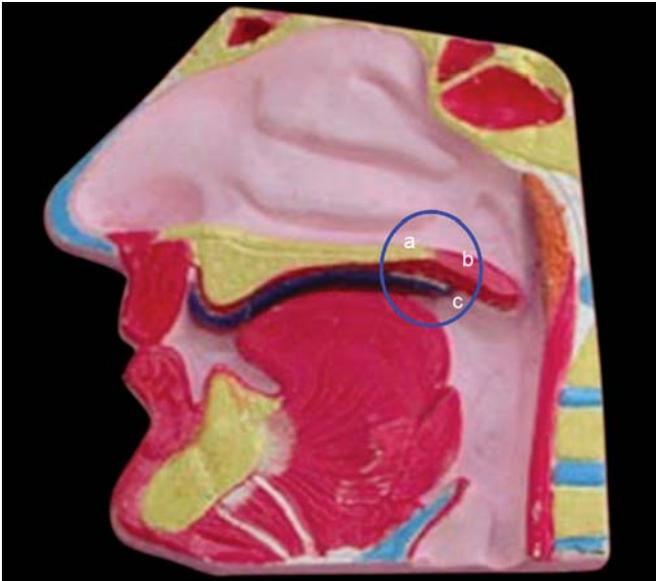


Fig. 1: Class I soft palate: (a) Hard palate, (b) soft palate, (c) palatal extension of denture

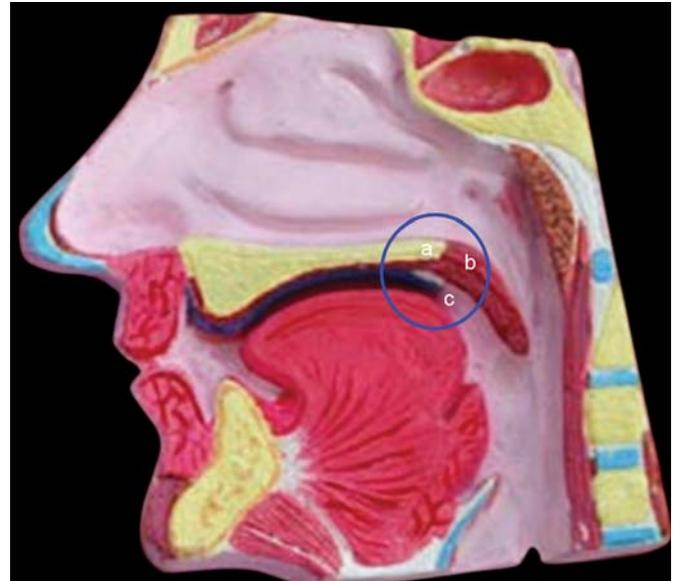


Fig. 3: Class III soft palate: (a) Hard palate, (b) soft palate, (c) palatal extension of denture



Fig. 2: Class II soft palate: (a) Hard palate, (b) soft palate, (c) palatal extension of denture

The palatal seal area has distinct anatomic and physiologic limits which once, when understood, make the placement of the palatal seal a straightforward procedure with predictable outcome.

The location of the palatal seal is debated throughout the literature. Posterior palatal seal area is frequently referred also as postdam area, vibrating line.^{2,4,23} Chen³¹ disapproved of terming the seal area as vibrating line stating that there is marked variance in tissue movement in this area from its most anterior aspect to its most posterior aspect and that it should be better described as a 'vibrating area'. Ultrasound investigation by Rajeev Narvekar³² revealed that the posterior vibrating line lies on the soft palate and that the seal area extends on average 4 to 6 mm anterior from here. Thus, the posterior palatal seal

contacts both masticatory mucosa of the hard palate and lining mucosa of the soft palate.³³

The mucosa of the seal region shows a transition from a fixed to loosely attached tissue beginning from its anterior extent on the glandular region of hard palate to its posterior extent on the soft palate.²⁵ The seal area extends from around the hamular notch on one side across the junction of hard and soft palate to the hamular notch on the other side. The seal area narrows down in the midpalatine area due to the scarcity of connective tissue and the prominence of posterior nasal spine. The seal can be divided into postpalatal seal and pterygo-maxillary seal for the convenience of locating and recording this area.^{10,23,25,29,30,33} The seal must be placed to sufficient depth to prevent air from entering under the denture during functional movements.

As the seal zone contains varying thickness of loose connective tissue covered by mucous membrane, it shows differing areas of tissue vibration which are referred to as anterior and posterior vibrating lines with the seal area stretching out between the lines. These lines are defined as follows:

Anterior Vibrating Line

It is an imaginary line located at the junction of the attached tissue overlying the hard palate and the movable tissue of the immediately adjacent soft palate, visualized while the patient is instructed to say 'ah' with short vigorous bursts.

Posterior Vibrating Line

It is an imaginary line at the junction of the aponeurosis of the tensor veli palatine muscle and the muscular portion of the soft palate visualized, while the patient is instructed to say 'ah' in short bursts in a normal unexaggerated fashion.^{13,23}

GPT-8 defines vibrating line as an imaginary line across the posterior part of the palate marking the division between the movable and immovable tissues of the soft palate.¹

Locating Posterior Palatal Seal Region

As tissues of this area are displaceable, the seal area can be identified when the movable tissues are functioning.²³ Methods that can be employed are as follows:

1. Palpation method using a 'T' burnisher.^{3,4,33-35}
2. Nose blow method or valsalva maneuver—closing both nostrils of the patient and asking him to blow gently through the nose.^{4,23,31,33,35}
3. Phonation method—visualizing the vibrating lines as the patient says 'ah'.^{4,23,31,33,35}
4. Anatomical landmark—using fovea palatinae to identify vibrating area.^{10,12,23,36}

Clinically, different methods may result in different locations of the vibrating line. Chen³¹ in his study on the reliability of methods to locate PPS reported that the vibrating line in the same individual observed by the nose-blowing method which is located slightly anteriorly than the vibrating line observed by the phonation method. But, the difference in the mean value between the lines identified was clinically insignificant. Vernie et al³⁵ studied a small study sample and found that the anterior vibrating line established by palpatory method was anterior to that established by nose-blowing method. They explained this by stating that the palpatory method locates the junction of hard and soft palate and nose-blowing method distinguishes the movable and immovable portion of the soft palate.

It is clear from the literature that the fovea palatini are not reliable anatomic landmarks for locating the vibrating line and that using them as a guide for determining the posterior extension of maxillary denture base can deprive from several millimeters up to a centimeter of denture bearing area.^{3,11,33,37,39}

Methods to Register Palatal Seal

Numerous techniques are mentioned in the literature to record PPS. Functional, semifunctional or empirical method by Hardy and Kapur,¹ conventional method by Winland and Young,⁴ William,²⁰ conventional physiological and arbitrary method by Appelbaum M,²³ etc. are a few to name.

PPS determination methods can be broadly categorized based on stage of denture construction as follows:

1. PPS determination in final impression stage.
2. PPS determination or designing on master cast.

Recording PPS in Secondary Impression Appointment Stage

In a functional technique, the final impression is border molded in the PPS area with soft stick compound or impression wax by making the patient perform sucking and bubbling movements and, in semifunctional technique, border molding is done by the dentist.^{1,23}

Studies measuring the efficacy of impression material in recording PPS indicate that best seal can be achieved by using green modeling compound or Korecta wax No. 4, and tissue displacement caused by zinc oxide and eugenol paste was less than that of other materials.³⁴

Patient position during impression making of palatal seal area:

As the denture should maintain contact with the soft palate throughout its functional range, this region should be recorded in function. Therefore, an impression should be made when the patient is seated in upright position with head flexed 30 degree forward, below FH plane to allow the soft palate to reach its functionally depressed position. The patient's tongue should be placed under tension against either the handle of the impression tray or the dentist's finger which is held in the region of the upper maxillary incisors. If the tongue is excessively protruded, the soft palate will foreshorten the posterior border of the impression to the anterior flexion line.^{22,23}

Determining PPS on Master Cast

The second commonly reported technique is locating and transferring the PPS area on the master cast followed by subsequent scrapping. The scraping of the PPS on the cast allows the seal area to have a convex surface on the denture that slightly displaces the soft palate thereby achieving peripheral seal.²² Some of the techniques of scrapping and designs of PPS are explained here. All of these scoring techniques are done after correctly transferring the PPS area on the master cast.

Boucher's Technique^{10,20}

The width of the posterior palatal seal is limited to a bead on the denture that is 1.5 mm deep and 1.5 mm broad at its base with a sharp apex (Fig. 4A).

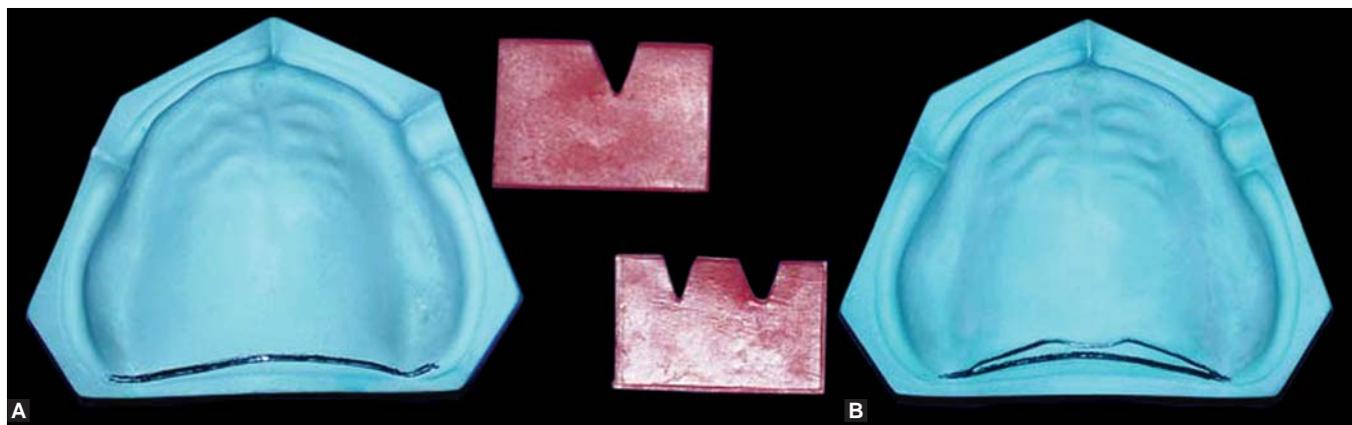
The resulting design is a beaded posterior palatal seal. The narrow and sharp bead will sink easily into the soft tissue to provide a seal against air being forced under the denture.

Bernard Levin's Technique⁴⁰

For class III soft palate forms: He describes a 'double bead' technique for class III soft palate (Fig. 4B). Here, the posterior vibrating line is scrapped 1 mm deep and 1.5 mm wide. An anterior bead line is created about 3 to 4 mm from the posterior border. This is considered as the 'rescue bead'. Bernard stated that even though the anterior bead is located on the hard palate, the keratinization of the mucosa can tolerate small amount of tissue displacement and pressure.

Bernard Levin's Technique⁴⁰

For class I and class II soft palate forms: Using No. 8 round bur of 2 mm diameter, two holes of 2 mm depth are drilled at the depth of the bur in the area between the midline and hamular notches (Fig. 5). One hole of 1 mm depth is drilled to half the diameter of the bur in the center. A cone-shaped acrylic resin



Figs 4A and B: PPS designs with the cross-sectional views depicted in wax: (A) Single bead (Boucher's technique) and (B) double bead (Bernard Levin class III technique)

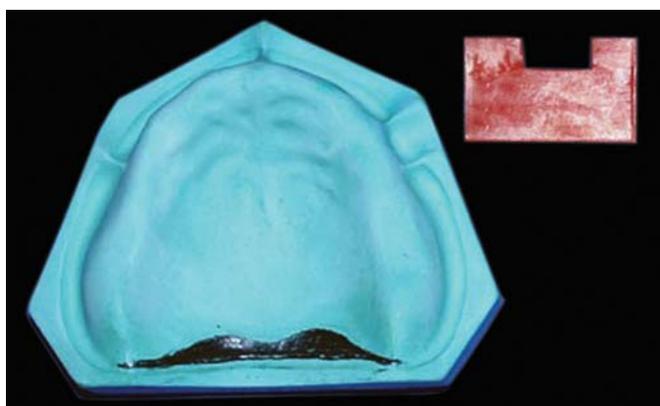


Fig. 5: Bernard Levin PPS design for class I and II soft palates with the cross-sectional view depicted in wax

bur is used to rough out the seal. The hamular notch region is not reduced more than 0.25 mm in width and 0.5 mm in depth and not extended onto the tuberosity vestibules. The softest part of the seal is scraped to 6 mm in width, whereas the median raphe region is scraped to 4 mm in width. A medium grid sand paper is used to smooth the surface.

Swenson's Technique^{20,30}

A groove is cut along the posterior line to a depth of 1 to 1.5 mm that will cause the posterior border stand straight out from the

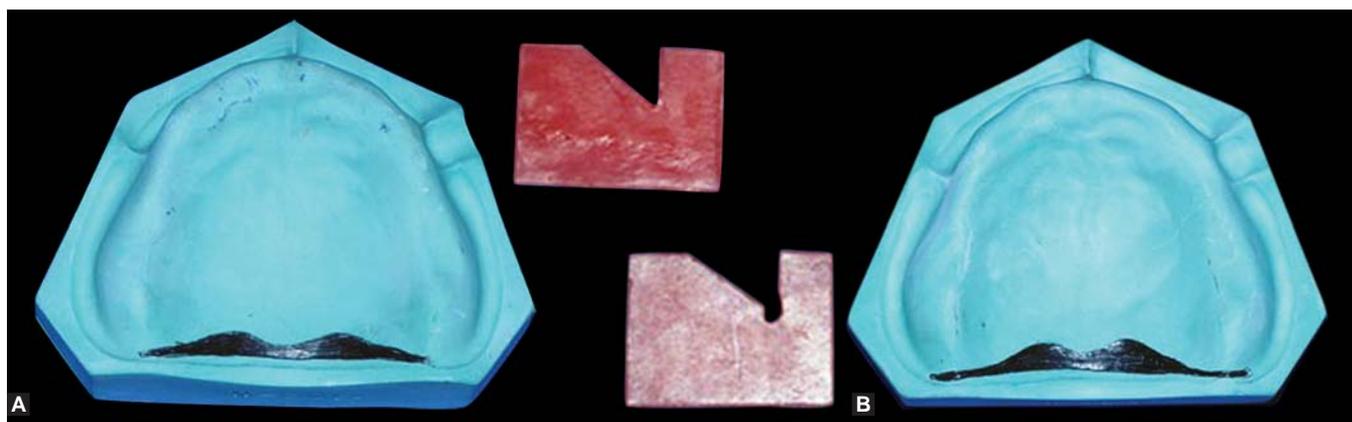
hard palate, turning neither up nor down (Fig. 6A). From the depth of this posterior cut, the cast is scraped in a tapering manner, so that it tapers up to the anterior line.

Calomeni, Feldman, Kuebker's Technique¹⁴

A posterior bead line is scraped on the cast to a depth of 1 to 1.5 mm extending bilaterally through the hamular notches (Fig. 6B). The anterior line is placed 5 or 6 mm anterior to the posterior line. The area between the anterior and posterior lines is scraped with Kingsley Scraper No 1. The depth of the cast scraped should vary from zero at the anterior line to the depth of 1 to 1.5 mm along the posterior border. In the midline, the distance between the anterior and posterior lines should be about 2 to 3 mm.

Pound's Technique²⁰

Pound advocates a single bead posterior palatal seal with anterior extensions for additional air seal (Fig. 7A). A 'V'-shaped groove is carved across the palate from the hamular notch to hamular notch 1 to 1.5 mm wide and 1 to 1.5 mm deep. This is placed 2 mm anterior to vibrating line. A loop is carved on either side of the midline to provide air seal. The depth and width of the anterior loop are determined by palpating the area with a blunt end of the instrument.



Figs 6A and B: PPS designs with the cross-sectional views depicted in wax: (A) Butterfly (Swenson technique) and (B) butterfly with bead (Calomeni technique)

Apple Baum-Winkler's Technique²³

A Kingsley scraper is used to score the cast (Fig. 7B). The deepest parts of the seal are located on either side of the midline, one-third distance anteriorly from the posterior vibrating line. It is scraped to a depth of 1 to 1.5 mm. Close to mid-palatine region, the area is scraped to a depth of 0.5 to 1.0 mm as it has little submucosa and cannot withstand the same compressive forces as tissues lateral to it. The scraping is gradually feathered out as it approaches the anterior vibrating line and is tapered toward the posterior vibrating line. The posterior palatal seal resembles, like Cupid's bow.

Silverman's Technique²²

A pencil line is inscribed from hamulus to hamulus midway between the anterior and posterior flexion lines (Fig. 8A). A shallow scratch mark is placed on the anterior flexion line and the posterior flexion line is scored to a depth of one half of that of the midscore line. The cast is scraped over the entire seal area. The depth of the cast scraping diminishes from the midline to the anterior and posterior vibrating lines. He also suggested that complete maxillary dentures can be extended on an average distance of 8.2 mm dorsally to the vibrating line.

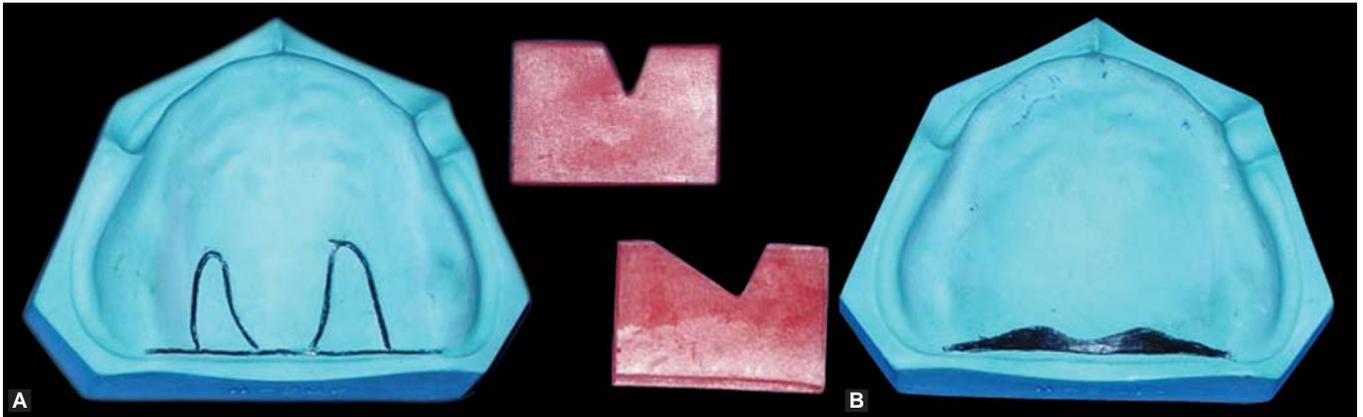
Hardy and Kapur Technique^{1,20}

The depth of the posterior palatal seal area is identified by pressing the ball portion of the T burnisher (Fig. 8B). The posterior palatal seal is extended 4 mm from the distal border of the denture and narrowed down to 2 mm in width through the hamular notch region. The scraping of the cast is done in such a fashion that the depth of the posterior palatal seal is maximum at the center and tapers to zero toward its anterior and posterior border.

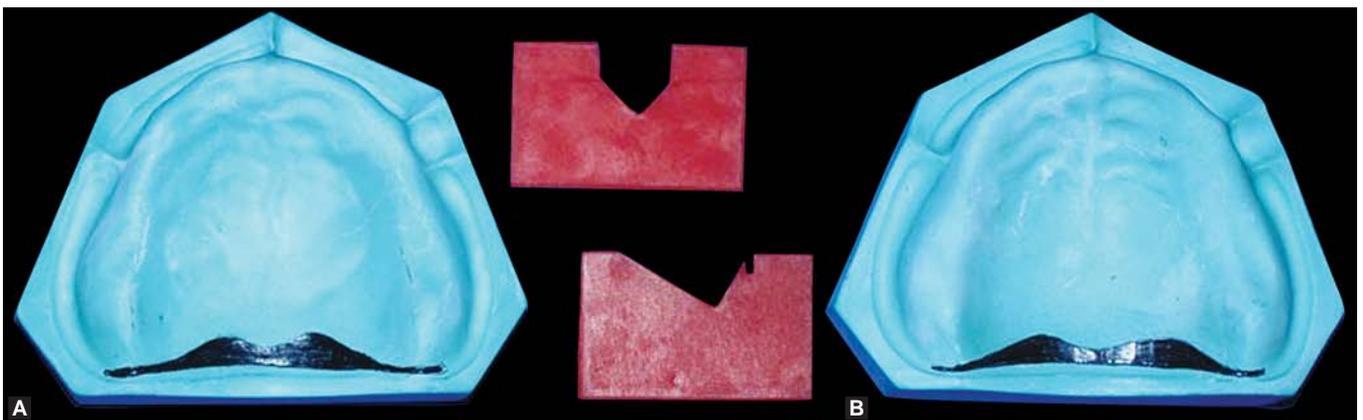
Winland and Young surveyed the commonly employed posterior palatal seal designs and summarized them as follows:⁴

1. A bead posterior palatal seal
2. A double bead posterior palatal seal
3. A butterfly posterior palatal seal
4. A butterfly posterior palatal seal with a bead on the posterior limit
5. A butterfly posterior palatal seal with the hamular notch area cut to half the depth of a no. 9 bur
6. A posterior palatal seal constructed in reference to House's classification of palatal forms.

On comparison of these designs with the scraping techniques discussed above; a beaded PPS design results from Boucher's technique of scraping, a double-beaded technique



Figs 7A and B: (A) Pound's technique and (B) Winkler's technique of PPS designs with the cross-sectional views depicted in wax



Figs 8A and B: (A) Silverman's technique (B) Hardy and Kapur's technique of PPS designs with the cross-sectional views depicted in wax

results from Bernard scrapping design for class III soft palate, butterfly PPS design using Swenson’s method, a butterfly design with a bead on the posterior limit results from Calomeni’s technique.

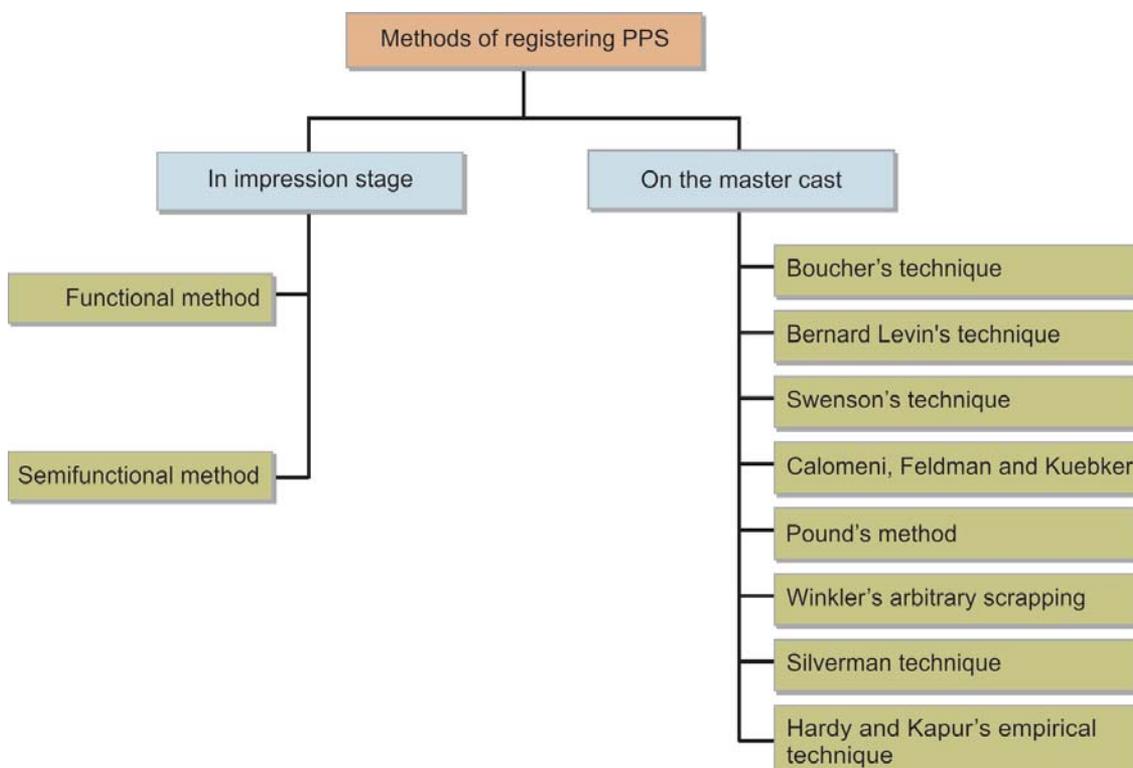
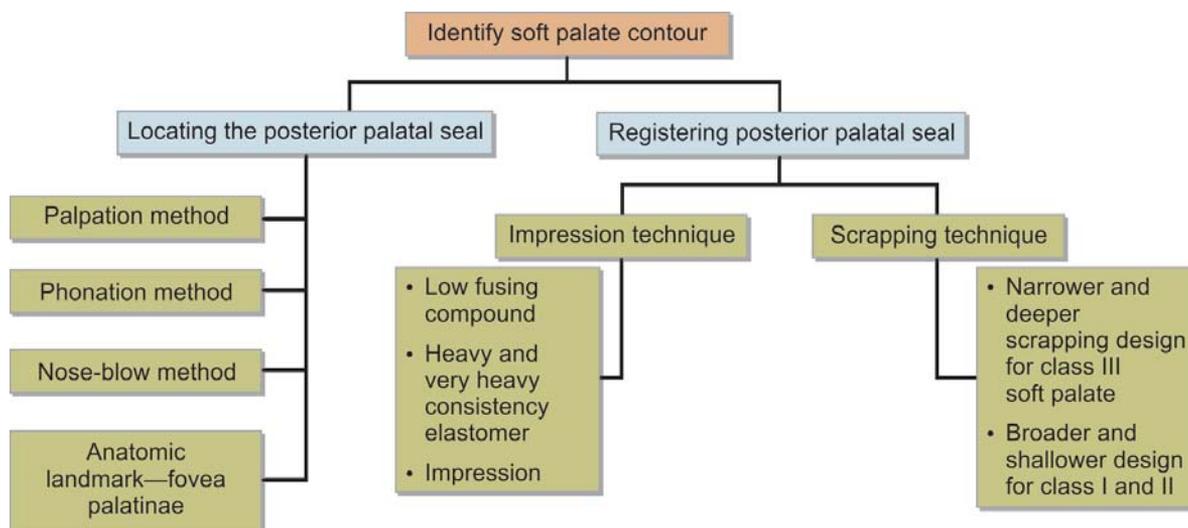
DISCUSSION

Literature on posterior palatal seal reveals the following findings as follows:

1. Except for mucostatic concept, all other studies on complete denture retention clearly emphasize the need for placing posterior palatal seal.^{1,3-14,20-40}
2. PPS design should follow soft palate configuration to allow uninterrupted velopharyngeal closure.^{20,23,26,40}

3. PPS is an area which can be located successfully by palpation, nose blow or phonation method without significant differences.^{4,9,20,23,26,31,34}
4. Determining posterior seal can be performed in final impression stage or scrapped on the master cast after correctly locating the area.^{1,4,10,20,22,23,26,31,40}
5. When it comes to scrapping patterns, no one type of design is found to be superior to the other. Posterior palatal seal enhances retention irrespective of the design.⁴ Literature reveals butterfly pattern is the most common design advocated.²⁶

RECOMMENDATIONS



CONCLUSION

Providing posterior palatal seal for complete denture has been practiced almost universally for so long that its origin is not discernible in dental history.²⁰ Numerous studies exist in literature to support the effect of posterior palatal seal in complete denture retention. Deficiencies of the distal border maybe in the width and the depth of the posterior palatal seal or both. These errors may lead to inadequate retention due to the lack of peripheral seal.²² Porter⁴ stated, 'The determination of the posterior limit and palatal seal of the maxillary denture is not the technician's obligation, but the responsibility of the dentist'. So, this phase of denture fabrication should be given due consideration for the success of the denture and the health of the patient.

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