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Distribution and Association of Lip Print Patterns with Dental Diastema in University of Port Harcourt Students

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ABSTRACT

Lip prints are unique patterns formed by the grooves on the labial mucosa and have been widely recognised as valuable tools in forensic identification and sex determination. Midline and other types of diastema, representing spacing between teeth, are also considered distinctive features in dental anthropology and forensic investigations. The present study aimed to examine the distribution of lip print patterns in relation to diastema types and to explore potential associations with sex. A cross-sectional study was conducted among 500 students of the University of Port Harcourt, comprising 301 females and 199 males. Lip prints were recorded and classified according to Suzuki and Tsuchihashi's method into five types (I–V), while diastema was categorised as mandibular, maxillary, or combined. Data were analysed using descriptive statistics and chi-square tests to determine associations between variables. The results revealed that in females, type I lip print was most prevalent (68.44%), while in males, type II (48.74%) and type III (38.69%) predominated. Maxillary diastema was more common in both sexes, with mandibular diastema being rare. Chi-square analysis indicated a significant association between lip print type and diastema category in males ($\chi^2 = 21.321$, $p < 0.05$), but not in females ($\chi^2 = 11.528$, $p > 0.05$). Additionally, a significant relationship was observed between sex and lip print type ($\chi^2 = 286.68$, $p < 0.05$), confirming sexual dimorphism in lip patterns. In conclusion, lip prints demonstrate sex-specific distribution and, in combination with diastema patterns, may serve as reliable adjuncts for human identification and sex determination in forensic and anthropological contexts. These findings underscore the potential utility of cheiloscopy and dental morphology as complementary tools in forensic investigations.

Keywords: Lip Prints, Diastema, Sex Determination, Cheiloscopy

INTRODUCTION

Accurate human identification is a crucial component of forensic science, especially in contexts involving mass casualties, criminal cases, and missing-person investigations. While conventional identifiers such as fingerprints, DNA, and dental records are widely utilised (1, 2), lip prints have received increasing interest as an additional biometric indicator. Cheiloscopy, the examination of lip-print patterns on the vermilion border, centres on the distinctive grooves and fissures that define each person (3, 2). Similar to fingerprints, lip prints feature unique ridge and furrow patterns, are established early in fetal development, mostly remain unchanged throughout one's life, and vary even among identical twins (4, 5). Due to their stability, permanence, and ease of collection, lip prints can serve as a dependable method for personal identification in forensic contexts, particularly when traditional evidence is compromised or unavailable.

Diastema, or the gap between adjacent teeth, is a significant aspect in dentistry for both functional and aesthetic reasons (6). Maxillary midline diastema (MMD) refers to a gap that exceeds 0.5 mm between the erupted maxillary central incisors, measured from their mesial surfaces. It is among the known dental anomalies that can greatly impact an individual's oral health, aesthetics, and psychosocial well-being (7). Typically occurring between the upper central incisors, it can also be present in the lower jaw. Various factors can lead to this condition, including genetic predisposition, discrepancies between tooth size and jaw length, extra teeth, an abnormal upper labial frenum, and oral habits such as thumb-sucking or tongue thrusting (8). In many African

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communities, particularly among Nigerians, a maxillary midline diastema is prevalent, culturally accepted, and not necessarily addressed (9).

Prior research has shown that there are notable variations in lip print types and diastema across different ethnic groups, age categories, and genders. Males generally possess longer and thicker lips compared to females (10, 11, 7, 12). Research has underscored the importance of facial soft tissue landmarks in exploring occlusion, lip dynamics, and proportionality (13, 14).

Despite advancements in forensic science and dental anthropology, there is a notable lack of information regarding the relationship between external morphological traits like lip prints and internal dental conditions, such as diastema, in Nigeria. This research aimed to assess the correlation between lip print patterns and the presence of diastema among the University of Port. Harcourt students.

METHODOLOGY

A cross-sectional, descriptive study design was employed to evaluate the association between lip-print patterns and the presence of diastema among undergraduate students at the University of Port Harcourt, Rivers State, Nigeria. A total of 500 students (301 females and 199 males), aged 16 to 30 years, were recruited. The sample size was calculated using Cochran's formula. Eligible participants had fully erupted anterior teeth and no history of orthodontic treatment or craniofacial trauma affecting the lips. Only subjects with the presence of a confirmed diastema were used; hence, students without a diastema were excluded. Students were drawn randomly from multiple faculties and departments to achieve balance by age and sex.

Lip-print impressions were collected using dark-colored lipstick, strips of transparent cellophane tape, and white A4-sized bond paper. A magnifying hand lens was used for detailed examination. For diastema assessment, a mouth mirror and a millimetre ruler were used. Before recording, participants were asked to clean and dry their lips. Dark-colored lipstick was applied to the lips, and participants pressed their lips gently onto a strip of transparent cellophane tape; the tape was then transferred and affixed to a labelled area on white bond paper for permanent recording.

Examination focused on the middle third of the lower lip. Lip prints were inspected with a magnifying hand lens and classified according to the Suzuki and Tsuchihashi system as follows: Type I, clear-cut vertical grooves; Type I prime, partial-length vertical grooves; Type II, branched grooves; Type III, intersected grooves; Type IV, reticular grooves; and Type V, undetermined patterns. Additionally, the oral anterior region was examined using a mouth mirror, and interdental spaces were measured with a millimetre ruler to determine the presence and location (maxillary or mandibular) of diastema.

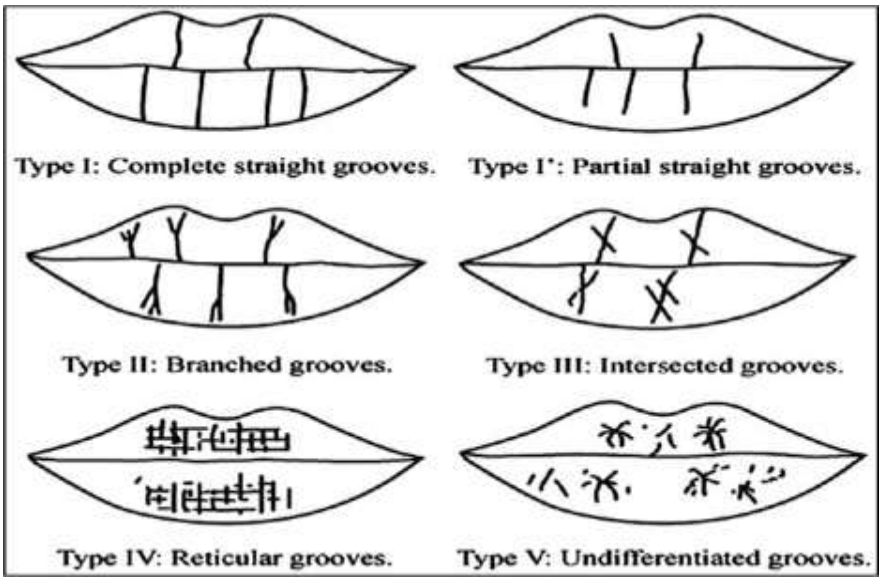

Figure 1: Suzuki and Tsuchihashi classification of lip prints (15)

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Each participant underwent an intraoral examination under natural daylight using a mouth mirror and a millimetre ruler. The presence of a diastema was recorded, with attention to its anatomical location in the dental arch: maxilla (upper jaw), mandible (lower jaw), or both. A gap of 0.5 millimetres or greater between adjacent anterior teeth was used to define a true diastema. A digital Vernier calliper was used to measure and confirm the presence of diastema. For this study, diastema was classified solely by its location within the dental arch (maxillary or mandibular).

Recorded data were entered into Microsoft Excel and subsequently analysed using the Statistical Package for the Social Sciences, version 25. Descriptive statistics (frequencies and percentages) summarised categorical variables. Chi-square tests were used to evaluate associations between lip-print patterns and diastema type, with analyses stratified by sex where appropriate. A probability value less than 0.05 was considered statistically significant.

Ethical approval for the study was obtained from the Research Ethics Committee of the University of Port Harcourt. Participation was voluntary, and informed consent was obtained from all participants. Participant confidentiality and anonymity were preserved throughout data collection and analysis.

RESULTS

The results of the study were presented in tables as follows:

Table 1: Distribution of lip print patterns by diastema category among females.

Lip Prints	**Types of Diastema**			
	Man. D	**Combined**	**Max. D**	**Total**
	n(%)	**n(%)**	**n(%)**	**n(%)**
Type I		52(25.24)	154(74.76)	206(68.44)
Type II		5(21.74)	18(78.26)	23(7.64)
Type III		4(30.77)	9(69.23)	13(4.32)
Type IV	1(4.76)	4(19.05)	16(76.19)	21(6.98)
Type V	1(2.63)	13(34.21)	24(63.16)	38(12.62)
Total	2(0.66)	78(25.91)	221(73.42)	301(100.00)

Man D= Mandibular Diastema; Max D= Maxillary Diastema; n= Sample Size; %= Percentage.

The result shows that out of the 301 female participants, 73.42% exhibited maxillary diastema, 25.91% had combined (Maxillary and Mandibular) diastema, and only 0.66% had mandibular diastema. Lip print pattern analysis revealed that Type I was the most predominant among females, accounting for 68.44%.

Table 2: Distribution of lip print pattern by type of diastema in males

Lip Prints	**Types of Diastema**			
	Man. D	**Combined**	**Max. D**	**Total**
	n(%)	**n(%)**	**n(%)**	**n(%)**
Type I	1(10.00)	2(20.00)	7(70.00)	10(5.03)

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Type II		24(24.74)	73(75.26)	97(48.74)
Type III		22(28.57)	55(71.43)	77(38.69)
Type IV		3(42.86)	4(57.14)	7(3.52)
Type V		1(12.50)	7(87.50)	8(4.02)
Total	1(0.50)	52(26.13)	146(73.37)	199(100.00)

Man D= Mandibular Diastema; Max D= Maxillary Diastema; n= Sample Size; %= Percentage.

The analysis revealed that of the 199 male participants, 73.37% presented with maxillary diastema, 26.13% had combined (Maxillary and Mandibular) diastema, and only 0.5% had mandibular diastema. The most common lip print pattern among males was Type II, accounting for 48.74% of the male sample.

Table 3: Chi-square test of independence between lip Print Type and Diastema Category in Females.

Lip Prints	**Types of Diastema**			**Total**	**□2**			**p-value**	**Inference**
	Man. D	**Combined**	**Max. D**		**df**	**calculated**	**Critical at α =0.05**		
TYPE I	0	52	154	206	8	11.528	15.507	p>0.05	Not Significant
TYPE II	0	5	18	23					
TYPE III	0	4	9	13					
TYPE IV	1	4	16	21					
TYPE V	1	13	24	38					
Total	2	78	221	301					

Man D= Mandibular Diastema; Max D= Maxillary Diastema; df= Degree of Freedom; X^2= Chi-square value.

The test result shows a calculated Chi-square value of 11.528 with eight degrees of freedom, compared against a critical value of 15.507 at a 0.05 significance level. Since the calculated value is less than the critical value, the result indicates that there is no statistically significant association between lip print type and the type of diastema among females. This implies that variations in female lip print patterns do not have a meaningful relationship with whether the diastema occurs in the maxilla, mandible, or both.

Table 4: Chi-square test of independence between lip print type and diastema category in males.

Lip Prints	**Types of Diastema**			**Total**	**□2**			**p-value**	**Inference**
	Man. D	**Combined**	**Max. D**		**df**	**calculated**	**Critical at α =0.05**		
TYPE I	1	2	7	10	8	21.321	15.507	p<0.05	Significant

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TYPE II	0	24	73	97					
TYPE III	0	22	55	77					
TYPE IV	0	3	4	7					
TYPE V	0	1	7	8					
Total	1	52	146	199					

Man D= Mandibular Diastema; Max D= Maxillary Diastema; df= Degree of Freedom; X^2= Chi-square value.

The analysis reveals a calculated Chi-square value of 21.321 with eight degrees of freedom and a critical value of 15.507 at the 0.05 level of significance; hence, a significant association was observed.

Table 5: Chi-square test of independence between sex and lip print type.

Sex	**Lip Prints**					**Total**	**□2**			**p-value**	**Inference**
	Type I	**Type II**	**Type III**	**Type IV**	**Type V**		**df**	**Calculated**	**Critical at α =0.05**		
Female	206	23	13	21	38	301	4	286.68	9.488	P<0.05	Significant
Male	10	97	77	7	8	199					
Total	216	120	90	28	46	500					

df= Degree of Freedom; X^2= Chi-square value.

DISCUSSION

The present study examined the distribution of lip print patterns in relation to the type of diastema among males and females. In females, type I lip print was the most prevalent (68.44%), followed by type V (12.62%) and type II (7.64%). Among males, type II was the most frequent (48.74%), followed by type III (38.69%) and type I (5.03%). These findings indicate a clear sexual dimorphism in lip print patterns, with type I dominating in females and type II in males. The chi-square analysis further confirmed a significant association between sex and lip print type ($\chi^2 = 286.68$, $p < 0.05$), indicating that lip prints may serve as a reliable indicator for sex determination in forensic and anthropological contexts. These results align with prior findings by Jaber et al. (16), who reported that type I lip prints were predominant in females (36.5%) while type III and II were more common in males (30.2% and 29.9%, respectively), highlighting the potential of cheiloscopy as a tool for human identification.

Regarding the relationship between lip print patterns and diastema, in females, type I lip print was most commonly associated with maxillary diastema (74.76%), while mandibular diastema was rare across all types. The chi-square test showed no significant association between lip print type and diastema category in females ($\chi^2 = 11.528$, $p > 0.05$), suggesting that lip print patterns in females are largely independent of diastema type. In contrast, in males, type II and III lip prints were predominantly associated with maxillary diastema (75.26% and 71.43%, respectively), and the chi-square test revealed a significant association ($\chi^2 = 21.321$, $p < 0.05$). This indicates a potential predictive relationship between lip print type and diastema occurrence in males, which may reflect underlying genetic or developmental factors influencing both lip morphology and dental spacing.

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The prevalence of diastema observed in this study also corresponds with earlier research on midline diastema. The majority of diastema cases in both sexes were maxillary, with mandibular diastema being relatively rare. This pattern is consistent with reports by Erfan et al. (17) and Modak et al. (18), who observed a higher frequency of maxillary midline diastema in comparison to mandibular. While Erfan et al. (17) reported a slightly higher prevalence in males, Modak et al. (18) noted a higher prevalence in females, which aligns with the current study's findings showing more maxillary diastema in females. Additionally, Al-Zazai et al. (7) emphasised that gender differences exist in the aetiology and prevalence of diastema, with males exhibiting higher generalised spacing and females showing a higher incidence of specific types of diastema, such as maxillary midline diastema.

The present findings also compare with previous studies on lip print patterns in broader populations. Paul et al. (15) and Sangam et al. (19) reported type II as the most common lip print overall, followed by type I, whereas in this study, type I predominated in females. This difference may be attributed to population-specific genetic factors and sample characteristics. Overall, these results reinforce the uniqueness of lip prints and their potential forensic utility, while highlighting the influence of sex and dental features, such as diastema, on lip print distribution. Future studies with larger and more diverse populations are recommended to further validate the observed associations and explore the underlying biological mechanisms linking lip morphology and dental spacing.

CONCLUSION

Based on the findings of this study, it can be concluded that lip print patterns exhibit clear sexual dimorphism, with type I being the most prevalent in females and type II and III being more common in males. Maxillary diastema was the predominant type in both sexes, while mandibular diastema was relatively rare. A significant association was observed between lip print type and diastema category in males, but not in females, suggesting potential sex-specific relationships between lip morphology and dental spacing. Overall, the results indicate that lip prints, in combination with diastema patterns, can serve as useful adjuncts for sex determination and human identification in forensic and anthropological investigations.

Conflict of Interest Statement

The authors declare that they have no known financial, personal, or institutional conflicts of interest that could have influenced the work reported in this study.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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