**Morphology and Morphometry of the Dorsal Aspect of the Tongue in Urhobo and Ukwani Ethnic Groups in Delta State Nigeria**

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**ABSTRACT**

**Background:**  The tongue is useful in forensic identification due to its unique features which indicate population, racial and ethnic differences. This study examined the morphology and morphometry of the tongue in two ethnic groups in Delta State Nigeria.

**Materials and Methods:** The study was conducted in Delta State Nigeria following ethical approval. Subjects from the Urhobo (200) and Ukwani (200) ethnic groups aged between 11-80 years were selected using non-random convenience sampling technique and their informed consent was obtained. The tongue was cleaned and protruded for inspection with subsequent exclusion of tongues with visible pathology. The dorsal surface of the tongue was photographed and the images used to evaluate the dorsal morphological features. The tongue’s length and width were measured using AutoCAD 2010. Statistical Package for Social Sciences version 23 was used to analyze the data. Chi-Square test was used to probe for the association between the tongue morphological features with gender, tribe and age. Independent t-test was used to ascertain ethnic and gender differences in the tongue dimensions while analysis of variance was used to determine the relationship between the dimensions and age-groups. P-value was considered significant at <0.05.

**Results:** The morphological features of the tongue showed significant association with age, gender and tribe (p<0.05). The dimensions of the tongue showed a significant association with gender and tribe while a significant relationship with age was observed in the length (p<0.05).

**Conclusion**: The tongue’s morphological features and dimensions were highly variable and showed significant association with gender, age and tribe. The accuracy of using tongue features in forensic investigations should be further investigated.

**Keywords:** Tongue, morphology, dimensions, sexual dimorphism

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**INTRODUCTION**

The tongue is located within the oral cavity and is bordered superiorly by the palate, inferiorly by the floor of the mouth and laterally by the mandibular teeth. Its anterior and posterior boundaries are the lips and the pharynx respectively.1,2 The anterior end of the tongue forms the tip while the posterior third forms its base. The root of the tongue is attached to the floor of the mouth. The tongue has two lateral margins and two surfaces; dorsal and ventral. 2,3 The smooth ventral surface is inferiorly located and attached to the floor of the oral cavity by the lingual frenulum. The dorsal surface is lined by stratified squamous non-keratinized epithelium characterized by fissures, crypts and papillae which house the taste buds which perceive taste. 4,5 The filiform papillae lack the taste buds and are large in number with high keratinization hence offer mechanical abrasion. Circumvallate papillae are arranged in an inverted V, posterior to the sulcus terminalis. The fungiform and foliate papillae are on the lateral borders of the tongue.4

The tongue is also used for articulation of speech, and formation of food bolus in preparation for swallowing. 4,5 This is made possible by its large skeletal muscle composition. It is made up of four intrinsic muscles (superior longitudinal, inferior longitudinal, vertical and transverse muscles) which are not attached to the bone. These muscles change the shape of the tongue.3,4 It also has four paired extrinsic muscles namely; genioglossus, hyoglossus, palatoglossus and styloglossus muscles that are attached onto the bone. These extrinsic muscles cause movements such as protraction, retraction and side to side movements which change the position of the tongue.3-5 The shape, size, colour, texture, dimensions and margins of the tongue have shown population, racial and ethnic differences. 4,5 These morphological parameters make the tongue a mirror of oral health and general health of an individual. 5,7

Forensic odontology is a branch of forensic science that deals with the identification of individuals by recognizing the unique features of the oral structures for legal purposes. 6,7 Forensic odontology assumes that no two mouths are alike. 2 The tongue is useful in forensic identification due to its unique dorsal features, easy accessibility and resistance to decomposition and carbonation due to its location in a moisturized closed cavity. 5 Its internal location offers it protection from forgery hence provides important information during postmortem evaluation. 2 Studies on the morphological evaluation and measurements of the tongue have not been documented in Delta State, Nigeria. This study aimed at assessing the morphology and morphometry of the tongue in two ethnic groups of Delta State, Nigeria.

## MATERIALS AND METHODS

This descriptive cross-sectional study was carried out in Ethiope east local government, Delta state, South Southern Nigeria. We adopted a time-bound sample size using the non-probability convenient sampling technique. Four hundred (400) participants aged between 11-80 years, with equal distribution from the Urhobo (200) and Ukwani (200) ethnic communities were enrolled in this study. Each ethnic group included 100 males and 100 females. Only apparently healthy subjects from both genders were included while subjects with contagious diseases (cough, running nose) and systemic diseases such as hypertension, diabetes, hyperthyroidism, gigantism, dwarfism, syphilis and Down’s syndrome were excluded from the study. Those with partial or complete edentulism, obvious acquired or developmental tongue lesions such as ankyglossia, ulcers or thrush and evidence of tongue surgery or trauma were also excluded. Likewise, subjects with smoking habits and tobacco chewing were not included in this study. Prior to obtaining history and collecting relevant data, verbal informed consent was obtained from the participants. This study was conducted in accordance with the ethical principles for medical research involving humans as provided by the Helsinki Declaration of 1975, and revised by the World Medical Association in 2001. 8 Additionally, ethical approval was obtained from the Ethics and Research Committee of the Faculty of Basic Medical Sciences, Delta State University, Abraka, Nigeria (Ref. No. DELSU/CHS/ANA/2021/72, Date; 23rd July, 2021).

## The tongue was examined clinically then cleaned with sterile gauze. The oral cavity was rinsed thoroughly with water to remove debris and food particles. While seated, the subjects were asked to protrude the tongue in a relaxed position in order to avoid marked contraction of striated lingual muscles which may alter the morphological parameters such as shape 9-11. The dorsal surface of the tongue was inspected and photographs were taken using a digital camera (Canon 700D/60D, 18 megapixel) under standard environmental and lighting conditions. These photographs were taken from a frontal view with a predetermined distance between the camera and the tongue that gives clear pictures, without compromising the quality and clarity of the images. 9 The photographs only captured the face region below the nose, hence, the identity of the subjects was concealed.

## The images acquired during the study were analyzed by two independent observers who evaluated; texture, size, surface, apical shape, borders, median septum and fissure. The length and width of the tongue were measured using AutoCAD Version 21; Ontario, Canada. The width was measured as a horizontal distance between the points where the tongue contacts the commissures of the lips bilaterally. From this horizontal line measuring the width, a perpendicular line to the tip of the tongue was measured as the length. (Fig. 1). 3



## Figure 1. Measurement of the tongue dimensions: A. Length (L) Width (W)

## Inter-observer concordance test was carried out to substantiate the reproducibility of the measurements. Using 50 tongue photographs, two observers independently measured the length and width of the tongues to test the inter-observer agreement. Data were analyzed using the Statistical Package for Social Sciences (SPSS) Version 23; IBM® Armonk, New York, USA and summarized in frequencies, means, standard deviations. Chi-Square test was used to probe for association between tongue morphological features with gender, tribe and age-groups. Independent t-test was used to assess the gender and tribe differences in the tongue dimensions while one-way Analysis of Variance (ANOVA) was used to determine the relationship between the dimensions and the age-groups. Statistical significance was considered at P<0.05.

## MATERIALS AND METHODS

The mean age of the 400 participants was 23.20± 7.31 years (Range 11-80 years). Majority were aged 20-30 years (271, 67.8%) followed by 11-20 years (114, 28.5%). The remaining subjects were aged 31-40 years (2, 0.5%), 41-50 years (8,2%) and 71-80 years (5, 1.25%). The inter-observer concordance test revealed no significant differences between the measurements carried out by the two investigators (length; r=0.532, p=0.294 and width; r=0.527, p=0.301).

## In the general studied population, the V-shaped lingual apex was the most prevalent (182, 45.5%) followed by the U-shape (119, 29.8%) and lastly bifid tongue (99, 24.8%). The U shape was predominantly in females (37.5%) while the V shape was common in males (49.5%) (Fig. 2 A-C).



**Figure 2.** Shape of the tongue: A. Bifid B. V-shaped C. U-shaped.

We observed partially scalloped border of the tongue in 152 out of all the 400 subjects (38.0%). This was followed by the smooth (145, 36.3%) and scalloped (103, 25.8%) borders (Table 1) (Fig. 3 A-C).



**Figure 3**. Lateral borders of the tongue: A. Smooth B. Partially Scalloped C. Scalloped.

Pale pink was the predominant tongue colour (147, 36.8%) followed by the whitish (127, 32.0%), reddish pink (109, 27.3%) and lastly, yellowish pink (17,4.0%). We report a slightly equal proportion of rough (201, 50.2%) and smooth texture (199,49.8%) of the dorsum tongue. The median septum was visible in 187 subjects (46.8%) and non-visible in 213 (53.3%) subjects (Table 1).

The absence of fissures was observed in 175 subjects (43.8%). The prevalence of vertical, multiple vertical and central fissures was 34.3% (137), 20.3% (81) and 1.8% (7) correspondingly. A larger proportion of the subjects (235, 58.5%) had large and broad tongue size while the remaining 165, 41.3% had short and broad tongues. The large and broad tongues were predominant in the male gender (61%) while the females predominantly had the short and broad type (48.5%). Majority of the Urhobos (68%) had a large and broad tongue while the short and broad type was more prevalent among the Ukwanis (50.5%). The prevalence of the geographical and scrotal tongue in the studied population was 47, 11.8% and 21,5.3% respectively (Table 1) (Fig.4 A and B).



**Figure 4**. Type of tongue surface: A. Geographical B. Scrotal

Significant gender differences were observed in the apical shape, colour, texture, surface, visibility of the median septum, and type of fissure in the studied population (P <0.05) (Table 1).

**Table 1.** Observed tongue features in the studied population and their association with gender.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Tongue features** | **Classification of features** | **Overall** | **Female (%)** | **Male (%)** | **P-value** |
| **Apical Shape**  |  Bifid | 99 (24.8) | 42 (21.0) | 57 (23.5) | 0.003\* |
|  | U-shaped | 119 (29.8) | 75 (37.5) | 44 (22.0) |
|  | V-shaped | 182(45.5) | 83 (41.5) | 99 (49.5) |
| **Borders**  | Partially Scalloped | 152 (38.0) | 74 (37.0) | 78 (39.0) | 0.866 |
|  | Scalloped | 103 (25.8) | 51 (25.5) | 52 (26.0) |
|  | Smooth | 145 (36.3) | 75 (37.5) | 70 (35.0) |
| **Colour**  | Pale pink | 147 (36.8) | 79 (39.5) | 68 (34.0) | 0.001\* |
|  | Reddish pink | 109 (27.3) | 51 (25.5) | 58 (29.0) |
|  | Whitish | 127 (32.0) | 69 (34.5) | 58 (29.0) |
|  | Yellowish pink |  17 (4.0) | 1(0.1) | 16(8.0) |
| **Texture**  | Rough | 201 (50.2) | 120 (60.0) | 81 (40.5) | 0.001\* |
|  | Smooth | 199 (49.8) | 80 (40.0) | 119 (59.5) |
| **Median septum** | Non visibility | 213 (53.3) | 123 (61.5) | 90 (45.0) | 0.001\* |
|  | Visible | 187 (46.8) | 77 (38.5) | 110 (55.0) |
| **Type of fissure** | Absent | 175 (43.8) | 93 (46.5) | 82 (41.0) | 0.049\* |
|  | Central | 7 (1.8) | 6 (3.0) | 1 (0.5) |
|  | Multiple vertical | 81 (20.3) | 32 (16.0) | 49 (24.5) |
|  | Vertical | 137 (34.3) | 69 (34.5) | 68 (34.0) |
| **Size**  | Large and Broad | 235 (58.8) | 113 (51.5) | 122 (61.0) | 0.361 |
|  | Short and Broad | 165 (41.3) | 87 (48.5) | 78 (39.0) |
| **Surface** | Geographical | 47 (11.8) | 37 (17.5) | 10 (5.0) | 0.001\* |
|  | None | 332 (83.0) | 160 (80.0) | 172 (86.0) |
|  | Scrotal | 21 (5.3) | 3 (1.5) | 18 (9.0) |
|  | **Total** | **400 (100.0)** | **200 (100.0)** | **200 (100.0)** |  |

**\*P value significant at <0.05**

Among the Urhobos, only the texture, size, surface and visibility of the median septum showed a significant association with gender (Table 2). On the other hand, among the Ukwanis, this association was observed in all morphological parameters except the border and visibility of the median septum (Table 3).

**Table 2:** Association between gender and observed tongue features among Urhobos

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tongue features** | **Classification**  | **Female (%)** | **Male (%)** | ***P* value** |
| **Apical Shape**  | Bifid | 17(17.0) | 11(11.0) | 0.098 |
|  | U-shaped | 39(39.0) | 30(30.0) |
|  | V-shaped | 44(44.0) | 59(59.0) |
| **Borders**  | Partially Scalloped | 50(50.0) | 46(46.0) | 0.847 |
|  | Scalloped | 18(18.0) | 20(20.0) |
|  | Smooth | 32(32.0) | 34(34.0) |
| **Colour**  | Pale pink | 42(42.0) | 40(40.0) | 0.317 |
|  | Reddish pink | 23(23.0) | 32(32.0) |
|  | Whitish | 35(35.0) | 28(28.0) |
| **Texture**  | Rough | 58(58.0) | 33(33.0) | 0.001\* |
|  | Smooth | 42(42.0) | 67(67.0) |
| **Median septum** | Non visibility | 59(59.0) | 38(38.0) | 0.003\* |
|  | Visible | 41(41.0) | 62(62.0) |
| **Type of fissure** | Absent | 33(33.0) | 30(30.0) | 0.809 |
|  | Central | 2(2.0) | 1(1.0) |
|  | Multiple vertical | 23(23.0) | 21(21.0) |
|  | Vertical | 42(42.0) | 48(48.0) |
| **Size**  | Large and Broad | 59(59.0) | 40(40.0) | 0.007\* |
|  | Short and Broad | 41(41.0) | 60(60.0) |
| **Surface** | Geographical | 24(24.0) | 10(10.0) | 0.031\* |
|  | None | 73(73.0) | 86(86.0) |
|  | Scrotal | 3(3.0) | 4(4.0) |
|  | **Total** | **100(100.0)** | **100(100.0)** |  |

**\*P value significant at <0.05**

**Table 3:** Association between gender and observed tongue features among Ukwanis.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tongue features** | **Classification**  | **Female (%)** | **Male (%)** | ***P* value** |
| **Apical Shape**  |  Bifid | 25(25.0) | 46(46.0) | 0.001\* |
|  | U-shaped | 36(36.0) | 14(14.0) |
|  | V-shaped | 39(39.0) | 40(40.0) |
| **Borders**  | Partially Scalloped | 24(24.0) | 32(32.0) | 0.411 |
|  | Scalloped | 33(33.0) | 32(32.0) |
|  | Smooth | 43(43.0) | 36(36.0) |
| **Colour**  | Pale pink | 37(37.0) | 28(28.0) | 0.001\* |
|  | Reddish pink | 28(28.0) | 26(26.0) |
|  | Whitish | 34(34.0) | 30(30.0) |
|  | Yellowish pink | 1(1.0) | 16(16.0) |
| **Texture**  | Rough | 62(62.0) | 48(48.0) | 0.047\* |
|  | Smooth | 38(38.0) | 52(52.0) |
| **Median septum** | Non visibility | 64(64.0) | 52(52.0) | 0.086 |
|  | Visible | 36(36.0) | 48(48.0) |
| **Type of fissure** | Absent | 60(60.0) | 52(52.0) | 0.002\* |
|  | Central | 4(4.0) | - |
|  | Multiple vertical | 9(9.0) | 28(28.0) |
|  | Vertical | 27(27.0) | 20(20.0) |
| **Size of tongue** | Large and Broad | 54(54.0) | 82(82.0) | 0.001\* |
|  | Short and Broad | 46(46.0) | 18(18.0) |
| **Surface** | Geographical | 13(13.0) | - | 0.001\* |
|  | None | 87(87.0) | 86(86.0) |
|  | Scrotal | - | 14(14.0) |
|  | **Total** | **100(100.0)** | **100(100.0)** |  |

**\*P value significant at <0.05**

All the morphological parameters of the tongue showed a significant association with age (P <0.05) (Table 4). Similarly, significant ethnic differences were observed in the size, apical shape, colour, surface, borders, and type of fissures (P <0.05) (Table 5).

**Table 4:** Association between age-groups and observed tongue features.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Tongue features** | **Classification**  | **11-20 yrs****(%)** | **21-30 yrs (%)** | **31-40 yrs (%)** | **41-50 yrs (%)** | **71-80 yrs (%)** | ***P* value** |
| **Apical Shape**  |  Bifid | 19 (16.7) | 80 (29.5) | - | - | - | 0.001\* |
|  | U-shaped | 30 (26.3) | 79 (29.2) | - | 5(62.5) | 5(100.0) |
|  | V-shaped | 65 (57.0) | 112 (41.3) | 2 (100.0) | 3 (37.5) | - |
| **Borders**  | Partially Scalloped | 48 (42.1) | 89 (32.8) | 2 (100.0) | 8 (100.0) | 5 (100.0) | 0.001\* |
|  | Scalloped | 32 (28.1) | 71 (26.2) | - | - | - |
|  | Smooth | 34 (29.8) | 111 (41.0) | - | - | - |
| **Colour**  | Pale pink | 49 (43.0) | 90 (33.2) | - | 3(37.5) | 5 (100.0) | 0.002\* |
|  | Reddish pink | 32 (28.1) | 70 (25.8) | 2(100.0) | 5 (62.5) | - |
|  | Whitish | 33 (28.9) | 95 (35.1) | - | - | - |
|  | Yellowish pink | - | 16 (5.9) | - | - | - |
| **Texture**  | Rough | 75 (65.8) | 126 (46.5) | - | - | - | 0.001\* |
|  | Smooth | 39 (34.2) | 145 (53.5) | 2(100.0) | 8 (100.0) | 5 (100.0) |
| **Median septum** | Non visibility | 71 (62.3) | 135 (49.8) | 2(100.0)  | 5 (62.5) | - | 0.013\* |
|  | Visible | 43 (37.7) | 136 (50.2) | - | 3 (37.5) | 5 (100.0) |
| **Type of fissure** | Absence | 50 (43.9) | 123 (45.4) | 2 (100.0) | - | - | 0.001\* |
|  | Central | 7 (6.1) | - | - | - | - |
|  | Multiple vertical | 13 (11.4) | 68 (25.1) | - | - | - |
|  | Vertical | 44 (38.6) | 80 (29.5) | - | 8 (100.0) | 5 (100.0) |
| **Size**  | Large and Broad | 53 (46.5) | 167 (61.6) | 2(100.0) | 8(100.0) | 5 (100.0) | 0.001\* |
|  | Short and Broad | 61 (53.5) | 104 (38.4) | - | - | - |
| **Surface** | Geographical | 32 (28.1) | 15 (5.5) | - | - | - | 0.001\* |
|  | None | 82 (71.9) | 235 (86.7) | 2(100.0) | 8 (100.0) | 5 (100.0) |
|  | Scrotal | - | 21 (7.7) | - | - | - |
|  | **Total** | **114(100.0)** | **271(100.0)** | **2(100.0)** | **8 (100.0)** | **5(100.0)** |  |

**\*P value significant at <0.05**

The mean width of the tongue in the general study sample measured 4.801±1.88 cm while the average length was 5.807±1.88 cm (Table 6). Both dimensions showed a significant association with gender (larger in females than males) and tribe (larger in Urhobos than Ukwanis) (P <0.05) (Table 6). The length of the tongue showed a significant association with age (P =0.003) (Table 7).

**Table 5:** Association between tribe and observed tongue features

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tongue features** | **Classification**  | **Ukwani (%)** | **Urhobo (%)** | ***P* value** |
| **Apical Shape**  |  Bifid | 71(35.5) | 28 (14.0) | 0.001\* |
|  | U-shaped | 50 (25.0) | 69 (34.5) |
|  | V-shaped | 79 (39.5) | 103 (51.5) |
| **Borders**  | Partially Scalloped | 56 (28.0) | 96 (48.0) | 0.001\* |
|  | Scalloped | 65 (32.5) | 38 (19.0) |
|  | Smooth | 79 (39.5) | 66 (33.0) |
| **Colour**  | Pale pink | 65 (32.5) | 82 (41.0) | 0.001\* |
|  | Reddish pink | 54 (27.0) | 55 (22.5) |
|  | Whitish | 65 (32.5) | 62 (31.0) |
|  | Yellowish pink | 16 (8.0) | 1(0.5) |
| **Texture**  | Rough | 110 (55.0) | 91 (45.5) | 0.057 |
|  | Smooth | 90 (45.0) | 109 (54.5) |
| **Median septum** | Non visibility | 116 (58.0) | 97 (48.5) | 0.057 |
|  | Visible | 84 (42.0) | 103 (51.5) |
| **Type of fissure** | Absence | 112 (56.0) | 63 (31.5) | 0.001\* |
|  | Central | 4 (2.0) | 3 (1.5) |
|  | Multiple vertical | 37 (18.5) | 44 (22.0) |
|  | Vertical | 47 (23.5) | 90 (45.0) |
| **Size**  | Large and Broad | 136 (68.0) | 99 (49.5) | 0.001\* |
|  | Short and Broad | 64 (32.0) | 101 (50.5) |
| **Surface** | Geographical | 13 (6.5) | 34 (17.0) | 0.002\* |
|  | None | 173 (86.5) | 159 (79.5) |
|  | Scrotal | 14 (7.0) | 7 (3.5) |
|  | **Total** | **200 (100.0)** | **200 (100.0)** |  |

**Table 6:** Association between tongue dimensions with gender and tribe.

|  |  |  |  |
| --- | --- | --- | --- |
| **Dimension** |  | **Mean ±SD (cm)** | ***P* value** |
| Gender differences |  |  |
| Width | Female | 5.090 ± 1.95 | 0.002\* |
| Male | 4.513± 1.78 |
| Average | 4.801±1.88 |  |
| Length | Female | 6.101±2.00 | 0.002\* |
| Male | 5.142± 1.71 |
| Average | 5.807±1.88 |  |
| Tribe differences |  |  |
| Width | Ukwani | 4.523±1.93 | 0.003\* |
| Urhobo | 5.080±1.79 |
| Length | Ukwani | 5.581± 2.06 | 0.016\* |
| Urhobo | 6.034±1.67 |

\*P value significant at <0.05 SD- standard deviation

**Table 7**: Association between age and tongue dimensions

|  |  |  |  |
| --- | --- | --- | --- |
| **Anthropometric values** | **Age group (yrs)** | **Mean ±SD (cm)** | ***P* value** |
| Width of the tongue | 11-20 | 4.757±1.92 | 0.228 |
| 21-30  | 4.776±1.90 |
|  | 31-40  | 6.624±0.03 |
|  | 41-50  | 6.013±0.67 |
|  | 71-80 | 4.254±0.42 |
| Length of the tongue | 11-20 | 5.546±1.87 | 0.003\* |
| 21-30  | 5.837±1.89 |
|  | 31-40  | 8.120±0.04 |
|  | 41-50  | 7.925±0.31 |
|  | 71-80 | 5.345±0.42 |

## DISCUSSION

The predominant apical shape of the tongue was the V shape (45.5%) followed by the U shape (29.8%). This contrasted with various Indian studies that documented a preponderance of the U shape followed by the V shape. 2,3,9 Conversely, Venkatesh *et al*. 1 in Malaysia observed the predominance of V (52.9%) and U (54.3%) shapes among the Indians and Malays respectively, although the racial differences were not significant. We observed a female and male preponderance of the U (37.5%) and V (49.5%) shaped tips respectively and this was contrary to other several studies. 3,7,10 Sreepradha *et al*. 10 attributed the sharp V shape lingual tips in females to their smaller mandibles. The prevalence of the bifid tip of the tongue (24.8%) was higher than the findings of Sreepradha *et al*. 10 and Musaad *et al*. 12 The shape of the lingual apex in this study showed significant gender differences in the studied population and among the Ukwanis. This conflicted with the reports by Stefanescu *et al*., 11 Jeddy *et al*., 9 and Sreepradha *et al*. 10 We report significant association between the apical shape of the tongue and age as well as tribe. Conversely, among the Indians, the association with age was not significant. 2

The present study reports a predominance of partially scalloped tongue borders (38%) followed by smooth (36.3%) and scalloped (25.8%) borders. These showed a significant association with age and tribe. Correspondingly, Sreepradha *et al*. 10 did not observe a significant association between the lateral border configuration and gender. However, Vijay *et al*. 5 documented scalloped margins predominantly in males. Scalloping is caused by the movement of the tongue against the teeth, mainly associated with thrusting, bruxism, sleep disorders and cheek sucking. 2 These parafunctional habits are more common in females and they create a negative pressure in the oral cavity causing teeth indentations on the tongue. 10 Scalloping can also occur due to macroglossia caused by nutritional deficiencies, temporomandibular joint disorders, systemic diseases, malocclusion and genetic disorders. 2,10 Awareness of tongue scalloping is important for early referral and diagnosis of the underlying cause that may be detrimental.

The predominant tongue colour in the current study was pale pink (36.8%) followed by white (32%), reddish pink (27.3%)

and yellowish pink (4%). This contrasted with the prevalence of white (80%), pale pink (14%), yellow (5%) and reddish pink (1%) coloured tongues reported by Madhusudan *et al*. 2 The tongue colour showed a significant association with gender in the studied sample and the Ukwanis. Similarly, a significant association with age and tribe was observed. Conversely, Madhusudan *et al*. 2 did not establish any association between colour and age or gender probably due to racial differences. Understanding the normal tongue colours is important since it may change in pathological conditions such as glossitis (red and smooth tongue) in pernicious anemia or iron deficiency anemia and white coating/furred tongue in hypertrophy of the filiform papillae due to hyperkeratosis caused by decreased rate of desquamation. 2

The slightly equal proportions of rough and smooth tongue texture (50.2%,49.8%) contradicted with Madhusudan *et al*. 2 who observed a preponderance of the rough (62%) texture. The texture showed a significant association with gender and age. Likewise, Madhusudan *et al*. 2 documented a significant association with age. The visibility of the median septum in the studied population had a significant association with age. Furthermore, among the Urhobos, the gender differences in the median septum was statistically significant with the males having more prevalent visible median septum (62%) than females (41%). Madhusudan *et al*. 2 similarly documented a preponderance of invisible median septum (58%) but did not establish any association with gender. Conflicting with Vijay *et al*., 5 there was a significantly higher prevalence of large and broad tongue in males and short and broad variant in females. These sizes were significantly predominant in the Urhobos and Ukwanis respectively and showed a significant association with age.

Parallel to Jeddy *et al*., 9 the presence of fissures was common (56.4%) in the studied population herein. The absence of fissures was predominant in females (46.5%) and this was congruent with Jeddy *et al*. 9 and Jayan *et al*. 3 The prevalence of single vertical, and multiple vertical fissures were lower than the findings of Venkatesh *et al*., 1 who also documented very low prevalence of central fissure (1.2%). Conflicting with Jayan *et al*., 3 the central fissures were more common in females. On the other hand, there was a male preponderance of the multiple fissures, conforming with Jeddy *et al*. 9 However, unlike the present study, Jeddy *et al*. 9 observed the single vertical fissure in males only and no significant association between tongue fissures and gender. The present study further observed significant association between the fissure patterns with age and tribe. These variations may be credited to differences in race, methodology, sample size and design of the study. Cognizance of the variant fissure patterns is important since they contribute to tongue prints which may be utilized in forensic identification. 7

The prevalence of the geographical tongue (GT) (11.8%) herein was higher than previous studies in Nigeria (2.1%-8.3%), Romania (0.3%) and Sudan (1.2%) and lower than the prevalence in Libya (17.2%), United Arab Emirates (14%) and Iraq (13.2%). 12-18 Consistent with several studies, this variant had a significant female preponderance in both tribes and was predominant in the 11-20 years’ age group. 6,16,17 However, Fomete *et al*. 14 documented a higher prevalence in males than females. The GT has benign migratory lesions on the dorsal tongue with central erythematous zone of atrophied filiform papillae and white regenerating margins. Its etiology is multifactorial, involving both genetic and environmental factors and commonly associated with allergy, stress, diabetes mellitus and hormonal changes. 15,16 The differences in its prevalence have been attributed to its transient nature, differences in genetics, environmental factors, diet, study design, sample size and type of sample; involving patients, healthy subjects, children, young adults and the elderly. 12,17

The scrotal or fissured tongue (ST) has lobulations and grooves of varying depths comprising a central furrow and multiple branching grooves radiating from it laterally. Its prevalence herein (5.3%) was higher than previous studies in Nigeria (3.2%-3.6%) and Romania (0.7%). 11,13,14 Higher frequencies of 40% was reported by Shayeb *et al*. 18 Consistent with Feil and Filippi,19 we observed a significant male preponderance of the ST (9.0%). This variant was only observed in the 21-30-year age group (7.7%). Feil and Fillipi 19 documented an increasing prevalence of ST with age. This occurs due to hyposalivation, decreased immune response and deoxyribonucleic acid repair. 14 The variation in the ST prevalence may be ascribed to differences in age, race, gender, methodology and diagnostic criteria based on depth or extent. ST is genetically determined and is seen in Down’s syndrome, acromegaly, psoriasis, Sjogren syndrome and Melkerson Rosenthal’s syndrome. 2 Moreover, it has been associated with smoking, diabetes mellitus, candidiasis, vitamin D and zinc deficiency. 18,19 It is usually asymptomatic,nonetheless, deep fissures may habour food residues that cause bacterial or fungal coinfection and halitosis. Subsequent inflammation causes soreness with acidic food and beverages, hence, the need for oral hygiene education. 20

## The mean length (5.81 cm) and width (4.80 cm) of the dorsal tongue surface in this study were larger than the measurements by Jayan *et al*. 3 (4.28 and 3.60 cm respectively). Using photography to evaluate the width of the tongue, Singh *et al*. 21 reported lower values in males and females (2.90 cm, 2.82 cm) compared to our findings (4.51 cm and 5.09cm). The length of the dorsal tongue in the current study was significantly associated with age, while both dimensions were significantly larger in females than males, contrary to Jayan *et al*. 3 and Singh *et al*. 21 These differences could be ascribed to race, sample size and methodology used; Vernier calipers, alginate casts and photography. The use of Vernier calipers is an old method that is more prone to errors. According to Singh *et al*. 21 the use of cast in tongue morphometry is more efficient than

## photography.

## CONCLUSION

## The tongue morphological features and dimensions were highly variable and showed sexual dimorphism besides significant association with age and tribe. The accuracy of using the tongue features in forensic investigations can be further investigated.

## LIMITATION OF STUDY

The morphological evaluation of the tongue was subjective. The dietary habits of the studied sample were not put into consideration.

## FUTURE RESEARCH DIRECTIONS

We recommend further studies in our population using Alginate impression to study the tongue morphological and morphometric features. Additionally, a larger sample size can be used to assess the accuracy and reliability of using the tongue morphological and morphometric parameters in forensic identification.

## REFERENCES

1. Venkatesh BS, Kamath V, Hasbullah NB, Mutalib SN, Nazeri MS, Putera AS, *et al*. Preliminary Study of Tongue Prints for Biometric Authentication. Shiraz E-Med J. 2019; 20: e96173.
2. Madhusudan A,Shipra S,Gaurav S, Ashutosh A,Aditi M. Lingual Morphology: A Secure Method for Forensic Identification. J Forensic Sci & Criminal Inves 2018; 9: 555758.
3. Jayan L, Bharanidharan R, Ramya R, Priyadharshini N, Kumar AR. Tongue morphometry: Evaluation of morphological variations in ethnic Tamil population. SRM J Res Dent Sci. 2019; 10:139-44.
4. Godbole M, Narang B, Palaskar S, Patil S, Bartake A. Tongue scanning as a biometric tool: a review article. Int J Health Sci Res. 2020; 10:108-114.
5. Vijay P, Sharma S, Chandra S, Pardhe N, Singh P, Srivastava Y. A Study on Evaluation of Various Tongue Patterns in North Indian Population and a Working Classification System for These Tongue Print Patterns. Int Health Res J. 2019; 3:76-79.
6. Abraham J, Binita G, Sandra E J . A Morphological Study of Tongue and its Role in Forensics Odontology. J Forensic Sci & Criminal Invest. 2018; 7: 555723
7. Abarnalingam, Shubhalakshmi, Desai D, Gem SC. Comparison of Lip Prints, Rugae Pattern and Tongue Prints among Karnataka, Kerala and Tamil Nadu Population – A Short Study. Int J Innov Sci Res Technol. 2019; 4:1182-1187.
8. World Medical Association.World Medical Association Declaration of Helsinki. Ethical principles for medical research involving human subjects. Bull World Health Organ. 2001; 79:373-374.
9. Jeddy N, Radhika T, Nithya S. Tongue prints in biometric authentication: A pilot study. J Oral Maxillofac Pathol 2017; 21:176‑9.
10. Sreepradha C, Vaishali MR, David MP. Tongue replica for personal identification: A digital photographic study. J Indian Acad Oral Med Radiol. 2019; Vol.31:57-61.
11. Stefanescu CL, Popa MF, Candea L. Preliminary study on the tongue‑based forensic identification. Rom J Leg Med.2014; 22: 263-6.
12. Musaad AH, Abuaffan AH, Khier E. Prevalence of Fissured and Geographic Tongue Abnormalities among University Students in Khartoum State, Sudan. Enz Eng. 2015; 5: 137.
13. Okoh M, Okoh DS, Ojo MA. Prevalence of tongue disorders among patients attending the oral medicine clinic at a tertiary hospital in Nigeria. Tanz Dent J. 2015; 19 :11-15.
14. Fomete B, Agbara R, Osunde OT, Bello SA, Yunus AA, Goni BAM. Pattern and Presentation of Tongue Lesions in Kaduna, Nigeria: a 10 Year Review. Ann Med Health Sci Res. 2017; 7:157-161
15. Oyetola EO, Oluwande A, Agho ET. Geographic tongue: pattern of presentation in a South Western Nigerian teaching hospital. Ann Ibd. Pg. Med 2018; 16:131-135
16. Byahatti SM, Ingafou MSH. The prevalence of Tongue Lesions in Libyan Adult Patients. J Clin Exp Dent. 2010; 2: e163-168.
17. Mushatat SF, Salih MF, Othman AA. Prevalence of common non-malignant tongue lesions. Int J Res Pharm Sci. 2017; 8:804-808.
18. Shayeb MA, Fathy E, Nadeem G, Aly El-Sahn N, Elsahn H, Khader IE, *et al*. Prevalence of most common tongue lesions among a group of UAE population: retrospective study. Oncol Radiother 2020;1: 001-005.
19. Feil ND, Filippi A. Frequency of fissured tongue (lingua plicata) as a function of age. Swiss Dent J. 2016; 126:886-97.
20. Aghel S, Esfehani M, Zarabadipour M. The Frequency of Normal Variations of Oral Mucosa in Patients Referred to Qazvin School of Dentistry Int J Ayurvedic Med., 2018; 9: 34-38.
21. Singh J, Singh S, Saleem M, Chandra S, Lodhi N, Chang CP. Tongue and its ties: Posterior tongue width in gender estimation – A forensic gratuity. Natl J Maxillofac Surg. 2020; 11:53-6.