Original Article

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The Role of Compartment-Specific Lip Print Patterns in Gender Identification and Blood Group Analysis – A pilot study

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ABSTRACT-

Introduction:

Cheiloscopy, the study of lip prints, is a valuable forensic tool akin to fingerprinting for crime scene investigation. This study aimed to determine the compartment-wise frequencies of different lip print patterns in males and females and to explore the correlation between these patterns and various blood groups.

Material and Methods: A pilot study was conducted with 42 subjects aged 18-25 years. Lip print records were obtained from the sample population, coded, and meticulously analyzed to meet the study objectives.

Results: The analysis revealed that different compartments exhibited varying predominant lip print patterns, with no significant correlation between lip print patterns and blood groups.

Conclusion: The study concludes that considering all compartments during sex identification through cheiloscopy is crucial. There is a need for a standardized method that encompasses all compartments for accurate lip print analysis.

Keywords- Cheiloscopy, lip prints, sex identification, forensic odontology

Introduction

The identification of individuals is one of the most challenging yet crucial tasks in forensic odontology[1]. Cheiloscopy, the study of lip prints, serves as a valuable tool for person identification in forensic investigations. Similar to fingerprints, lip prints are unique to each individual and remain consistent over time, except in cases of trauma, inflammation, viral infections, or congenital abnormalities. Importantly, lip prints recover their distinctive patterns shortly after the resolution of such conditions, making them reliable for forensic analysis[2].

Lip prints can be discovered at crime scenes on various surfaces such as cutlery, cigarettes, glasses, and crockery items[3]. Latent lip prints, which are not visible to the naked eye, can be recovered using conventional powders, magnetic powders, or a magna brush[4]. Lip prints from suspects can be obtained through several methods, including digital photography and the application of transfer mediums to the lips. Although digital photography is increasingly preferred due to technological advancements, traditional methods involving lipstick still offer superior visualization of the lip grooves[5].

Most studies on cheiloscopy have focused on the central compartment of the lips due to its better visibility and consistent presence in lip print traces[6,7]. However, this approach overlooks the potential variations across different lip compartments. In this study, we conducted a compartment-wise assessment of all six compartments, as proposed by Tsuchihashi[8], to identify the dominant lip print patterns in each compartment. We further analyzed these patterns with the sex and blood group of the individuals.

The study also explores the relationship between lip print patterns and blood groups. Blood group, like lip prints, is a stable biological marker that does not change over time[9]. By examining the compartment-wise frequency of lip print patterns among different sexes and blood groups, this pilot study aims to determine the compartment-wise

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frequencies of different lip print patterns in males and females, and correlate these patterns with the individual blood groups.

Material and Methods

Study sample: This pilot study was conducted among 42 subjects (20 males and 22 females) aged between 18 and 25. The procedure for recording lip prints was explained to the participants and informed written consent was obtained from each subject.

Inclusion criteria: Individuals with no pathology, swelling, cuts, cleft scarring on the lip were included in the study.

Recording lip prints: A dark-colored, non-gloss lipstick was applied to both the lips in a single uniform motion. The lip prints were carefully lifted using a ten cm long strip cellophane tape and transferred onto a white A5-sized sheet to create a permanent record (lipstick-cellophane method).

Classification of prints: Each lip print record was tagged with the age, blood group, and sex of the subject and assigned a unique code. The lip prints were carefully analyzed and divided into six compartments: A, B, C, D, E, and F.

The Tsuchihashi classification system[8] (Figure 1). The patterns were classified into six types: Type I (vertical grooves running across the entire lip), Type I' (vertical grooves not running across the entire lip), Type II (branching grooves), Type III (intersecting grooves), Type IV (reticular pattern), and Type V (undifferentiated grooves).

The compartment-wise lip print patterns were recorded independently by 2 observers in order to ensure intra-observer concordance. Then the data was methodically sorted and studied to identify the frequency of each lip print pattern in the different compartments for both males and females, as well as among the different blood groups. The dominant pattern in each compartment was recorded and analyzed to determine any significant trends or correlations.

Results

The present study showed that all the lip prints obtained were unique and no two lip prints completely matched each other. The overall frequencies of lip print patterns showed that type II (Branching) pattern was the most common pattern observed in the overall sample (Figure3). The lip prints frequencies in females, showed a predominance of Type I pattern in compartments A, C, and E; the Type II pattern was most common in compartments D and F; and the Type IV pattern was prevalent in compartment B . In males, the Type II pattern was the most frequent except compartment E (lower middle compartment), where the

Tsuchihashi Classification

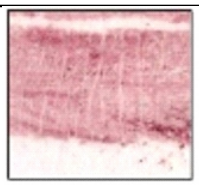
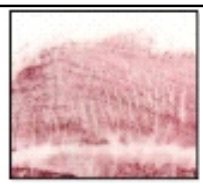
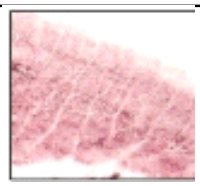
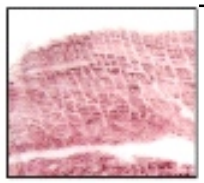
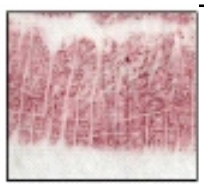
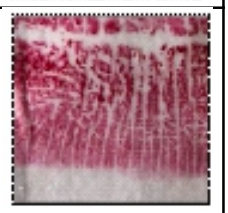
Type I	**Vertical grooves that run across the entire lip**	
Type I'	**Vertical grooves that do not run the entire lip**	
Type II	**Grooves with Branching pattern**	
Type III	**Grooves with intersecting pattern**	
Type IV	**Grooves with the reticular pattern**	
Type V	**Morphologically undifferentiated grooves**	

Figure 1: Lip print patterns observed in the study

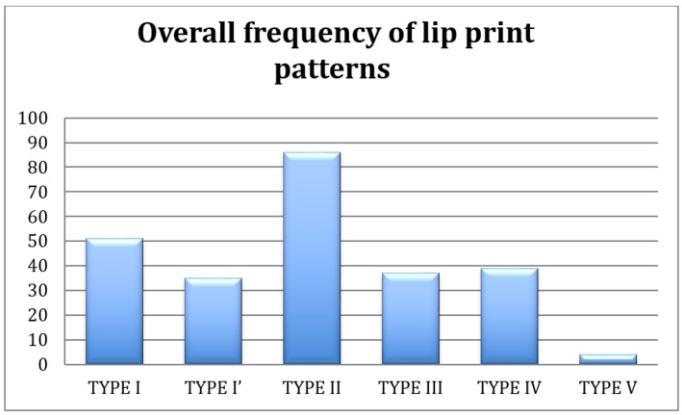


Figure 2 Overall Frequency Distribution of Lip Print Patterns

Type IV pattern was predominant. The detailed compartment-wise frequency of lip print patterns in females and males is summarized in Table 1 and Table 2, respectively.

No specific lip print pattern predominated among the different blood groups. The analysis of the relationship between lip print patterns and blood groups is presented in Table 3.

This indicates that while certain patterns are more common in specific compartments for males and females, blood group does not significantly influence lip print patterns.

Discussion

Forensic odontology plays a crucial role in the field of justice by handling, examining, evaluating, and presenting dental evidence[10]. Forensic odontology utilizes many methods for individual identification such as rugoscopy, bite mark analysis, tooth prints, and Cheiloscopy. The study of lip prints or Cheiloscopy is gaining importance due to the unique and consistent patterns lip prints exhibit. These patterns, characterized by numerous elevations and depressions on the external surface of the lips, can be reliably used for individual identification, even after minor injuries or disease recovery[11]

Lip prints can be found on various surfaces at a crime scene, such as clothing, cups, glasses, cigarettes, windows, and doors. They are inherently unique to each individual, with no two people, not even identical twins, having the same lip prints[12,13]. Latent lip prints can be identified and picked up from scenes of crime even after a month of the actual crime[14].Anatomical landmarks of the lip, including the chelion, stomian, labrale superius, and labrale inferius, play a significant role in providing objectivity to the study. This uniqueness makes lip prints a valuable tool in forensic investigations, particularly since criminals often overlook lip prints when attempting to remove evidence.

In our study we used the lipstick-cellophane tape method to record the lip prints as this has been recommended as the method of choice due to its simplicity, clarity, and cost-effectiveness, especially for large-scale recording in a study done to compare the various techniques for recording lip prints by Verghese et al.[15] We recorded the lip prints in 6 compartments: upper right, upper middle, upper left, lower left, lower middle, and lower right. The lip prints at the extreme edges of the lips were often smudged and hence that area was excluded from the analysis.

The results of this study align with previous research, confirming the uniqueness of lip prints and their potential for use in personal identification[9,16].

The most predominant pattern observed overall in our study was Type II or the branched groove pattern, which was same as a study done in Maharashtra by Borase et al.(n=496), whereas another study from North India by Randhawa et al. (n=600) reported the type I pattern, complete vertical grooves as the most predominant pattern.[17]

Specifically, in males, Type II was the most common in five out of six compartments, whereas in females three compartments (A, C, and E) showed the predominance of Type I pattern, two compartments (D and F) showed the predominance of Type II pattern and one compartment (B) showed the predominance of Type IV pattern. This compartment-wise variation was reported as a male pattern in past studies done by Malik R.et al, 2011[6] and

Table 1: Compartment-wise frequency of lip print patterns in females

Pattern	Compartments (n(f))					
	A	B	C	D	E	F
TYPE I	7(0.32)	6(0.27)	8(0.36)	4(0.18)	10(0.45)	3(0.14)
TYPE I'	5(0.23)	2(0.09)	5(0.23)	5(0.23)	3(0.14)	2(0.09)
TYPE II	6(0.27)	6(0.27)	5(0.23)	8(0.36)	2(0.09)	13(0.59)
TYPE III	3(0.14)	1(0.04)	4(0.18)	2(0.09)	2(0.09)	2(0.09)
TYPE IV	1(0.04)	7(0.32)	0(0)	3(0.14)	4(0.18)	1(0.04)
TYPE V	0(0)	0(0)	0(0)	0(0)	1(0.04)	1(0.04)

*Frequency (f) = n/N, n is equal to the no. of subjects having particular pattern. N is equal to total no. of female subjects.
**A,B,C,D,E,F = Compartments

Table 2: Compartment-wise frequency of lip print patterns in males

Pattern	Compartments (n(f))					
	A	B	C	D	E	F
TYPE I	2(0.10)	2(0.10)	3(0.15)	2(0.10)	2(0.10)	2(0.10)
TYPE I'	4(0.20)	2(0.10)	4(0.20)	0(0)	3(0.15)	0(0)
TYPE II	6(0.30)	9(0.45)	6(0.30)	10(0.50)	6(0.30)	9(0.45)
TYPE III	4(0.20)	0(0)	3(0.15)	7(0.35)	1(0.05)	8(0.40)
TYPE IV	3(0.15)	7(0.35)	3(0.15)	1(0.05)	8(0.40)	1(0.05)
TYPE V	1(0.05)	0(0)	1(0.05)	0(0)	0(0)	0(0)

*Frequency (f) = n/N, n is equal to the no. of subjects having particular pattern. N is equal to total no. of male subjects.
**A,B,C,D,E,F = Compartments

Table 3: Compartment-wise frequency of predominant lip print pattern in different blood groups.

		Compartments					
BLOOD GROUP	NO. OF SUBJECT	A	B	C	D	E	F
A+	8	TYPE II f=0.5	TYPE II f=0.5	TYPE I f=0.37	TYPE II f=0.37	TYPE I f=0.5	TYPE II f=0.5
A-	0	-	-	-	-	-	-
B+	17	TYPE I' f=0.35	TYPE II,IV f=0.35 EACH	TYPE I, II f=0.35 EACH	TYPE II f=0.47	TYPE IV f=0.35	TYPE II f=0.47
B-	1	TYPE I' f=1	TYPE II f=1	TYPE II f=1	TYPE II f=1	TYPE I' f=1	TYPE II f=1
O+	12	TYPE I f=0.33	TYPE IV f=0.42	TYPE III f=0.33	TYPE II f=0.42	TYPE I', IV f=0.25 EACH	TYPE II f=0.58
O-	1	TYPE II f=1	TYPE II f=1	TYPE IV f=1	TYPE III f=1	TYPE II f=1	TYPE III f=1
AB+	2	TYPE III,II f=0.5 EACH	TYPE I, IV f=0.5 EACH	TYPE III,II f=0.5 EACH	TYPE III,II f=0.5 EACH	TYPE I, IV f=0.5 EACH	TYPE II f=1
AB-	1	TYPE I' f=1	TYPE I f=1	TYPE I' f=1	TYPE I' f=1	TYPE I f=1	TYPE III f=1

f(frequency)= n/N, n is defined as no. of subject having particular type, N is defined as total no. Of subjects of a particular blood group.

Vahanwala S.et al,2005[18]. The lip print pattern in females in our study matched well with a study done by Sultana et al[19] where type I is more predominant (54%) followed by type I' (28%) and next is type III (10%), type IV (4%), type II (1%)and type V(2%); but the results in males were quite contrary with a predominance of type III pattern (40%) in males, followed by type IV (22%), type I (18%) and type I' (12%). These variations in our results might be possible due to our small sample size or due to the assessment of different compartments.

The study also aimed to explore the potential relationship between lip print patterns and blood groups. The present study and most previous work show no correlation [19,20] between lip prints and blood groups, suggesting that while lip print patterns are unique, they do not appear to be influenced by an individual's blood group.

A significant insight from this study is the importance of considering all compartments during lip print analysis for sex identification. Previous studies have often focused on the central compartment due to its visibility and presence in most lip print traces. However, our findings indicate that each compartment can exhibit different predominant patterns, and ignoring these variations could lead to inaccurate results.

Forensic experts should consider incorporating compartment-wise analysis into standard cheiloscopy protocols to improve the accuracy of sex identification and overall forensic analysis. Further research with larger sample sizes is necessary to validate these findings and refine the methods for utilizing lip print patterns in forensic investigations.

Conclusion

This study underscores the significance of compartment-wise analysis in cheiloscopy for forensic identification. The findings reveal that different lip print patterns predominate in specific compartments for males and females, emphasizing the need for a comprehensive approach that considers all compartments. While no significant correlation was found between lip print patterns and blood groups, the study highlights the reliability of lip prints in individual identification.

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