Evaluations of Palatal Rugae Patterns and its individualistic Nature amongs basic Medical students of University of Port-Harcourt, Nigeria

Ibeachu P.C.1, Didia B.C.1 and Arigbede A.O.[2]
Department of human Anatomy1 and Restorative Dentistry[2], College of Health Sciences, University of Port Harcourt, Choba, Rivers State, NIGERIA

Abstract

The unique morphological structural patterns of palatal rugae has long been an interesting anatomical structure studied by researchers from various discipline mainly in the fields of Anthropology, comparative Anatomy, Genetics, Forensic Odontology, Prosthodontics and Orthodontics, so as to evaluate its usefulness.This study aimed at evaluating the palatal rugae patterns of basic medical students of University of Port-Harcourt.A total number of 140 volunteers, 70 males and 70 females within the age range18-35 years were recruited for this study. After obtaining consent from the volunteers, maxillary dental casts were made and interpretation of the rugae pattern was done. Thetotal number, length, shape and unification of the palatal rugae patterns were analysed for the right and left side of the palate. This study showed that each individual has a different and unique palatal rugae pattern. The predominant patterns of palatalrugae were wavy and curve patterns followed by straight. This study revealed that the females had slightly more number of rugae which is insignificant in proportion with percentage value of (50.0%) than the male with percentage value of (49.9%). The wavy pattern of rugae was higher in females than males while the males had more curve pattern than the females. There was an insignificant (P>0.05) gender differences proportionality in the total number of palatal rugae, shape and length of rugaeamongst male and female students. There was insignificant difference in total number of unification of rugae between males and females, with males presenting more diverging pattern than females while females had more converging pattern than males. Chi-sqaure analysis however revealed insignificant association in the distributionand combination patterns of palatal rugae amongst males and females. Our findings concluded that the palatal rugae patterns of an individual are uniquely structured and specie specific. There was no similarity in the rugae patterns of males and females which provides clear evidence of rugae patterns being highly individualistic.

Keywords: Palatal rugae patterns, individual uniqueness, gender, human identification.

Introduction

Palatal rugae are irregular, asymmetric ridges of mucous membrane extending lateral from the incisive papilla and the anterior part of the median palatal raphe, which is just behind the maxillary central incisor teeth[1]. Palatal rugae have been studied for various reasons, most important one being personal identification. Human identification is based on scientific principles mainly involving fingerprints, dental records and DNA analysis. Limitations to the use of fingerprints occur in situations where the hands are charred or mutilated and while teeth are more durable, identification using dental records may also prove to be inconclusive, since many antemortem dental records may be inaccurate or incomplete[2]. In the literature there is consensus opinion that palatal rugae remains fairly stable in number and do not undergo any change due to growth, ageing, tooth extraction and disease[3]. Morphological changes may occur due to trauma, surgery, persistent pressure and proliferative benign and malignant lesions[4]. The uniqueness and stability of palatine rugae to individuals has been recognized in forensic science as providing a reliable source of identification[4, 5]. Also, Palatal rugae play an important role in medicolegal identification because their individual morphological

characteristics are stable over time[6]. Studies on the role of palatal rugae in sex determination have been documented by many researchers[7-10]. The important of palatal rugae patterns in human identification has been established in different populations. The only study of palatal rugae pattern in Nigeria population was by Eboh[11] in his study of palatal rugae patterns of Urhobos in Abraka, South-Southern Nigeria. However, there is paucity of information on the individualistic nature of palatal patterns and its role in human identification in our population. This work is therefore aimed at investigating the different rugae patterns among basic medical student population, University of Port-Harcourt Nigeria.

Material and Methods

This study was conducted at the Dental Centre in University of Port Harcourt teaching hospital (UPTH). The study consisted of 140 volunteers (students of the University of Port Harcourt) of which 70 were females and 70 males, with age ranging from 18-35 years. The ethical committee, University of Port-Harcourt and University of Port-Harcourt teaching Hospital approved the study. After explaining the nature of the study, those who consented were used for the study.

Exclusive Criteria: The subjects with congenital anomalies/malformations, previous orthognathic surgery, bony and soft tissue protuberances, active lesions, deformity or scars and trauma of the palate were not selected. Also, subjects who were wearing partial dentures and braces were excluded.

Inclusive Criteria: Normal subjects who are basic medical student of University of Port-Harcourt.

Methodology: The subjects were made to sit upright on the dental chair. The alginate paste was prepared by mixing the alginate impression powder (Spofadental, A Kerr Company, LOT: 2302461) with water as instructed by the manufacturer. Maxillary impressions of the subjects were taken using a perforated impression tray loaded with an alginate (figure-1). Dental casts were made with type 4 dental stone (Spofadental A Kerr Company, LOT: 4511215). The rugae were highlighted by a black pen marker on the cast under spotlight and recorded while the length was measured with a digital caliper calibrated to 0.0mm

Method of Identification: The study was based on the classification given by Thomas andKotze[12] and Kapali*et al.,*[13]

Figure-1
Diagram showing picture of freshly made impression

Length of rugae: Fragmentary (<3mm), Secondary (3-5mm), Primary (>5mm), Shape of rugae: The shapes of individual rugae were classified into 4 major types, Curve: The curved type had a simple crescent shape with a gentle curve., Wavy: The wavy rugae were serpentine (snake-like) in shape., Straight: The straight types ran directly from their origin to insertion., Circular: They are classified as rugae that showed definite continuous ring formation., Unification: This occurs when two rugae are joined at their origin or termination. Unification is classified into two categories: Diverging: Rugae were considered to be diverging if two rugae had the same origin but immediately branched. Converging: Rugae were considered to be converging if two rugae with different origins join on their lateral portions.

Statistical Analysis: The total numbers of the various rugae pattern were counted, the percentages were recorded and Bar-chats were used to describe the distribution of the various patterns. Z-test was used to compare the proportionality differences in distribution of the patterns in the ethnic groups. The associations between the distributions of the different rugae shapes were tested using Chi-square analysis. *P*-value ≤0.05 is considered as being statistically significant.

Results and Discussion

This study however, revealed that no two palates are alike in their configuration, with each presenting an organized pattern of rugae specific to the individual (figure-2). Our evaluations showed that the wavy, curve and straight patterns were predominantly common while circular and unification of rugae were less common. There was an insignificant (P>0.05) gender differences in the total number of palatal rugae, shape and length of rugaeamongs male and female students.
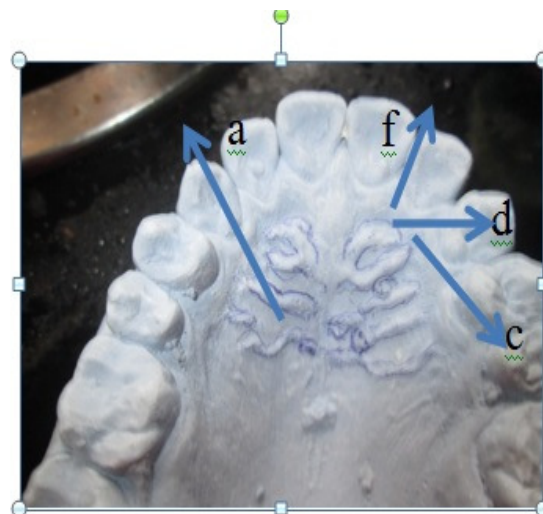

Figure-2.
Dental cast showing the indiviualistic nature of rugae patterns
a= wavy, b= curve, c= straight, d= circular, e= converging, f= diverging

The total number of palatal patterns among male and female students populations: There was no significant (P>0.05) difference in the total number of rugae between male**s** and females. The wavy, straight and converging were more in females than in males while males had more of the curve, circular and diverging than the females. Further consideration of the most predominant patterns revealed the females had more number of wavy patterns with percentage value of 306 (48.3%)

which was not significant, as compared to males with a mean value of 289 (45.7%). On the other hand, curve pattern also showed an insignificant gender difference in proportionality, with percentage value of 193 (30.5%) for males as compared to females with percentage curve value of 183 (28.9%) (table-1 and 2). The total number of the various pattern showed insignificant association in the distribution pattern (table- 3)

Table-1
The total number of different Rugae Patterns and their percentage distributions

Gender	Patterns					
	Wavy	**Curve**	**Straight**	**Circular**	**Converging**	**Diverging**
Male	289(45.7%)	193(30.5%)	65(10.3%)	34(5.4%)	17(2.7%)	35(5.5%)
Female	306(48.3%)	183(28.9%)	66(10.4%)	33(5.2%)	25(4.0%)	21(3.3%)

Table- 2
Test of proportionality for the distribution of rugae pattern between male and female uniport students

		Observed Population (n)	**Total Population (n)**	**Observed Proportion**	**z-value (cal)**	**|z| crit**	**P-value (obs)**	**Inference**
Wavy	Male	289	633	0.457	-0.931	1.96	0.352	No Significant difference in proportions
	Female	306	634	0.483				
Curve	Male	193	633	0.305	0.633	1.96	0.529	No Significant difference in proportions
	Female	183	634	0.289				
Circular	Male	34	633	0.054	0.132	1.96	0.897	No Significant difference in proportions
	Female	33	634	0.052				
Straight	Male	65	633	0.134	-0.083	1.96	0.936	No Significant difference in proportions
	Female	66	634	0.104				
Converging	Male	17	633	0.027	-1.106	1.96	0.267	No Significant difference in proportions
	Female	25	634	0.038				
Diverging	Male	35	633	0.055	1.92	1.96	0.055	No Significant difference in proportions
	Female	21	634	0.033				

Inference: No significant difference in the distribution by proportion of the patterns in male and female uniport students.

Table-3
Chi-square test of association between the palatal rugae pattern distribution and gender (at 0.05 significant level)

	Circular	**Curve**	**Straight**	**Wavy**	**Converging**	**Diverging**	**Df**	**Chi - ($\chi 2$)**	**Critical value**	**Chi (p) calculated p-value**	**Inference**
Male	34	193	65	289	17	35	5	5.797	11.1	0.326	No Significant association
Female	33	183	66	306	25	21					

Right and left distribution of palatal rugae patterns: The predominant patterns, wavy, curve and straight were found to be more on the left than the right while the less predominant patterns, circular and unification of rugae were more on the right than the left. The males had more curve pattern on the left than the right while the female had more number of wavy patterns on the left than the right (figure-3 and 4 below). Chi-square analysis of the pattern of distribution on the sides showed insignificant association in the pattern of distribution of the various shapes ($P<0.05$) (table- 4 and 5)
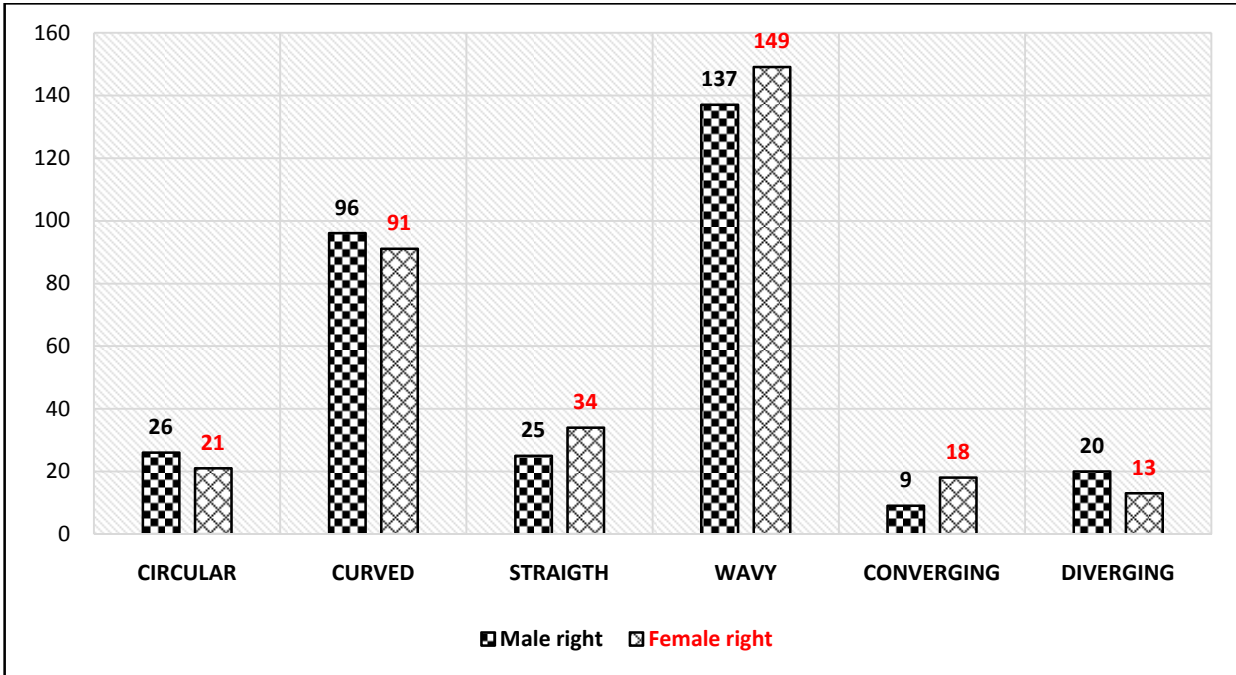

Figure-3
Frequency distribution of various shapes of palatal rugae patterns on the Right side of males and females
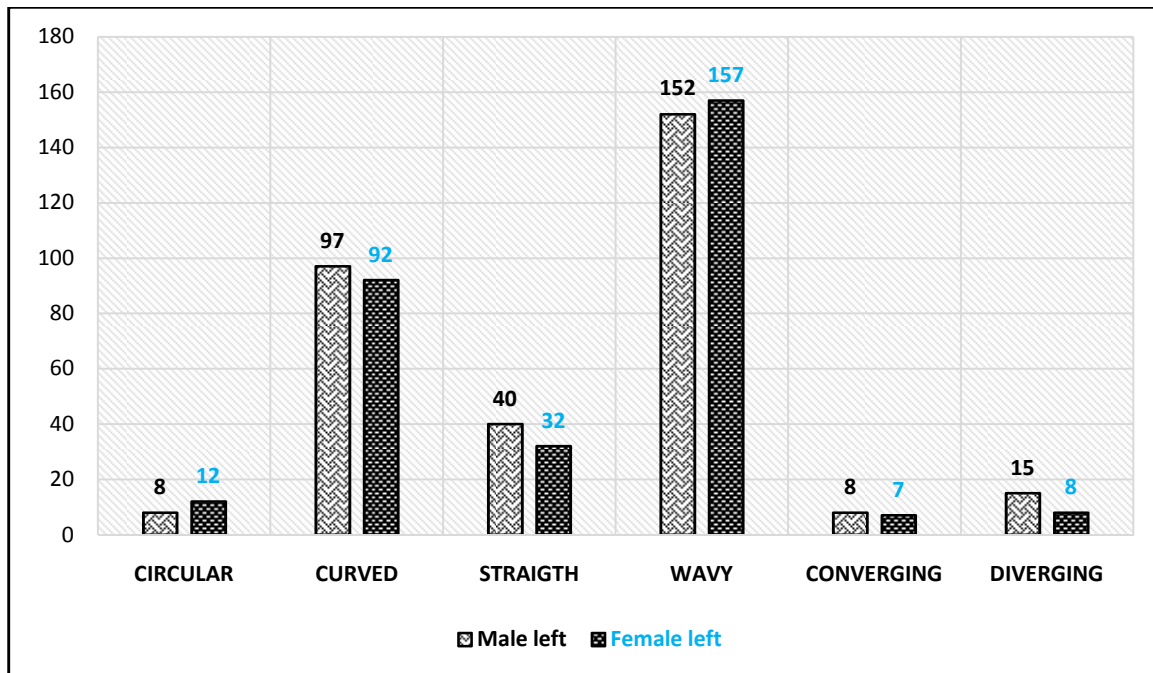

Figure-4
Frequency distribution of various shapes of palatal rugae patterns on the Left side of males and females

Table-4
Chi-square test of association between the palatal rugae pattern distribution in the right side and gender (at 0.05 significant levels)

	Circular	Curve	Straight	Wavy	Converging	Diverging	Df	Chi - (χ2)	Critical value	Chi (p) calculated p-value	Inference
Male right	26	96	25	137	9	20	5	6.765	11.1	0.239	No Significant association
Female right	21	91	34	149	18	13					

Table-5
Chi-square test of association between the palatal rugae pattern distribution and gender (at 0.05 significant levels)

	Circular	Curve	Straight	Wavy	Converging	Diverging	Df	Chi- (χ2)	Critical value	Chi (p) calculated p-value	Inference
Male	34	193	65	289	17	35	5	5.797	11.1	0.326	No Significant association
Female	33	183	66	306	25	21					

Length of rugae patterns: The rugae were basically primary rugae (>5mm) with few secondary rugae (3-5mm), while the fragmentary rugae (<3mm) was obviously insignificant. The males had more primary rugae than females while the females had more secondary rugae than males.

Discussion: The uniqueness of palatal rugae patterns and its role in forensic investigations has been attributed to its anatomical location which makes it stable and perennial, and to some inherent factors like variability and immutability. Palatal rugae have been studied for various reasons, most important one being personal identification.

The present study revealed that the palatal rugae patterns are highly individualistic with unique characteristic which makes them stable and reliable as to meeting the appropriate criteria for forensic investigations. In this study, there was no significant difference in the total number of palatal rugae pattern and this confirms the work of Sarafet al[7] and Faisal et al[9] in their respective studies of gender differences in palatal rugae patterns. This observation also gives credence to Sathish et al[14] who did not notice any statistical difference in palatal rugae patterns of males and females and suggest that palatoscopy may not be an efficient tool for sex determination but in contrast with contrast to Madankumar et al[8] who reported significant difference in the number of rugae between the genders among Indian population of Chennai. We observed the various patterns of rugae amongst males and females in this study, although the level of predominance differs. The predominant patterns were wavy, curve, followed by straight while circular and unification of rugae were few. This finding goes in accordance with Sharma et al[15] and Surekha et al[16] who also observed similar patterns.

There was an insignificant gender differences in proportionality in the various rugae patterns of male and female students. This is in contrast with Deekshaet al[17] who said that the distribution of rugae pattern according to sexes showed that there was a significant difference between genders for rugae pattern. The females had more wavy than the males while males had more curve the than female, though insignificant. This is in contrast with Surekhaet al[16] who stated that Manipuri females had more curve pattern than their females. The females had more wavy, straight and converging while males had more curve, circular and diverging than their counterpart. The incidence of higher converging in females and higher circular in males has also been reported by Sarafet al[9] and Faisal et al[11]. Again, the higher number of converging rugae in females and diverging rugae in males, though insignificant disagrees with Paliwal et al[3] and Jibi et al[18] who concluded that these changes can be attributed to genetic or environmental variation. The predominant patterns, wavy, curve and straight were found to be more on the left than the right while circular and unification of rugae were more on the right than the left. The males had more curve pattern on the left than the right while the female had more number of wavy patterns on the left than the right. The evidence of left dominance in palatal rugae patterns is in agreement with the study done by Dipshikha et al,[19] Surekhaet al,[16] Dohke and Osato[20] and Kallianpur et al [21] who also proved that the left side of palatal rugae is dominant, and explained it to be the phenomenon of regressive evolution. The analysis of the rugae length showed it was basically primary rugae with no prove of significant.

Our study however did not record any statistical significant gender difference in total number of rugae, shapes of rugae and

even in the rugae length and this observation agrees with the study of Sarafet al[7] who reported insignificant difference in the total number and length of rugae between the sexes. However, there was insignificant association between the distribution patterns of palatal rugae and sex.

Conclusion

This study has indeed demonstrated a clear evidence of the individualistic nature of palatal rugae as have been reported by several authors because there was no incidence of similarity observed in the study. Every individual presented a distinct but unique pattern with no evidence of sexual dimorphism.

References

1. Paliwal A.,Wanjari S. and Parwani R., Palatal rugoscopy,Establishing identity, *J Forensic Dent Sci.,* **2(1),** 27-31 (**2010)**

2. Buchner A., The identification of human remains, *Int Dent J*, **35**, 307- 11 **(1985)**

3. Caldas IM., Magalhães T. and Afonso A., Establishing identity using cheiloscopy and palatoscopy, *Forensic Sci. Int.*, **165(1),** 1-9 **(2007)**

4. Bansode S.C. and Kulkarni M.M., Importance of palatal rugae in individual identification, *J Forensic Dent Sci.,* **1(2),** 77-80 **(2009)**

5. English W.R., Robison S.F., Summitt J.B., Oesterle L.J., Brannon R.B. and Morlang W.M., Individuality of human palatal rugae, *J. Forensic Sci.*, **33(3),**718-26**, (1988**)

6. Patil M.S., Patil S.B. and Acharya A.B., Palatine Rugae and their significance in clinical dentistry: A review of the literature, *J Am Dent Assoc*, **139**,1471-8**(2008)**

7. Saraf A, Bedia S, Indurkar A, Degwekar S and Bhowate R, Rugae patterns as an adjunct to sex differentiation in forensic identification, *J Forensic Odontosl*, **29**, 14-9 **(2011)**

8. Madhankumar S., Natarajan S., Maheswari U., Anand V., Padmanabhan T. and Fathima B., Palatal rugae pattern for gender identification among selected student population in Chennai, *India. J Scientific Research Reports,* **2(2),** 491-96 **(2013)**

9. Faisal F.M., Shamrani S.M. and Talic YF., Rugae pattern in a Saudi population sample of males and females, *Saudi Dent. J*, **13(2),** 92–5 **(2001)**

10. Amandeep C., Rao N.C, Nidhi G. and Shelja V., Palatal rugae and arch length : A tool in gender determination, *Journal of Forensic Dental Sciences*, **(2)**, 54-59 **(2013)**

11. Dennis E.O., Palatal Rugae Patterns of Urhobos in Abraka, South-Southern Nigeria, *Int. J. of Morph,* **30(2)**, 709 **(2012)**

12. Thomas C.J. and Kotze T., The palatal rugae pattern, A new classification*., J Dent Assoc S Afr,* **38**, 153-7 **(1983)**

13. Kapali S., Townsend G., Richards L. and Parish T., Palatal rugae patterns in Australian aborigines and Caucasians, *Aust Dent J.,* **42(2),** 129-33 **(1997)**

14. Sathish Kumar., Vezhavendhan N., Shanthi V., Balaji N., Sumathi M.K. and Priya V., Palatine Rugoscopy among Puducherry Population, *J. of Comt. Dental Practices,* **13(3),** 401-404 **(2012)**

15. Sharma P., Saxena S. and Rathod V., Comparative reliability of cheiloscopy and palatoscopy in human identification, *Indian J Dent Res*, **20**, 453-7 **(2009)**

16. Surekha R., Koneru A., Vikram S.R., Santosh H., Shamala R. and Neela R., Assessment of palatal rugae patterns in Manipuri and Kerala population, *Journal of Forensic Dental Sciences,* 4(2), 93-96 **(2012)**

17. Deeksha K.S., Priyanka S.M., Suyog C.S. and Syed A.T., Comparison of palatal rugae patterns in Kodava and Malayalee populations of South India, *Journal of forensic Dental Sciences,* **5(2),** 85-89 **(2013**)

18. Jibi PM, Gautam KK, Basappa N and Raju OS., Morphological pattern of palatalrugae in children of Davangere, *J Forensic Sci*, **56**, 1192-7 **(2011)**

19. Bajracharya Dipshikha, Vaidya Anisha, Thapa Sunaina and Shrestha Sujita, Palatal Rugae Pattern in Nepalese Subjects, *Orthodontic Journal of Nepal*, **3,** 2 **(2013)**

20. Dohke M. and Osato S., Morphological study of the palatal rugaerugae in Japanese -Bilateral differences in the regressive evaluation of the palatal ruga, *Jap J Oral Biol.*, **36**, 126-40 **(1994)**

21. Kallianpur S., Desai A., Kasetty S., Sudheendra U. and Joshi P., An anthropometric analysis of facial height, arch length, and palatal rugae in the Indian and Nepalese population, *J Forensic. Dent Sci.*, **3(1),** 33-37 **(2011)**