

HEREDITARY TRENDS AND NOVEL MORPHOLOGICAL VARIANTS IN LIP PRINT PATTERNS: A FORENSIC CHEILOSCOPY STUDY IN A SOUTH INDIAN POPULATION

Lokashree Dharmalingam^{1,3}, Labhini Rahangdale², Anjaly Prasad^{1,3}, Srinivasan Nagasundar^{1,3}, Vidhun Sakthivel^{1,3}, Jeyaraj Prabhu³, Raju Nandhakumar^{3*}

¹Division of Criminology and Forensic Science, Karunya Institute of technology and sciences (Deemed-to-be-university)

²School of Biosciences and Bioengineering, Division of Forensic Science, DY PATIL International University, Akurdi, Pune-412101.

³Fluorensic Materials Lab, Division of Physical Sciences, Karunya Institute of technology and sciences (Deemed-to-be-university), Karunya Nagar, Coimbatore-641114

E-Mail: dharmalingamlokashree@gmail, labhini147@gmail.com, anjalyseemaprasad@gmail.com, sv200226@gmail.com, vidhun21@gmail.com, prabhuj@karunya.edu, nandhakumar@karunya.edu*

ABSTRACT

This study examines the forensic capabilities of lip prints analysis in both identifying individuals and supporting investigations. Lip prints, though promising, are rarely accepted in court due to limited credibility. Using Afchar-Bayat and Kasprzak classifications along with non-parametric chi-square analysis, lip print patterns were examined across three consecutive generations in 30 families (110 individuals). The analysis revealed hereditary trends, with patterns more commonly inherited from parents than grandparents, suggesting a genetic influence on pattern distribution. Novel and undocumented patterns, including “S” shape, inverted pentagon, leaf, alphabetic “E,” and numeric “8,” were also identified, expanding the existing cheiloscopic database. These findings highlight the importance of regional and generational analysis in enhancing lip print-based forensic identification.

KEYWORDS: Forensic cheilioscopy; Afchar-Bayat classification; individual features; novel patterns; personal identification; South Indian population.

1. INTRODUCTION

The analysis of lip print patterns, termed cheilioscopy, has been proposed as an adjunctive method for human identification in forensic scenarios where conventional biometric modalities such as fingerprints, DNA profiling, or dental records are unavailable. The theoretical foundation of cheilioscopy is based on two principal assumptions: (1) that lip groove patterns demonstrate individuality, and (2) that these patterns exhibit relative morphological stability over time, thereby permitting potential use in personal identification. Despite longstanding acceptance of these assumptions in forensic literature, contemporary systematic evaluations have called for greater scientific scrutiny. Chaves et al. conducted comprehensive systematic reviews assessing both the reliability of cheiloscopic classification systems and the evidence supporting heritability of lip print patterns.[1] Their analyses identified substantial methodological weaknesses across primary studies, including small and non-representative samples, absence of standardized recording protocols, inconsistent use of classification systems, limited inter- and intra-observer reliability testing and high risk of bias. Furthermore, these findings suggest that while lip prints may exhibit observable inter-individual variation, the forensic validity of cheilioscopy remains inadequately supported by high-quality empirical data. Concerns regarding reproducibility, examiner subjectivity, and lack of external validation limit its evidentiary weight in judicial contexts.[2,3] Accordingly, contemporary forensic standards require that cheilioscopy be interpreted cautiously and considered, at best, an adjunctive investigative aid rather than a definitive biometric identifier.

Nevertheless, these particular patterns serve as valuable forensic evidence when lip impressions appear as hidden prints on clothes, glass surfaces, skin and other materials found at crime scenes[4]. According to Suzuki and Tsuchihashi (1970) the sulci labiorum rubrorum creates lip prints during the sixth week of IU (Intra-Uterine) life by forming creases & grooves on the vermilion quarter of lips. The development of these patterns depends on both environmental influences and genetic inheritance through multiple genes but they primarily start from genetic foundations. These biological unique characteristics along with their long-lasting nature make lip prints a supplementary tool for forensic identification method when fingerprint evidence is unavailable after mass disasters or sexual assaults [5]. The forensic importance of cheilioscopy remains unestablished in legal and investigative systems although it shows promising characteristics. The main challenge in cheilioscopy recognition remain the undefined classification systems together with difficulties in identifying new or mixed patterns from different ethnic and geographical groups. The classification frameworks developed by Afchar-Bayat (1979), Suzuki and Tsuchihashi (1970) and Kasprzak (1990) have not received validation across the global populations [6]. This study investigates how lip prints pass down through generations in Tamil people from South India while adding new lip print patterns to the cheiloscopic database.

Historical Background

The scientific interest in lip prints dates back to the early twentieth century. In 1902, Fischer was among the first to describe the presence of grooves on the vermilion zones of both the upper and lower lips, laying the foundational anatomical basis for subsequent cheiloscopy research. In 1932, Edmond Locard recommended the potential use of lip prints in personal identification and criminal investigations, recognizing their possible forensic value within the broader framework of trace evidence analysis. This marked one of the earliest formal endorsements of cheiloscopy as a forensic technique. Further conceptual support emerged in 1950, when Synder, in his book *Homicide Investigation*, emphasized the uniqueness of lip groove patterns. He compared their individualistic characteristics to the ridge patterns observed in fingerprints, thereby reinforcing the notion that lip prints could serve as a supplementary identification tool. The practical application of lip prints in forensic science was more systematically explored in 1967 by Suzuki, who discussed techniques for recording and analyzing lip impressions. Subsequently, in 1970, Suzuki and Tsuchihashi introduced the term *figura linearum labiorum rubrorum* to describe the characteristic groove patterns of the vermilion borders. In 1971, they further advanced the field by conducting extensive studies and proposing a widely recognized classification system for lip print patterns, which remains one of the most frequently cited frameworks in cheiloscopy research.

In 1972, McDonnell examined lip prints in identical twins and reported that, despite genetic similarity, their lip patterns were not identical. This observation was frequently cited as supportive evidence for the individuality of lip prints, although later systematic reviews have called for cautious interpretation of such findings due to methodological limitations. Collectively, these early contributions established the theoretical basis for cheiloscopy and shaped its development as a proposed forensic identification method. However, contemporary evaluations emphasize the need for rigorous validation before definitive forensic conclusions can be drawn. In 1981 Cottone mentioned cheiloscopy as a specific technique for individualization in his book "Outline of Forensic Dentistry." Additionally, Vahanwala conducted a study on lip patterns in 2000 to further promote cheiloscopy in forensic science. In 1990, Kasprzak conducted research for five years on 1500 persons to elaborate on the practical use of lip prints. It was during the period 2000-2012 that the study was carried out by several researchers from other countries as well as India [7]. Cheiloscopy currently functions as a supplementary biometric method in forensic science that investigators apply during cases when traditional identifiers including fingerprints remain unavailable. It is very helpful in instances of homicide and sexual assault (e.g., lip impressions on clothing, spectacles, or skin), Identification of mass disasters, Identity verification in biometric studies and so on with some limitations.

Anatomy and Classification of Lip Prints

The human lips comprises of two extremely fragile moving folds which consist of muscle along with glands skin and mucous membrane. These structures form the front border of the oral cavity which surrounds the opening of the mouth. The lip area forms the oral sphincter according to anatomy regardless of whether it is covered with mucosa or skin. The lower lip exists beneath the labiomental sulcus which defines its inferior boundary while the upper lip emerges below the nose to stretch toward the cheeks starting from the nasolabial sulcus; the buccal fend divides two lips but they join together at the mouth corners called commissures. [8-10]

Grouping of Lip Prints

The classification of lip prints is generally based on the patterns formed by the grooves and furrows present on the labial mucosa. The following are the different types of classifications of Lip prints.

- Martin-Santos classification
- Suzuki-Tsuchihashi classification
- Renaud classification
- Afchar-Bayat classification
- Jose Maria Dominguez classification
- Vahanwala et al. (classification of Sex of the individual)
- 23 types of Individual features of patterns
- Other classification

Martin Santos classification (1966)

The Martín Santos classification was created in the year 1967 by forensic dentist Clauco Martin Santos. The classification method represents one of the earliest systems which researchers used to identify lip prints for forensic purposes. [11]

- Simple Wrinkles
- curved line
- angled line
- sine-shaped curve
- straight line
- Compound Wrinkles
- Bifurcated
- Trifurcated

- Anomalous

Renaud classification

This forensic method of cheiloscopy classifies and categorizes lip prints into 10 types labeled from A to J. The classification system was developed by French researcher Renaud in 1973 to analyze lip lines and grooves through their shapes and positions relative to upper and lower lips.[12]

- Complete vertical
- Incomplete vertical
- Complete bifurcated
- incomplete bifurcated
- complete branches
- incomplete branched
- Reticular pattern
- X or Coma form
- Horizontal
- Other forms (ellipse, triangle)

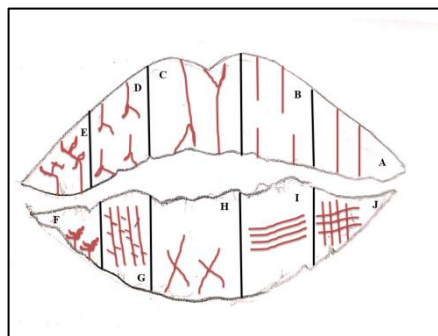


Figure 1: Renaud classification

Suzuki-Tsuchihashi classification (1970)

The Suzuki-Tsuchihashi method for cheiloscopy works in forensic research by categorizing lip prints through their specific groove patterns [13,14,15]. The Japanese scientists Yasuo Tsuchihashi and Kazuo Suzuki developed this classification system which groups lip prints into six distinct categories:

- Class I: Clear-cut grooves running vertically across the lip
- Class Ia: Straight grooves that disappear halfway
- Class II: Fork grooves in their course
- Class III: Intersecting grooves
- Class IV: Reticulate grooves
- Class V: Undetermined

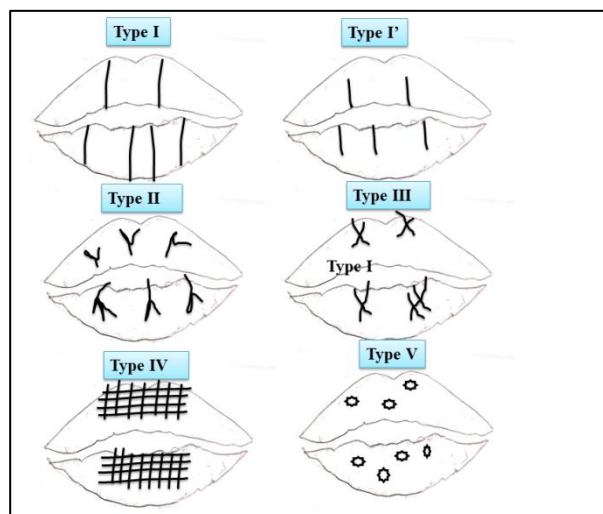


Figure 2: Suzuki-Tsuchihashi classification

Afchar-Bayat classification (1979)

The Afchar-Bayat lip print classification emerged from the work of Afchar and Bayat in 1979 to serve as an extensive approach for lip pattern classification in cheiloscopy. The system divides lips into two halves each of which contains four quadrants for pattern classification of vertical and branching and converging and reticular

patterns. The classification system assigns specific letters and numbers to its final formula. This method functions as a modified version of the Suzuki-Tsuchihashi classification to provide a methodical structure for describing and analyzing distinctive lip print characteristics that supports forensic identification. [11]

- A1: Vertical & straight grooves covering the whole lip
- A2: Vertical & straight grooves, but not covering the whole lip
- B1: Straight, branched grooves
- C: Converging grooves
- D: Reticular pattern grooves
- E: Other grooves

Jose Maria Dominguez classification

This classification purely depends on Suzuki & Tsuchihashi's classification. As reported by Suzuki & Tsuchihashi, branched grooves often divide upwards in the upper lip and downwards in the lower lip. But they observed some grooves, the so-called IIInd type, branched the other way around. [16]

Vahanwala et al. classification of Sex of the individual

Vahanwala and et al. worked on determination of sex using Suzuki & Tsuchihashi's classification as a base. [11,17]

- Type I and I' pattern dominant: Female
- Type I and II pattern dominant: Female
- Type III pattern dominant: Male
- Type IV pattern: Male
- Type V varied patterns: Male

23 types of Individual features of patterns/Kasperzak classification [13,14]

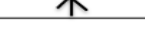
An Eye		A double eye	
A Hook		Hexagonal Pattern	
A Bridge		Crossing lines	
A Dot		Closing bottom bifurcation	
A rectangle like		Delta like opening	
A triangle like		A simple opening	
A group of dots		Closing top bifurcation	
Simple Top bifurcation		Pentagonal structure	
Simple Bottom bifurcation		Branch like top bifurcation	
A fence		A star like bifurcation	
A branch like bottom bifurcation		Double fence	
A line			

Figure 3: 23 individual features of patterns

2.8 Other classifications [7,11,12]

In this classification, only a 10mm portion of the middle part of the lower lip is used.

- Linear "L"- If the lines prevail
- Bifurcation "R" - If the bifurcation is dominant
- Reticular "S"- If the lines cross
- Undetermined "N"- When no superiority can be established.

Experimental Section

The inclusion and exclusion criteria for lip print study define the standards for selecting participants to ensure accuracy and consistency of results. Inclusion criteria typically involve healthy individuals within a specified age range who possess intact, unaltered lips free from scars, deformities, or chronic conditions that may distort natural lip patterns. Participants should not have undergone cosmetic procedures, permanent makeup, or recent trauma affecting the lips, and they must provide informed consent to participate. Exclusion criteria, on the other hand,

eliminate individuals with congenital anomalies such as cleft lip, visible scars, recent injuries, infections, or any artificial alterations that can interfere with the natural print. Those unwilling or unable to cooperate are also excluded. These criteria are essential to maintain the reliability and reproducibility of findings in forensic, anthropological, or identification studies. The following are the inclusion and exclusion criteria.

Inclusion criteria

Family Composition:

Only families with a minimum size of three members, comprising a father, mother, and at least one biological child (son or daughter), were considered for inclusion. This criterion ensures the presence of both parents and offspring within the same genetic lineage, which is essential for accurate familial pattern analysis and reduces the variability caused by missing parental data.

Absence of Genetic Disorders:

Participants included in the study were required to have no known genetic diseases or hereditary disorders. This was confirmed through medical history records and self-reported health information. The exclusion of individuals with genetic diseases helps eliminate confounding factors that may influence the study variables (e.g., lip pattern morphology, hereditary traits, or other physiological characteristics) and ensures that the observed traits represent typical genetic expression rather than being altered by pathological conditions.

Exclusion criteria

Exclusion criteria:

Allergy to Lipsticks:

Individuals who reported any form of allergy or hypersensitivity to lipsticks, lip balms, or similar cosmetic products were excluded to avoid allergic reactions during the lip print collection process, which often involves the application of lipstick to obtain clear impressions.

Active Lesions, Wounds or Cuts:

Participants with any form of active lesions, open wounds, or cuts on the lips were excluded to prevent interference with the visibility and integrity of the natural lip groove patterns, as well as to avoid the risk of infection or discomfort during sampling.

Inflammation of Lips:

Those exhibiting signs of inflammation, such as swelling, redness, or irritation, were excluded since these conditions could temporarily distort the lip patterns, leading to inaccurate interpretation and compromised data reliability.

Deformity, Abnormality or Trauma:

Participants with congenital deformities, structural abnormalities, or a history of significant trauma affecting the lips were not included, as such conditions could alter or obscure the natural configuration of the lip grooves, affecting the authenticity of the recorded patterns.

Surgical Scars or Burns:

Individuals with visible surgical scars, burn marks, or any post-surgical alterations on the lips were excluded because these modifications can disrupt or obscure the natural lip print patterns, potentially leading to misclassification or erroneous analysis.

A cross-sectional study is an observational research design that involves analyzing data from a population, or a representative subset, at a single point in time. It is widely used in biomedical, forensic, and epidemiological research to determine the prevalence of a characteristic, assess correlations between variables, or generate hypotheses for further investigation. In this work, a cross-sectional study was conducted on a cohort of 30 families, comprising a total of 110 individuals, including 56 males and 54 females. The recruitment process adhered strictly to predefined inclusion and exclusion criteria to ensure the representativeness of the study population and to minimize potential sources of selection bias. Families were selected to provide a balanced demographic profile and to enhance the generalizability of the findings to a wider population. Each participant underwent a systematic and standardized evaluation under controlled conditions to minimize environmental and procedural variability. This standardization included uniform sample collection protocols, consistent timing of data acquisition, and adherence to aseptic procedures, wherever applicable, to preserve the integrity of the study variables. Such methodological rigor was employed to enhance both intra-observer and inter-observer reliability, while also ensuring the reproducibility of the results in future research.

The sample composition demonstrated a nearly equal gender distribution (56 males vs. 54 females), offering a balanced representation that permits robust gender-based comparative analyses. This balance reduces the potential for confounding arising from sex-linked traits and provides a more reliable framework for interpreting the data. Furthermore, the inclusion of multiple families, rather than isolated individuals, allows for an improved

understanding of hereditary or familial trends in the studied parameter, thus increasing the depth of interpretation. Overall, this methodological approach reinforces the internal validity of the study, reduces systematic errors, and supports the accurate, unbiased interpretation of the observed outcomes, making the findings more reliable and generalizable for future applications. The materials used in this study are shown in Figure 4.



Figure 4: Materials used in this study

METHODOLOGY

The research methodology employed involves a standardized protocol for the acquiring and analysis of lip prints to ensure the precision, reproducibility, and minimal procedural variability. Prior to collection, participants were instructed to thoroughly clean and dry their lips to eliminate any residual oils, moisture, or contaminants that could interfere with print quality. Lipstick was applied uniformly using a fine applicator brush to achieve an even and thin layer across the entire vermilion border of the lips. Participants were then instructed to gently rub their lips together to facilitate uniform distribution of the lipstick, ensuring optimal adherence to the lip surface.

Subsequently, a sterile cellophane tape strip was carefully placed over the lips with minimal, uniform pressure to capture the print without smudging or excessive distortion. The tape bearing the lip print was then affixed onto a pre-labeled lip print card for archival and analysis. Each lip print was systematically divided into eight distinct quadrants to allow for detailed regional analysis: four segments on the upper lip (A–D) and four segments on the lower lip (E–H). The quadrant assignment of lip print quadrants started at the subject's upper right corner and followed a clockwise pattern using alphabetic labels to ensure consistency and eliminate ambiguities during data interpretation. [UPPER LIP (UP) - A, UP - B, UP - C, UP - D; LOWER LIP(LP)-E , LP - F , LP - G, LP - H] as shown in Figure 5. This methodological approach not only facilitated clear demarcation of lip zones but also minimized artifacts, distortions, and overlapping impressions during transfer. Precise labeling and quadrant division enabled structured documentation, enhanced traceability of each recorded print, and improved the accuracy of subsequent pattern analysis for individual identification.

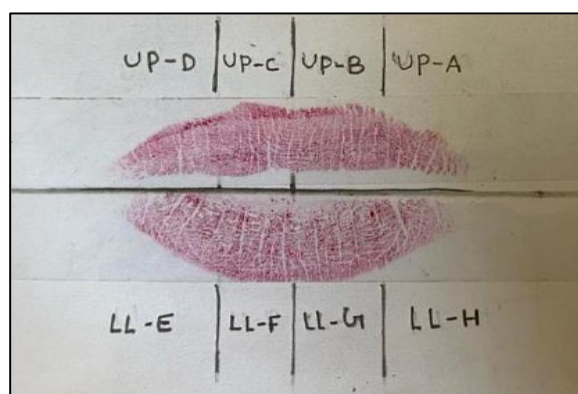


Figure 5- Lip print assigned with Quadrants for analysis

RESULT AND DISCUSSION

The present study reveals the details about the lip print pattern inheritance and distribution among a Tamil population by analysing lip impressions collected from 30 families, comprising 110 individuals. Using the Afchar-Bayat classification system, a total of 889 quadrant-level observations were systematically recorded and evaluated to determine predominant lip print types and assess potential familial transmission patterns. Statistical analysis using the chi-square test (χ^2) revealed a highly significant deviation from an equal distribution model ($\chi^2 = 447.7$, $p < 0.01$, $DF=5$, $\text{cramers } V= 0.71$ (large effect), indicating that certain lip print patterns occur with markedly higher frequency within the study population. The parent-child quadrant concordance value is calculated to be 61.4% and grandparent to grandchildren concordance is calculated to be 32.7%. The most prevalent lip print

configurations were identified as Type B1 (angular branched grooves) and Type D (reticular grooves), which together accounted for more than 56% of all recorded patterns. (Fig.6) In contrast, Type A1 (full vertical grooves) emerged as the least frequent, representing less than 2% of the total observations. These findings partially corroborate earlier studies, such as those by Varalakshmi & Sangeeta (2019), who reported vertical-type patterns as common in specific regional cohorts, and Devi et al. (2015), who identified Type III and reticular patterns [19,20]

In addition to validating established classification trends, this study expanded the morphological repertoire of lip print analysis by documenting novel variants using the Kasprzak system. Distinctive patterns such as “S-shape,” “Inverted Pentagon,” and “Number 8” were identified for the first time within this demographic, suggesting the potential existence of region-specific morphotypes that may have remained undocumented in previous research. From a hereditary perspective, the data demonstrated a notable degree of intra-familial resemblance, with several cases exhibiting shared quadrant patterns between parents and offspring. Occasional instances of non-linear inheritance, including pattern similarities skipping a generation (grandparent to grandchild), were also observed. However, no complete pattern concordance was found across any family unit, supporting the hypothesis that lip print morphology exhibits a complex polygenic mode of inheritance influenced by both genetic and environmental factors. (Fig. 7 & 8).[21-33]

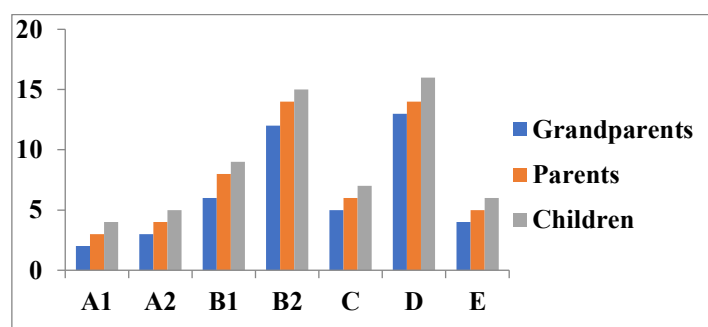


Fig. 6. The comparison of the frequency of different lip print types across three generations.

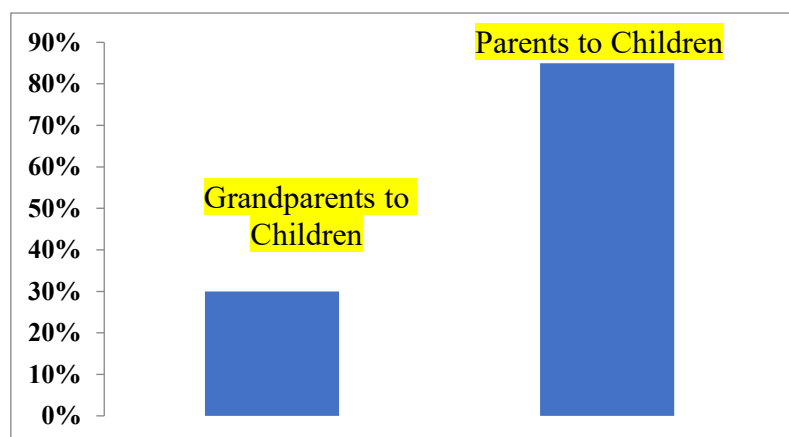


Fig.7. The inheritance trend states that most of the lip print traits are passed from parents than grandparents.

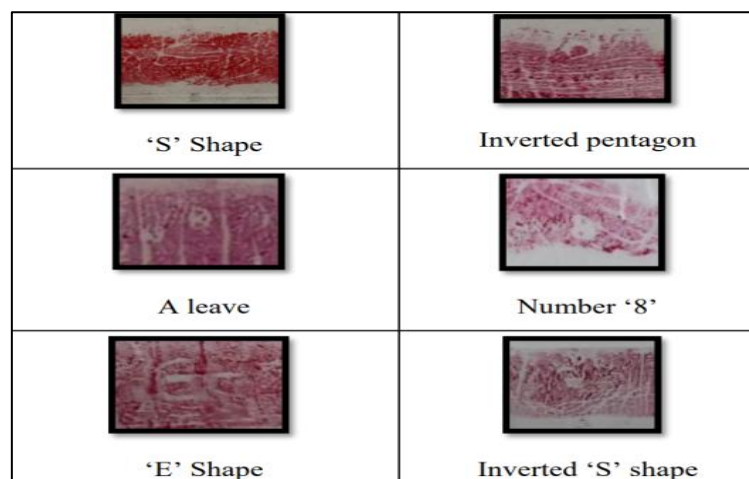


Fig. 8. The novel patterns that were identified in the analysis of lip prints

Table 1: Demographic and generational distribution of the study population

Generation	Role	n- number	Age range (Years)	Mean $\pm$ SD
I	Grandparents	30	52-78	64.3 $\pm$ 6.8
II	Parents	60	28-52	39.6 $\pm$ 6.1
III	Children	20	6-25	14.8 $\pm$ 5.4
Total		110		

CONCLUSION

The research presents evidence that specific lip print patterns exist with statistical significance among different generations while showing evident genetic correlations. Lip print patterns serve as unique individual identifiers because reticular and angular-branched patterns along with rare yet consistent novel morphological variants exist. The inheritance of lip morphology via multiple genes has been proven by significant familial resemblances that strongly affect parent-child relationships. New patterns discovered through the Kasprzak classification method indicate that researchers should add regional variations to existing classification frameworks. The study provides evidence that forensic science gains credibility through its use of cheiloscopy as an alternative biometric method when fingerprint identification fails.

ACKNOWLEDGEMENTS

Lokashree Dharmalingam, Anjaly Prasad, Srinivasan Nagasundar and Vidhun Sakthivel are very much thankful to Karunya Institute of Technology and Sciences (deemed to be University) for providing the financial support through Research associateship fellowship.

REFERENCES

- Chaves T, Azevedo A, Caldas I. (2023) Are lip prints hereditary? A systematic review. *Int J Legal Med.*;137(4):1007–1019. doi:10.1007/s00414-023-02987-2
- Alhussin A, Basmaji A, Fares H, Abdelaziz M, Abushihab R, Baaziz Y, Al-Rawi N, Al Kawas S, Mohammed M, Shetty S. (2024) The reliability of cheiloscopy and palatoscopy in human identification: a systematic review. *Romanian J Legal Med.*;32(1):52–61. doi:10.4323/rjlm.2024.52
- Bhattacharjee, R., & Kar, A. K. (2024). Cheiloscopy: A crucial technique in forensics for personal identification and its admissibility in the Court of Justice. *Morphologie*, 108(360), 100701. <https://doi.org/10.1016/j.morpho.2023.100701>
- Pal, M., & Kaushal, A. (2020). Cheiloscopy: A vital tool in forensic investigation for personal identification in living and dead individuals. *International Journal of Forensic Odontology*, 5(2), 71. https://doi.org/10.4103/ijfo.ijfo_15_20
- Kapoor, N., & Badiye, A. (2015). A study of distribution, sex differences and stability of lip print patterns in an Indian population. *Saudi Journal of Biological Sciences*, 24(6), 1149–1154. <https://doi.org/10.1016/j.sjbs.2015.01.014>
- Dongarwar, G. R., Bhowate, R. R., & Degwekar, S. S. (2013). Cheiloscopy method of person identification and sex determination. *Journal of Clinical & Diagnostic Research*, 7(10), 2193–2196. <https://doi.org/10.7860/JCDR/2013/5371.3468>
- Fingerprints & other impressions. (n.d.-b). In FORENSIC SCIENCE PAPER No. 3: Fingerprints & Other Impressions [Journal-article]. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000016FS/P000690/M011456/ET/1516188794FSC_P3_M34_e-text.pdf. (n.d.). In FORENSIC SCIENCE PAPER No. 3: Fingerprints & Other Impressions [Journal-article]. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000016FS/P000690/M011456/ET/1516188794FSC_P3_M34_e-text.pdf.
- Thomas, C. J., & van Wyk, C. W. (1988). The palatal rugae in an identification. *J. Forensic Odontostomatol.*, 6(1), 21–27
- Utsuno, H., Kanoh, T., Tadokoro, O., & Inoue, K. (2005). Preliminary study of post mortem identification using lip prints. *Forensic Science International*, 149(2–3), 129–132. <https://doi.org/10.1016/j.forsciint.2004.05.013>
- Warwick, R., & Williams, P. L. (Eds.). (1979). *Gray Anatomia* (35th ed., pp. 1137–1140; 1168–1173). Rio de Janeiro, Brazil: Guanabara Koogan
- Loganathan, M., Sengottuvelu, P. H. M., Loganathan, A., & Muthusamy, R. (2019). Comparison of lip prints in smokers and non-smokers. *Indian J Dent Res* 2001;12:234-7., 5(6).
- Dineshshankar, J., Ganapathi, N., Yoithapprabhunath, T. R., Maheswaran, T., Kumar, M. S., & Aravindhan, R. (2013). Lip prints: Role in forensic odontology. *Journal of Pharmacy and Bioallied Sciences*, 5(Suppl 1), S95–S97. <https://doi.org/10.4103/0975-7406.113305>
- Dongarwar, G. R., Bhowate, R. R., & Degwekar, S. S. (2013). Cheiloscopy method of person identification and sex determination. *Journal of Clinical and Diagnostic Research*, 7(10), 2193–2196. <https://doi.org/10.7860/JCDR/2013/5371.3468>.

14. Rajendran, A., & Sivapathasundharam, B. (Eds.). (2016). Textbook of Oral Pathology (7th ed.). Elsevier Health Sciences
15. Domínguez, J. M., Romero, J. L., & Capilla, M. J. (2017). New insights of cheiloscopy. *Annals of International Medical and Dental Research*, 3(3), DE11–DE15.
16. Domínguez, J. M., Romero, J. L., & Capilla, M. J. (1975). Estudio de las huellas labiales. *Revista Española de Medicina Legal*, 2(5), 25–32.
17. Sharma, P. (2009). The study of lip prints in sex identification. *National Journal of Forensic Dental Sciences*, 1(1), 24–27.
18. Chandrakala, J., Suganya, G., Yadava, T. S., Doddawad, V., Nagarathna, J., & Kalavathi, M. (2022). Lip print patterns: Similarities among the parents and their children. *Journal of Oral and Maxillofacial Pathology*, 26(1), 134. https://doi.org/10.4103/jomfp.jomfp_194_21
19. Varalakshmi, K. L., & Sangeeta, M. (2019). Cheiloscopy: Study of lip prints in establishing identity of an individual. *International Journal of Anatomy and Research*, 7(3.1), 6751–6755.
20. Devi, A., Astekar, M., Kumar, V., Kaur, P., Singh, N., & Sidhu, G. K. (2015). The study of inheritance analysis and evaluation of lip prints in individuals. *Journal of Forensic Dental Sciences*, 7(1), 49–53. <https://doi.org/10.4103/0975-1475.150309>
21. D, V. K. (2013). Efficacy of cheiloscopy in determination of sex among South Indians. *JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH*. <https://doi.org/10.7860/jcdr/2013/5371.3468>
22. Pal, M., & Kaushal, A. (2020). Cheiloscopy: a vital tool in forensic investigation for personal identification in living and dead individuals. *International Journal of Forensic Odontology*, 5(2), 71. https://doi.org/10.4103/ijfo.ijfo_15_20
23. Bhattacharjee, R., & Kar, A. (2023). Cheiloscopy: A crucial technique in forensics for personal identification and its admissibility in the Court of Justice. *Morphologie*, 108(360), 100701. <https://doi.org/10.1016/j.morpho.2023.100701>
24. Krishan, T. K. K. (2013). Personal identification in forensic examinations. *Anthropology*, 02(01). <https://doi.org/10.4172/2332-0915.1000114>
25. Garg, R., Gupta, S., Dagal, N., & Shekhawat, S. (2015). Study of morphological patterns of lip prints: Application in personal identification. *International Journal of Medical Research Professionals*, 1(1), 12–21
26. Kapoor, N., & Badiye, A. (2015). A study of distribution, sex differences and stability of lip print patterns in an Indian population. *Saudi Journal of Biological Sciences*, 24(6), 1149–1154. <https://doi.org/10.1016/j.sjbs.2015.01.014>
27. Caldas, I. M., Magalhães, T., & Afonso, A. S. (2007). Establishing identity using cheiloscopy and palatoscopy. *Forensic Science International*, 165(1), 1–9. <https://doi.org/10.1016/j.forsciint.2006.04.010>
28. Manickam, S., Meghala Priya, P., Nandini, D. B., & Madhushankari, G. S. (2016). Study of lip print pattern in Kerala sample population. *International Journal of Current Research*, 8(11), 41279–41282
29. Smita Chaware et al: Lip Prints (Cheiloscopy): An Insight. (n.d.). Smita Chaware Et Al: Lip Prints (Cheiloscopy): An Insight.
30. Kasprzak, J. (1990). Possibilities of cheiloscopy. *Forensic Science International*, 46(1–2), 145–151. [https://doi.org/10.1016/0379-0738\(90\)90154-Q](https://doi.org/10.1016/0379-0738(90)90154-Q)
31. Dongarwar, G. R., Bhowate, R. R., & Degwekar, S. S. (2013). Cheiloscopy method of person identification and sex determination. *Journal of Clinical & Diagnostic Research*, 7(10), 2193–2196. <https://doi.org/10.7860/JCDR/2013/5371.3468>
32. Bhattacharjee, R., & Kar, A. K. (2024). Cheiloscopy: A crucial technique in forensics for personal identification and its admissibility in the Court of Justice. *Morphologie*, 108(360), 100701. <https://doi.org/10.1016/j.morpho.2023.100701>
33. Pal, M., & Kaushal, A. (2020). Cheiloscopy: A vital tool in forensic investigation for personal identification in living and dead individuals. *International Journal of Forensic Odontology*, 5(2), 71. https://doi.org/10.4103/ijfo.ijfo_15_20