

ABSTRACT

Palatoscopy is the study of palatal rugae patterns, that have sufficient characteristics to discriminate between individuals, and allows human identification even in extreme circumstances. The aim of the study was to determine the relationship between palatoscopy and lip shape characteristics among Ibolo ethnic group in Kwara and Osun state. 500 Ibolo individuals (250 males and 250 females) of age group 18-65 years in kwara and osun state were studied. A randomized unbiased simple sampling technique was employed for the purpose of this study.

The Statistical Package for Social Sciences (IBM. version 23, Armonk, New York, USA) was used to determine group differences. Using Chi-square Automatic Interaction Detector (CHAID), a model of the relationship between the predominant rugae types and the predominant lip shape patterns were described. Differences were declared significant when $P \leq 0.05$ and correlation exist when $P \leq 0.001$. From the results, there was a relationship between the rugae pattern of the right anterior palate and the lip shape type and that the lip shape types do not explain the distribution of rugae pattern at the Right posterior palate , left anterior palate , left posterior palate , i.e the Right anterior palate can be used to predict the lip print type in both males and females. In conclusion, sex differences, lip shape types and palatal rugae patterns can be predicted from checking specific segments in the lip shapes and palatal rugae, therefore with other diagnostic tools, it can be useful in forensic investigation.

Keywords: Palatoscopy, lip shape type, sex, rugae.

INTRODUCTION

Palatoscopy is the name given to the study of palatal rugae in order to establish a person's identity. Palatal rugae have been shown to be highly individual and consistent in shape throughout the life. It is well-established fact that the palatal rugae pattern is unique to human, as his fingerprints ([Hemanth et al., 2010](#)).

The appearance of palatal rugae is constant, as they do not demonstrate changes after the completion of growth of the individual. The mouth is important in the process of human identification in criminal investigations as it enables fast and secure processes with the multitude of possibilities it presents. The lips, teeth, and the hard palate, are known to have features that have led to personal identification ([Paliwal et al., 2010](#)).

Palatal rugae also referred to as plicae palatine transversae or rugae palatine are asymmetrical and irregular elevations of the mucosa located in the anterior third of the palate, made from the lateral membrane of the incisive papilla arranged in transverse direction from palatine raphe located in the mid-sagittal plane ([Hermosilla et al., 2009](#)).

These formations have been used in medicolegal identification processes because of the stability of their individual morphological characteristics over time ([Hermosilla et al., 2009](#)).

Palatoscopy or palatal rugoscopy: is the study of palatal rugae in order to establish a person's identity. Anatomically, the rugae consist of about 3 to 7 rigid and oblique ridges. The rugae facilitate food transportation, participate in chewing and contribute to the perception of taste due to the presence of gustatory and tactile receptors ([Bullar et al., 2011](#)).

Palatoscopy is an unusual and uncommon technique in individual identification applied in situations in which there are limitations to other techniques used for personal identification in forensic science such as the use of fingerprints due to mutilated hands ([Nayak et al., 2007](#)).

Palatal rugae also resists decomposition changes for up to seven days after death.

Palatoscopy data is obtainable as ante-mortem data from records found in dental practice in different forms such as dental casts and photographs. Palatoscopy might not be so useful in crime scene investigations in the linking of suspects to crime scenes as well as the possibility of rugae pattern forgery which could lead to misleading ante-mortem data but allows for human identification in extreme circumstances (Patil *et al.*, 2008).

Lips, are soft pliable anatomical structures that form the [mouth](#) margin of most vertebrates, composed of a surface epidermis (skin), [connective tissue](#), and (in typical mammals) a muscle layer. The lips are an essential component of the symmetry and aesthetics of the face (Kar *et al.*, 2018). Anthropometric studies have shown that wider and fuller lips in relation to facial width as well as greater vermilion height contribute to defining female attractiveness (Farkas *et al.*, 1987).

In virtually all females since the beginning of recorded history, full lips have been associated with youth, beauty and voluptuousness. Robust, pouty lips are considered to be sexually attractive by both males and females (Sarnoff *et al.*, 2012).

Certain ethnic groups, especially Blacks, genetically have greater lip volume. Because the increased melanin in their skin is protective throughout their lifetimes, the skin of Blacks is less prone to solar elastosis. Consequently, they rarely develop radial rhytides in the lips and their vermilion tends to retain its volume even subsequent to aging (Sarnoff *et al.*, 2012).

Lips allow us to chew and swallow with our mouth closed; to hold onto things like nails and clothes pegs, and to suckle at the breast. But even more importantly, our lips are used in communication. They allow us to smile, to bare our teeth and to kiss. Lips are an important aesthetic unit in the lower face and the window of such diverse emotions as joy, sadness, and anger. A face looks appealing or off-putting depending on the shape of the mouth corners.

Typically, lips with slightly upturned corners look friendly and warm to others while downturned corners look depressed and angry (Ackerman *et al.*, 1998).

MATERIAL AND METHOD

MATERIALS

1. A Digital Camera (SONY)

Focal length: 26-130mm and a infinix rear camera with 13-mega-pixel (f/1,8)

2. Magnifying glass

3. Pencil

4. Hand gloves

5. Laboratory Coat

6. Nose mask

7. Questionnaires and Consent form

STUDY POPULATION

The study was conducted in 5 different local governments among Ibolu ethnic group in Kwara and Osun state for a period of three weeks. kwara state is located in west-central, Nigeria and Osun state is located in southwestern Nigeria. According to 2006 national population census, kwara state population was 2,365,353 and osun state population was 3,416,959 (National Population Commission, 2006). The sum of the L.G.A Population considered using Odo Otin, Ejigbo, Ikirun, Ijagbo, Offa was 562,670 (Census, 2006). Age group percentage (18 – 65) = $19.8+15.5+12.8+3.9+2.4= 54.4$ (Census, 2007).

SAMPLE SIZE

Sample size was determined using Fishers formulae (Fisher, 1935).

$$S = \frac{Z^2 \times P \times Q}{D^2}$$

Where S = Sample size

$$Z=1.96(\text{constant})$$

$$D=\text{Tolerance level} = 0.05$$

$$Q= 1 - P$$

CONSIDERED POPULATION = 562,670

$$P = \frac{\text{AGE GROUP X CONSIDERED POPULATION}}{100}$$

$$= \frac{54.4 \times 562,670}{100} = 306,092.48$$

$$100$$

$$P = \frac{306,092.48}{562,670} = 0.62$$

$$562,670$$

$$P= 0.544$$

$$\text{Therefore; } Q = 1 - P = 1 - 0.544$$

$$= 0.46$$

Substituting values into the fischer's formula;

$$\text{Sample Size} = \frac{(1.96)^2 \times 0.544 \times 0.46}{(0.05)^2}$$

$$= \frac{3.8416 \times 0.544 \times 0.46}{0.0025}$$

$$= \frac{0.961321984}{0.0025} = 384.52879$$

$$= \frac{0.961321984}{0.0025} = 384.52879$$

$$= 422.98 \approx 423.$$

Attrition Rate = 384.52879+ 10% of 384.52879

$$= 384.52879 + 38.453$$

$$= 422.98 \approx 423.$$

Approximately 500

Sample size is 500.

423 being the minimum sample size permitted, sample size of choice was 500.

A sample size of five hundred was obtained from the population of individuals above the age of 18 within the kwara state and osun state metropolis. The sample size is composed of 250 males and 250 females.

Inclusion Criteria:

All subjects had to be indigenes of Ibolu ethnic group, from both parents up to the second generation. All subjects had to be between the ages of 18 and 65years. All subjects were confirmed to be healthy and free from any deformity, congenital anomaly of the lips, lip piercing and inflammation of the lips.

Ethical Approval

Ethical clearance was sorted and obtained from the Department of Anatomy, Ethical Review Committee of the University of Ilorin, Ilorin.

SAMPLING TECHNIQUE:

Informed consent was obtained from study cohorts who met the inclusion criteria, after which a structured questionnaire was administered. Literate subjects were asked to fill the required information while subjects who could not write were assisted.

The following procedures were then followed to obtain their palatal rugae;

- The subjects were asked to sit down on a chair upright, with their heads tilted upwards
- Their mouths opened-wide to get a clear picture of the hard palate.
- The palatal rugae of volunteers were photographed intraorally while they were seated.
- Identification of palatal rugae pattern was based on classification by Trobo (1932).

The following procedures were then followed to obtain their palatal Lip shape:

- The volunteers were asked to sit upright on a chair
- The lip shapes of volunteers were photographed while they were seated, with their mouths closed and in neutral position.
- Identification of lip shapes was based on classification by (Jeong *et al.*, 2020).

Photographs of all these 500 individuals were taken using an infinix rear camera with 13-megapixel (f/1,8) and a digital camera (SONY) Focal length: 26-130mm to standardize all the photographs.

Figure 1; shows the Photograph of palatal rugae taken during field work

PALATAL RUGAE DATA ANALYSIS: Analysis commenced by dividing the palatal rugae picture into compartments as follows, Right Anterior Quadrant (RAQ), Right Posterior Quadrant (RPQ), Left Anterior Quadrant (LAQ), Left Posterior Quadrant (LPQ) (Trobo, 1932 classification).

Figure 2; shows photography of lip shape taken during field work.

Table 1: Shows Trobo, 1932 classification.

ANALYSIS OF LIP SHAPE PATTERNS

For the analysis of the lip shapes, a horizontal line was drawn on the picture with a sharp pencil and a line was drawn from the left lip edge (cheilion) to the right lip edge. The classification will be based on the position of the stomion on the horizontal line.

Figure 3: shows the labeling of the lip shape.

Using (Jeong *et al.*, 2020) classification:

Figure 4: shows the classification of mouth corners.

- A mouth corner was classified as **TYPE I**, if the stomion was located above an imaginary line connecting the oral commissure in either side.

- A Mouth corner was classified as **TYPE II**, if it was located on or below the line.

Subtype “a” if the lower margin of the upper lip continuing to the oral commissure was upturned around a one-quarter point laterally in the upper lip lateral, and subtype “b” if it was flat or downturned around the point

THAT IS:

A- type Ia. B- type Ib.

C- type IIa. D- type IIb.

STATISTICAL ANALYSIS

The analysis of the data were presented in tables and graphs, and the variables were in categorical forms, presented as frequency (percentages). Using Chi-square Automatic Interaction Detector (CHAID), a model of the relationship between the predominant rugae types and the predominant lip shape patterns were described. Statistical significance was considered when ($P=0.05$ or $P\leq 0.05$).

RESULTS

The distribution of the palatal patterns and test of sex-associated differences for the right anterior is presented in Table 2, right posterior in Table 3, left anterior in Table 4, and left posterior in Table 5. The distribution of the lip shapes type patterns and test of sex-associated differences is presented in Tables 6

Distribution of palatal rugae patterns and test of sex-associated differences

Table 1: Shows the distribution of rugae pattern on the right anterior palate and test of association. The result in table 1 shows an association between sex and the distribution ($P<0.001$)

In table 2, using the Trobo (1932), right-anterior segment shows the predominance of type E pattern in the males volunteers (30.4%) and predominance of type B in the female volunteers (31.6%) as shown in figure 5 and 6 respectively. The test of association between right-anterior segment and sex was significant ($X^2 = 32.440$, $P = <0.001$)

Table 3: shows the distribution of rugae pattern on the right posterior palate and test of association. The result in table 3 shows an association between sex and the distribution (P=0.014).

In table 3, the right-posterior segment shows a type E predominance in both male and female subjects (52.4%) and (51.6%) as shown in figure 7 and 8 respectively, with no exhibition of type F pattern in the male volunteers where there is (0.4%) exhibition in the female volunteers. The test of association between right-posterior segment and sex was significant ($X^2 = 15.952$, $P = 0.014$).

Table 4: shows the distribution of rugae pattern on the left anterior palate and test of association.

The result in table 4 shows an association between sex and the distribution ($P < 0.001$).

In table 4, left-anterior segment shows the predominance of type E pattern in the male volunteers (34.0%) and type D pattern in the female volunteers (32.0%) as shown in figure 9 and 10 respectively. The test of association between right-anterior segment and sex was significant ($X^2 = 74.413$, $P = < 0.001$).

Table 5: shows the distribution of rugae pattern on the left posterior palate and test of association. The result in table 5 shows an association between sex and the distribution ($P < 0.019$).

In table 5, The left-posterior segment shows a type E predominance in both male and female volunteers with (62.0%) and (53.6%) as shown in figure 11 and 12 respectively. with no exhibition of type F pattern in both the male and female volunteers (0%). The test of association between right-anterior segment and sex was significant ($X^2 = 13.506$, $P < 0.019$).

DISTRIBUTION OF LIP SHAPE PATTERNS AND TEST OF SEX-ASSOCIATED DIFFERENCES

Table 6: shows the distribution of the combination of lip shape types and test of association Significant association between sex and the distribution of the combination of lip shape types (P=0.001).

In table 6, both male and female volunteers show the predominance of Type IIb (75.2%) and (76.4) pattern as shown in figure 13 and 14 respectively. The test of association between sex and the distribution of the combination of lip shape types ($X^2 = 15.716$, $P = <0.001$).

In figure 15 there is a relationship between palatal pattern of RAP and lip type. Type II a & b lip patterns were significantly associated with ruggae pattern Type B, Node 1 [Type IIb, and IIa, (29.4%)] while Type I a & b patterns; Node 2 [Type Ib , and Ia (23.2%)] seems to be associated with the ruggae pattern Type Bs ($X^2=18.559$; $P=0.035$).

In figure 16 there is no significant relationship

In figure 17 there is no significant relationship

In figure 18 there is no significant relationship.

SUMMARY OF ANALYSIS

It can be concluded that there is a relationship between palatal rugae of the right anterior palate (RAP) and the lip shape type and that the lip shape do not explain the distribution of rugae pattern at the Right posterior palate (RPP), left anterior palate (LAP), left posterior palate (LPP).

5.1 DISCUSSION

Palatoscopy is the study of palatal rugae which are asymmetrical irregular elevations of the mucosa made from lateral membrane of the incisive papilla, located in the anterior third of the hard palate (Paliwal *et al.*, 2010). When recognition of an individual is convoluted by other forensic methods, palatal rugae are considered as an alternative source because they are specific to racial groups (Nayak *et al.*, 2007).

Lip shape identification is a forensic investigation technique that deals with identification of humans based on lips traces. Anthropometric studies have shown that wider and fuller lips in relation to facial width as well as greater vermilion height contribute to defining female attractiveness (Farkas *et al.*, 1987).

PALATAL RUGAE PATTERN IN RELATION TO SEX

In this study a low degree of sexual dimorphism was noticed, this could be due to an evolutionary change or genetic and environmental factors. Males had more Type E rugae pattern, while females had more of Type B in the RAQ and then Type E in the RPQ, and LPQ, and Type D in the LAQ, while Type F, Type A, and Type C rugae patterns were the least seen in contention with [\(Sheikhi *et al.*, 2018\)](#) who found that palatal rugae patterns could not differentiate males and females and had low abilities to classify the racial subsets.

Research description pattern

Table 7: shows the research results table for common palatal rugae patterns

Table 8: shows the research results table for common lip shape type

LIP SHAPE TYPE IN RELATION TO SEX

In this study, a low degree of sexual dimorphism was noticed, this could be due to an evolutionary change or genetic and environmental factors. In the present study, Type IIb was the most common lip type pattern seen, and Type IIa and Type Ia patterns were the least seen in males and females respectively. Jeong *et al.*, 2020, used this classification to determine the Mouth Corners of Asian Women and the predominant pattern was Type IIb.

This type of mouth to mouth classification developed by Jeong *et al.*, 2020, has not been used to determine sex earlier until now.

RELATION BETWEEN PALATAL RUGAE AND LIP SHAPE.

This study indicates that there is significant correlation of palatoscopy with lip print and they can also be utilized as personal identification marker in forensic odontology. It has been observed that there are differences in the lip shape pattern as well as rugae pattern within the same population. Hence, it may be necessary to determine specific values for a specified population to make identification easier for measuring dental records (Saraf *et al.*, 2011).

This present study showed a correlation between lip print pattern and palatal rugae pattern in both sexes.

CONCLUSION

Identification of living or dead people is often a difficult, challenging and time-consuming process. Palatal rugae have been shown to be highly individualistic and consistent in shape throughout the life. It is well-established fact that the palatal rugae pattern is unique to human being, as his fingerprints, thus its use in forensic identification is fairly justified. Hence the palatal rugae can be used as a reliable tool in forensic

identification of humans. In cases of dead, damaged and mutilated bodies, the gender determination is of prime importance for any medicolegal examination. The lips are an essential component of the symmetry and aesthetics of the face, also the lip shape used is clinically useful in lip classification system for mouth corners, which is expected to help facilitate patient counseling and communication between medical staff in lip plastic surgery

In this present study, low degree of sexual dimorphism existed and there is a significant correlation between palatoscopy and lip shape which only occurred on the Right Anterior Quadrant while the Right Posterior Quadrant, Left Anterior Quadrant and Left Posterior Quadrant had no significance.

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COMPETING INTEREST:

There was no conflict of interest declared by any party and the research was fully funded by the researchers.

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