

Cheiloscopy - A diagnostic and deterministic mirror for establishment of person identification and gender discrimination: A study participated by Indian Medical students to aid legal proceedings and criminal investigations

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Abstract

Introduction: Positive foolproof identification of known or unknown, living or deceased individuals are the primary universal roles in forensic criminal or social investigations wherein the definite procedures such as finger printing, karyotyping, dental records play the director role although expensive and technique sensitive. Herein lies the importance of oral and peri oral tissues in which cheiloscopy is an emerging, cost effective and simple technique. Cheiloscopy (derived from the Greek word cheilos which meaning lips) is the study of characteristic patterns of depressions and elevations, anatomically found on oral mucosa. Previous studies have proved that lip prints were unique permanent records of human being analogous to finger prints, hence its classification for a particular individual can be a source of antemortem record in future for a correct identity. **Materials and Methods:** The study sample comprised of 150 medical students i.e., 88 boys and 62 girls in age group of 18–21 years of Government Medical College, Raigarh, Chhattisgarh. With prior ethical clearance (vide ethical dispatch number 200 dated December 07, 2015) and informed consent, lip prints were recorded by application of a nonsmudged but thin and even coat of dark colored lip stick over the oral labial mucosa of the upper and lower lips and transferring the obtained replica to a cellophane paper fixed on to a permanent bond paper. The lip prints were analyzed with classification of Suzuki and Tsuchihashi for discrimination of gender in addition to individual personal identification and common lip print patterns in Raigarh. **Observation and Results:** The results showed that of the total 150 students, 133 (88.67%) were correctly identified. The common lip pattern among males in the study was Type III (28.41%). Among females,

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Type I (33.87%) was the dominant pattern. Males showed grading of lip print pattern as III > IV > II > I' > I > V and females had a grading pattern was of II > I > I' > III > IV > V. **Conclusion:** As lip prints do not change during the life of a person hence still further studies needs to be undertaken to substantiate the cheiloscopy technique on the upper crest as a predominant technique for personal and gender identification.

Key words: Cheiloscopy, gender identity, lip prints, sex determination, Tsuchihashi classification

INTRODUCTION

Establishing the human identity using skeletal and dental traits has provided a comprehensive data for routine forensic investigations, law enforcement agencies, judicial system, mass disasters, legal proceedings including criminal investigations, and palaeo-anthropology and is based on proved scientific methodological ideologies and certain physical characteristics unique to an individual, the objective of which is to predict, identify and register individuals for civil, criminal and forensic purposes (Nagalaxmi, et al. 2014; Rastogi and Parida, 2011; Nagrale, et al. 2014). Although human beings belong to same species, the genetic determinants encode the distinctive characteristics of every individual facilitating the identification possible (Nagalaxmi, et al. 2014; Rastogi and Parida, 2011; Nagrale, et al. 2014). Identification of humans is a prerequisite for personal social and legal reasons (Shailesh, et al. 2009). It is well known fact that facial features differ among different races and ethnic groups (Babel, et al. 2013) Human face is not only important anatomically but is best used for its expression, beauty and individual identity (Babel, et al. 2013). Gender discrimination is the important aspect of the human identification which has helped to establish biological profile from the skeletal and dental remains and also aided in the facial reconstruction of unidentified bodies (Nagalaxmi, et al. 2014)

In India, as well as all over the world today, crimes of diverse nature are on the rise (Khanapure, et al. 2014). Both educated elite of the society and criminals are using sophisticated techniques while committing their crimes, to put the forensic dentist, police, and the public off the scene (Khanapure, et al. 2014) Hence, the role of crime detectives has become tough than ever in this sophisticated modern world. Forensic dentistry is a specialized branch of forensic medicine and may be described as that part of odontology which deals with the handling and examination of dental evidence, in which a proper evaluation and presentation of dental findings can be made (Nagalaxmi, et al. 2014). Forensic odontology has been shown to play a vital role in identification of human remains (Babel, et al. 2013). Historical records also documented the use of Forensic Odontology since 49 AD (Khanapure, et al. 2014).

Age, race, sex, stature determination, dental evidence collection, and facial reconstruction on skeletal remains are the important specialties of the forensic dentistry (Kundu, et al. 2014). Forensic identification by its nature is a multidisciplinary approach which relied on positive identification methodology as well as presumptive or exclusionary methodologies which deal with proper handling and examination of dental findings (Mujoo, et al. 2012). No two individuals in the world look alike and this concept of uniqueness have been utilized in the human identification procedures. Various methods are known to establish forensic identity but the reliability of each of these methods varies and in many cases cannot be used (Kundu, et al. 2014). Although DNA profiling, finger prints, anthropometric data, dental records can be used as standard methods, sometimes it becomes obvious to employ other methods such as cheiloscopy, palatoscopy and other odontometric measurements that are capable of giving comparatively reliable results when performed systematically (Caldas, et al. 2007).

Cheiloscopy (cheilos means lips and skopien means to see, in Greek) (Mujoo, et al. 2012) or lip print analysis is the study of characteristic pattern of elevations and depressions on oral labial mucosa called as sulci labiorum (Sultana, et al. 2014). Lip prints are normal lines and fissures in the forms of wrinkles and grooves present in the zone of transition of human lip, between the inner oral labial mucosa and outer skin or vermilion border (Dongarwar, et al. 2013; Almuhaizia, et al. 2014). Lip prints are normal Anatomical character of human lips (Saad, et al. 2005) Cheiloscopy has been reported to easier to perform and helpful due to its unique pattern and often more helpful in criminal investigations when other identification methods or parameters are either not available or difficult to analyze (Saad, et al. 2005). The interesting aspect of cheiloscopy is that the wrinkles and cracks of the lips specifically maintain the uniqueness and recordability when the question of sex determination or of identity of that person comes. Study shows that lip print pattern does not change even as age advances (Saad, et al. 2005). Since lip prints are unique like the finger prints for an individual, it has also been used as a supplementary tool to verify the presence or absence of a person at the site of crime (Sultana, et al. 2014). The significance of cheiloscopy is linked to the fact that lip prints are inherent, once developed at

the 6th month of intrauterine life they are permanent, unalterable even after death, and unique to each person except for monozygotic twins (Rastogi and Parida, 2011). It has also been confirmed that lip prints recover after undergoing alterations such as inflammation, trauma, and diseases such as herpes and that the disposition and form of the furrows does not vary with environmental factors (Dwivedi, et al. 2013). However, major trauma to lips may lead to pathosis, scarring and the surgical treatment given for lip rectification may alter the shape and size of the lips, thereby altering the pattern and morphology of grooves (Dwivedi, et al. 2013).

Dental identification, DNA comparisons, and fingerprints are the most common techniques used in this context, allowing rapid and secure identification processes. However, since these techniques cannot always be used, sometimes it is essential to apply different and less recognized techniques (Babel, et al. 2013). Article 6 of the Universal Declaration of Human Rights states that; everyone has a right to identify as a person, before the law (Harpreet, et al. 2011). Any process that possesses the possibility of assisting the forensic field in identifying a suspect should be pursued and, if discovered pertinent, utilizes in the act of criminal investigations and legal proceedings (Reddy, 2011). The use of lip prints fall into this category and because they have been proved reliable and trustworthy to link a suspect to a crime, more emphasis should be given to this field (Reddy, 2011).

Cheiloscopy reflects sharp implication and correlation with sign and symptoms of criminology. It has been noticed that criminals are still not much aware of this specialized method of criminal identification, which often makes them exposed to the court of law (Sharma, et al. 2009). In this connection detailed study of lip print will bear definite importance. Discussing these aspects, the study of such an important human anatomical presenting feature will open new horizons in today's rising criminal activities and medico legal disputes among the population. History has proved that cheiloscopy has played a crucial role in making scientists work to bring to light the lesser known facts; hence, the present study was undertaken to investigate and evaluate the uniqueness of lip impressions and correlating them with gender discrimination. Do lip impressions have the potential of sexual prediction and determination among human population? The study broadly also underlines the predominant lip pattern among participating human individuals. The research also tries to access and ascertain complete reliability in discrimination of sex of an unknown individual by cheiloscopic configurative landmarks. It may also be highlighted that this is, the first study of its kind on cheiloscopy in the State of Chhattisgarh (India).

In 1902, anthropologist R. S. Fischer first described the system of furrows on the red part of human lips. In 1932, Edmond Locard, one of France's greatest criminologists, suggested the use of lip prints in personal identification (Dwivedi, et al. 2013). In 1950, Synder mentioned in his textbook of homicide investigation that the lip grooves are individually distinct as fingerprints. Dr. Martins Santos in 1960 proposed that these lip characteristics could be used in personal identification and devised a simple system for classifying lip prints. It was in Hungary during 1961 that the first research in Europe was carried out in the subject of lip prints after lip traces had been found on a glass door at the scene of a murder proving the usefulness of the lip traces for criminalistic identification (Prabhu, et al. 2012).

In 1967, Suzuki made a detailed exploration of the lip measurement, the use and the color of rouge and method of drawing out useful data for forensic application. Later, in 1970–1971, Suzuki and Tsuchihashi carried out a study and they devised their own classification and established the biological phenomenon that the arrangement of lines and prints on the lips of an individual is unique for each human being (Mujoo, et al. 2012; Dineshshankar, et al. 2013). McDonell in 1972 conducted a study on lip prints among two identical twins and revealed that two identical twins seemed to be indistinguishable by every other mean but they had different lip prints. Cottone, in 1981, reported in his book Outline of Forensic Dentistry that cheiloscopy is one of the unique techniques used for person identification. In 1990, Kasprzak conducted research for the period of 5 years on 1500 persons to intricate the practical use of lip prints. In 1999, the Federal Bureau of Investigation and the Illinois State Police considered that lip prints are unique like fingerprints and are a useful means of identification (Dineshshankar, et al. 2013).

During the years 1985–1997, cheiloscopic techniques had been used in 85 cases, including 65 burglary cases, 15 cases of homicide, and 5 cases of assault. In 34 cases the identification was positive, which means that cheiloscopic techniques were equal in value to other types of forensic evidence. It has also been included in evidence for presentation in court (Prabhu, et al. 2012).

It was during the period 2000–2010 that studies were carried out by several researchers in India and other countries. Different aspects of the lip prints such as stability, sex determination, and various morphological patterns using lip prints among different groups of population were studied. A study on postmortem changes of lip prints was also carried out to find out the changes in anthropometric measurements of the lip region before and after fixation. All these studies were in agreement

with the Japanese research and thus helped in concluding that the cheiloscopic studies can be implemented as an auxiliary method of identification (Prabhu, *et al.* 2012).

Alvarez, *et al.* (2000 and 2002) and Vahanwahal, *et al.* (2000) gave the explanation that vermilion borders of the lips have minor salivary glands and sebaceous glands secretions and moisturizing property of which makes the latent lip prints available at most of the crime scenes. (Prabhu, *et al.* 2012) stated that lip prints can be properly recorded without the use of any recording medium with the help of suitable non porous surface. In the study of Castello, *et al.* (2005) on luminous lip prints, used luminescence as the special property for the search of invisible evidences at the scene of a crime. Recently, Vahanwahal and Parekh in 2000 conducted a study of lip patterns to promote the importance of cheiloscopy in forensic science identification.

Mujoo, *et al.* (2012) presented a research where the researchers highlighted that lip prints patterns are distinct for an individual. A statistically significant prevalence of curve and wavy form were seen in males and straight pattern in females. Khanapure, *et al.* (2014) summarized the view that statistically significant association existed between gender and lip print patterns whereas, association between geographic location and lip print was not statistically significant. They also reached a conclusion that the distribution of lip prints is unique for males and females and the association between geographic location and lip print was not statistically significant (Babel, *et al.* 2013). Malik and Goel, (2011) worked upon cheiloscopy and reached the conclusion that no two lip patterns matched each other, thus establishing uniqueness of lip prints. In their study, 48 females and 45 males were correctly discriminated on the basis of lip prints. Nagalaxmi, *et al.* (2014) published an article on cheiloscopy where statistically significant difference was found with the different lip print patterns analyzed in males and females. Sultana, *et al.* (2014) brought forward an original research regarding cheiloscopy in which the investigators reflected promising results and indicated the uniqueness of lip prints such as fingerprints for every individual. They commented that cheiloscopy hold a possible potential to determine the sex of an individual and hence can be used as records for personal identification (Lampe and Roetzscher, 1994). Dongarwar, *et al.* (2013) concluded that 18 of the actual 20 lip prints of the females and 16 of 20 males were correctly diagnosed as females and males respectively in their study on cheiloscopy. Lip prints of 38 of 40 individual were correctly matched, thus identification of the person). Almuhaizia, *et al.* (2014) presented a published manuscript on gender determination using cheiloscopy in pediatric population in which they commented critically

that no two lip print patterns matched each other thus establishing the uniqueness of lip prints. It was also found that branched grooves were the predominant pattern in both males and females. Very recently in Chhattisgarh State, researchers Nagrale, *et al.* (2014) published a paper on establishing cheiloscopy as a tool for identification on 500 subjects in central India where they dynamic results where 229 male of 250 and 226 female of 250 were positively identified.

MATERIALS AND METHODS

The study was conducted in the Department of Anatomy, Government Medical College, Raigarh (Chhattisgarh State).

Study Sample

One hundred and fifty students consisting of 1st year, 2nd year (3rd semester) and 2nd year (5th semester) MBBS students, (88 males and 62 females) were selected by convenient sampling methodology, aged between 18 and 24 years following inclusion and exclusion criteria. All participants of the study were explained in detail the broad spectrum of the study so that written informed consent could be obtained from them. All lip impressions were recorded on the same day to rule out variability.

Ethical Clearance

It was obtained from the Ethics Committee.

Inclusion Criteria

The individuals having healthy lips without any pathology and having absolutely normal transition zone between mucosa and skin (vermilion border of lips) and willing to participate in the study.

Exclusion Criteria

Individuals with embryological or acquired oro-facial/lip pathology including inflammation, traumatic/surgical scars, ulcers or other soft tissue lesion, orthodontic/orthognathic treatment, malocclusion, regressive alterations on teeth, history of cleft lip surgery and allergy/hypersensitivity to lipstick or cosmetics, or generalized skin allergy.

Study Materials

A dark colored frosted nonglossy lipstick (Revlon Red Number 64) as impression material (to be applied over the lips), cellophane tape, small painting brush (for applying and evenly spreading he lipstick), thin bond paper of size 6 cm × 3 cm (for transferring the obtained cellophane paper impression to permanent paper impression), deep pore cleanser (for cleaning the lip prior to lipstick application), white chart paper glued to a cardboard, magnifying lens (×10) (for visualization and



Figure 1: Materials used for study



Figure 2: Lip stick application

detailed study of the impression), plain glass slab (for smoothening the obtained bond paper impression), pen/pencil (for marking the individual impression), marker pens (for marking the individual impression), scissors, tissue paper, doctor's spirit, gauze with saline for removal of the lipstick, image scanner (for transferring the impressing to a computer for study), Adobe Photoshop software version 7.0 (Softonic). (To convert hard copy of impression into soft copy which may be utilized for detailed magnified computerized study) [Figure 1].

Procedure

The outer surface of the lipstick was swabbed clean on tissue paper and with doctor's spirit prior to each use for hygienic purpose. The subject was asked to open the mouth wide and lipstick applied evenly on the upper lip followed by the lower lip. The lipstick was then evenly spread over the surface of the lips with a brush. A strip of cellophane tape, 2–3 inch long was cut out with scissors. The subject was asked to open the mouth slightly, and to keep the mouth stationary during the procedure. The glued portion of the cellophane tape was then applied on the lower lip and held in place, applying gentle and even pressure for a few seconds, to allow the print to form on the tape. The subject was subsequently instructed to retain both the lips in relaxed position with the cellophane tape in place for about 2–3 min. Then the tape was carefully lifted from the lip, from one end of the strip to the other, in a single jerk avoiding any smudging of the print. The strip of cellophane tape was then stuck on to a piece of white bond paper (which serves as a permanent record) for further visualization using magnifying lens to confirm whether entire lip impression was reproduced [Figures 2-6].

Analysis of Lip-prints

The obtained lip impressions were scrutinized for quality and samples which were not clear, incomplete or smudged were declared unsuitable for whom fresh impression were prepared on the same day. The lip-prints

were scanned using an image scanner set at a resolution of 200 ppi. The images so obtained were magnified and studied using Adobe Photoshop version 7.0 software. All the scanned lip prints were analyzed using classification of Suzuki and Tsuchihashi (1974) [Table 1] as explained later. The most common pattern of lip prints among male and female student were taken into separate consideration and similarity of lip prints among two individuals among the participating subjects were also evaluated.

For personal identification

Topographically, each lip print was divided into six segments/quadrants in such a manner so that each lip has three zones; right upper lateral (UR) as the first quadrant, upper middle as second quadrant, left upper lateral (UL) as the third quadrant, left lower lateral (LL) as the fourth quadrant, lower middle (LM) as fifth quadrant and right lower lateral (LR) as the sixth quadrant [Figure 7]. For cheiloscopic evaluation only UL, UR, LL and LR were taken into consideration as proposed by classification of Suzuki and Tsuchihashi (1974). The number of furrows and lines present, their length, branching patterns, total numbers of horizontal lines, vertical lines, partial vertical lines, Y shaped pattern, intersected pattern and their combinations were counted using $\times 10$ magnifying glass in each part of every print of all 100 medical students and data tabulated for every subject. To avoid bias results, all the tabulated lip prints were compiled, analyzed and interpreted by both the collaborators to determine the sex and identity of the individual. Each lip print was coded keeping an account the name and sex of each respective individual. The name and sex of the subject to the observers were not revealed while analysis as reported in Table 1a and b.

The above coding was hidden for actual verification of obtained results. The actual coded lip print was passed on to the second investigator [Table 1b].



Figure 3: Spreading the lip stick



Figure 4: Impression over cellophane tape



Figure 5: Impression fixed on bond paper




Figure 6: Obtained impressions fixed on bond paper and coded

Table 1a: Coding of lip print for first investigator

Code	Lip print	Name	Sex
A1	Actual lip print	Mr. XYZ	Male

Table 1b: Coded lip print as received by second investigator without name of subject

Code	Actual lip print
A1	

For sex discrimination

The predominant and visible patterns in each zone considered in sex prediction which were later verified and matched with the details of the subjects for

permanent conclusions. While studying the obtained lip prints for classification, middle 10 mm of lower lip (LM) [Figures 6 and 7] was selected for the study due to clear visibility of the lines as suggested by Vahanwahal and Parekh (2000); Sivpathasundaram, et al. (2001). Since this fragment was almost always legible in any pattern, the determination of the pattern depended on numerical superiority of properties of the lines on this study area [Figure 8].

The lip print patterns were analyzed following the classification of Suzuki and Tsuchihashi (1974) [Table 2 and Figure 9]. The data were compiled and the following results were drawn.

The sex of an individual can be discriminated as decoded by Vahanwahal and Parekh (2000); Sivpathasundaram, et al. (2001) in their study.

- Type I and I' pattern dominant: Female
- Type I and II pattern dominant: Female
- Type III pattern dominant: Male

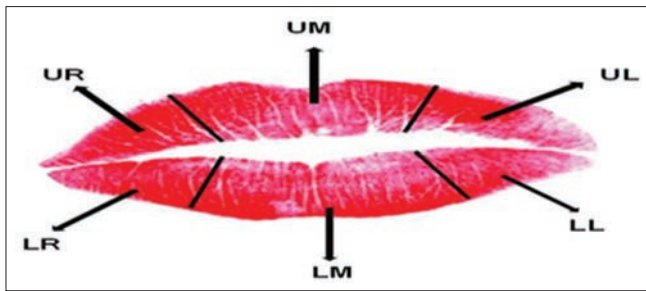


Figure 7: Topographic subdivision of lips into six quadrants for lip print analysis

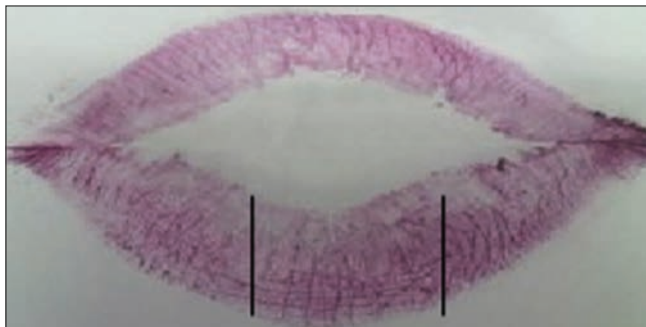


Figure 8: Middle part (10 mm) of the lower lip impression

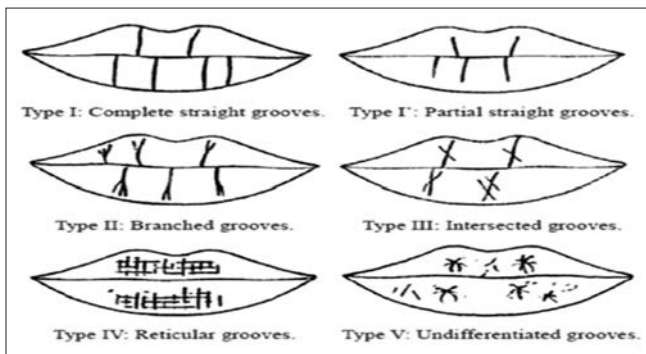


Figure 9: The pattern of lip prints by Suzuki and Tsuchihashi (1974) (pictorial representation)

- Type IV pattern: Male
- Type V patterns: Male.

The obtained results and observations were verified and decoded by each researcher with the coded data preserved at the beginning of the study [Table 3]. The result obtained were statistically analyzed with Microsoft excel work sheet.

OBSERVATIONS AND RESULTS

The research revealed the following observations:

1. All four quadrants (UR, UL, LR and LL) showed different types of lip patterns and in each quadrant there were also multiple patterns visible. No quadrant showed only single type of grooves but a combination of varied types as classified

Table 2: Suzuki and Tsuchihashi (1974) classification of lip-prints

- Type I: Clear-cut grooves running vertically across the lip
- Type I': The grooves are straight vertical but discontinuous not running entirely across the lip
- Type II: The grooves branch in their course in the shape of Y
- Type III: Intersecting grooves
- Type IV: Reticular pattern
- Type V: The grooves do not fall into any of the types I–IV, and cannot be differentiated morphologically and are irregular

Table 3: Configured and tabulated table with discriminated gender

Code	Lip print configuration	Sex determination
A1	UR - I, II, I (I) UL - II, III, III (III)	Female
	LR - III, I, I (I) LL - I', II, II (II)	

UR - Upper right, UL - Upper left, LR - Lower right, LL - Lower Left

2. Each lip print was different from the other
3. Type IV and V were predominant among males and Type I and I' were commonly seen among females
4. No male had Type I' pattern
5. No female had Type V pattern
6. Of the 150 students, 133 (88.67%) were correctly identified [Table 4 and Chart 1]
7. Total of 78 (88.64%) males and 55 (88.71%) females were correctly recognized on the basis of lip prints [Table 4 and Chart 1]
8. Seven (4.67%) participants were undecided as weather they are male or female gender and in 10 (6.67%) individuals the diagnosis of gender discrimination was wrong [Table 4 and Chart 1]
9. The study revealed almost equal correct identification of male and female gender as 88.64% and 88.71% respectively [Table 4 and Chart 1]
10. Common lip prints among all students were tabulated by taking into consideration all the 600 quadrants. The result brought forward the following facts: (i) Males 30 (8.5%) had Type I lip pattern, 40 (11.36%) had Type I', 60 (17.05%) had Type II, 100 (28.41%) had Type III lip pattern, 95 (26.99%) had Type IV and lastly 27 (7.67%) had Type V lip pattern. Females had a significant variation as 84 (33.87%) reflected Type I lip pattern, 70 (28.23%) Type I', 59 (23.79%) Type II, 15 (6.05%) Type III, 20 (8.06%) as Type IV and lastly none had Type V pattern [Table 5 and Chart 2]
11. The common lip pattern among males in the study was Type III (100 [28.41%]) [Table 5 and Chart 2]
12. Maximum females had Type I with 84 (33.87%) impressions [Table 5]
13. Type II lip impression was found almost on equal number (119 [19.83%]) among males (60 [17.05%]) and females (59 [23.79%])

14. Tables 6-9 and Chart 2 also has reflected that Type III pattern was more common on the upper lip both for males and females (91 [60.67%] in upper lip as compared to 73 [48.67%] in lower lip). While Type IV and Type V was predominant on the lower lip in both sexes
15. Twenty-three (15.33%) males showed similar lip pattern in Type I' and V while the same was 55 (36.67%) in females in Type I, III, IV and V pattern in all quadrants
16. Two zones in each lip showed similarity in patterns in 50% of the students but different patterns in other quadrants, hence aiding in identification
17. To report uniqueness and permanency, lip prints of 15 randomly chosen subjects were recorded again after 6 months and compared with the patterns obtained and preserved before to rule out any variations. Surprisingly no variations were observed indicating their permanence once they were formed doesn't change in the lifetime

This is in accordance with previous study quoting that the patterns of the vermilion zone were shown to be stable with the passage of time (Nagrale, et al. 2014).

Table 4: Cheiloscopic evaluation for gender determination

	Male	Female	Undecided	Wrong diagnosis
Actual Investigator number 2	88 (88.64%)	62 (88.71%)	7 (3 males and 4 female) out of 150 (4.67%)	10 (7 males and 3 females) out of 150 (6.67%)

Table 5: Lip patterns among all investigating males and females (600 quadrants)

Type of lip pattern	Males (%)	Females (%)	Total (%)
Type I	30 (8.5)	84 (33.87)	114 (19)
Type I'	40 (11.36)	70 (28.23)	110 (18.33)
Type II	60 (17.05)	59 (23.79)	119 (19.83)
Type III	100 (28.41)	15 (6.05)	115 (19.17)
Type IV	95 (26.99)	20 (8.06)	115 (19.17)
Type v	27 (7.67)	0 (0)	27 (4.5)
Total	352 (100)	248 (100)	600 (100)

Table 6: Lip pattern in the upper right quadrant

Types	Sex		Total (%)
	Male (%)	Female (%)	
Type 1	8 (9.09)	20 (32.25)	28 (18.67)
Type 1'	2 (2.27)	10 (16.13)	12 (8)
Type 2	26 (29.55)	28 (45.16)	54 (36)
Type 3	45 (51.14)	3 (4.84)	48 (32)
Type 4	5 (5.68)	1 (1.61)	6 (4)
Type 5	2 (2.27)	0 (0)	2 (1.33)
Total	88 (100)	62 (100)	150 (100)

18. Among males the grading of lip print pattern was III > IV > II > I' > I > V and among females the grading pattern was as II > I > I' > III > IV > V [Chart 3].

Quadrant Wise Distribution of the Lip Patterns Among the Study Subjects

Tables 6-9 show Type I lip pattern – (i) Among males is as: 8 (9.09%) in first quadrant (UR), 12 (3.64%) in second quadrant (UL), 5 (5.68%) in third quadrant (LR) and 20 (22.73%) in fourth quadrant (LL). (ii) Among females

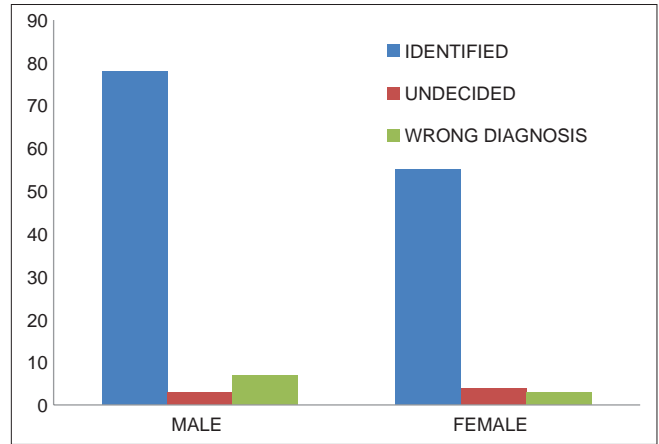


Chart 1: Cheiloscopic evaluation for gender determination

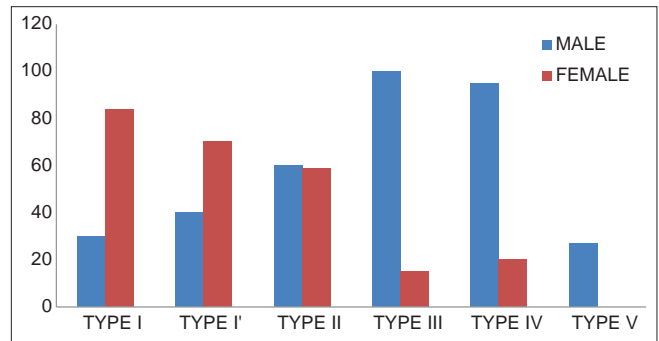


Chart 2: Lip patterns among all investigating males and females (600 quadrants)

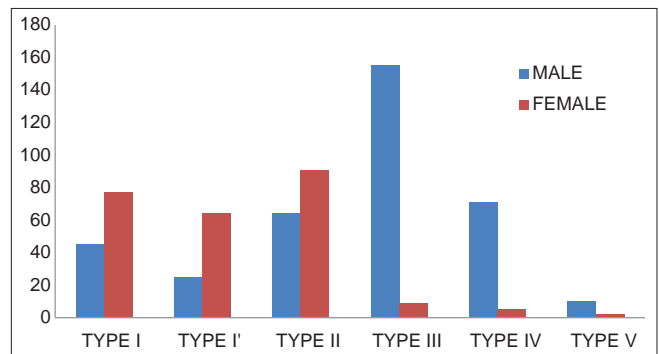


Chart 3: Distribution of overall lip patterns among males and females in all quadrants

Table 7: Lip pattern in the upper left quadrant

Types	Sex		Total (%)
	Male (%)	Female (%)	
Type 1	12 (13.64)	18 (29.03)	30 (20)
Type 1'	10 (11.36)	15 (24.19)	25 (16.67)
Type 2	12 (13.64)	23 (37.10)	35 (23.33)
Type 3	40 (45.45)	3 (4.84)	43 (28.67)
Type 4	12 (13.64)	2 (3.23)	14 (9.33)
Type 5	2 (2.27)	1 (1.61)	3 (2)
Total	88 (100)	62 (100)	150 (100)

Table 8: Lip pattern in the lower right quadrant

Types	Sex		Total (%)
	Male (%)	Female (%)	
Type 1	5 (5.68)	20 (32.25)	25 (16.67)
Type 1'	6 (6.82)	14 (22.58)	20 (13.33)
Type 2	16 (18.18)	24 (38.71)	40 (26.67)
Type 3	22 (25)	2 (3.23)	24 (16)
Type 4	36 (40.91)	1 (1.61)	37 (24.67)
Type 5	3 (3.41)	1 (1.61)	4 (2.66)
Total	88 (100)	62 (100)	150 (100)

Table 9: Lip pattern in the lower left quadrant

Types	Sex		Total (%)
	Male (%)	Female (%)	
Type 1	20 (22.73)	19 (30.65)	39 (26)
Type 1'	7 (7.95)	25 (4.32)	32 (21.33)
Type 2	10 (11.36)	16 (25.81)	26 (17.33)
Type 3	48 (54.55)	1 (1.61)	49 (32.67)
Type 4	18 (2.45)	1 (1.61)	19 (12.67)
Type 5	3 (3.41)	0 (0)	3 (2)
Total	88 (100)	62 (100)	150 (100)

is 20 (32.25%) in first quadrant (UR), 18 (29.63%) in second quadrant, 20 (32.25%) in third quadrant (LR) and 19 (30.65%) in fourth quadrant (LL).

Tables 6-9 show Type I' lip pattern – (i) among males is as: 2 (2.27%) in first quadrant (UR), 10 (11.36%) in second quadrant (UL), 6 (6.82%) in third quadrant (LR) and 7 (7.95%) in fourth quadrant (LL). (ii) Among females is 10 (16.13%) in first quadrant (UR), 15 (24.19%) in second quadrant, 14 (22.58%) in third quadrant (LR) and 25 (4.32%) in first quadrant (LL).

Tables 6-9 show Type II lip pattern – (i) Among males is as: 26 (29.55%) in first quadrant (UR), 12 (13.64%) in second quadrant (UL), 16 (18.18%) in third quadrant (LR) and 10 (11.36%) in fourth quadrant (LL). (ii) Among females is 28 (45.16%) in first quadrant (UR), 23 (37.13%) in second quadrant, 24 (38.71%) in third quadrant (LR) and 16 (25.81%) in fourth quadrant (LL).

Tables 6-9 show Type III lip pattern – (i) Among males is as: 45 (51.14%) in first quadrant (UR), 40 (45.45%) in second quadrant (UL), 22 (25%) in third quadrant (LR)

and 48 (54.55%) in fourth quadrant (LL). (ii) Among females is 3 (4.84%) in first quadrant (UR), 3 (4.84%) in second quadrant, 2 (3.23%) in third quadrant (LR) and 1 (1.61%) in fourth quadrant (LL).

Tables 6-9 show Type IV lip pattern – (i) Among males is as: 5 (5.68%) in first quadrant (UR), 12 (13.64%) in second quadrant (UL), 36 (40.1%) in third quadrant (LR) and 18 (2.45%) in fourth quadrant (LL). (ii) Among females is 1 (1.61%) in first quadrant (UR), 2 (3.23%) in second quadrant, 1 (1.61%) in third quadrant (LR) and 1 (1.61%) in fourth quadrant (LL).

Tables 6-9 show Type V lip pattern – (i) Among males is as: 2 (2.27%) in first quadrant (UR), 2 (2.27%) in second quadrant (UL), 3 (3.41%) in third quadrant (LR) and 3 (3.41%) in fourth quadrant (LL). (ii) Among females is 0 (0%) in first quadrant (UR), 1 (1.61%) in second quadrant, 1 (1.61%) in third quadrant (LR) and 1 (1.61%) in fourth quadrant (LL).

DISCUSSION OF THE OBTAINED RESULTS

The positive identification of living or deceased individual (in homicide, suicide, accident, and mass disaster) remains the backbone of forensic sciences wherein the investigator searches for known unique anatomical traits of the person. The traditional methods for personal identification include anthropometry, dermatoglyphics, sex determination, age estimation and measurement of height, differentiation by blood groups, DNA and odontology. Here lies the prime role of forensic odontology where cheiloscopy plays a significant evidential credit to unearth the credentials of the unidentified culprit.

Lip prints an important and emerging discriminatory tool in forensic criminology. If a definite description of the different parts of the upper lip and the lower lip is available for an individual by detailed study, this anti-mortem record can be used for matching the details of lip prints in postmortem records for personal identification (Dongarwar, *et al.* 2013). Lip pattern are unique for each of the examined individuals, even in twins and family relatives (Dongarwar, *et al.* 2013).

The use of lipsticks is not indispensable for leaving lip prints. In recent years, lipsticks have been developed that do not leave any visible trace with contact surfaces of glass, clothing, cutlery, and cigarette butts (or even on windows and doors) (Ball, 2002). These lip prints were characterized by their permanence (similar to karyotyping, finger print and palatal rugae) and are referred to as “persistent” lip prints. Although invisible, these prints can

be lifted using materials such as aluminum oxide powder, magnetic oxide powder and fluorescent dyes such as Nile blue, Nile red, oil red O, Sudan III and Sudan black (Ball, 2002). Anatomically, lips have sebaceous glands (Ball, 2002). Thus, secretions of glands enable development of “latent” lip prints (Ball, 2002). Even though the lines and furrows were present both in the upper and lower lip from one corner to the other, only the middle portion in the lip were taken into account, since this portion is always visible in any traces (Dineshshankar, et al. 2013). However, the use of lip prints in criminal cases was limited because the credibility of lip prints has not been firmly established in the court system (Ball, 2002). Even if environmental factors and pathologies affecting the lips could bring about changes in lip patterns, it has been observed that the lip prints reassume their former pattern on recovery (Caldas, et al. 2007). In fact, only those pathologies that damage the lip subtract-like burns seem to rule out the cheiloscopic study (Caldas, et al. 2007).

Determination of sex of an individual by forensic methodology is warranted in cases of heirship, marriage, divorce and rape. With the advent of science and complicated technologies, man has been quite successful in deceiving law. However, truth should prevail as truth. Hence, if sex of an individual is known, it is easy to shortlist the array of suspects with the motive of crime. Positive identification of lip prints concludes the fact that the beholder was a visitor or is related to the scene of crime by some means (Malik and Goel, 2011).

Cheiloscopic investigations in the index study were in accordance with the research conducted by many authors. Lip prints obtained in this study were distinct in pattern and no two patterns were similar. This was also observed in various studies. Our study deviated in the prediction of the commonest lip pattern among individuals. We reached a conclusion that the common lip pattern among males is Type III (100 [28.41%]) as compared to females with Type I with 84 (33.87%) impressions [Table 5 and Chart 2]. However, Dongarwar, et al. (2013) in their study found Type IV and Type V patterns to be dominant in males and Type I and Type I' patterns to be dominant in females. Study done by Sharma, et al. (2009) showed that Type I, I' was most commonly seen in females, whereas Type IV was seen most commonly in males. In contrast to this, study done by Rastogi and Parida (2011) showed Type I and Type I' patterns were more common in males and Type II, Type III, Type IV and Type V patterns were more common in females

In this study, we diagnosed a particular pattern on the basis of numerical excellence of types of lip patterns seen. If more than one pattern predominated, it was classified as undecided. In the present study, Type I and Type II patterns were found to be predominant in females while

Type III and IV pattern was common in males. We also observed that no lip prints matched with each other. Study conducted by Vahanwahal and Parekh (2000) showed that all four quadrants with the same type of lip prints were predominantly seen in female subjects and male subjects showed the presence of different pattern in a single individual. Similar kind of results were reported by Sharma, et al. (2009); Malik and Goel, (2011), Prabhu, et al. (2012). This fact also was also similar to our study.

There seems to be an association between geographical location and lip print. Study in Kerala done by Verghese et al. showed that Type IV was the most frequently observed in both the sexes. Gupta et al. in their study conducted in Karnataka found out that in males frequencies of lip prints: Type I > Type I' > Type III > Type II > Type IV. In females frequencies of lip prints: Type I > Type III > Type I' > Type II > Type IV. In contrast to present study, study done by Rastogi et al. to know the relationship of lip prints and geographic area showed statistically significant difference in lip print patterns of South Indians and North Indians i.e., there found to be geographic variation in lip print patterns (Babel et al. 2013). But our analysis revealed that among males the grading of lip print pattern was III > IV > II > I' > I > V and among females the grading pattern was as II > I > I' > III > IV > V in Chhattisgarh population within Raigarh District [Chart 3]. The overall grading of lip print pattern in our study of Raigarh District of Chhattisgarh is II > III > IV > I > I' > V [Tables 10 and 11 and Chart 3].

Table 10: Association between geographic location and lip print pattern

Lip print types	Kerala Khanapure, et al. (2014) (%)	Karnataka Khanapure, et al. (2014) (%)	Chhattisgarh (present study) (%)
Type I	3 (6.98)	3 (7.14)	28 (18)
Type I'	0 (0)	1 (2.38)	25 (18.33)
Type II	10 (23.26)	16 (38.1)	31 (20.83)
Type III	8 (18.6)	6 (14.29)	30 (19.17)
Type IV	20 (46.51)	14 (33.33)	29 (18.17)
Type V	2 (4.65)	2 (4.76)	7 (5.5)
Total	43 (100)	42 (100)	150 (100)

Table 11: Grading of lip print pattern

Previous study	Obtained grading of lip prints
Tsuchihashi (1974)	III>I > II>IV
Vahanwahal and Parekh (2000)	I>I'>II>IV>III
Malik and Goel (2011)	I>IV>V > I'>II>III
Nagalaxmi, et al. (2014)	III>I'>II>IV>V > I
Nagrle, et al. (2014)	II>III>I > I'>IV
Khanapure et al. (2014)	IV>II>III>I > V>I'
Sultana et al. (2014)	I>III>I'>IV>II>V
Almuhaizia et al. (2014)	III>II>I > IV>V
Present study	II>III>IV>I > I'>V

The grading of lip print pattern in our study can be statistically compared with similar thesis work of other researchers as per the following bibliographic data:

The grading of lip impression in all the 4 quadrants can also be compared with previous studies with that our research works [Table 12].

CONCLUSION

The antiqueness, permanency, and stability shown by the relatively emerging promising Cheiloscopy technique in identification of an unknown living or deceased individual elicit the robustness of the technique in itself. Nothing further needs to be commented in the necessity of adopting lip print impression technique as one of the principal tools of forensic discriminatory methods so that investigative procedures can scale new height of accuracy and dependability.

No similarity was depicted in the cheiloscopic study between lip impressions of same sex, same age group and similar race and ethnic origins of an unknown person. The results got verified and validated by itself when no change in the lip prints were noticed even when repeat impression were made 6 months after the original impression suggesting that lip prints are truly an important ancillary and supplemental tool for forensic criminology.

Cheiloscopic methodology should accordingly be utilized to identify the following four classes of lips: (a) Thin lips (common in the European Caucasian); (b) medium lips (from 8 to 10 mm, is the most common type); (c) thick or very thick lips (usually having an inversion of the lip cord and are usually seen in negroes); (d) mix lips (usually seen in orientals). Lip patterns remain a constant anatomical structure from time immemorial, hence attempt should be processed in creating anti-mortem database of lip prints so that the tedious work of forensic experts may be made less cumbersome.

Table 12: Comparison of lip pattern among quadrants from previous studies

Previous studies	Grading of the lip pattern	
Saraswathi et al. (2009)	UR	III>I>II>IV
	UL	III>II>I>IV
	LR	III>II>I>IV
	LL	III>II>I>IV
Nagrath et al. (2014)	UR	II>III>I>I'>IV
	UL	II>III>I>I'>IV
	LR	III>I'>I>II>IV
	LL	II>IV>I>III>I'
Present study	UR	II>III>I>I'>IV>V
	UL	III>II>I>I'>IV>V
	UR	II>IV>I>III>I'>V
	LL	III>I>I'>II>IV>V

UR - Upper right, UL - Upper left, LR - Lower right, LL - Lower Left

Though cheiloscopic technique is not an infallible method, but the findings of the current paper do promise ample light to the investigative procedures of civil and criminal issues.

Limitations of the Study and Recommendations

Although the study is quite extensive, it is not complete in itself. Factors may certainly modify lip impressions. The patterns depend on the anatomical position of the lips. The grooves are better elucidated in closed mouth approach than open mouth technique. Erroneous results occur in cases of lip lesions and/or loss of anterior teeth. The lip print appearance may also be modified by the pressure, direction used while making the impression.

However, to improve the practical potential applicability of cheiloscopy, further studies with larger sample size including pediatric population, family members, twins, siblings, and persons of varied ethnicity are recommended to determine the relation between lip prints and geographical location so that investigators and anthropologists benefit from the diagnostic and prognostic value of the simple, inexpensive procedure by name cheiloscopy to enable cheiloscopy one step further closer to the truth to shortlist the array of suspects with a intention of crime.

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Conflicts of Interest

There are no conflicts of interest.

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