

# An In-vivo Analysis of the Positional Relationship Of Palatal Rugae With Maxillary Teeth In Different Arch Forms Among Young Dentulous Gujarati Individuals-a Pilot Study

## Abstract:

**Background:** The palatal rugae are transverse folds of tissue located in the anterior portion of the hard palate. They are considered to be reliable landmarks with manifold uses in the field of orthodontics and forensics. The current study was carried out with the aim of determining if a positional relationship of palatal rugae exists with the maxillary teeth in individuals with different maxillary arch forms.

**Material and method:** The study was carried out in 100 participants (87 females and 13 males). Irreversible hydrocolloid impressions were made and casts were poured in Type 3 dental stone. The casts were divided according to arch forms as taper, ovoid and square. Palatal rugae on the casts were assessed digitally and the position of the most posterior rugae evaluated in relation with the adjacent maxillary teeth.

**Results:** It was observed that the palatal rugae had a highly significant positional relationship with the maxillary posterior teeth (p value <0.0001). In the ovoid and square arches, majority of the individuals had the most posterior rugae lying at the level of distal margin of 2<sup>nd</sup> premolar while in cases of taper dental arches, maximum number of individuals had the distal margin of 1<sup>st</sup> premolar coincide with the most posteriorly located rugae.

**Conclusion:** Hence, it can be concluded that the most posterior limit of the rugae may serve as a reliable guide for the arrangement of the maxillary teeth in different arch forms.

**Key-words:** Palatal Rugae, maxillary anterior teeth, denture aesthetics

## Introduction:

It is an accepted fact that the human body is unique to each individual. This uniqueness which is reflected in characteristics like the genetic composition, fingerprints and teeth has interested many researchers over the years. Studies have concluded that there are various anatomical landmarks that bear a stable positional relationship with natural teeth. [1-3] These may be utilized for fabrication of a dental prosthesis with the artificial teeth in harmony with the orofacial musculature.

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The palatine rugae or plica palatinae transversae are one such intraoral landmark. Winslow[4] seems to be the first to describe the palatal rugae in 1732. The rugae appear well formed in the human body at the time of birth and their orientation is in a typical pattern for that person[5]. The palatal rugae serve an important role in orthodontics, forensics and diagnosis of cleft repair[6,7,8]. The position of the rugae has been previously analysed in relation with the position of maxillary teeth[9].

The present study was carried out to study the position of the most posterior rugae in relation with the maxillary teeth. Also the variation according to the arch form was analysed to check if there was any significant difference in position of the palatal rugae according to the arch form.

**Aims and objective:**

The aim of the current study was to establish if a positional relationship exists between the position of the most posterior rugae and the maxillary teeth in dentulous Gujarati individuals with different arch forms. The objective hence was to determine if the rugae can be used as a reliable guide for the position of the maxillary teeth according to the arch form.

**Materials and method:**

The study was conducted in the Dept of Prosthodontics and Crown & Bridge, College of Dental Sciences and Research Centre, Bopal. It was carried out in accordance with the protocols reviewed and approved by the Institutional Ethical Board. The study also adhered to the Declaration of Helsinki. Study design 100 participants (83 females and 17 males) between the ages of 18-35 participated in the study after an informed consent was obtained from them. The inclusion criteria for the participants consisted of the presence of all maxillary teeth upto second molar. Exclusion criteria included diastema or crowding, history of orthodontic treatment or surgery for cleft repair.

**Procedure:**

A full arch maxillary impression was made in each of the participants in a metal tray with irreversible hydrocolloid impression material (Tropicalgin, Zhermack). Then, the impressions were poured in Type III dental stone (Goldstone, Asian chemicals) and casts were obtained. The casts were divided according to arch shapes as ovoid, tapered and square forms as per the technique described by Pachore et al.[10]

The bases of the casts were trimmed in such a way that when placed on the dental surveyor, the occlusal plane of posterior teeth was parallel to the surveyor platform and casts were analysed digitally as shown in Figure 1. A line was first made through the mid palatine raphae (depicted as red line) and a second line was made perpendicular to the first line (depicted as black line) passing through the distal most raphae on left and right side. The position of the line in relation to the maxillary teeth was determined and categorised as lying:

- distal to 1<sup>st</sup> premolar
- middle of second premolar
- distal to 2<sup>nd</sup> premolar

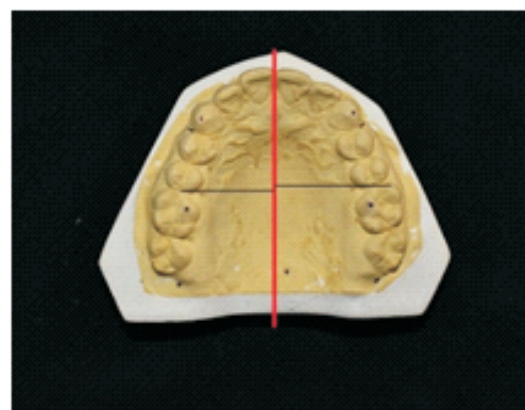


Figure 1. Cast analysis for checking the position of most posterior palatal rugae

**Observations and Results:**

Out of the 100 subject casts, it was observed that majority were of ovoid arch shape (41), followed by square arch type (31) and least casts belonged to the tapered arch category (28). The position of the tip of most posterior rugae was examined in relation to the maxillary teeth. This was The distribution of sample casts according to arch shape, gender and rugae position is depicted in Table 1.

Table 1. Distribution of sample casts according to arch shape and rugae position

Position of most posterior rugae	OVOID ARCH n=41			SQUARE ARCH n=31			TAPER ARCH n=28		
	Male	Female	TOTAL	Male	Female	TOTAL	Male	Female	TOTAL
Dist 1 PM n=23	1	4	5	0	3	3	1	14	15
Mid 2 PM n=16	1	5	6	0	4	4	0	6	6
Dist 2 PM n=61	5	25	30	6	18	24	3	4	7
Total	7	34	41	6	25	31	4	24	28

As evident in Table 1, out of the 100 samples, 61 samples had the most posterior rugae in level with the distal half of second premolar. However, when the arch shape parameter was

taken into consideration, the taper arch form had the most posterior rugae in level with the distal half of first premolar in majority of cases whereas ovoid and square shaped arch had majority of the samples with most posterior rugae in line with the distal half of second premolar.

Statistical analysis carried out using the SPSS statistics software (version 22.0; IBM Corp.; U.S.) on the data shown in Table 2 with the help of Chi-square test showed that the value of Chi-square was 24.9 and the p value < 0.0001.

Table 2. Incidence of the position of most posterior rugae according to arch shape.

Arch Shape	DIST 1 PM	MID 2 PM	DIST 2 PM
Taper	15	6	7
Square	3	4	24
Ovoid	5	6	30

Chi-squared value = 24.9 ; p < 0.0001.

This means that there is a highly significant relationship of the position of the most posterior rugae with maxillary teeth based on the dental arch shape.

**Discussion:**

The rehabilitation of an individual with any dental prosthesis aims to restore their form, function and esthetics. Hence, it is the responsibility of the clinician to ensure that the prosthesis is in complete harmony with the patient's stomatognathic system.

The position of the prosthetic teeth should be accordance to the or ofacial musculature as well as be esthetically pleasing. This becomes a challenging task in absence of pre-extraction records. A number of extraoral and intraoral landmarks have been suggested in previously published literature which can guide in the selection and arrangement of artificial teeth. These include ;among others, the inter-alar distance, inner-canthal distance, intercommisural distance, incisive papilla, hamular notch and the palatal rugae.[1,2,3,9,11,12]

The palatal rugae are ridge like structures located behind the incisive papilla on the anterior portion of the hard palate and on either side of the mid palatine raphe.[13] It has been established that rugae can be used as reliable landmarks for assessing the movement of molars during orthodontic treatment.[14] In a study conducted by Peavy and Kendrick,

it was observed that the lateral ends of the rugae that terminated close to the teeth had a tendency to change position with the migration of tooth.[15] These results were similar to the results observed by Almeida et al who concluded that lateral rugae are less stable points of reference but the medial rugae points were more stable and can be used reliably for longitudinal cast analysis.[16]

A study conducted by Tucker and Pearson to assess the relationship of anteriormost rugae with the maxillary canine concluded that the anterior rugae didn't have a significant positional relationship with the canine.[17] The current study was undertaken with the aim to determine if the posteriormost rugae had any specific positional relationship with the maxillary teeth in dentulous arches of different forms (taper, square and ovoid). If such a relationship exists then the posterior teeth position and size can be decided accordingly . The results of the present study were concurrent with the one conducted by Bhandari et al who also concluded that the most common position of the base of the rugae was in relation to the distal end of the 2<sup>nd</sup> premolar.[9] However , the current study additionally took the type of arch form into consideration.

The significance of the study lies in the fact that most often the arrangement of teeth is a task delegated to the dental technician who doesnt have access to extraoral landmarks. Hence the arch form and the posterior most rugae can be utilized to arrange the teeth in a more stable and harmonious position.

**Limitations of the study:**

The limitations include relatively small sample size and unequal number of males and females making it difficult to assess gender variations.

**Conclusion:**

Within the limitations of the study, it was concluded that the most commonly found arch form was the ovoid form , followed by square and the least observed arch form was the taper arch form.

Furthermore, it was also observed that there was a statistically significant variation in the position of the most posterior rugae according to the arch form. Hence, in individuals with square or ovoid shape of arch, the second premolar can be arranged in relation to the most posterior rugae and in persons with tapering type of arch form, the first premolar set at the level of base of rugae may give a more harmonious occlusion.

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