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# A cheiloscopic study in relation to maxillary odontometrics of Igbomina ethnic group in Nigeria

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***ABSTRACT***

*The study was designed to determine the relationship between lip prints and odontometric parameters of the maxilla among Igbomina people of Kwara state, Nigeria within age range 18-50years. 422 (211males and 211 females) participated in the research. The lip print was obtained by removing dirt with wipes and applying lip gloss on the lip evenly.Microscope slide was then placed on the lip with gentle pressure ensuring the mouth of the subject remained stationary for few seconds. The microscope slide was removed from the lip and carbon black was sprayedon the slide in little quantity to obtain the print. The odontometrics were measured using a digital vernier caliper and the mean value ofthe Intercanine width (ICW), interpremolar width (IPW) and mesiodistal dimension (MDD) of the left and right maxillary canine were established. Mean and SD were derived from the data obtained through statistical analysis and t-test was used to check for any sex association and statistical significance was put into consideration when (P≤0.05). Traditionally CHAID splits the lip prints into categories. The results of the study showed that type II was the most common lip print in both male and female among this population. Conversely, ICW of the maxilla has the highest sexual dimorphism than other odontometric parameters considered in this research. Also type II lip pattern of the ULQ and LLQ has a significant relationship with ICW of the maxilla. Conclusively, cheiloscopy and odontometrics, can be used jointly as a tool inpersonality identification in medico-legal contexts.*

*KEY WORDS: Cheiloscopy, Maxilla, Odontometry, Sexual dimorphism, Personality identification, Medico-legal.*

## INTRODUCTION

Forensic anthropology is aspecial subfield of physical anthropology that deals with the identification of primary human skeletal remains (Schwartz and Christopher, 2005).Individual identification whether dead or living is due to the fact that each person has a unique identity (Vijay *et al*., 2016). The positive proof of identification of unknown or known, deceased or living individuals are the main universal rolesof forensic criminal or social investigations using explicit procedures like finger printing, karyotyping, dental records plays the direct role, although they are technique sensitive and expensive (Surajit*et al*., 2016).

Forensic odontology is a developing science and indispensable in medico-legal issues and in identification of persons. The dental tissues (teeth) are often preserved even upon diminishing body (Nadeem *et al*., 2017). Forensic odontology is a Latin word meaning "Forum" for discussion of legal matters. It is an area of dentistry which involves use of dental knowledge for criminal and civil laws in justification (Poonam *et al*., 2016).

Cheiloscopy was derived from a Greek word "*Cheilos"* which means lips (Surajit*et al*., 2016). Cheiloscopy is the study of pattern of elevation and depression present on the mucosa of the lip and it's unique for individuals. It was proposed as an element for identification around 1932 by Edmond Locard (1877-1966) who was one of the France's greatest criminologists. Lips are movable parts of the body made up of skin, muscles, glands that are found in the region of the mouth. Lip print is used as a means of identification because the prints are unique for individual and can't be altered (Kyaw*et al*., 2019). Lip print can be used to determine gender and race.

Odontometry is the study and measurements of tooth size. Teeth are invaluable component in non-living population for sex determination because they usually resist damages and are potential sources of information about dimorphism (Carlos *et al*., 2012).Determining sex is one of the most significant steps in the identification of unknown persons, teeth are a potential source of information on sex (Marin *et al*., 2017). The length and breadth of the teeth can be measured from side to side using calipers. Teeth are made from the most enduring mineralized tissues in the human body. The dentition is considered as being useful in sex determination in skeletal remains since they are hard and resistance to postmortem destructions and disintegration including mechanical, thermal, physical and chemical (Sudeendraand Ashith,2009).. Marin *et al*. (2017) says "sex determination using dental features is primarily based on comparison of tooth dimensions in male and female". Sexual dimorphism shown in tooth size and the accuracy of odontometric sex prediction has been found to vary with regions, hence, the need for population specific-data (Sudeendraand Ashith2009).

## MATERIALS AND METHOD

A total of four hundred and twenty-two subjects were used for this research (211 males and 211 females) across the Igbomina ethnic group of Kwara state, Nigeria. The subjects were within the age range of 18-55 years. Questionnaires were issued to the participants to determine their demographical status and written consent was also obtained from each participant. Only subjects who are indigene (pure bred) of Igbomina ethnic group were used. The sample size was determined using the Fischer's formula for the large population (> 10000).

$$S = \frac{Z^2 \times p \times q}{d^2}$$

Where
S= Sample size
Z= 1.96(constant)
$P = proportion = \frac{\text{age group}}{\text{Total population}}$
Q=1-P
D= Tolerance level=0.05
Age group 18-50 years=28,610
Total population= 59,481
Population= 28,610/59,481= 0.481
Q= 1-0.4809= 0.519
S=1.96×0.481×0.519/0.0025=383.61
Attrition rate f sample size is 10% hence= (10/100)× 383.61
383.61+38.361=421.971~ 422
Hence sample size used = 422

### Inclusion Criteria

Participants who are indigeneswith lips free of scarwere included. Individual with fully erupted permanent teeth and Individual with properly aligned teeth were also included.

### Exclusion Criteria

Subjects who react to lip gloss or Vaseline were excluded. Subjects with pathological conditions, malocclusion, dental caries, gap between two teeth, cleft lips and subject below 18 years of age were also excluded.

### Ethical approval

Ethical clearance was obtained from the Department of Anatomy Ethical Review Committee of the University of Ilorin, Nigeria. The ethical approval number is 17/46KA079/06/21.

## DATA COLLECTION METHOD

### Cheiloscopy data collection method

The process was done with consent of the subjects. Wipes were used to clean the lips to remove any dirt on the lip surface. Lip gloss or preferably Vaseline was applied on the lip slightly and evenly, microscope slide was then placed on the lip with gentle pressure ensuring it touches both sides of the lips while the mouth of the subject remained stationary, for few seconds. The microscope slide was then removed carefully from the lip and carbon black was sprayed (in little quantity) on the slide. The lip print was visible at this stage. The slide was then taped to the paper containing the details of the subject; age, serial number, sex, date. The lip print was identified based on Suzuki and Tsuchihashi's classification. The lip was divided into six sections; upper left quadrant (ULQ), upper middle quadrant(UMQ), upper right quadrant (URQ), lower right quadrant (LRQ), lower middle quadrant(LMQ), lower left quadrant (LLQ) to determine the type of print present in each section. Magnifying glass was used to enhance visualization.

**Fig 1; Placing of microscope slide on the upper and lower lip of a female participant**

**Analysis of lip prints**

The lip prints were divided into sections for both upper and lower lip

- Upper Right Quadrant URQ
- Upper Middle Quadrant UMQ
- Upper Left Quadrant ULQ
- Lower Right Quadrant LRQ
- Lower Middle Quadrant LMQ
- Lower Left Quadrant LLQ

They were divided into estimation areas or compartments as shown in the diagram below;

Type I Complete vertical

Type I’ Incomplete vertical

Type II Branched

Type III Intersected

Type IV Reticular

Type V Undifferentiated

**Odontometrics data collection**

It was performed on individuals with fully erupted permanent teeth. Individual with improper teeth alignment, malocclusion dental caries, gap between two teeth were all excluded. The measurements in consideration wasthe maxillary odontometric parameters which included; the Intercanine width (ICW), interpremolar width (IPW) and mesiodistal dimension (MDD) of the left and right maxillary canine. Digital vernier caliper beaks were used for measurements. To measure the Intercanine width, the digital vernier caliper was set to zero and placed on the cusp (tip) of both canine of maxilla (the measurement was taken twice for accuracy and the average was recorded for all the parameters). The interpremolar width was measured by placing the digital vernier caliper beaks on the cusp of the first premolar to the cusp of the first premolar of the opposite side in the maxilla. The mesiodistal width of the left and right canine was taken as the distance between the mesio (medial) and distal (farther) surface of the canine on left and right of the maxilla. The digital vernier caliper was cleaned after using on each subject.

**Statistical analysis**

Chi-square Automatic Interaction Detector (CHAID) was used to build a predictive classification tree model. The upper and lower cheiloscopic patterns of the right, middle and left lips were the response variables, while the maxillary odontometric parameters were the predictor variables used in the model. Statistical significance was put into consideration when ($P=0.005$ or $P\leq0.005$). Traditionally CHAID splits the lip prints into categories (nodes) with approximately equal number of observations, creating all possible cross-tabulations for each category. This process was repeated until the best outcome was achieved.

**RESULTS**

Which were described as frequency (percentages) and continuous variables as mean (±S.D). The association between chieloscopic patterns and maxillary odontometrics; for the upper and lower quadrant are presented in Figs 2 – 4 (URQ, UMQ, and ULQ) and Figs. 5 – 7 (LRQ, LMQ, and LLQ) respectively.

**Distribution of lip print patterns and test of sex-associated differences**

**Table 1:** Distribution of lip print types on the upper quadrants and test of association

| Quadrants | Sex | Lip print pattern Type I | Type I' | Type II | Type III | Type IV | Type V | Chi-Square Tests Df | χ2 | P-value |
|---|---|---|---|---|---|---|---|---|---|---|
| URQ | Male | 11<br>7.3% | 1<br>0.7% | 80<br>53.3% | 11<br>7.3% | 36<br>24.0% | 11<br>7.3% | 5 | 10.328 | 0.066 |
| | Female | 11<br>7.3% | 1<br>0.7% | 98<br>65.3% | 9<br>6.0% | 16<br>10.7% | 15<br>10.0% | | | |
| | **Total** | **22<br>7.3%** | **2<br>0.7%** | **178<br>59.3%** | **20<br>6.7%** | **52<br>17.3%** | **26<br>8.7%** | | | |
| UMQ | Male | 9<br>6.0% | 7<br>4.7% | 31<br>20.7% | 15<br>10.0% | 71<br>47.3% | 17<br>11.3% | 5 | 8.474 | 0.132 |
| | Female | 9<br>6.0% | 5<br>3.3% | 26<br>17.3% | 32<br>21.3% | 58<br>38.7% | 20<br>13.3% | | | |
| | **Total** | **18<br>6.0%** | **12<br>4.0%** | **57<br>19.0%** | **47<br>15.7%** | **129<br>43.0%** | **37<br>12.3%** | | | |
| ULQ | Male | 10<br>6.7% | 6<br>4.0% | 79<br>52.7% | 9<br>6.0% | 40<br>26.7% | 6<br>4.0% | 5 | 17.452 | **0.004** |
| | Female | 5<br>3.3% | 0<br>0.0% | 107<br>71.3% | 8<br>5.3% | 22<br>14.7% | 8<br>5.3% | | | |
| | **Total** | **15<br>5.0%** | **6<br>2.0%** | **186<br>62.0%** | **17<br>5.7%** | **62<br>20.7%** | **14<br>4.7%** | | | |

*Note: URQ=Upper right quadrant, UMQ=Upper middle quadrant, ULQ=Upper left quadrant;* **χ2***=Chi square, df=degree of freedom*

In table 1, using the Suzuki and Tsuchihashi (1971) classification, the upper right quadrant shows type II lip print as the highest in the upper right quadrant in both male and female. The test of relationship between upper right quadrant and sex was (χ2=10.328, P=0.066). Upper right quadrant frequency of lip print reveals: Type II> type IV> type V> type I> type III>type I'.

The upper middle quadrant shows type IV pattern as the highest in the upper middle quadrant in both sexes. The test to show association between upper middle quadrant and sex was (χ2=8.474, P=0.132). Upper middle quadrant lip print frequency shows; Type IV>type II>type III> type V> type I>type I'.

In upper left quadrant, type II pattern was highly exhibited in the upper left quadrant. Association test between upper left quadrant and sex was significant (χ2=17.452, P=0.004). Chi-square analysis showed that sex was a significant influence for lip print pattern of only the upper left quadrants of the lip. Upper left quadrant shows lip print frequency: Type II>type IV>type III>type I>type V> type I'.

**Table 2:** Distribution of lip print types on the lower quadrants and test of association

| Quadrants | Sex | Lip print pattern | | | | | | Chi-Square Tests | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Type I | Type I' | Type II | Type III | Type IV | Type V | Df | χ2 | P-value |
| LRQ | Male | 21<br>14.0% | 1<br>0.7% | 87<br>58.0% | 9<br>6.0% | 32<br>21.3% | 0<br>0.0% | 5 | 24.895 | <0.001 |
| | Female | 20<br>13.3% | 3<br>2.0% | 106<br>70.7% | 6<br>4.0% | 8<br>5.3% | 7<br>4.7% | | | |
| | **Total** | **41**<br>**13.7%** | **4**<br>**1.3%** | **193**<br>**64.3%** | **15**<br>**5.0%** | **40**<br>**13.3%** | **7**<br>**2.3%** | | | |
| LMQ | Male | 16<br>10.7% | 9<br>6.0% | 16<br>10.7% | 8<br>5.3% | 93<br>62.0% | 8<br>5.3% | 5 | 28.957 | <0.001 |
| | Female | 29<br>19.3% | 6<br>4.0% | 20<br>13.3% | 32<br>21.3% | 55<br>36.7% | 8<br>5.3% | | | |
| | **Total** | **45**<br>**15.0%** | **15**<br>**5.0%** | **36**<br>**12.0%** | **40**<br>**13.3%** | **148**<br>**49.3%** | **16**<br>**5.3%** | | | |
| LLQ | Male | 15<br>10.0% | 4<br>2.7% | 86<br>57.3% | 5<br>3.3% | 39<br>26.0% | 1<br>0.7% | 5 | 21.000 | 0.001 |
| | Female | 12<br>8.0% | 3<br>2.0% | 113<br>75.3% | 10<br>6.7% | 12<br>8.0% | 0<br>0.0% | | | |
| | **Total** | **27**<br>**9.0%** | **7**<br>**2.3%** | **199**<br>**66.3%** | **15**<br>**5.0%** | **51**<br>**17.0%** | **1**<br>**0.3%** | | | |

Note: LRQ=Lower right quadrant, LMQ=Lower middle quadrant, LLQ=Lower left quadrant; **χ2**=Chi square, df=degree of freedom

In table 2, using Suzuki and Tsuchihashi classification, type II pattern was predominant in lower right quadrant in both male and female participants. The association test between lower right quadrant and sex was significant (χ2=24.895, P=0.001). The lower right quadrant shows: Type II>type I>type IV>type III>type V>type I'.

Type IV pattern was found to be predominant in lower middle quadrant. The association test between the lower middle quadrant and sex was significant (χ2=28.957, P=0.001). The lip pattern frequency for the lower middle quadrant reveals: Type IV>type I>type III>type II>type V>type I'.

The type II pattern of lip print was predominant in the lower left quadrant. Association test between the left lower quadrant and sex was significant (χ2=21.000, P=0.001). Chi-square analysis showed that sex was a significant influence for lip print pattern of all quadrants of the lower lip. Type II>type IV >type I> type III> type I'> type V in the lower left quadrant.

**Table 3:** Descriptive statistics and sex difference in mean values of the maxillary odontometric parameters

| Parameter | Sex | Mean±S.D | df | Mean Difference | t-value | P-value |
|---|---|---|---|---|---|---|
| **ICW (mm)** | **Male** | 35.67±2.63 | 291.2 | 1.547 | 4.696 | <0.001 |
| | **Female** | 34.13±3.06 | | | | |
| **IPW (mm)** | **Male** | 43.68±2.66 | 298 | 1.629 | 4.798 | <0.001 |
| | **Female** | 42.05±3.19 | | | | |
| **MWRC (mm)** | **Male** | 7.24±0.56 | 298 | 0.248 | 3.901 | <0.001 |
| | **Female** | 6.99±0.55 | | | | |
| **MWLC (mm)** | **Male** | 7.16±0.57 | 298 | 0.240 | 3.645 | <0.001 |
| | **Female** | 6.92±0.57 | | | | |

Note: 1. ICW;Intercanine width, IPW; Interpremolar width, MWRC; Mesiodistal width of right canine, MWC; Mesiodistal width of left canine 2.S.D; Standard deviation, df; Degree of freedom.

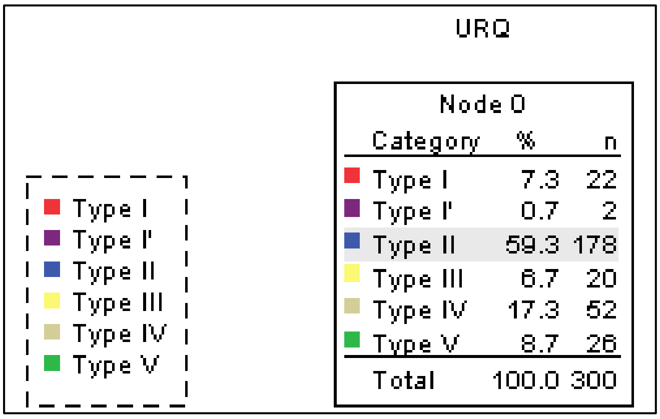
In table 3, a positive mean difference for intercanine width indicates that males have higher mean values. The sex difference is significant in the intercanine width.

The positive mean differences show that males have higher interpremolar mean values than females.

The mean and S.D value of the mesiodistal width of the right maxillary canine was 7.24± 0.56 in male participants and was 6.99± 0.55 in female participants. The difference in the mean value in male and female mesiodistal width of right canine is positive with 0.248 value.

Mean and S.D of mesiodistal of left maxillary canine for male volunteers was found to be 7.16± 0.57 and was 6.92±0.57 in female volunteers. The mean difference is 3.645 which is also positive and signifying higher male mean value than female. This phenomenon is called sexual dimorphism and it can be calculated using Garn and Lewis formula which is (Xm/Xf)-1×100where; Xm is the mean value for male odontometricsXf is the mean value for female odontometricsPercentage of sexual dimorphism for the intercanine width is (35.67/34.13)-1×100 = 4.51%Percentage of sexual dimorphism for the interpremolar width is (43.63/42.05)-1×100 = 3.76%Percentage of sexual dimorphism for mesiodistal width of right canine is (7.24/6.99)-1×100 = 3.58%Percentage of sexual dimorphism for mesiodistal width of left canine is (7.16/6.92)-1×100 = 3.47%.

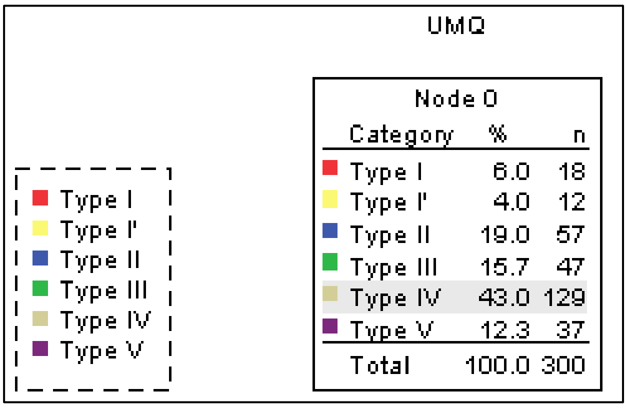
## Relationship between cheiloscopy and odontometrics




| Category | % | n |
|---|---|---|
| Type I | 7.3 | 22 |
| Type I' | 0.7 | 2 |
| Type II | 59.3 | 178 |
| Type III | 6.7 | 20 |
| Type IV | 17.3 | 52 |
| Type V | 8.7 | 26 |
| Total | 100.0 | 300 |

**Figure 2:** Decision tree for explaining the relationship between lip print pattern of the upper right quadrant and the maxillary odontometric parameters.

This node above shows the association between lip print pattern and maxillary odontometric parameters. It can be concluded that no relationship exists between the lip print pattern of upper right quadrant of the lip and the maxillary odontometric parameters. The lip print pattern highest in the upper right quadrant is type II with 59.3% and the lowest is type I' found in 0.7% of the population.




| Category | % | n |
|---|---|---|
| Type I | 6.0 | 18 |
| Type I' | 4.0 | 12 |
| Type II | 19.0 | 57 |
| Type III | 15.7 | 47 |
| Type IV | 43.0 | 129 |
| Type V | 12.3 | 37 |
| Total | 100.0 | 300 |

**Figure 3:** Decision tree for explaining the relationship between lip print pattern of the upper middle quadrant and the maxillary odontometric parameters.

No additional node was created aside the initial grouping, thus it can be concluded that lip print pattern of the upper middle quadrant do not explain the maxillary odontometric parameters. Type IV lip print pattern (43.0%) is however predominant in the upper middle quadrant and type I' is the lowest with 4.0%.

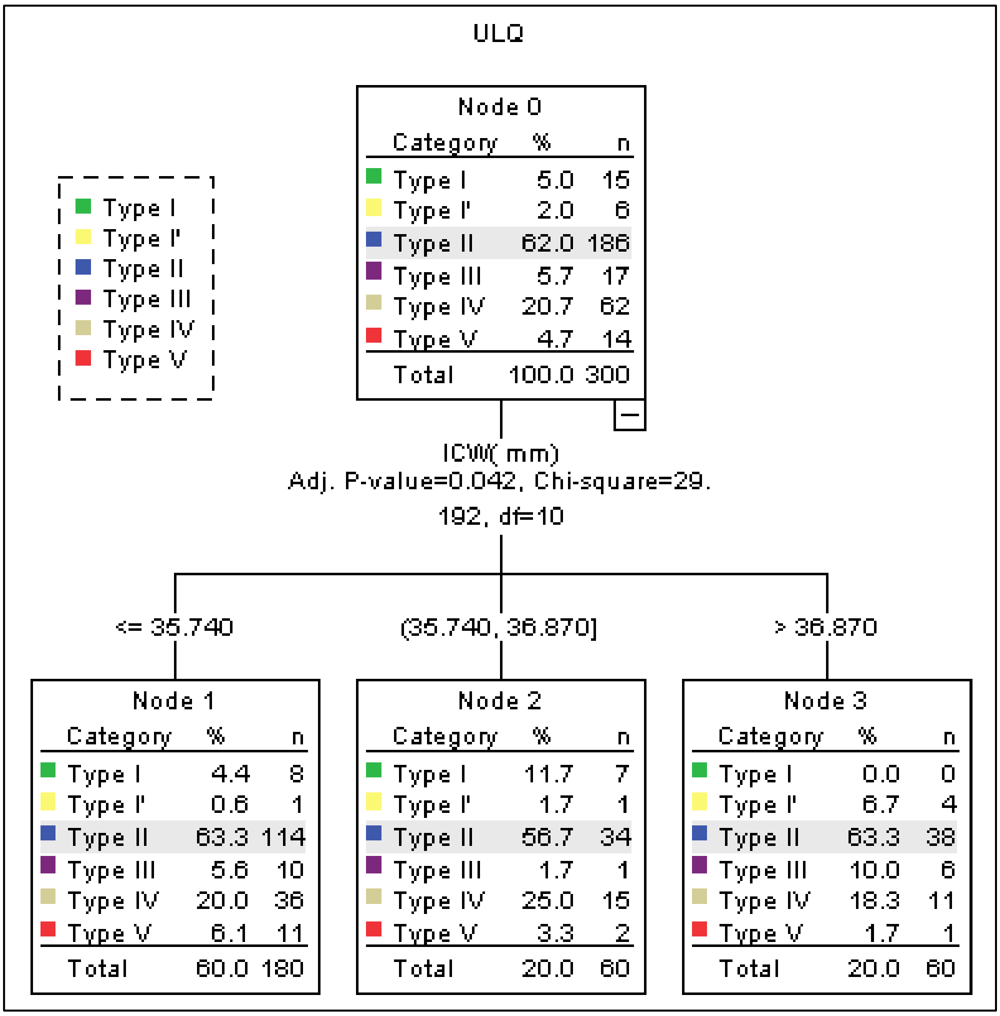



**Figure 4:** Decision tree for explaining the relationship between lip print pattern of the upper left quadrant and the maxillary odontometric parameters.

At the upper left quadrant, there is arelationship between the lip print pattern and the intercanine width ($\chi 2$=29.192, P=0.042) such that type II was predominant in node 1 (35.740, 63.3%), node 2 (35.740;36.80,56.7%) and node 3 (36.870,63.3%). Type I was higher in Node 2 (11.7%) than in Node 1 and Node 3. However, type IV is the second highest in Node 1(20%), Node 2(25%) and Node 3(18.3%).

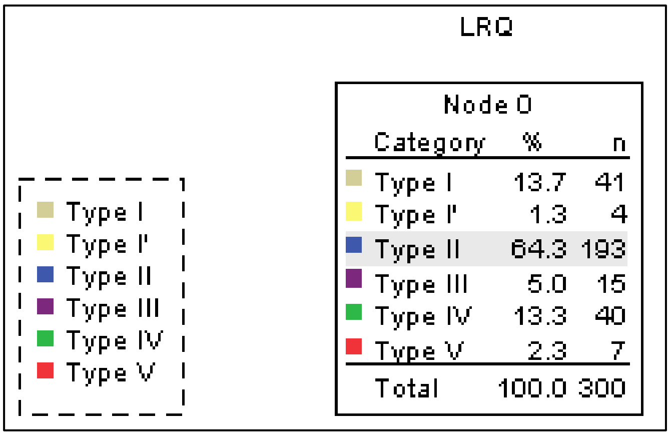



**Figure 5:** Decision tree for explaining the relationship between lip print pattern of the lower right quadrant and the maxillary odontometric parameters.

No additional node was created and this indicates no relationship exist between lip print pattern in the lower right quadrant and maxillary odontometric parameters. Type II lip print pattern (64.3%) was predominant in the lower right quadrant and type I' was found to be least predominant with 1.3%.

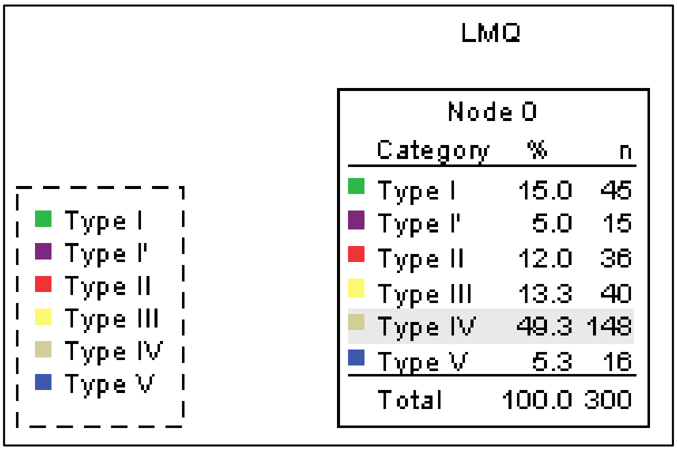



**Figure 6:** Decision tree for explaining the relationship between lip print pattern of the lower middle quadrant and the maxillary odontometric parameters.

The node shows no significant relationship between the lip print pattern distribution in the lower middle quadrant and the maxillary odontometric parameters. However, type IV lip print(49.3%) was found to be predominant in the lower middle quadrant and the lowest pattern found was type I' (5.0%).

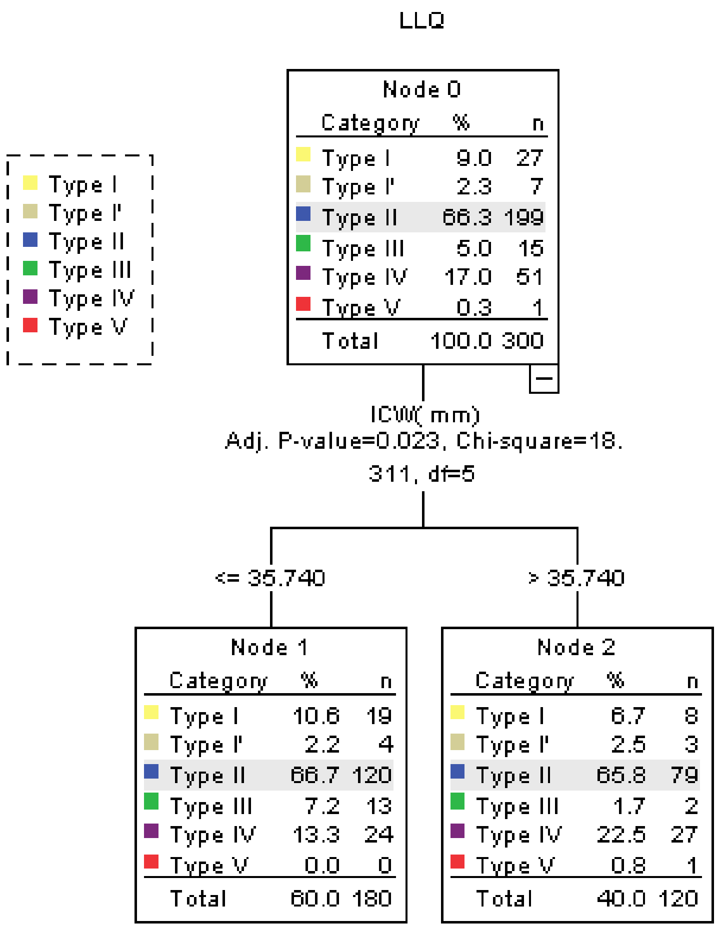



**Figure 7:** Decision tree for explaining the relationship between lip print pattern of the lower left quadrant and the maxillary odontometric parameters.

In the lower left quadrant of the lip, the pattern of print distribution had significant association with the intercanine width of the maxilla ($\chi 2$=18.311, P=0.023) such that type II lip print was predominant in both Node 1 (35.740,66.7%) and Node 2 (35.740,65.8%) but type III was higher in Node 1 (7.2%) than in Node 2 (1.7%). Type V was least predominant in both Node 1(0%) and Node 2(0.8%).

## DISCUSSION

Cheiloscopy helps in identifying the humans based on lips traces. The pattern of wrinkles on the lips has individual characteristics like the fingerprints (Rachana*et al*., 2012). Identification of an individual is a pre-requisite for certification of death and for personal, social and legal purposes (Shailesh *et al*., 2009).

Odontometry deals with the study of human dentition, majorly its size. The human dentition is considered useful in skeletal sex determination particularly since teeth are resistant to post-mortem fragmentation and devastation (Sudeendraand Ashith,2009).

The predominant lip print type ( type II) is in tandem with that found predominantly among the Igbos in Nigeria, where type II was found to have highest frequency in both male and female (Chijoke*et al*., 2020). This also agrees with the research done on Indian and Malaysian students which reveals type II pattern as the predominant lip print in the four quadrants in both Indian and Malaysian students irrespective of the gender (Karteek*et al*., 2015).Similarly, a study conducted on Bihar population showed type I lip pattern as the most frequent pattern in the population irrespective of the gender (Ruquaiya and Shyam, 2020). Type I lip print was also found to be the most common lip print among Punjabi population in Pakistan (Shirza*et al*., 2019). In contrast, Alabi*et al*. (2020) research reveals the predominant lip print pattern of the upper lip and lower lip in both sexes among University of Ilorin, students in Nigeria to be type III.

Maxillary odontometric parameters, withintercanine width exhibiting the highest percentage of sexual dimorphism in the current research. This is related to research carried out by Dilpreet*et al.* (2017) to check sexual dimorphism in maxillary odontometric parameters; the intercanine width, interpremolar width, arch length and combined length of the six anterior maxillary teeth, the mean value and SD for all the parameters for male were higher than in female. This is also in line with a study conducted by Mathias *et al*.(2019) among Anang ethnic group of Nigeria, where the research shows significant difference in male and female values in the maxillary canine, maxillary central incisor and mandibular canine. However, the result on research on mesiodistal width of all maxillary and mandibular permanent teeth except second and third molars showed there was no significant sex difference in the parameters (Hayder*et al*., 2017).

## CONCLUSION

In conclusion, relationship exist between the lip print pattern (Type II in ULQ and LLQ) and odontometrics (ICW) hence, these two methods can be conjointly used in sex prediction in medicolegal context.

## ACKNOWLEDGEMENTS

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