Original Article

Gender variation in morphological patterns of lip prints among some north Indian populations

Yogesh Vats[1],
Jasmine Kaur Dhall[2],
AK Kapoor[3]
[1]Researcher, Department of
Anthropology, [2]UGC-JRF,
[3]Professor, Anthropology
Department, University of Delhi,
Delhi, India

Abstract

Background: Personal identification is an integral part of forensic investigations. For the same, DNA profiling and fingerprints are the most commonly used tools. But these evidences are not ubiquitous and may not necessarily be obtained from the crime scene. In such a scenario, other physical and trace evidences play a pivotal role and subsequently the branches employed are forensic osteology, odontology, biometrics, etc. A relatively recent field in the branch of forensic odontology is cheiloscopy or the study of lip prints. A comparison of lip prints from the crime scene and those obtained from the suspects may be useful in the identification or narrowing down the investigation. **Aim:** The purpose of the present study is to determine the gender and population variability in the morphological patterns of lip prints among brahmins, Jats, and scheduled castes of Delhi and Haryana, India. **Settings and Design:** Samples were collected from Jats, brahmins, and scheduled castes of Delhi and Haryana. The total sample size consisted of 1399 individuals including 781 males and 618 females in the age group of 8–60 years. Care was taken not to collect samples from genetically related individuals. The technique was standardized by recording lip prints of 20 persons and analyzing them. **Materials and Methods:** Lip prints were collected by using a corporate's invisible tape and analyzed using a hand lens. The patterns were studied along the entire length and breadth of both the upper and the lower lip. The data were analyzed by SPSS statistical package version 17 to determine the frequencies and percentages of occurrence of the pattern types in each population group and a comparison between males and females among the groups was carried out by using the z test. **Results and Conclusions:** The z-test comparison between patterns of males and females shows significant differences with respect to pattern types I′, II, III, and IV among brahmins; I′, II, III, IV, and Y among Jats; and I, I′, II, III, and V among scheduled castes. Thus, it can be concluded that the variability of the lip print pattern can help sex differentiation among groups and that more studies on the lip print pattern should be carried out to bring new dimensions to forensic anthropology and to aid the law enforcement agencies.

Key words: Cheiloscopy, gender, population variability

Address for correspondence:
Ms. Jasmine Dhall,
4/57 Punjabi Bagh, New Delhi,
India.
E-mail: jasmine_1759@yahoo.
co.in

Introduction

Personal identification plays an inevitable role in forensic investigations. Personal identification methods are employed for the identification of an unknown deceased in mass disaster cases or in missing-person cases as well as for inclusion, exclusion, or identification of the suspect. Visual examination is not always possible, especially after

decomposition, facial trauma, and skeletonization. This is when fingerprints, DNA profiling, osteology, odontology, etc., play a mammoth role.[1,2] However, the availability of the aforesaid evidences is not ubiquitous. Thus, any physical or trace evidence at the scene of crime may be used for the identification or narrowing down the investigation.

Lip prints are the characteristic patterns of the fissures (*sulci labiorum*) in the form of elevations and depressions on labial mucosa present in the zone of transition between the inner labial mucosa and the outer skin. The study of the lip prints is called *cheiloscopy*. Lip prints are important because of their uniqueness (except in monozygotic twins) and permanence.[3] It is possible to identify the lip patterns as early as the sixth week of the fetal stage.[4,5] Since then, the lip print pattern remains permanent, resisting climatic change, minor traumas, inflammation, and afflictions such as herpetic lesions.[4,5] The oily and moist secretions from sebaceous and salivary glands located at the vermillion border and subsequent moisturization from the tongue enables the formation of a latent lip print.[6] Various physical evidences at the crime scene, such as photographs, letters, glass, window panes, cutlery, cigarette butts, clothing, and even biological materials such as skin may bear latent, visible, or both types of lip prints. The latent lip prints can be developed by using a wide variety of chemicals, ranging from conventional powders to lysochrome dyes (for persistent lipstick prints).[7] This trace evidence can provide information on the basis of the conclusion of the sex, occupation, habits, cosmetic used, and the pathological change to narrow down the investigation. But most importantly, lip prints can be used as an evidence for identification.[8]

It was Snyder[9] who commented on the possibility of using lip print for personal identification. Santos[10] then divided the grooves into simple and compound types. Subsequently, some classifications were given, among which is the classification given by Suzuki and Tsuchihashi,[11] who devised a classification method of lip prints that divides them into six types. They further endorsed convictions on the basis of latent lip prints obtained from the crime scene. Apart from qualitative analysis, even quantitative studies have been conducted to characterize the cosmetic from the latent lip print residue.[12]

Research and application of this field is scanty in spite of its mammoth role in forensic investigations. A database is necessary for a better comparative analysis that may be of immense help in both civil and criminal investigations. A standard protocol from collection to comparison is yet to be established to avoid rigorous interrogations in the court of law and be universally accepted.

The present study aims to provide a deeper insight into the subject and has focused on the sexual and population variability in the lip print pattern of homogeneous groups of Delhi and Haryana. This will not only give a new dimension to forensic anthropology but also give a helping hand to the law enforcement agencies.

Materials and Methods

Subjects
The total sample size consisted of 1399 individuals comprising 781 males and 618 females in the age group of 8–60 years. The subjects conformed to three population groups: brahmins, Jats, and scheduled castes of two different geographical regions – Delhi and Haryana. Informed consent was taken from each of the subjects. The subjects were selected whose lips were free from any pathologies, such as inflammation, mucocele, cicatrization, and deformities such as cut marks or lesions.

Recording the lip prints
Dark-colored, nonpersistent, nonglossy, nonmetallic with less moisture, and oil content lipsticks were used to develop clear lip prints. White papers (white A4 bilt Copy Power 75 gsm copy papers), transparent corporate's invisible cellulose tape, and tissue papers (Kleenex) were used in the process. The methodology is the same as employed by Sharma *et al*. but with slight modifications.[13] Cleaning was done by using a wet tissue paper followed by the application of a thin layer of lip balm, which was subsequently wiped off after keeping it on for 1 min. A thin layer of lipstick was applied evenly on the vermillion border and left for 3 min. A strip of corporate's invisible tape was taken slightly more than the breadth of subject's lips. The strip of the tape was gently pressed from the right side of subject's lips to the left end. It was taken care that during the process, the lips of the subject should be relaxed and slightly separated. The tape bearing the lip prints was then lifted and pasted on a white glaze paper sheet. The same technique has been used for both upper and lower lips. Care was taken that the tape covered the entire length and breadth of both the upper and the lower lip. At least five prints were taken from each subject to take into account the pressure differences and choose among them the print displaying sufficient characteristics for examination. Each print was recorded and kept in specific folder.

Examination of the prints
The obtained prints were analyzed using a magnifying lens since the lip print remains secured under the tape and can be analyzed even after 2 or more months of recording. The patterns were studied along the entire length and breadth of both the upper and the lower lip.

The lip prints were studied based on the classification of Suzuki and Tsuchihashi,[11] with modifications done by including one more pattern type as encountered in the study. Thus, the used classification was as follows: I = long

vertical grooves; I' = short vertical grooves; II = branched grooves; III = diamond grooves; IV = rectangular grooves; V = unknown patterns; Y = blend of two or more than two patterns. The data were statistically analyzed [Figure 1].

Statistical analysis

All data were analyzed using SPSS statistical package version 17 to determine the frequencies and percentages of occurrence of the pattern types in each population group as well as a comparison between males and females.

Results and Discussion

It has already been stated that latent and visible lip prints may be encountered at various types of crime scenes, ranging from burglary to murder. The prints can then be lifted from the substrata or photographed directly (if it is a visible print) and can be used for identification.[8] Lack of comprehensive database may become an obstacle for identification purposes. But in such a scenario the gender and population variability of lip prints can help in
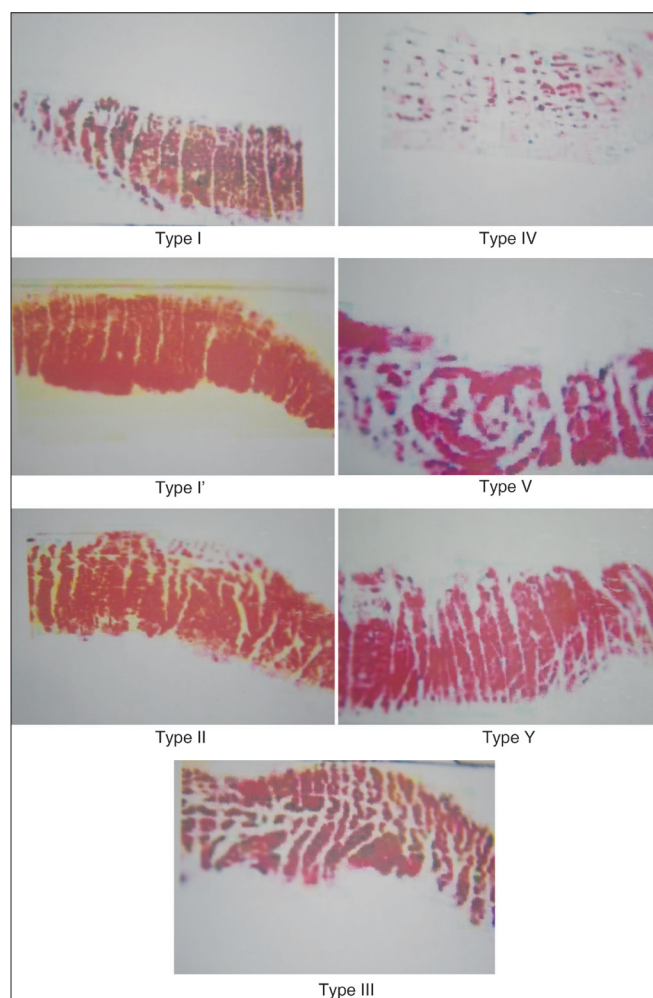

Figure 1: Various pattern types encountered: I = long vertical grooves; I' = short vertical grooves; II = branched grooves; III = diamond grooves; IV = rectangular grooves; V = unknown patterns; Y = blend of two or more than two patterns

narrowing down the investigation. Throughout the study on 1399 individuals (781 males and 618 females) comprising brahmins, Jats, and scheduled caste population groups of Delhi and Haryana, no similar lip print pattern appeared in two subjects. A variation in the lip print pattern is being seen among population groups.

The brahmins (inclusive of both Haryana and Delhi) exhibit the maximum prevalence of the groove type Y for both males and females. Pattern IV shows the minimum occurrence among males, whereas pattern V shows the minimum occurrence among females. It shows that the prevalence of pattern Y is 37.4% among males followed by patterns II (27.9%), III (27.9%), I (3.2%), I' (1.4%), and V (1.4%). The minimum occurrence is shown by pattern IV (0.8%). Likewise, in females the maximum occurrence is shown by pattern Y (40.0%), followed by pattern II (20.6%), III (18.4%), I' (12.5%), I (3.9%), and IV (3.3%). The minimum occurrence is shown by pattern V (1.3%). The *z*-test comparison between patterns of males and females shows significant differences with respect to pattern types I', II, III, and IV. Whereas the probability of finding patterns I' and IV is higher in females, the same is true for pattern types II and III in males. Likewise, the Jats of Delhi and Haryana exhibit a variation in lip prints. In males, the highest percentage of occurrence is shown by pattern III (41.7%) followed by patterns II (28.9%), Y (20.0%), I' (4.7%), and I (4.7%). Patterns IV and V are not reported in Jat males. Likewise, in females the maximum occurrence is shown by pattern Y (33.2%) followed by patterns III (29.4%), II (23.4%), I' (9.2%), and I (4.2%). The minimum occurrence is shown by pattern IV (0.6%). Pattern V is not reported in Jat females. The *z*-test comparison shows significant differences with respect to patterns I', II, III, IV, and Y; whereas the probability of finding patterns I, I', II, and III is higher in males, the same is true for patterns IV and Y in females. It has been observed among the schedule caste groups of Delhi and Haryana that the maximum prevalence is of pattern III (38.3%) among males followed by patterns Y (32.1%), II (22.1%), I' (4.4%), and I (1.9%). The minimum occurrence is shown by patterns IV (0.6%) and V (0.6%). Similarly, in females the maximum occurrence is shown by pattern Y (30.8%) followed by patterns III (24.2%), I' (18.8%), II (13.9%), I (6.0%), and V (4.8%). The minimum occurrence is shown by pattern IV (1.5%). According to the *z*-test values, the probability of finding patterns I, I', and V is higher in females and the probability of finding patterns II and III is higher in males [Table 1].

The occurrence of patterns in various percentages shows that some patterns are common to all the populations. However, the occurrence of patterns in higher percentages in one population and very low in others may lead to the conclusion that these patterns are the unique characteristics of these populations. It can be clearly seen that patterns II, III, and Y are the common patterns among the population

Table 1: Gender variation in morphological patterns of lip prints among brahmins, Jats, and scheduled castes

Pattern type	Brahmins Males Number of patterns	Percentage	Females Number of patterns	Percentage	z test	Jats Males Number of patterns	Percentage	Females Number of patterns	Percentage	z test	Scheduled castes Males Number of patterns	Percentage	Females Number of patterns	Percentage	z test
I	20	3.2	25	3.9	0.758	30	4.7	27	4.2	0.406	9	1.9	29	6.0	3.310[a]
I'	9	1.4	80	12.5	7.802[b]	30	4.7	59	9.2	3.186[a]	21	4.4	90	18.8	6.964[a]
II	179	27.9	132	20.6	3.063[a]	185	28.9	150	23.4	2.225[a]	106	22.1	67	13.9	3.274[a]
III	179	27.9	118	18.4	4.039[a]	267	41.7	188	29.4	4.613[a]	184	38.3	116	24.2	4.734[a]
IV	5	0.8	21	3.3	3.170[a]	0	0.0	4	0.6	2.003[a]	3	0.6	7	1.5	1.271
V	9	1.4	8	1.3	0.244	0	0.0	0	0.0	0.000	3	0.6	23	4.8	3.976[a]
Y	239	37.4	256	40.0	0.975	128	20.0	212	33.2	5.315[a]	154	32.1	148	30.8	0.417
Total	640	100	640	100		640	100	640	100		480	100	480	100	

[a]Significant at 5% level of significance

groups with a variation in the percentage of occurrence and dominance. Gondivkar *et al.*[14] conducted a study on 140 subjects of Indian origin and confirmed that the most predominant pattern, in the studied population, taking both the upper and the lower lip together is type II (28.59%). According to their work, type III is prevalent among males (51.05%) and type II among females (37.06 The females of all the three population groups show the Y pattern dominance. Jat and scheduled caste males show a maximum occurrence of pattern III, which is similar to the results of Vahanwala and Parekh.[15] The Brahmin males exhibit prevalence of type Y. Sharma *et al.*[13] studied the lip print patterns on the middle portion of the lips in people from Meerut, Uttar Pradesh, India, and have reported types I and I' to be the most common among females and type IV among males. They further demonstrated patterns III and IV to be dominant among males. Vahanwala and Parekh[15] conducted a study of lip patterns of 50 male and 50 female Indian subjects and concluded the Y-shaped and end-to-end patterns to be the most frequent. They further reported that 52% of the individuals have at least the same pattern in two quadrants, equally distributed in both males and females. Augustine *et al.*[16] investigated 600 individuals of rural and urban localities of Aurangabad, Maharashtra, and the study showed pattern III to be predominant when upper and lower lips are taken together. The same is true for the scheduled caste and Jat males of the present study. Other than the Indian populations, a detailed study of lip print patterns has been done by El Domiaty *et al.*[5] in the Saudi Arabian population. They divided the print into six topographic regions and reported type J (horizontal with other forms) to be the most frequent type in the upper middle area of both males and females and groove I (horizontal) to be the least frequent. They further reported the absence of type F (incompletely branched) among the lip prints of Saudi population. Among the Egyptians, a reticular pattern is reported to be common in the Lower Egypt and a complete vertical in the Upper Egypt.[17] These variations among population groups and sexes thus suggest the untapped utilization in civil, criminal, and medicolegal investigations.

Conclusion

In order to completely utilize the mammoth role of cheiloscopy in forensic investigations, it is mandatory to carry out more studies on different population groups to analyze the variations and establish a database. There is a dire need to standardize the protocols for lip print collection, development, preservation, and examination. It is essential to throw more light on the aspects of personnel identification by using cheiloscopy.

References

1. Budowle B, Bieber FR, Eisenberg AJ. Forensic aspects of mass

disasters: Strategic considerations for DNA- based human identification. Legal Med 2005;7:230-43.

2. Rai B, Anand SC. Role of forensic odontology in tsunami disasters, Internet J Forensic Sci 2007;2:1.

3. Tsuchihashi. Studies on personal identification by means of lip prints. Forensic Sci Int 1974;3:233-48.

4. Castello A, Segui MA, Verdu FA. Lumenous lip-prints as criminal evidence. Forensic Sci Int 2005;155:185-7.

5. El Domiaty MA, Al-gaidi SA, Elayat AA, Safwat MD, Galal SA. Morphological patterns of lip prints in Saudi Arabia at Almadinah Almonawarah province. Forensic Sci Int 2010;200:179.e.1-9.

6. Ball. The current status of lip prints and their use for identification. J Forensic Odontostomatol 2002;20:43-6.

7. Caldas IM, Magalhaes T, Afonso A. Establishing identity using cheiloscopy and palatoscopy. Forensic Sci Int 2007;165:1-9.

8. Kasprzak. Possibilities of cheiloscopy. Forensic Sci Int 1990;46:145-51.

9. Snyder LM. Homicide Investigation. (3rd Ed.). In: Thomas CC., Springfield, 1977.

10. Santos. Queiloscopy, A supplementary stomatological means of identification. Int Microform J Leg Med 1967;2:66.

11. Suzuki K, Tsuchihashi Y. A new attempt of personal identification by means of lip print. Can Soc Forensic Sci J 1971;4:154-8.

12. Russell LW, Welch AE. Analysis of lip sticks. Forensic Sci Int 1984;25:105-16.

13. Sharma P, Saxena S, Rathod V. Cheiloscopy: The study of lip prints in sex identification. J Forensic Dent Sci 2010;1:24-7.

14. Gondivkar SM, Indurkar A, Degwekar S, Bhowate R. Cheiloscopy for sex determination, J Forensic Dent Sci 2009;1:56-60.

15. Vahanwala SP, Parekh DK. Study of lip prints as an aid to forensic methodology. J Indian Dent Assoc 2000;71:269-71.

16. Augustine J, Barpande SR, Tupkari JV. Cheiloscopy as an adjunct to forensic identification: A Study of 600 individuals. J Forensic Odontostomatol 2008;27:44-52.

17. Youssef AT, El. Emary AT. A study of the patterns of lip prints in Lower Egypt. Proc. First Egypt Int Cong Legal Med 1987.

Author Help: Reference checking facility

The manuscript system (www.journalonweb.com) allows the authors to check and verify the accuracy and style of references. The tool checks the references with PubMed as per a predefined style. Authors are encouraged to use this facility, before submitting articles to the journal.

- The style as well as bibliographic elements should be 100% accurate, to help get the references verified from the system. Even a single spelling error or addition of issue number/month of publication will lead to an error when verifying the reference.
- Example of a correct style
  Sheahan P, O'leary G, Lee G, Fitzgibbon J. Cystic cervical metastases: Incidence and diagnosis using fine needle aspiration biopsy. Otolaryngol Head Neck Surg 2002;127:294-8.
- Only the references from journals indexed in PubMed will be checked.
- Enter each reference in new line, without a serial number.
- Add up to a maximum of 15 references at a time.
- If the reference is correct for its bibliographic elements and punctuations, it will be shown as CORRECT and a link to the correct article in PubMed will be given.
- If any of the bibliographic elements are missing, incorrect or extra (such as issue number), it will be shown as INCORRECT and link to possible articles in PubMed will be given.