Original Research Article

Lip Print Analysis: A Study on Patterns and Forensic Applications

Hema Sundar Pydi[1], Pedada Rama Krishna[2], Sravanthi Gurugubelli[3]

[1]Assistant Professor, [2]Associate Professor, Dept. of Forensic Medicine & Toxicology, Government Medical College, Srikakulam, [3]Senior Resident, Dept. of Pathology, Great Eastern Medical School and Hospital Srikakulam.

How to cite this article: Hema Sundar Pydi, Pedada Rama Krishna, Sravanthi Gurugubelli. Lip Print Analysis: A Study on Patterns and Forensic Applications. Indian Journal of Forensic Medicine and Toxicology / Vol. 18 No. 4, October-December 2024.

Abstract

Lip prints are lines, also known as grooves and fissures, on the skin that form at the junction of the labial mucosa and the lip's exterior surface. The study of these lip prints is known as chelioscopy. They are known to follow a pattern, which has been classified into multiple categories by various experts. Suzuki & Tsuchihashi's classification proved to be the most popular. They are also noted for having a few distinguishing characteristics that aid in determining a person's personality. The current study was conducted to examine quadrant-wise patterns and differences between males and females. In our study, the most prevalent lip print in males was type I (32.91%), followed by type 3 (22.50%). In females, type 1 was the most common (39.16%), followed by type 3 (20%). Study found significant variations between males and females in lower lip print patterns.

Key words: Lip print types; Chelioscopy; Suzuki and Tsuchihashi; Quadrant wise analysis

Introduction

Lip prints are typically intriguing due to the conspicuous appearance of lips on the face and their aesthetic value. We usually find latent or accidental imprints on smooth surfaces. Fingerprints, palms, footprints, lips, teeth, rugae, and other sources can all cause them.[1] These impressions necessitate a comparative investigation in situations of crimes. Lip prints are lines and/or fissures in the form of wrinkles and grooves. They form naturally in the transition zone between the inner labial mucosa and the outer surface of the human lip. Lip prints can be appreciated as early as the sixth intrauterine week.[2,3] Lip prints, like fingerprints, can be used to identify individuals. The creases along the vermilion border of the lips, as well as the raised reddish patches indicated by these creases, are similar to the furrows and ridges on the skin of the fingers.[4] Lip prints have been discovered to be invariable, unique, and permanent in nature. They are found to have no changes occurring during an individual's life. The prints also help to create a classification.[5,6] It has also been discovered that lip prints heal after changes such as herpes disease, trauma, and inflammation. The layout and shape of the furrows do not change with environmental conditions.[7,8] Although a specific hereditary pattern has not been found, there are some similarities between the lip prints of parents, offsprings, as well

Corresponding Author: Sravanthi Gurugubelli, Senior Resident, Dept. of Pathology, Great Eastern Medical School and Hospital, Srikakulam, Andhra Pradesh.

E-mail: sravanthi.354@gmail.com

Submission date: April 18, 2024 **Revision date:** May 30, 2024 **Published date: Oct 9 , 2024**

This is an Open Access journal, and articles are distributed under a Creative Commons license- CC BY-NC 4.0 DEED. This license permits the use, distribution, and reproduction of the work in any medium, provided that proper citation is given to the original work and its source. It allows for attribution, non-commercial use, and the creation of derivative work.

as those of siblings.[9] It has also been discovered that males and females exhibit different patterns, which can be utilized to determine sex of a person.[10]

Lipstick traces were discovered on human body parts, drinking glasses, cigarette buttocks, clothing, windows, doors, food items, and tissue papers. They are all useful as forensic evidence in investigations into crimes like sexual assault or homicide. [11] The expertise is also useful in lip repair procedures and other face pattern and esthetic treatments. [12]

Between 1970 and 1974, well-known Japanese doctors Suzuki and Tsuchihashi[7] carried out some of the most important Cheiloscopy studies. They presented six various types of groove patterns[7], as illustrated in image 1, which were used in our study.

Aims and objectives: The current study was conducted to understand different lip patterns, document common patterns, and determine variances by quadrant in the study participants. To determine any discrepancies in these patterns between male and female sexes. To investigate the potential use of lip prints in person identification. The study's findings will help forensic experts, police officers, and other law enforcement agencies identify suspects from crime scenes, like when performing autopsies on unidentified bodies or retrieving only mutilated or fragmentary head and face remains.

Material and Methods

The study was done between January and April 2024 on 120 people aged 18 to 25 who lived in the Srikakulam district of Andhra Pradesh. Persons having a congenital anomaly, malformation, trauma, mucocele, deformity, cicatrization, or surgical scars on their lips were excluded from the study. The study materials included white (A4 size) paper, disposable tissue papers, cellophane tape, a magnifying glass. Lip sticks utilized in this study are non-glossy, dark matty, or dark pink in color, depending on the study participants' choice.

The potential participants were explained about the study and technique, after which an informed consent was obtained. Participants were asked to apply lip stick on their clean, dry, slightly parted lips. The lipstick was applied uniformly. Cellophane tape was then softly applied from the right to the left, covering the entire length and width of the top and lower lips from the adhesive side. Care was taken that smudge traces do not emerge. Then cellophane tape was gently removed and was pasted on a white A4size paper sheet. Another piece of cellophane tape is again applied to obtain another copy of the print. Then the participant was let free to remove the lipstick with tissue paper or washing. This way, at least two prints were taken from each participant to account, and the print with the most significant characteristics was chosen for study. The collected lip prints were then carefully examined under bright light with a Magnifying Glass to determine the type of lip print.

The lip print was separated into four quadrants (each lip was divided into two), and each quadrant was examined separately to determine the type of grooves. This was done by drawing a perpendicular line through the midline to split each lip into left – right. The space between top and bottom lips is useful to separate it into upper and lower. This way, each lip print was separated into four areas: the right upper quadrant (RUQ), the left upper quadrant (LUQ), the right lower quadrant (RLQ), and the left lower quadrant (LLQ). The maximum number of groove types in a given quadrant determines the type of lip print in that quadrant. Various classification schemes have been proposed by researchers over time; however, the most widely accepted classification was developed by Suzuki and Tsuchihashi[7]was used in this study.

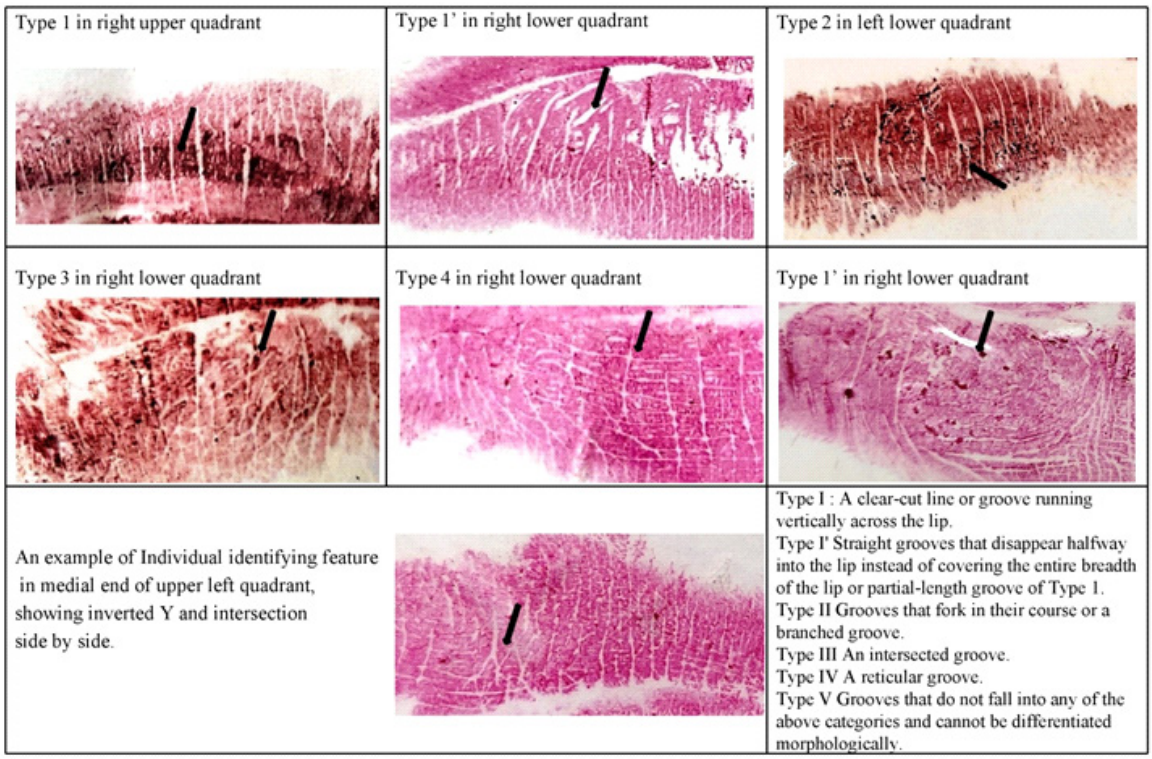
Results

Each lip print consisted of a variety of grooves rather than just one. This study found that type I is the most prevalent lip print in males (32.91%), followed by type 3 (22.50%). Type 1 was the most common among females (39.16%), followed by type 3 (20%). Further results for each quadrant are detailed in table number 1. There was no statistically significant difference ($P > 0.05$) between male and female lip prints in the right upper quadrant (RUQ) or left upper quadrant (LUQ). Lip prints of males and females showed a significant difference ($P < 0.05$) in the lower quadrants (right and left).

Table 1: showing the results obtained in our study showing lip print types distribution in different quadrants

	Males (n = 60)						Females (n=60)					
	RUQ	LUQ	RLQ	LLQ	Total /240	%	RUQ	LUQ	RLQ	LLQ	Total /240	%
Type 1	23	28	14	14	79	32.91%	27	21	22	24	94	39.16%
Type1′	10	6	4	5	25	10.42%	9	8	3	3	23	9.59%
Type 2	9	6	18	16	49	20.41%	3	4	8	11	26	10.84%
Type 3	12	11	16	15	54	22.50%	8	14	15	11	48	20%
Type 4	3	4	6	7	20	8.34%	11	9	8	6	34	14.16%
Type 5	3	5	2	3	13	5.42%	2	4	4	5	15	6.25%

Image 1: showing sample pictures from our study, one for each type of lip prints as per Suzuki and Tsuchihashi's classification



Discussion

Each person has a distinct lip print pattern, which differs depending on pattern kind, position, and number. In this study, type I was the most common (32.91% in men and 39.16% in women). Our study's findings are similar to a study by Peterson [13], in which the most prevalent lip print pattern was type I, as opposed to a study conducted by Sunil et al [14], which indicated type 1′ as the most common. Type III (32.3%) lip prints were discovered to be the predominant type in research by Tsuchihashi Y [7] and Sivapathasundharam et al [5]. Various studies in India have indicated variations in different populations. Sivapathasundharam et al[5] and Saraswati et al [15], discovered that Type III was the most frequent lip pattern in the Indo-Dravidian population. This variance in lip print occurrence across other researchers could be attributed to the fact that this study included a broad population, whereas other studies were limited to a certain region, or it could be due to regional diversity. The observed variance could also be due to a smaller sample size. So lip prints cannot be used to identify populations or races. Increase in the use of lip prints in forensic applications can be made by developing efficient technology and databases over time for lip print recognition, recording, and matching. Several factors

can influence lip print recording. The teeth position has an effect on lip prints as well. Habits like lip biting can cause repeated microtrauma to lips surface and alter the lip prints. Pathology and front tooth loss may produce deceptive results. The pressure, orientation, and method used to capture the imprint, inter observer bias may also have an impact on the appearance of the lip print. [16]

In addition to the patterns, the individual features of the grooves were analyzed, revealing that no two or more study participants had the same lip print. This is similar to a study by Sunil et al.[17], who found the individuality of lip prints in the their study on Delhi population. This has useful forensic applications in establishing the individuality of a person.

Comparison of lip print patterns in each quadrant of lips in both sexes:

Right upper quadrant (RUQ): In this study of lip prints in 60 males, and 60 females - in the right upper quadrant (RUQ): Type I was the most common (38.3%) in Males, followed by type 3 (20%). In cases of females, Type I lip print was seen in maximum numbers (45%), followed by type 4 (18.3%). It was similar to Ghimireet al.[18], who found that Type I pattern was seen in 62% of males and 32% of females in the right upper quadrant. In a study by Mathew SA et al. [19], females had predominant pattern as Type IV in the upper right quadrant, while the males showed a predominant Type I pattern in all four quadrants. This was in contrast to the findings of some authors' in previous studies. Among males, it was found that intersected pattern was most common in the right upper quadrant (42%) and females (38%) (Saraswathi TR et al.) [15] ; Type II pattern was most common in the right upper quadrant among females and males (DeepaJatti et al.)[20]

Left upper quadrant (LUQ): In this study: in males, Type I was seen in highest numbers (46.6%), followed by type 3 (18.3%). While in cases of females, type I lip print was seen in maximum numbers (35%), followed by type 3 (23.3%). In a study by (Peeran W et al.)[21], the Type I pattern was most prevalent in 43.24% of males and 56.71% of females. Some research found that males and females have different forms of lip prints in the left upper quadrant. Whereas in a study by (Mathew SA et al.) [18], Males in the left upper quadrant exhibited the highest prevalence of Type I lip print (48%), whereas females had Type IV lip print (44%).

Right lower quadrant (RLQ): In males, Type II was seen in maximum numbers (30%), closely followed by type 3 (26.6%). While in cases of females, Type I lip print was seen in maximum that is (36.6%), followed by type 3 (25%). Gender variations in outcomes were also observed by other authors where in the right lower quadrant, Type I pattern was seen in 54% of males, compared to 45% of females (Ghimire et al.)[18]. Mathew SA et al. [19]noted that in males Type I was present in the maximum population i.e., in 32% of total males while females had Type I lip print in 68% of female population.

Left lower quadrant (LLQ): In males, Type II was seen as the most frequent type (26.6%), closely followed by type 3 (25%). While in cases of females, Type I lip print was seen in a maximum that is (40%) of female population. Followed by type 2 and 3(each 18.33%). Some studies showed that there were no differences in lip print pattern in males and females in left lower quadrant. Type I pattern was seen in 57% of males, compared to 51% of females (Ghimire et al.).[18] Similarly, in another study (Mathew SA et al.)[19], in left lower quadrant, Type I was seen in 40% of total males and 46 % of total females.

Conclusion

This study revealed that the lip print did not have the same one type of pattern in all 4 quadrants of a lip. The most prevalent lip print pattern among the overall study participants is the Type I. In males, type I is the most common (32.91 %%) lip print, followed by type 3 (22.50%). In females, type 1 was the most common (39.16%), followed by type 3 (20%). The study showed significant difference in the predominant patterns between males and females in lower lip only. Larger and a more well defined studies will help to reduce inter observer bias. The study also demonstrated the uniqueness, indicating that no two lip prints are identical. Lip print analysis is a concise and affordable method, without much sophisticated equipment. Because of its uniqueness and ability to remain stable over time, lip print patterns may be utilized as a supplementary means of personal identification. Development of data

base and technological advancements can aid in the more precise forensic application in identification of persons.

Conflict of Interest /Source of Funding: Nil

Ethical Clearance: Obtained: IEC 25 / GMC & GGH/ SKLM/ 090124/11, Dated: 09-01-2024

References

1. Dillon DJ. The identification of impressions of non friction-ridge-bearing skin. J Forensic Sci 1963; 8: 576-81.
2. Venkatesh R, David MP. Cheiloscopy: An aid for Personal Identification. J Forensic Dent Sci. 2011;3(2):67–70.
3. Utsuno H, Kanoh T, Tadokoro O, Inoue K. Preliminary study of post mortem identification using lip prints. Forensic Sci Int. 2005;149: 29-32.
4. Williams TR. Lip prints – Another means of identification. J Forensic Ident 1991; 41 (3): 190-4.
5. Sivapathasundharam B, Ajay Prakash P, Sivakumar G. Lip prints (Cheiloscopy). Indian J Dent Res 2001; 12: 234-7.
6. Ball J. The current status of lip prints and their use for identification. J Forensic Odontostomatol 2002; 20: 43-6.
7. Tsuchihashi Y. Studies on personal identification by means of lip prints. Forensic Sci 1974; 3: 233-48.
8. Hirth L, Göttsche H, Goedde HW. Lippenfurchen – Variabilität und genetik. Lip prints - Variability and genetics. Hum Genet 1975; 30: 47-62.
9. Lévêque JL, Goubanova E. Influence of age on the lips and perioral skin. Dermatology 2004; 208: 307-13.
10. Vahanwala SP, Parekh BK. Study of lip prints as an aid to forensic methodology. J Forensic Med Toxicol 2000; 17: 12-8.
11. Castelló A, Seguí AM, Verdú F. Luminous lipprints as criminal evidence. Forensic SciInt 2005;155:185-7.
12. Nanda RS. The contributions of craniofacial growth to clinical orthodontics. Amer J Orthodontics and Dentofacial Orthopedics 2000;553-5
13. Petersen, LC. Lip Prints. Anil Aggrawal's Internet Journal of Forensic Medicine and Toxicology 2009 Jan - June;10(1).
14. Sunil, Mukta Rani, ShashankTyagi, Shrayash Singh. J Punjab Acad Forensic Med Toxicol2022;22(2); 22-26
15. Saraswathi T R, Mishra G, Ranganathan K. Study of lip prints. J Forensic Dent Sci2009;1:28-31.
16. Kavitha B, Einstein A,Sivapathasundaram B, Saraswati TR. Limitations in forensic odontology. J Forensic Dent Sci. 2009;1:8–10.
17. Sunil, Rani M, et al. A Comparative Analysis of Quadrants-Wise Distribution of Lip Print Pattern in Both Genders. J Indian Acad Forensic Med. 2023; Jan-Mar 45 (1): 72-75
18. Ghimire N, Nepal P, Upadhyay S, Budhathoki SS, Subba A, Kharel B. Lip print pattern: an identification tool. Health Renaissance. 2013;11(3):229-33.
19. Mathew SA, Kasim K, Mrudula KI, Jayashekeran. Establishing identity using cheiloscopyand palatoscopy. Sch J Dent Sci. 2016;3(3):74-80
20. Jatti D, Rastogi P. Digital analysis of lip prints for personal identification: A cross sectional study in South Indian Population. J Indian Acad Forensic Med. 2015July- Sept;37(3):289-93.
21. 21. Peeran SW, Kumar N, Abdalla KA, Azaruk FA, Manipady S, Alsaid FM. A study of lip print patterns among adults of Sebha city, Libya; J Forensic Dent Sci. 2015 Jan- April;7(1):67-70.