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Palatal Rugae Pattern for Gender Identification among Selected Student Population in Chennai, India

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Authors' contributions

This work was carried out in collaboration between all authors. Author SM designed the study, performed the statistical analysis, wrote the protocol. Authors SM and SN wrote the first draft of the manuscript. Authors UM and VAK analysed the study 2. Author PTV done the final formaating of the article. Author FB made literature searched for the present study. All authors read and approved the final manuscript.

Research Article

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ABSTRACT

Aim: To evaluate the gender differences with regard to the shape of the palatal rugae and identify the most predominant pattern.
Study Design: Cross sectional design
Place and Duration of Study: June 2009 to October 2009 in the Faculty Dental Sciences at Sri Ramachandra University, Chennai, India.
Methodology: 135 students aged 17-25yrs participated in the study. Based on gender they were divided into two groups comprising of 62 male and 73 female students respectively. Maxillary impressions made were cast in dental stone were utilised to analyse and study the variation in rugae pattern based on classification by Thomas and Kotze. The data obtained were tabulated and analysed using IBM SPSS 19.0 version. The incidence of specific rugae pattern and its association with gender was analysed using chi-square test.
Results: Straight and curve forms were most prevalent rugae shapes in both the genders. Chi-square analysis for association between rugae shape and gender showed significant differences in total number of rugae and unification pattern of rugae.

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Conclusion: Observation of rugae pattern is a useful additional method and complementary technique for human identification, providing a significant contribution for forensic identification.

Keywords: Palatal rugae; gender; forensic anthropology; Chennai population; South India; rugae pattern.

1. INTRODUCTION

Forensic odontology can be defined as a branch of dentistry which deals with the appropriate handling and examination of dental evidence and with the proper evaluation and presentation of dental finding in the interest of justice [1]. Proper identification of the deceased is very important to claim certification of death and for personal, social and legal reasons. When identification of the deceased gets difficult or fails due to adverse situations, the palatal rugae can be considered as an alternate source for identification. Palatal rugae or transverse palatine folds, refers to the irregular elevations of the mucosa seen on the anterior third of the palate. They are the projections in the transverse direction from the palatine raphe located of the mid-sagittal plane. These rugae have significant characteristics features as they are unique patterns in each individual and remain stable from the time of development until death [2-7]. Rugae patterns can contribute reliable details to forensic odontology in identification of the deceased [2,8,9] Even in extreme cases of trauma or incineration the rugae remains somewhat protected, the anatomic position of the rugae which is placed in the oral cavity remains less disturbed. They are well protected from heat as the lips, tongue and the buccal fat pads act as insulators [10]. The objective of the present study is to:

1) Understand the distinctive rugae patterns of the study population.
2) Determine the contribution of the rugae patterns in gender identification.

2. MATERIALS AND METHODS

The study was conducted from June 2009 to October 2009 in the Faculty Dental Sciences at Sri Ramachandra University, Chennai, India. The study population included 135 students aged between 17-25yrs who were devoid of congenital abnormalities, inflammation, trauma and orthodontic treatment. They were divided two groups based on gender which comprised of 62 male participants and 73 female participants. A convenience sampling technique was utilized for data collection. The study population were explained about the objectives, study methodology and an informed consent was procured.

Maxillary impressions were recorded using irreversible hydrocolloid material and perforated dentulous stock trays of suitable dimension. The impression was poured with type III gypsum product. The positive replicas of palatal rugae obtained on the cast were highlighted using 0.3mm graphite pencil and were observed under adequate light and magnification.

The cast were then analysed following the classification of Thomas and Kotze [11,12] which presented a practical classification based on rugae location (Table 1). The rugae were marked as follows. Initial rugae, the most anterior one was represented by a capital letter while several complementary rugae were represented by numbers. The identified shapes were classified as curved, wavy, straight and circular. The unification was grouped either as

converged or diverged. Converged are those where two rugae originated away from the centre and united towards it. While diverged ones are those rugae which originated from the centre and diverged away from it. The results were observed and tabulated.

Table 1. Descriptive statistics of mean and standard deviation in different types of rugae as categorized by gender

	Gender	Number	Mean	Std. deviation	Pearson chi-square Value (p<0.05)
Total no of Rugae	Male	62	9.50	1.597	0.015
	Female	73	10.22	1.828	
Right side	Male	62	4.77	1.078	0.473
	Female	73	5.12	1.154	
Left side	Male	62	4.73	1.058	0.203
	Female	73	5.10	1.260	
Primary	Male	62	7.66	1.482	0.128
	Female	73	8.188	1.678	
Secondary	Male	62	1.84	1.776	0.326
	Female	73	2.03	1.708	
Straight	Male	62	4.79	2.174	0.193
	Female	73	5.08	2.253	
Curved	Male	62	2.32	1.412	0.136
	Female	73	1.74	1.270	
Wavy	Male	62	1.95	1.583	0.498
	Female	73	2.04	1.703	
Unification	Male	62	0.27	0.557	0.006
	Female	73	0.71	0.858	
Non-specified	Male	62	0.16	0.413	0.138
	Female	73	0.40	0.682	
Circular	Male	62	0.00	0.000	0.220
	Female	73	0.12	0.557	

A significance level of data were analysed by using IBM SPSS 19.0 version. Two-sample t-test and chi-square tests were used for comparison of means and relationship between the attributes.

3. RESULTS

The results were tabulated in Table 1 includes total number of rugae, mean, distribution of rugae types and the descriptive statistics. On analysing the results there were no significant differences in the total number of rugae on the right side or left side of the palate among the male and female participants. Incidence of primary, secondary, straight and wavy rugae were more in females than male participants, whereas curved rugae had more predilections towards male population. Statistical analysis showed there was no difference in rugae pattern between genders, but there was a statistical difference in the no. of unification type of rugae which was found to be higher among the among the females than the males ($p = 0.006$).In addition, statistical difference was observed between male and female in total number of rugae ($p=0.015$).

4. DISCUSSION

Forensic odontology is a specialty in dentistry which occupies a primary niche within the total spectrum of methods applied to medico-legal identification [13]. Anthropometric values have been used as tools in distinguishing characteristics within as well as between races. In the facial region, numerous parameters have been utilized to gather anthropometric data including facial length, nasal height, skull dimensions and inter-pupillary distance. The uniqueness of rugae patterns in each individual and their unchanged nature during an individual life makes them reliable parameters in forensic odontology and anthropometry. English et al. [2] and Peavy et al. [4] noted that the characteristic pattern of the palatal rugae does not change as a result of growth, it remain stables from the time of development until the oral mucosa degenerate at death. Van der Linden [5] proved that the anterior rugae do not increase in length after 10 years of age. Though certain changes occur with orthodontic movement but morphology remains the same [14].

The present study has utilised cast models to study the rugae pattern in age group of 17-25 years. For a more accurate result, the use of cast made from jaws rather than the dentures were suggested by Sognnaes [15]. Similarly, the study of Jacob and Shalla [16] reported 100 percent accuracy on evaluation of the entire cast while only 79 percent accuracy on evaluating the rugae tracing. Thus their study insisted on the use of entire cast topography.

The present study analysed the number, patterns in a selected samples of student population and also to determine the difference in rugae pattern among the genders . This is an additional method of differentiating the sexes, especially if other indicators are missing during antemortem**.** The study of Dohke and Osato (1994) [6] done to compare the primary and secondary rugae of Japanese population reported that the number of rugae on the right side was comparatively lesser than that on the left side. Their conclusions were not seemed to be validated in our study because for both the genders there was not much difference between the right side and the left side. In contrast, the Nepalese with more secondary and fragmentary rugae had smaller number of left side rugae. Thus it was deducted that secondary and tertiary rugae may have greater discriminatory potential than the primary rugae [7]**.**

Kapli et al. [17] in their study did not reveal any significant differences in the number of primary rugae between aboriginal males and females. But, the present study showed significant difference in the number of rugae between the genders. In our study we found that the rugae pattern did not simply comprise of one form alone, but appeared as a mixture of varying forms. Straight forms were the most commonly seen followed by other forms. In this study the palatal rugae patterns of all 135 research participants were distinct and unique. None of the patterns was identical and also in each individual no bilateral symmetry was observed. These findings were in congruity with results obtained from the similar studies conducted by English WR et al. [2].

We observed that straight and curve forms were the most prevalent rugae shapes in both the genders and were consistent with the findings of the previous study conducted by Nayak et al. [10] on Indian populations. However, a significant difference was found to be in unification shape of rugae in the present study ($p=0.006$). But, study conducted in puducherry population has showed prevalence of wavy pattern [18]. It can therefore concluded that certain rugae shapes are specific to particular population and might have better utility in population differentiation.

The shortcomings of palatoscopy are that proper identification during postmortem is impossible in the absence of antemortem data. In addition, intra and interobserver errors are likely to occur in cases of complex rugae patterns [14]. So also dentures, mal-positioned teeth and palatal pathologies were identified to cause variations in rugae patterns **(**Kapali et al) [17].

4. CONCLUSION

From this present study, we can conclude that the incidence of total number of rugae between male and female research participants were different. But, significant differences were found only in unification type of rugae which was found to be higher in females than in males. Observation of rugae pattern is a useful additional method and complementary technique for human identification, providing a significant contribution for forensic identification. However further research is necessary with a larger sample size in order to substantiate the findings of the present study. This method of identification can be used only when an antemortem record of palatal rugae is available.

CONSENT

All authors declare that 'written informed consent was obtained from the patient (or other approved parties) for publication of this study.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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