Palatal Rugae: A Potential Reference to Determine Key Anterior Maxilla Dimensions and Tooth Positions

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Palatal rugae have been suggested as a stable landmark and potential biometric guide for positioning anterior maxillary teeth. This study aimed to evaluate the use of palatal rugae as a biomarker by establishing mathematical correlations with anterior maxillary dental arch geometry and tooth positions. One hundred dental casts were obtained from fully dentate individuals with normal occlusal relationships. Thirteen reference points were analyzed. Significant correlations were found between measurements in the anterior dental segment and palatal rugae measurements. Those correlation coefficients were, however, low. Although some correlation values obtained were statistically significant, they are not likely to have significant clinical predictive value. *Int J Prosthodont 2013;26:227–229. doi: 10.11607/ijp.3167*

The palatal rugae possess unique individual characteristics[1,2] and reasonable stability during growth[3–5] that makes them suitable reference points from which reference planes necessary for longitudinal cast analysis can be derived. This study attempted to investigate this relatively unexplored topic by analyzing a large sample size to minimize biases by chance. A previous study of the subject showing the relationship between lateral ends of palatal rugae had a sample size of fifty.[5] The use of palatal rugae as a biomarker will be evaluated by establishing mathematic correlations between anterior maxillary dental arch geometry and tooth positions.

Materials and Methods

One hundred maxillary casts were obtained from fully dentate patients who could be considered to have a subjectively pleasing smile and objectively radiant symmetry in the arrangement of their maxillary anterior teeth. They all had a full complement of teeth with Class I occlusion with horizontal and vertical overlap of approximately 2 mm and good oral hygiene. Previous orthodontic or extensive prosthodontic treatment and tooth shape and size problems were reasons for exclusion.

The manufacturer's instructions for handling the impression and pouring process were followed. Vernier calipers were used to obtain sagittal and transverse measurements. Five consecutive readings of each measurement were taken by the same operator, and the mean was recorded. Measurements were taken from different locations (Fig 1). First, mean values and standard deviations were obtained. Data were then analyzed statistically through regression equations and Pearson correlation coefficients. Acceptable accuracy and reliability was assumed by using the mean of five consecutive measurements. Considering the sample size was 100, it is expected that a good approximation to normal distribution was obtained. Therefore, Pearson correlation coefficients were used (Tables 1 and 2).

Results

All 13 measurements along with age were analyzed statistically to identify significant correlations. Only seven correlations were statistically significant. Of the seven correlations, only three depicted the relationship between palatal rugae geometry and anterior tooth positions (Table 1). Three regression equations were derived (Figs 2 to 4).

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1. Sum of mesiodistal width of incisors.
2. Width of anterior dental segment at the level of the first premolars. This dimension was measured by placing the two sharp ends of the caliper in the center of the central groove of the first premolars on either side.
3. The length of the first palatal ruga. The transversal extent of the ruga was recorded by measuring the length of the ruga at the level of the most lateral terminal points.
4. Length of third palatal ruga. Transversal extent of the ruga was recorded by measuring the length of the ruga at the level of the most lateral terminal points.
5. Distance from the end of the first palatal ruga to the end of third palatal ruga (left side).
6. Distance from the end of first palatal ruga to the end of third palatal ruga (right side).
7. Distance from the end of first palatal ruga to the tip of canine (left side).
8. Distance from the end of first palatal ruga to the tip of canine (right side).
9. Distance from incisive papilla to the midpoint of central incisor (left side).
10. Distance from incisive papilla to the midpoint of central incisor (right side).
11. Distance from the posterior-most point of the incisive papilla to a line connecting the premolars.
12. Perpendicular distance from the midpoint of incisal surface of a central incisor to the line connecting the premolars.
13. Distance from the posterior-most point of the incisive papilla to the midpoint of the junction of third palatal ruga and the median palatal raphe.
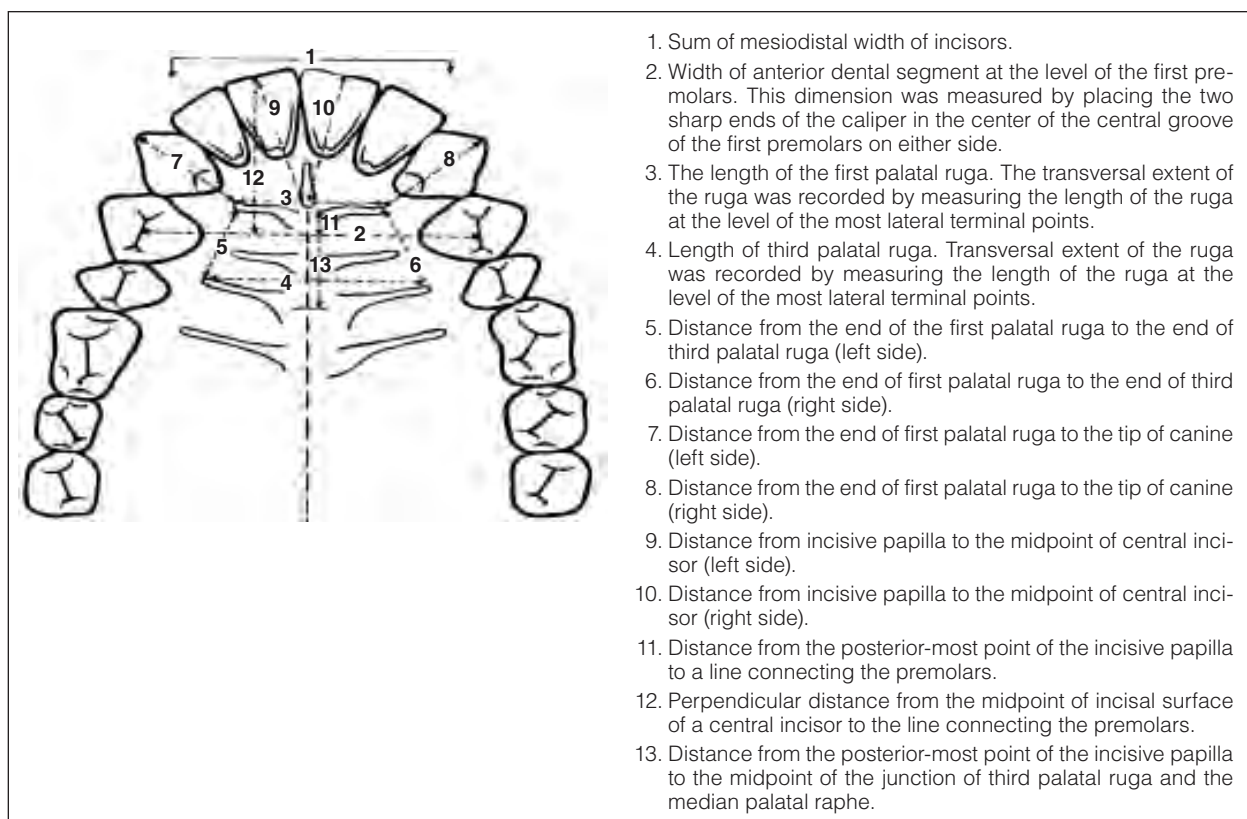
Fig 1 Locations 1 to 13.

Table 1 Statistically Significant Correlation Coefficients Between Measured Variables

Sr No.	Location no.	Correlation coefficient (r)	P
1	2 and 4	0.484	< .001
2	2 and 12	−0.20	< .001
3	2 and 5	0.38	< .001
4	11 and 12	0.40	< .001
5	3 and 4	0.33	< .001
6	3 and 5	0.22	< .001
7	11 and 13	0.27	< .001

Sr No. = serial number (of correlations).

Table 2 Mean and Standard Deviation of Measurements Used in the Formulae

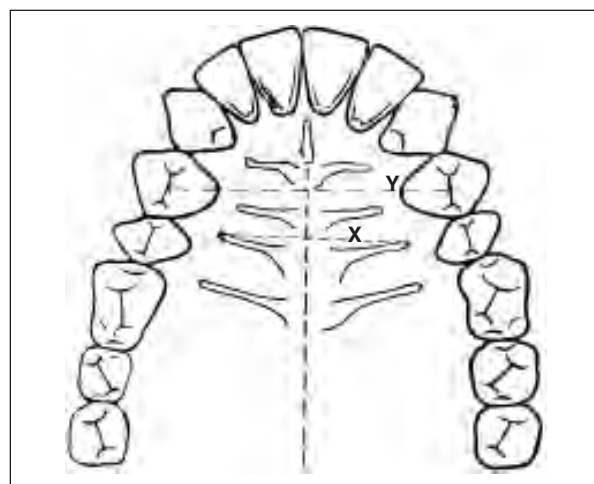| Location no.	n	Mean	Standard deviation
2	100	34.50	2.22
4	100	24.44	2.33
12	100	10.34	3.11
11	100	21.69	2.18
13	100	9.32	1.81

Fig 2 Regression equation $Y = 0.36X + 26.42$ ($r = 0.48$, $P \le .001$) where X (location 4) is the length of the third palatal ruga in millimeters, and Y (location 2) is the width of anterior dental segment in millimeters.
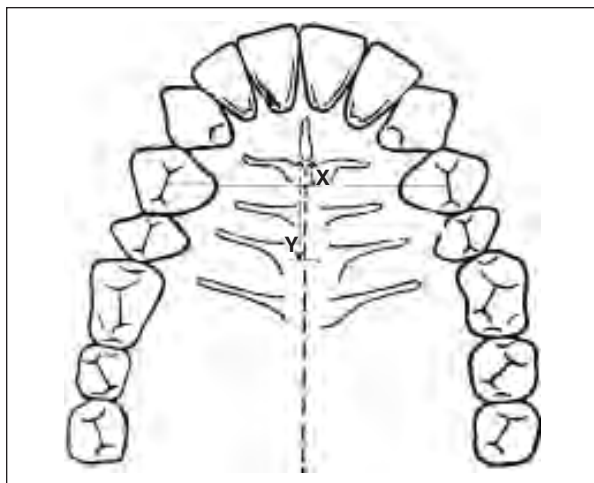
Fig 3 Regression equation $Y = 0.22X + 7.067$ (r = −0.20, $P \le .001$) where Y (location 13) is the distance from the posterior-most point of the incisive papilla to the midpoint of the junction of the third palatal ruga and the median palatal raphe in millimeters, and X (location 11) is the distance from the posterior-most point of the incisive papilla to a line connecting the premolars in millimeters.
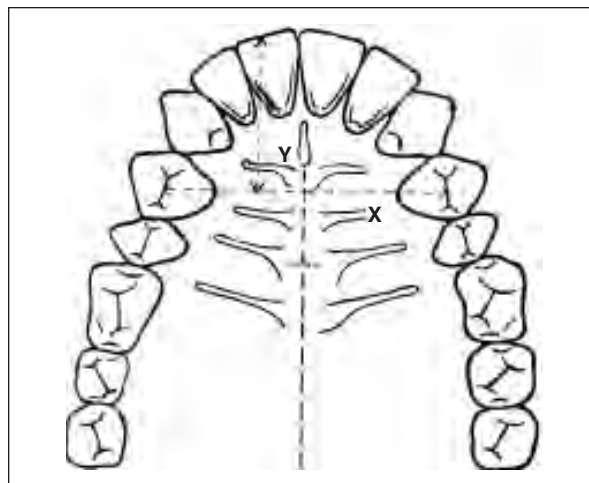
Fig 4 Regression equation $Y = -0.28X + 33.35$ (r = 0.27, $P \le .001$) where X (location 2) is the width of the anterior dental segment in millimeters, and Y (location 12) is the perpendicular distance from the midpoint of incisal surface of a central incisor to the line connecting the premolars in millimeters.

Discussion

Although from the derived formulae, central incisor position and placement of first premolars in relationship with the width of the anterior dental segment can be achieved in edentulous patients using the palatal rugae as references, caution needs to be exercised as the correlation values, although statistically significant, could not be considered strong enough to be of clinical importance. With formula 1, the coefficient of determination attained only 23.04%, basically implying that the formula only explains close to one quarter of the variability of the width of the anterior dental segment.

This study demonstrated that the geometry of the palatal rugae can be useful, if used as an adjunctive diagnostic tool, in determining key dimensions of the anterior maxilla and the position of the anterior teeth in an edentulous patient. Each provided formula can be used independently to acquire specific measurements used to determine anterior tooth positions in the maxilla.

Natural dentition does reveal infinite variations in the placement of teeth in relation to each other. This study does not explore abnormal dental arches so it is limited to patients having normal arch relations. Therefore, further clinical studies are necessary to validate these formulae in different populations, especially since the correlations found in this study are not very strong.

Conclusion

Palatal rugae geometry may be a useful guide in predicting certain key parameters of maxillary arch dimensions and position of some maxillary anterior teeth but only when associated with other occlusal esthetic and functional factors. The correlation values obtained in this study, although statistically significant, do not alone have substantial conventional or clinical application value.

Acknowledgment

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