

# Assessment of lip print patterns and its use for personal identification among the populations of Rajnandgaon, Chhattisgarh, India

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## Abstract

**Background:** Personal identification plays an inevitable role in forensic investigation. Lip print is one of the evidences that can be left in the crime scene, which helps in identification purpose. Hence, the present study was undertaken to provide deeper inside view of use of cheiloscopy in personal identification, focusing on sex and age variability of lip print patterns in the population of Rajnandgaon city, Chhattisgarh, India. **Materials and Methods:** The cross-sectional study was conducted among 200 (100 males and 100 females) subjects of age 15-55 years, residing in different areas of Rajnandgaon city. The sex of the individual was determined as per the description given by Vahanwala *et al.* Frequency distribution and Chi-square test were used for data analysis by SPSS 16.0 V software. **Results:** The most common lip print pattern in entire population was Type I (27.5%). Very highly significant difference was found in the distribution of lip print patterns among males and females in the entire population, group I, and group III, respectively ( $P < 0.0001$ ). The overall accuracy of cheiloscopy in sex determination was (high) 87.95%, 87.65%, 90.5%, and 80% in group 1, 2, 3, and 4, respectively. **Conclusion:** Thus, it can be concluded that lip prints can be used as one of the important forensic tools for personal identification on the basis of their age and gender variability among the populations.

**Key words:** *Cheiloscopy, forensic science, lip prints, personal identification*

## INTRODUCTION

In India, as well as all over the world today, crimes of different nature are on the rise. Both criminals and educated elite of the society are making use of sophisticated technical measures while committing their crimes, to put the forensic scientist, police, and the public off the scene. Hence, the role of crime scene detectives has become challenging than ever in this civilized modern world.

As the crime scene investigation procedures are becoming more methodical and scientific, criminals are evolving novel techniques to beat them.<sup>[1]</sup> Personal identification plays an inevitable role in forensic investigation. Visual examination is not always possible, especially after decomposition, facial trauma, and skeletonization. This is when fingerprints, DNA profiling, osteology, odontology, etc., play an important role.<sup>[2,3]</sup> The positive identification of living or deceased persons using the unique traits and characteristics of the teeth and jaws forms a cornerstone of forensic science.<sup>[4]</sup>

According to Locard's exchange principle, when two objects come into contact, there is always a transfer of material from each other. Traces from the scene may be carried away on the person and at the same time may be left at the scene.<sup>[5]</sup> Lip print is one of the evidences that can be left in the crime scene, which helps in

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identification purpose.<sup>[6]</sup> Lip prints are the characteristic pattern of the fissures (sulci laborum) in the form of elevations and depressions on the labial mucosa present in the zone of transition, between the inner labial mucosa and the outer skin, the study of which is known as cheiloscopy. Lip prints are important because of their uniqueness and permanence.<sup>[7]</sup> A lip print found at the scene of a crime can be a basis for conclusions as to the character of the event, the number of people involved, sexes, cosmetics used, habits, occupational traits, and the pathological changes of lips themselves.<sup>[8]</sup>

In the past, many researches have been conducted to study lip print stability,<sup>[1,9,10]</sup> sex determinations,<sup>[11,12]</sup> and various morphological patterns<sup>[13-16]</sup> in India and other countries.<sup>[9-16]</sup> However, previous studies lack any definitive conclusion on the relation of lip prints with age and sex, and no study on lip prints had been carried out among immigrants. Hence, the present study was undertaken to provide deeper understanding of the use of cheiloscopy in personal identification, focused on sex and age variability of lip print patterns among the immigrant population of Rajnandgaon city, Chhattisgarh, India.

## MATERIALS AND METHODS

This cross-sectional study was conducted during January–February 2013 on 200 people (100 males and 100 females) of age 15-55 years, residing in different areas of Rajnandgaon city. Multistage and random sampling technique was used to select the study population from four different zones of Rajnandgaon city. From each zone, 40 samples were selected, thus making the final sample with 200 subjects. Prior to the study, the protocol was approved by the Ethical Committee of Chhattisgarh Dental College and Research Institute, Sundra, Rajnandgaon city. All the participants were briefed about the purpose of the study, and written informed consent was obtained from them. Participants who were present at the time of the study, those who wanted to take part in the study willingly, and those whose lips were free from any active and passive lesions were included. Subjects with any inflammation, trauma, congenital deformity, or any other disease of lips or known hypersensitivity were excluded. All the lip prints were taken by a single examiner who was calibrated by and against a “senior examiner” in a pilot study of 20 participants during a 1-week period. The method of taking of lip prints and visualization was standardized in the Department of Public Health Dentistry of Chhattisgarh Dental College and Research Institute, Sundra. Inter-examiner reliability of 90% was observed.

The materials used were dark-shaded non-glossy lipstick, ear buds, cellophane tape, A-4 sized paper, scissors, magnifying lens, and tissue paper to wipe lipstick.

The survey was carried out by a self-designed format. The demographic profile of the participants was recorded separately in the consent form. Each lip print was recorded on the A-4 sized paper using the above-mentioned materials and assigned a specific code. For recording lip prints, the lips of the individuals were cleaned and sufficient dark-shaded non-glossy lipstick for the upper lip was taken on one end of the ear bud and was applied in a single stroke. Similarly, for the lower lip, the other end of the ear bud was used and discarded thereafter, thus maintaining the decorum of asepsis. The participants were asked to close the mouth, and lip prints were obtained in relaxed position. A strip of cellophane tape slightly more than the breadth of subject's lips was taken. The strip of tape was uniformly pressed from the left end to the right end of the lip, taking care that the lips of the subject should be closed and relaxed. The tape was taken out in a single jerk motion and was pasted on the A-4 size paper. At least three lip prints was taken from each subject, taking into account the pressure differences, and the print displaying sufficient characteristics for examination was chosen, which was then visualized carefully with the help of magnifying glasses. The middle part of the lower lip was considered as the study area.<sup>[13]</sup> Analysis of lip prints was done as per the classification proposed by Suzuki and Tsuchihashi,<sup>[17]</sup> which is as follows: Type I, complete vertical pattern; Type I', incomplete vertical pattern; Type II, branching or “Y” pattern; Type III, criss-cross pattern; Type IV, reticular pattern; and Type V, all other patterns. Triple blinding technique was used at the time of analyzing the lip prints. The sex of the individual was determined as per the description given by Vahanwala *et al.*<sup>[11]</sup> in which Type I, I', and II patterns dominated in females whereas Type III and IV patterns were predominant in males. Same pattern in all quadrants pattern dominate females. All the data were entered in the Microsoft Excel sheet. Statistical Package for Social Software (SPSS) 16.0 Version SPSS INC; Chicago, IL, USA was used for statistical analysis. The frequency of each type of lip print was tabulated and the percentage of each type was calculated. Chi-square test was used to compare the lip prints.  $P < 0.001$  was considered as significant and  $P < 0.0001$  as very highly significant.

## RESULTS

Out of total 200 participants, 50% were males and females, respectively. Majority (38.5%) of

them belonged to 26-35 years age group and the least were >45 years old (10%). Majority (17%) of males were of 15-25 and 26-35 years of age and majority (21.5%) of females were 26-35 years of age, while only 7.5% males and 2.5% females were >45 years of age [Table 1].

The most common lip print pattern in the entire population was Type I (27.5%) and the least common was Type V (7%). Type III (41%) lip print pattern was commonly found in males and Type V pattern was found in only 12% of males. In females, the most common lip print pattern was Type I (50%) and the least common pattern was Type II (16%) [Table 2].

In age group 1 (15-25 years), 27 (79.4%) out of 34 were correctly identified as males and 28 (96.5%) were correctly identified as females. Type III (35.2%) was the most common lip pattern among males and Type I (58.6%) pattern was commonly found in females [Table 3].

**Table 1: Demographic profile of the study population**

Age group	n (%)		
	Male	Female	Total
15-25	34 (17)	29 (14.5)	63 (31.5)
26-35	34 (17)	43 (21.5)	77 (38.5)
36-45	17 (8.5)	23 (11.5)	40 (20)
>45	15 (7.5)	05 (2.5)	20 (10)
Total	100 (50)	100 (50)	200 (100)

**Table 2: Sex wise distribution of lip print patterns**

Type	Male	Female	Total
I	05	50	55
I'	06	26	32
II	06	16	22
III	41	03	44
IV	30	03	33
V	12	02	14
Total	100	100	200

$\chi^2=13.53, P<0.0001$

**Table 3: Sex wise variation in the morphological pattern of predominant lip print in age group 1 (15-25 years)**

Type	Male	Female	Total
I	02	17	19
I'	03	05	08
II	02	06	08
III	12	01	13
IV	09	00	09
V	06	00	06
Total	34	29	63

$\chi^2=11.64, P<0.0001$

In age group 2 (26-35 years), 28 (82.3%) out of 34 were correctly identified as males and 40 (93%) were correctly identified as females. The most common lip print found among males was Type III (44.1%) and among females was Type I (51.1%) [Table 4].

In group 3 (36-45 years), 16 (94.1%) out of 17 were correctly identified as males and 20 (86.9%) out of 23 were correctly identified as females. The most common lip print found among males was Type IV (52.9%) and among females was Type I (86.9%) [Table 5].

In group 4, 80% (12 out of 15) were correctly identified as males and females, respectively. Type III (53.3%) was the most common lip print pattern among males and

**Table 4: Sex wise variation in the morphological pattern of predominant lip print in age group 2 (26-35 years)**

Type	Male	Female	Total
I	02	22	24
I'	01	11	12
II	03	07	10
III	15	01	16
IV	09	02	11
V	04	00	04
Total	34	43	77

$\chi^2=8.32, P<0.001$

**Table 5: Sex wise variation in the morphological pattern of predominant lip print in age group 3 (36-45 years)**

Type	Male	Female	Total
I	01	10	11
I'	00	08	08
II	00	02	02
III	06	00	06
IV	09	01	10
V	01	02	03
Total	17	23	40

$\chi^2=10.43, P<0.0001$

**Table 6: Sex wise variation in the morphological pattern of predominant lip print in age group 4 (>45 years)**

Type	Male	Female	Total
I	00	01	01
I'	02	02	04
II	01	01	02
III	08	01	09
IV	03	00	03
V	01	00	01
Total	15	05	20

$\chi^2=7.84, P<0.001$

Type I' (40%) pattern was commonly found among females [Table 6].

Chi-square analysis revealed very highly significant difference in the distribution of lip print patterns among males and females in the entire population ( $\chi^2 = 13.53$ ), group 1 ( $\chi^2 = 11.64$ ), and group 3 ( $\chi^2 = 10.43$ ), respectively ( $P < 0.0001$ ). Regarding the distribution of lip prints among males and females, in group 2 ( $\chi^2 = 8.32$ ) and group 4 ( $\chi^2 = 7.84$ ), significant difference was observed ( $P < 0.001$ ).

## DISCUSSION

It has already been stated that traces from the scene may be carried away on the person and at the same time may be left at the scene.<sup>[5]</sup> Lip print is one of the evidences that can be left in the crime scene.<sup>[6]</sup> The prints can then be lifted from the substrata or photographed directly for identification.<sup>[18]</sup> This may be attributed to the fact that the edges of the lips have sebaceous glands with sweat glands in between; therefore, secretion of oil and moisture enables development of latent lip prints, analogous to fingerprints.<sup>[19]</sup> Lack of comprehensive database may become an obstacle for the identification purpose. In such a situation, the sex and age variability of lip prints could help in narrowing down the investigation.

In spite of the few studies available, the current study utilizes the standard classification proposed by Suzuki and Tsuchihashi<sup>[17]</sup> to establish facts, so as to aid in getting further details of lip prints. In the present study, the lip prints were recorded in relaxed and closed positions. This may be due to the fact that the uniqueness of lip prints depends upon the relaxation of muscle to produce a particular pattern.<sup>[13]</sup> It was found that lips exhibit well-defined grooves in closed mouth position as compared to open mouth position.<sup>[12]</sup> The middle portion of lower lip, of width 10 mm, was taken as the study area in this study as per the classification proposed by Sivapathasundaram *et al.*, because this area is almost always visible in any trace and determination of pattern depends on the numerical superiority of the line of current study.<sup>[13]</sup> Lipstick–cellophane tape method was used in lifting the lip print because the lipstick–paper–cardboard description by Bindal *et al.*<sup>[20]</sup> could not produce clear lip print. However, the former method improves the visualization of the lip print.<sup>[15]</sup>

In the present study, no two lip print patterns matched each other, thus establishing the uniqueness of lip prints, which is in agreement with the report of Tsuchihashi

*et al.*<sup>[7]</sup> The most common lip print pattern in the entire population was Type I, which is in agreement with the study done by Vahanvala and Parekh.<sup>[1]</sup> While in a study conducted on Indo-Dravidian population, Sivapathasundaram *et al.* found that Type III pattern was predominant.<sup>[13]</sup> Verghese *et al.*, in their study on Kerala population, found that Type IV pattern was predominant.<sup>[15]</sup>

In the present study, the most common lip print pattern found among males was Type III, followed by Type IV and Type V, respectively. While among females, Type I was the most commonly found lip print, followed by Type I' and Type II. Various studies reported different results. Vahanwalla and Parekh reported in their study that Type III pattern was commonly found among males and type II among females.<sup>[1]</sup> Similarly, Gondivkar *et al.*<sup>[12]</sup> reported in their study that the most predominant pattern among males was Type III and among females was Type II. While Sivapathasundaram,<sup>[13]</sup> Manipady,<sup>[15]</sup> Verghese *et al.*,<sup>[15]</sup> and Sandhu *et al.*<sup>[21]</sup> reported in their study that Type III, Type II, Type IV, and Type I were the predominant lip print patterns found among males and females, respectively.

In the present study, the most predominant pattern of lip prints in age group 1 was Type I, followed by Type III and Type IV. Type III was the most common lip print pattern among males, and Type I pattern was commonly found in females. In age group 2, Type I was the most common, followed by Type III and Type I'. The most common lip print found among males was Type III and among females was Type I. Type I was the most common pattern found in group 3, followed by Type I, Type IV, and Type I', respectively. The most common lip print found among males was Type IV and among females was Type I. Age group 4 showed Type III as the most common lip print, followed by Type I' and Type IV, respectively. Type III was the most common lip print pattern in males, and among females, Type I' pattern was commonly found. These findings are in agreement with previous studies<sup>[22]</sup> that documented diversity in the pattern of lip prints among individuals of different age groups.

The overall accuracy of cheiloscopy in sex determination was (high) 87.95%, 87.65%, 90.5%, and 80% in group 1, 2, 3, and 4, respectively. This is in agreement with the study done by Gondivkar *et al.*<sup>[12]</sup> on 70 male and 70 female subjects in Maharashtra and it shows its ability to predict the high degree of accuracy. But this is not in agreement with the study done by Randhawa *et al.*,<sup>[23]</sup> in which the reported overall accuracy of cheiloscopy for



sex determination was 58.67%, 76%, and 61.33%. The variation in accuracy may be attributed to the variation in lip maturity among males and females,<sup>[24-26]</sup> the ability of lips to maintain their tonicity in late 30s,<sup>[27]</sup> occurrence of wrinkles in the adjacent face, and thinning of lips altering the lip morphology.<sup>[28]</sup>

Limitations of the present study include variations in registration and analysis of lip prints due to mobility of lips, the amount of lipstick taken, pressure direction, and the method used. Smudging of lip prints (5%) among males due to presence of facial hairs is another limitation. We had not considered the possibility of variation of lip prints with seasons, which could be a limiting factor. Postmortem analysis of lip prints has not been done in the present study.

Thus, it can be concluded from the present study that lip prints can be used as one of the important forensic tools for personal identification on the basis of their age and gender variability among populations.

Longitudinal studies with larger sample need to be conducted in future to validate the above conclusion. Studies on the lip print patterns should be carried out focusing on assessing the variability of lip prints with respect to climatic change, as well as postmortem. There is a need to develop a standardized system of classification, method of registration, and analysis with the help of software that will aid the law enforcement agencies to bring up the new vista of forensic anthropology.

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## REFERENCES

- Vahanwala SP, Parekh BK. Study of lip prints as an aid to forensic methodology. *J Forensic Med Toxicol* 2000;17:12-8.
- Budowle B, Bieber FR, Eisenberg AJ. Forensic aspect of mass disasters: Strategic considerations for DNA-based human identification. *Legal Med (Tokyo)* 2005;7:230-43.
- Rai B, Anand SC. Role of forensic odontology in tsunami disasters. *Internet J Forensic Sci* 2007;2:1540-2622.
- Sweet D. Why a dentist for identification? *Dent Clin North Am* 2001;45:237-51.
- Reddy KS. The essential of forensic medicine and toxicology. In: Forensic Science Laboratory. 30<sup>th</sup> ed. India: K. Sugana Devi; 2011.
- Dikshit PC. Textbook of forensic medicine and toxicology. In: Identification. 1<sup>st</sup> ed. New Delhi: Peepee Publishers and Distributors (P) Limited; 2007.
- Tsuchihashi Y. Studies on personal identification by means of lip

- prints. *Forensic Sci* 1974;3:233-48.
- Reddy LV. Lip prints: An overview in forensic dentistry. *J Adv Dent Res* 2011;2:17-20.
- Vahanwala SP, Parekh BK. Study of lip prints as an aid to forensic methodology. *J Indian Dent Assoc* 2000;71:268-71.
- Coward RC. The stability of lip pattern characteristics over time. *J Forensic Odontostomatol* 2007;25:40-56.
- Sharma P, Saxena S, Rathod V. Cheiloscopy: The study of lip prints in sex identification. *J Forensic Dent Sci* 2009;1:24-7.
- Gondivkar SM, Indurkar A, Degwekar S, Bhowate R. Cheiloscopy for sex determination. *J Forensic Dent Sci* 2009;1:56-60.
- Sivapathasundaram B, Prakash PA, Sivakumar G. Lip prints (cheiloscopy). *Indian J Dent Res* 2001;12:234-7.
- Saraswati TR, Mishra G, Ranganathan K. Study of lip prints. *J Forensic Dent Sci* 2009;1:28-31.
- Varghese AJ, Somesekar M, Babu UR. A study on lip prints types among the people of Kerala. *J Indian Acad Forensic Med* 2010;32:6-7.
- El Domiaty MA, Al-gaidi SA, Elayat AA, Safwat MD, Galal SA. Morphological pattern of lip prints in Saudi Arabia at Almadinal Almonawarah province. *Forensic Sci Int* 2010;200:179.e1-9.
- Suzuki K, Tsuchihashi Y. New attempt of personal identification by means of lip prints. *J Indian Dent Assoc* 1970;42:8-9.
- Kasprzak J. Possibilities of cheiloscopy. *Forensic Sci Int* 1990;46:145-51.
- Alvarez Seguí M, Miquel Feucht M, Castello Ponce A, Verdú Pascual F. Persistent lipsticks and their prints: New hidden evidence at the crime scene. *Forensic Sci Int* 2000;112:41-7.
- Bindal U, Jethani, SL, Mehrotra N, Rohatgi RK, Arora M, Sinha P. Lip prints as a method of identification in human being. *J Anat Soc India* 2009;58:152-5.
- Sandhu SV, Bansal H, Monga P, Bhandari R. Study of lip print pattern in Punjabi population. *J Forensic Dent Sci* 2012;4:24-8.
- Augustine J, Barpande SR, Tupkari JV. Cheiloscopy as an adjunct to forensic identification: A study of 600 individuals. *J Forensic Odontostomatol* 2008;26:44-52.
- Randhava K, Narang RS, Arora PC. Study of the effect of age changes on lip print pattern and its reliability in sex determination. *J Forensic Odontostomatol* 2011;29:45-51.
- Mamandras AH. Linear changes of the maxillary and mandibular lips. *Am J Orthod Dentofacial Orthop* 1988;94:405-10.
- Genecov JS, Sinclair PM, Dechow PC. Development of the nose and soft tissue profile. *Angle Orthod* 1990;60:191-8.
- Subtelny JD. A longitudinal study of soft tissue facial structures and their profile characteristics, defined in relation to underlying skeletal structures. *Am J Orthod* 1959;45:481-507.
- Gordon RW. Age grouping to optimize augmentation success. *Dent Today* 2010;29:128-31.
- Gordon RW. Vermillion Dollar Lips: Lip and Perioral Augmentation for the Cosmetic Dentist. Tampa, Florida: Vermillion Dollar Publications; 2008.

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