Assessment of palatal rugae patterns in Manipuri and Kerala population

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Abstract

Background: Palatal rugae comprises three to seven ridges radiating out tangentially from the incisive papilla on the anterior part of the palate. These rugae patterns are studied for various reasons, mainly in the fields of anthropology, genetics, orthodontics, prosthodontics, and forensic science. **Objective:** To compare the palatal rugae pattern in two different populations (Manipuri and Kerala), and to assess the predominant pattern if any in the selected groups. **Materials and Methods:** Sixty maxillary study models (30 from each group including males and females) were examined in the age group ranging from 17 to 23 years. Palatal rugae pattern were analyzed on the right and left sides of the palate for total number, length, shape, direction, and unification. **Results:** After analyzing the rugae patterns in both the groups and between the two sides of the palate, the wavy pattern was found to be predominant followed by curved, straight, and circular in overall population. Manipuri population showed predominant curved shape than the Kerala population and was statistically significant. Females in general had slightly more rugae than males and the left side of the palate showed comparatively more number of rugae than on the right side. **Conclusion:** A statistically significant association between the shape of the rugae and population exists although, subtle. Parameters like direction and unification need more attention for better understanding.

Key words: Forensic odontology, individual identification, palatal rugae pattern, population identification

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Introduction

In forensic dentistry, the oral cavity plays a very important role because of the unique anatomy of the teeth. In certain situations, if teeth are lost due to any reason, such as trauma, the use of human palatal rugae has been suggested as an alternative method for identification.[1]

Palatal rugae form a pattern in the anterior part of the palate and are considered unique to an individual, analogous to finger prints.[2] They are protected from trauma by their inter position in the head, and from heat by the tongue, and buccal pad of fat. Sassouni have stated that no two palates are alike in their configuration and that the palatoprint does not change during growth.[3] Once formed, they do not undergo any changes except in length (due to normal growth) and remain in the same position throughout a person's entire life.[1]

Palatal rugae pattern may be specific to racial groups facilitating population identification. Its uniqueness, postmortem resistance, overall stability, and additional low cost make palatal rugae an ideal forensic identification parameter.[4] Hence, the present study aims to determine the number and pattern of palatal rugae in two different populations namely, Manipuri and Kerala and also to analyze the predominant pattern if any in the selected groups.

Materials and Methods

The study consisted of 60 subjects, 30 each from 2 groups of geographically different regions of India, namely Manipur and Kerala students from Navodaya Dental College, Raichur.

Criteria for selecting the population:
1. Manipuri population: Subjects belonging to Mangoloid race showing mongol features originally residing in northeast part of India, Manipur.
2. Kerala population: Subjects belonging to Aryan-Dravidian race showing Dravidian features originally residing in southwest part of India, Kerala.

The sample size was equally distributed among both the sexes in the age range of 17-23 years. After obtaining informed consent, alginate impression of maxillary arch was made and the study models were prepared with dental stone for interpretation. The rugae were delineated using a sharp graphite pencil and recorded according to the classification given by Thomas and Kotze (1983) [Figure 1].[5]

The rugae pattern was classified based on their length, shape, direction, and unification.

A. The Rugae were classified based on their length and was determined by measuring its greatest dimension regardless of its shape :
   Primary (more than 5 mm)
   Secondary (3-5 mm)
   Fragmentary (2-3 mm)
   Rugae < 2 mm were disregarded

B. The rugae were divided into four types based on their shapes as: (Origin is that point of rugae nearest to the midline and termination is the point where the rugae end from the origin).
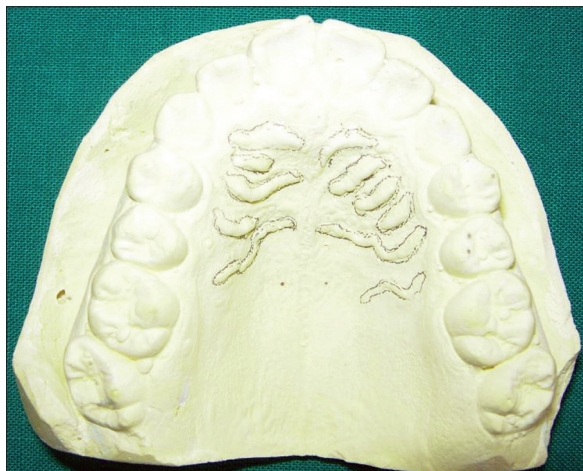1. **Curved**: They had a crescent shape and curved gently.

Figure 1: Tracing of palatal rugae pattern on a cast

Evidence of even the slightest bend at origin or termination of rugae led to it being classified as curved rugae.
2. **Wavy**: If there was a slight curve at the origin or termination of curved rugae, it was classified as wavy.
3. **Straight**: They ran directly from their origin to termination.
4. **Circular**: Rugae that formed from a definite continuous ring were classified as circular.

C. The direction of the rugae was determined by measuring the angle formed by the line joining its origin and termination and the line perpendicular to the median rugae. Forwardly directed rugae were associated with positive angles, backwardly directed rugae were associated with negative angles, and perpendicular rugae were associated with zero angles.
D. Unification occurs when two rugae are joined at their origin or termination. Rugae were considered diverging if two rugae had the same origin but immediately branched. Rugae with different origins, which joined on their lateral portions, were considered converging [Figure 2].

Association between rugae forms and population and between rugae forms and gender were tested using univariate analysis of variance. *P*-value < 0.05 is considered as statistically significant.

Results

Rugae were tested for gender, population, and for each side of the palate using following parameters:
1. Total number of rugae
2. Length of rugae
3. Predominant shape
4. Predominant direction
5. Unification of rugae

Statistical analysis showed that although no difference was found in the total number of rugae for two populations and between the two sides of palate, females in general had slightly more rugae than males and the left side of the palate showed comparatively more number of rugae than on the right side [Table 1].

On observing the length of rugae, primary rugae were predominant compared to secondary rugae in both the populations but not statistically significant [Table 2].

The predominant rugae shape in both the populations (males and females) was wavy pattern followed by curved, straight, and circular. However, curved pattern was predominant in Manipuri compared to Kerala population and was statistically significant [Table 3].

When the direction of rugae and unification were

analyzed, no statistical significant difference was observed [Table 4].

Discussion

The application of palatal rugae pattern for personal identification was suggested by various authors.[6] Palatal rugoscopy was first proposed in 1932, by a Spanish investigator named Trobo Hermosa.[7] It was not until 1955 that a proper classification of palatal rugae was put forward by Lysell.[8] This classification was modified by Thomas

Table 1: Distribution of rugae number in Kerala and Manipuri population

Group	Kerala	Manipuri	Total	Chi-square value (p)
Males	146	150	296	Chi-Sq = 0.957, *P* value = 0.328 NS
Females	163	143	306	
Right side	153	144	287	Chi-Sq = 0.008, *P* value = 0.928 NS
Left side	156	149	305	

NS = Non-significant, S = Significant

Table 2: Distribution of rugae shapes in Kerala and Manipuri population

Group	Kerala			Manipuri			Chi-square value (p)
	Males	Females	Total	Males	Females	Total	
Wavy	13	14	27	14	15	29	0.2679 (0.612) NS
Curved	4	2	6	5	8	13	3.774 (0.05) *S
Straight	0	5	5	0	2	2	0.6469 (0.4238) NS
Circular	2	0	2	0	1	1	0.351 (0.99) NS

*S = Significant

Table 3: Distribution of rugae length in Kerala and Manipuri population

Group	Kerala			Manipuri			Chi-square value (p)
	Males	Females	Total	Males	Females	Total	
Primary	14	15	29	15	12	27	0.0782 (0.78) NS
Secondary	1	3	4	3	4	7	0.351 (0.99) NS

and Kotze in 1983 and it was considered to be the most acceptable one.[5,9]

Palatal rugae have been studied for various reasons, the most important one being for personal identification in the field of forensic odontology. Several investigators such as Carrea (1938), Lysell (1955), Sassouni (1957), and English Wetal (1988) have recognized palatal rugae pattern to be distinct.[9]

It has also been proven that rugae maintain a constant shape throughout life[10] and may be specific to racial groups facilitating population identification.[2,11]

Hauser *et al*. (1989) compared the rugae pattern of Swazi and Greek populations and found definite difference in the rugae pattern between the two populations.[12] According to English *et al*. 1988, palatal rugae pattern is sufficiently characteristic to discriminate between individuals and distinctive enough for population based comparisons.[13]

The present study was undertaken to evaluate the palatal rugae pattern in two different populations (Manipuri and Kerala), and to assess the predominant pattern if any in the selected groups.

When analyzed for the number of palatal rugae, the right side of the palate showed fewer rugae compared to the left side but not statistically significant. Our observations were similar to Dhoke and Usato (1994) *et al*. who also reported that the right side of the palate had fewer rugae than the left side. It was explained that this was due to the phenomenon of regressive evolution, dominating the right side of the palate.[4]

On measuring the length of the rugae, primary rugae were considerably longer in Kerala population than in Manipuri population, whereas secondary rugae were longer in Manipuri population.
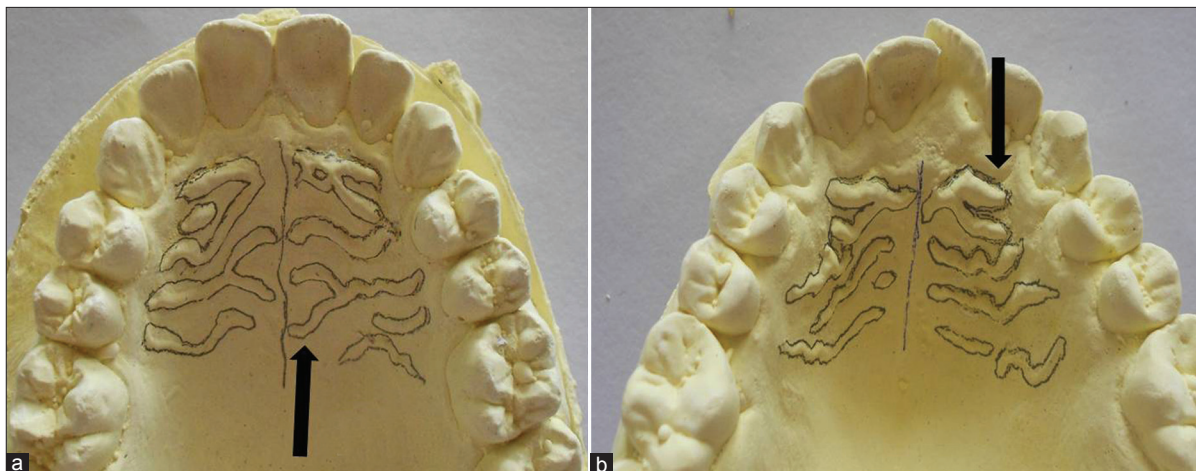

Figure 2: Classification of rugae based on unification, (a) Converging (b) Diverging

Table 4: Distribution of rugae direction and unification in Kerala and Manipuri population

Group	Kerala			Manipuri			Chi-square value (p)
	Males	Females	Total	Males	Females	Total	
Forward	12	9	21	11	14	25	0.3505 (0.554) NS
Backward	5	2	7	9	6	15	0.0018 (0.99) NS
Perpendicular	1	4	5	0	2	2	0.4667 (0.99) NS
Converging	2	3	5	0	2	2	0.0175 (0.999) NS
Diverging	13	12	25	10	12	22	0.0241 (0.772) NS

When shape of the palatal rugae pattern was assessed, the predominant rugae shape in both Manipuri and Kerala population was wavy pattern followed by curved and straight. This finding goes in accordance with Kapali *et al*. (1997)[2] who also observed similar pattern. However, curved pattern was predominant in Manipuri population than in Kerala and was statistically significant. Furthermore, Manipuri females had more curved rugae when compared to Manipuri males.

In addition, in the present study, when the direction and unification were assessed in both the populations, forwardly directed rugae were predominant followed by backwardly and perpendicular rugae and diverging rugae was more compared to converging rugae. Comparisons of direction and unification within the population and individual identification failed to show any systemic trends and needs understanding and further research.

Conclusion

In the present study, on comparing the rugae shape, Manipuri population showed significantly predominant curved shape than the Kerala population and wavy shape was predominant in both the populations. Thus, a statistical significant association between the rugae shape in two populations exists, although subtle but definite. It would thus be helpful to conduct further studies with larger sample. On the whole, palatal rugae pattern is distinctive to an individual and is considered to have population specific pattern, therefore it may well be used as an aid to identification.

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