

## Palatal Rugae Patterns of Urhobos in Abraka, South-Southern Nigeria

Patrones de Rugas Palatinas de los Urhobos en Abraka, Sur-Sur de Nigeria

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**SUMMARY:** Human identification is a major task undertaken in forensic sciences. Palato-rugoscopy is based on the principle that no two palates are the same. The study of palatine rugae and the study of fingerprints are sometimes complementary as they operate in similar methods based on same scientific basis. The study intends to describe the shape and gender distribution of the palatine rugae and their prevalence in the studied population. The study sample consisted of 84 subjects, 42 males and 42 females of Urhobo ethnic and cultural background, between 17 and 30 years old, with full complement of maxillary teeth, drawn purposively from Abraka. The prevalence of palatal rugae shapes was: line (27.2%), sinuous (21.1%), angle (18.1%), polymorphhic (15.5%), point (7.5%), curve (6.2%), circle (4.2%). The total number of palatal rugae shape in the overall sample was 520, with females being slightly higher (51.5%) having mean of 6.38 (SD 1.45) than males (48.5%) having mean of 6 (SD 1.72). However, the difference between male and female was not statistically significant. The individualized pattern of palatal rugae makes it a reliable guiding tool in forensic identification.

**KEY WORDS:** Forensic anthropology; Palatal rugoscopy; Human identification; Morphology.

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### INTRODUCTION

Palatine rugae are irregular transverse ridges, radiating outwards from the palatine raphae in the anterior half of the hard palate (Standring, 2008). Patal rugae pattern is an anatomical character of the human palate. Palatoscopy or palatal rugoscopy is the name given to the study of palatal rugae in order to establish a person's identity (Caldas *et al.*, 2007; Bansode & Kulkarni, 2009). Palatal rugae contain a core of connective tissue (Standring), and are formed in about the 12th week to 14th week of prenatal life and remain stable throughout the person's life (Bansode & Kulkarni; Patil *et al.*, 2008).

The histological study of the development of palatal rugae carried out in mice showed that they develop as localized regions of epithelial proliferation and thickening even in advance of the elevation of the palatal shelves (Luke, 1988; Kapali *et al.*, 1997). Thereafter, fibroblasts and collagen fibers which accumulate in the connective tissue beneath the thickened epithelium assume a unique orientation. The collagen fibres run antero-posteriorly across the base of each ruga and determine the orientation of the rugae (Kapali *et al.*). Histologically, the palatine rugae have stratified squamous, usually parakeratinized epithelium on connective tissue base (Bansode & Kulkarni).

In neonates, the rugae which usually corrugate the hard palate assist gripping of the nipple when suckling (Standring). They are also involved in the oral swallowing and help to improve the relationship between food and the taste receptors in the dorsal surface of the tongue (Buchtová *et al.*, 2003; Hermosilla *et al.*, 2009).

The design and structure of palatal rugae are unchanged and are not altered by chemicals, heat, disease or trauma, or, if they are destroyed, are reproduced exactly on the same site they were located (Hermosilla *et al.*; Almeida *et al.*, 1995). The form, layout and characteristics are not affected by the eruption of the teeth or their loss, but sometimes palatal rugae adjacent to the alveolar arch slightly change their position after tooth extraction (Hermosilla *et al.*; Peavy & Kendrick, 1967). However, some events may contribute to changes in the pattern of palatine rugae, such as finger sucking in childhood and persistent pressure due to orthodontic treatment. Furthermore, it has been reported that extractions can produce a local effect on the direction of the palatal rugae (Hermosilla *et al.*; Limson & Julian, 2004). It has been postulated that palatal rugae patterns have genetic undertone (Kapali *et al.*; Lysell, 1955).

The uniqueness and stability of palatine rugae to individuals has been recognized in forensic science as providing a reliable source of identification (Kapali *et al.*; English *et al.*, 1988). This is so because no two palates are alike in their configuration (Sassouni *et al.*, 1957). The study of palatal rugae and the study of finger prints are united as similar methods based on same scientific basis. The two methods are said to be sometimes complementary: for example, palatoscopy can be of special interest in cases where there are no fingers to be studied, as in burnt bodies in severe decomposition (Bansode & Kulkarni). The tasks of classifying palatal rugae have been found a difficult part of palatal rugae studies. The subjective type of observation and interpretation with and between observers poses a problem; hence several palatal rugae classifications have been proposed (Caldas *et al.*).

A search of the literature revealed that the study on palatine rugae has not been documented in Nigeria. Therefore, this study intends to describe the shape and gender distribution of the palatine rugae and their prevalence in a sample of 84 adult subjects of Urhobo ethnic nation resident in Abraka, Delta State, South-Southern Nigeria.

## MATERIAL AND METHOD

The study consisted of 84 subjects, 42 males and 42 females between 17 and 30 years old, with full complement of maxillary teeth (not considering the third molar) drawn purposively from Urhobos resident in Abraka, a sub-urban town in Delta state, South-Souther Nigeria, and the Delta state university situated therein.

The subjects were informed of the nature of the study and only those who gave their consent and showed willing cooperation participated. In addition, the study was approved by the Research Ethics committee of the College of Health

Sciences, Delta State University, Abraka, Delta State, Nigeria. Subjects with severe malocclusions, with palatal asymmetries and palate with a history of surgery were excluded.

Eighty-four maxillary study models (casts) of subjects were produced from an alginate impression. Each of the study models was well examined with the aid of a magnifying glass for shape classification and number of shape types based on the classification of Trobo (Hermosilla *et al.*) (Fig. 2). This classification divides rugae into simple rugae, classified as ABCDEF, where rugae shapes are well defined, and compound rugae, classified as type X, with a polymorphisms variety (the compound shapes result if there is union of two or more simple rugae). The present study regards every separate, well defined ruga as a simple ruga. A compound or polymorphic ruga is one involving the union of two or more simple rugae. Hence, a ruga is either simple or compound (polymorphic). The rugae shapes that correspond to the respective classification are: A=point; B=line; C=curve; D= angle; E= sinuous; F= circle; X= compound (polymorphic) (Fig. 1). All the palatal rugae types were recorded in the data chart the data was analyzed descriptive statistics and t-test to assess significance between males and females, using Microsoft Excel Windows 2007. P value < 0.05 was considered statistically significant.

## RESULTS

In this study, all the palatal rugae shapes were represented in the samples analyzed. The prevalence of palatal rugae shapes is shown in Table I. Females had slightly higher (51.5%) number of rugae than males (48.5%). Test of significance (t-Test) shows mean to be 5.98 in males and 6.38 in female; t Stat was -1.17, t-critical was 1.99 and p-value was 0.25. The difference between males and females was not statistically significance.

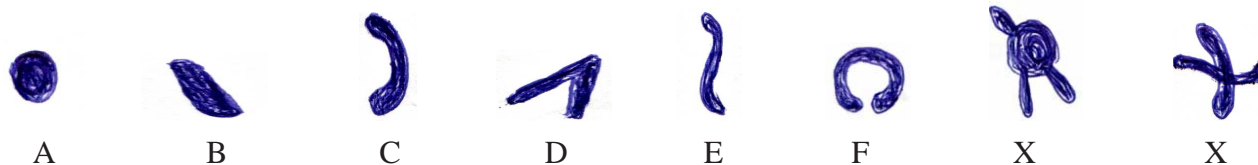


Fig. 1. Palatal rugae types, using modification of Trobo's classification. Type A=Point; Type B= Line; Type C=Curve; Type D=Angle; Type E=Sinuous; Type F=Circle; Type X=Compound.

Table I. Descriptive statistics of palatal rugae. SD=Standard Deviation.

Palatal rugae shape/Classification	Sex	n	Mean	SD	Minimum	Maximum	Sum (%)
Point/A	Male	42	0.55	0.63	0	2	23 (4.4)
	Female	42	0.38	0.76	0	3	16 (3-1)
Line/B	Male	42	1.64	1.23	0	4	69 (13.3)
	Female	42	1.74	0.83	0	3	73 (14.0)
Curve/C	Male	42	0.45	0.59	0	2	19 (3.7)
	Female	42	0.31	0.52	0	2	13 (2.5)
Angle/D	Male	42	1.19	0.86	0	3	50 (9.6)
	Female	42	1.05	0.91	0	3	44 (8.5)
Sinuous/E	Male	42	1.12	0.94	0	3	47 (9.0)
	Female	42	1.5	1.11	0	4	63 (12.1)
Circle/F	Male	42	0.21	0.56	0	2	9 (1.7)
	Female	42	0.31	0.64	0	2	13 (2.5)
Polymorphic/X	Male	42	0.83	0.82	0	3	35 (6.7)
	Female	42	1.1	0.96	0	3	46 (8.9)
Total	-	-	-	-	-	-	520 (100)
All rugae types by gender	Male	42	6	1.72	3	11	252 (48.5)
	Female	42	6.38	1.45	3	10	268 (51.5)
Total	-	-	-	-	3	11	520 (100)
Rugae classification	-	-	-	-	-	-	-
A	-	84	0.46	0.7	0	6	39 (8)
B	-	84	1.69	1.04	0	4	142 (27)
C	-	84	0.38	0.56	0	2	32 (6)
D	-	84	1.12	0.88	0	3	94 (18)
E	-	84	1.31	1.04	0	4	110 (21)
F	-	84	0.26	0.6	0	2	22 (4)
X	-	84	0.96	0.9	0	3	81 (16)
Total	-	-	-	-	0	6	520 (100)

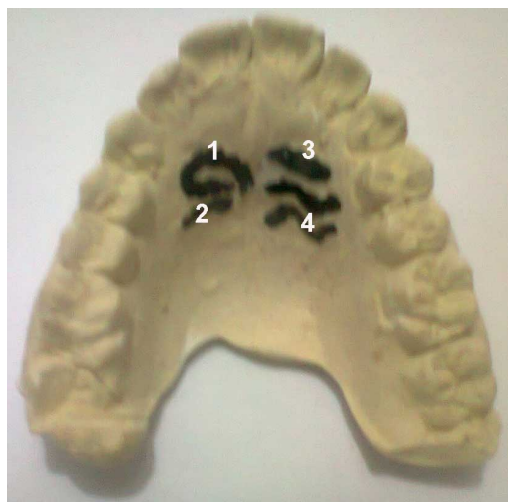


Fig. 2. Study model (cast) showing some rugae patterns. 1. Circle; 2. Curve; 3. Line; 4. Sinuous.

## DISCUSSION

In the present study, of the 84 study maxillary models examined, no two palates showed the same arrangement of palatal rugae. This observation gives credence to the reports that palatal rugae are unique to individuals (Kapali *et al.*; English *et al.*), as no two palates are alike in their configuration (Sassouni *et al.*).

The palatal rugae were disposed posterior to the incisive foramen on each side of the palatine raphe and medial to the gingivae. In the samples studied, the posterior most limits were the second upper premolars and, only one of the 520 ridges was found to cross the midline. In addition, the pattern of the rugae was individualized. This is in line with studies which stated that palatal rugae do not extend beyond the anterior half of the hard palate and also contradicts some which maintained that palatal rugae never cross the midline (Patil *et al.*; van der Linden, 1978).

In this study, the commonest palatal rugae shapes were line (27.2%) and sinuous (21.1%) compared with sinuous and curves observed in Caucasian and aboriginal Australians (Kapali *et al.*), in two population Indies (Nayak *et al.*, 2007) and Chilean (Hermosilla *et al.*) studies.

Comparing the relative occurrence of palatal rugae between sexes in this study, it was observed that males had higher mean values of palatal rugae types A, C and D, while females had higher mean values of types B, E, F and X (Table 1). This arrangement is different from Hermosilla *et al.*, (2009), who observed males to have higher mean values of types B, E, F and X, while females had higher mean values of types A and C.

Numerically, more rugae were found in females (51.5%) compared to males (48.5), but the difference was not statistically significant. In a related study, Hermosilla *et al.*, reported average palatal rugae count higher in males than females, but no significant difference.

In this study, the right side had slightly higher rugae than the left side, the difference was not significant. These depart from the report in a related study that fewer rugae occur on the right side than the left, and that females have fewer rugae than males (Dhoke & Osato, 1994). The authors maintained that this was due to the phenomenon of regressive evolution dominating the right side of the palate and being more evident in females. Some authorities suggest the

presence of sexual dimorphism in the Biometric features of the palatal rugae (Yamazaki, 1962; Reuer, 1973). The present study agrees with Kashima (1990) who compared the palatal rugae and shape of the hard palate in Japanese and Indian children. The author found there was no significant difference between male and female in either group.

Hermosilla *et al.*, noted that with limited literature of the palatal rugae, and lack of uniformity in nomenclature, makes it difficult to compare results, as the various methods were developed individually, and not validity information reported, with low reproducibility.

It has been noted a statistically significant association between rugae forms and ethnicity (Kapali *et al.*; Hermosilla *et al.*). In this study it was observed that the dominant rugae form among Urhobo ethnic group was line followed by sinuous.

In conclusion, this study clearly demonstrates distinct pattern of palatal rugae in different individual and in association with different sex, though it fails to establish any significant sex difference in number of rugae. The association between palatal rugae and ethnicity is also shown. The individualized pattern of palatal rugae and their low utilization costs make it a reliable guiding tool in forensic identification and its clinical importance can be found in the field of dentistry. It will be useful to conduct further studies with larger sample sizes in other populations to compare with other ethnic groups

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**RESUMEN:** La identificación humana es la principal tarea de las ciencias forenses. La palatorugoscopia se basa en el principio de que no hay dos paladares iguales. El estudio de los pliegues palatinos y el estudio de las huellas dactilares son en ocasiones complementarios, ya que operan con los mismos métodos, basados en las mismas bases científicas. Este estudio pretende describir la forma y la distribución por sexo de las rugas palatinas y su prevalencia en la población estudiada. La población de estudio consistió en 84 sujetos, 42 hombres y 42 mujeres de origen étnica y cultural Urhobo, entre 17 y 30 años de edad, con dotación completa de los dientes superiores, realizado en Abraka. La prevalencia de las diferentes formas de rugas palatinas fue: lineal (27,2%), sinuosa (21,1%), angular (18,1%), polimórfica (15,5%), en punto (7,5%), curva (6,2%) y circular (4,2%). El número total de formas de rugas palatinas en la muestra fue de 520, ligeramente superior en mujeres (51,5%) con una media de 6,38 (DE 1,45) que los hombres (48,5%), con una media de 6 (DE 1,72). Sin embargo, la diferencia entre hombres y mujeres no fue estadísticamente significativa. El patrón individualizado de las rugas palatinas es una herramienta de guía confiable para la identificación forense.

**PALABRAS CLAVE:** Antropología forense; Rugoscopia palatina; Identificación humana; Morfología.

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