

Cheiloscopy: An identification tool in personal authentication

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ABSTRACT

Background: Identification of sex and ethnicity has always been a challenge in the field of forensic medicine and criminal investigations. Fingerprinting and DNA comparisons are probably the most common techniques used in this context. However, since they cannot always be used, it is necessary to apply different and less known techniques such as lip prints. The objective of this study is to determine predominant lip print pattern found among population of Siwan district of Bihar (India) and to evaluate whether any sex difference exists. **Materials and methods:** To accomplish the proposed objectives of the study a total 110 volunteers (55 males and 55 females) were recruited and the lip prints were collected on a white bond paper. Each lip print was divided into four compartments and were classified and scored according to Suzuki and Tsuchihashi classification. Data were statistically analyzed. **Results:** The results showed that the overall, Type II (Branched) was the most frequently observed and Type V (Undetermined) was least frequently observed pattern in the examined subjects of the Siwan (Bihar) population in India. Type II (Branched) lip print pattern was found to be most commonly found in both sexes i.e., males and females. In male lip prints, the order of appearance of patterns were Type II > Type I' > Type III > Type I > Type IV > Type V (least common) and in female lip prints, the order of appearance of patterns were Type II > Type I' > Type IV > Type III > Type I > Type V (least common). **Conclusion:** This study contributed to the cheiloscopic characterization of an Indian sample and, despite the results of the present study, does not prove that sex determination through cheiloscopy is perfect. It is established that there is no similarity of lip prints from one individual to another individual and between males and females.

Keywords: Lip print pattern, Cheiloscopy, forensic science, Human identification

INTRODUCTION

In the field of criminal investigations and forensic medicine, human identification has always been a challenge (Dikshit, 2007; Kundu *et al.*, 2016). Identification plays a major role in any crime investigation. Establishing the human identity using skeletal and dental traits has provided a comprehensive data for routine forensic investigations and is based on proved scientific methodological ideologies and certain physical characteristics unique to an individual (Rastogi and Parida, 2011; Nagalaxm *et al.*, 2014; Nagrale *et al.*, 2014; Aziz *et al.*, 2016). In human identification, various well known techniques like fingerprints, retina, dental record and blood group etc. have already been implemented. Fingerprinting and DNA typing are probably the most common techniques used in this context. There is an increasing awareness of such advanced techniques in crime detection among general public, proportion of offences are committed with deliberate attempts not to leave behind any fingerprint at the crime scene. In such cases, there is a need of alternative methods that are equally reliable and dependable. This fact has raised the attention of investigating officers/scientists to apply different and less known techniques such as cheiloscropy. Cheiloscropy deals with the study of lip prints. Cheiloscropy (from the Greek words *cheilos* meaning 'lips' and *e skopein* meaning 'to see') is the name given to the lip print studies (Molano *et al.*, 2002). Lip prints are normal lines and fissures in the form of wrinkles and grooves present in the zone of transition of human lip, between the inner labial mucosa and the outer skin. They are arranged in various shapes and drawings, which are individual for each person (Choras, 2010). The importance of cheiloscropy is linked to the fact that the lip prints are unique to one person, except in monozygotic twins (Neville *et al.*, 2002; Rastogi and Parida, 2011). Like fingerprints and palatal rugae, the lip grooves are permanent and unchangeable (Saad *et al.*, 2005). It is possible to identify the lip patterns as early as the 6th week in uterine life (Caldas *et al.*, 2007; Koneru *et al.*, 2013). From that moment on, the lip groove patterns rarely change, resisting many afflictions, such as herpetic lesions. Analysis of the lip prints left at a scene of crime, and their comparison with those of the suspected person may be useful for identification. No two people have identical lip furrows arrangement. Those patterns are identifiable as early as the sixth week of intrauterine life. A lip print at the scene of crime can be a clue for the character of the event, the number of the people involved, sexes, cosmetics used, habits, occupational traits, and the pathological changes of the lips themselves, which help in the reconstruction of the crime.

Lip print patterns can lead us to important information and helps in person's identification. The grooves present on human lip are unique to each person and can be used to determine identity (Malik *et al.*, 2011). Depending upon the scenario of/at the crime scene, lip prints may be found on various physical evidences at the crime scene, such as shirt, handkerchief, tissue paper/wipes, cups, photographs, letters, glass, window panes, cutlery, fruit skin/peel, cigarette butts, clothing, and even biological materials such as skin (Kavitha *et al.*, 2009; Vats *et al.*, 2012). So lip prints are useful in forensic investigations and are considered to be important forms of transfer evidence, and are analogous to fingerprints. The present study has been designed in the view of the importance of lip prints found at the crime scene for identification of an individual. So, this preliminary study will help to contribute data regarding the predominant type of lip print pattern and sex-dependent variations in the lip prints if any, among population of Siwan district of Bihar, India.

MATERIALS AND METHODS

Study Design and Sampling

To accomplish the proposed objectives, the present study enrolled a total of 110 unrelated healthy subjects (55 males and 55 females) from Siwan district of Bihar (India). The age group of the subjects was 15-30 years. Age distribution of the studied participants is given in **Table 1** and mean age of males and females was 16.6 years and 17.27 years, respectively. Data collection was done by purposive sampling method. An informed consent as per Indian Council of Medical Research (ICMR) guidelines was obtained prior to sample collection from all the participants enrolled. Information regarding name, gender, age, ethnicity and current residence of the each subject was recorded. Inter-observer error was calculated on 20 samples and was found to be 90% reliable.

Inclusion and Exclusion Criteria

The individuals having healthy lips without any pathology and having absolutely normal transition zone between mucosa and skin (vermilion border of lips) and were willing to participate in the study were included. Subjects with any known hypersensitivity to lipstick or evidence of any pathology such as inflammation and deformities such as cut marks or lesions of lips were excluded from the study.

Materials required for recording Lip Prints

For the purpose of lip print collection the materials used included Dark, bright color non glossy lipstick, transparent cellophane tape, white bond paper, pencil, ruler and magnifying lens.

Technique Used

The subjects were asked to clean their lips, and then the lipstick was applied on the lips, subsequently, with a single stroke. Lip “impressions” was recorded in the normal rest position of the lips by dabbing a strip of cellophane tape, 10 cm long, in the center first and then pressing it uniformly toward the corners of the lips, taking care to avoid sliding of lips to prevent smudging of the lip print. (Williams, 1991) After that, the cellophane strip was then stuck on to the white bond paper for permanent record purpose and then the recorded lip prints was visualized with a magnifying lens. Details from each individual participating in the study (sex, age and residence) were documented. To ensure the blind study, each lip print was assigned a serial number and the identity regarding the sex of an individual was not disclosed at the time of analysis.

Classification Used

In the present study, Lip patterns are classified on the basis of the classification proposed by two Japanese Scientist Suzuki and Tsuchihashi, (*Suzuki and Tsuchihashi, 1971 and Tsuchihashi, 1974*). According to their classification, there are 5 types of lip print (**Figure 1**)

Analysis of the Lip Prints

Each lip print obtained on bond paper was divided into four quadrants by drawing a horizontal line that demarcates the upper lip from the lower one and a second median vertical line (Medline) that divides lips into right and left halves with the help of pencil and ruler. Right upper as the first quadrant, left upper as the second quadrant, left lower as the third quadrant, and right lower as the fourth quadrant, in a clockwise sequence starting from the upper right side of the lips as showing in **Figure 2**. The lip prints were observed using magnifying lens (with direct light focused on it) and were categorized into particular type depending on the predominant pattern. According to Suzuki and Tsuchihashi classification, the determination of the pattern in each segment of the lip was based on the numerical superiority of properties of the lines on the fragment (Suzuki and Tsuchihashi, 1971; Tsuchihashi, 1974; Sharma *et al.*, 2009) Then, scoring the different types of the lip print in each quadrant follow; type I was given score 1, type I' score 2, type II score 3, type III score 4, type IV score 5 and type V score 6.

Statistical Analyses

Statistical methods were used to organize and interpret large volumes of numerical data. The data collected were entered into MS-Excel 2007. The data was then analyzed statistically using SPSS (Statistical Package for Social Sciences, version 16.0) computer software (SPSS, Inc., Chicago, IL, USA). Arithmetic mean and standard deviation of age was computed. The frequency of each type of lip print pattern was tabulated and the percentage of each type was calculated. The frequency distribution of different types of lip prints patterns in each quadrant were compared using Chi square test. The level of significance was set at $p \leq 0.05$.

RESULTS

In the present study, overall, Type II (Branched) pattern was found to be the most frequent and Type V (Undetermined) was the least frequently observed pattern (**Table 2**). A Type II (Branched) pattern was the most predominant in both sexes and accounted for occurrence of 32% and 26% in males and females (**Table 3**). In male lip prints, the order of appearance of patterns were Type II > Type I' > Type III > Type I > Type IV > Type V (least common). In females also the Type II lip print pattern was the most commonly found which was followed by, Type I' > Type IV > Type III > Type I > Type V (least common) (Table 3 & figure 3). **Table 4** demonstrated quadrant wise distribution of lip print patterns among studied population. In quadrant 1 the frequency of type I' pattern was highest in males and type III in females. In quadrant 2 the frequency of type II pattern was highest in males and females and type V was least in both sexes. It was observed that in quadrant 3 the frequency of pattern I' and II was in equal in females and pattern II was highest in males. In quadrant 4 the incidence of type I' pattern was highest in males and type II in females and type V pattern was least in both males and females.

Table 5 revealed significant differences between males and females in quadrant 3 where ($p=0.025$). There was a not significant difference between both sexes in quadrant 1, 2 and 4.

DISCUSSION

Detailed studies of each lip print have shown that each print is unique and remain unchanged during a person's lifetime (Vahanwalla and Parekh, 2000; Sivapathasundharam *et al.*, 2001; Gondvikar *et al.*, 2009; Saraswathi *et al.*, 2009; Singh *et al.*, 2010; Redd, 2011). If a definite

description of the different parts of the upper lip and the lower lip are established 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 (Saraswathi *et al.*, 2009). According to Kautilya *et al.*, 2013 lip print patterns are an effective method of determining the gender of an individual, especially when the prints are corroborated with the diameter of the lips. In spite of the few studies available, the current study utilizes the standard classification proposed by Suzuki and Tsuchihashi, 1970 to establish facts, so as to aid in getting further details of lip prints. If the lip prints are visible the prints can directly be used for the purpose of analysis but these days lipsticks are available in the market that do not leave any trace on the object of contact. In such cases, these prints can be lifted by aluminum and magnetic powders (Castellu *et al.*; 2005; Segui *et al.*, 2000). 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. Lip prints can be classified by various methods including Renaud's, Afchar Bayat's, Jose Maria Dominguez's classification (Costa and Caldas, 2012). The present study used the classification suggested by Suzuki and Tsuchihashi (1970) which is most commonly used worldwide. In the present study, it was observed that type II (Branched) was more common in both sexes 32.27 % in male and 26.36% in females. Similar pattern (dominance of Type II lip print pattern) was also reported by Costa and Caldas, 2012 in portugues population. Further, statistical significant difference was obtained between the predominating pattern of lip prints in male (Type III) and female (Type II) subjects. The results of the present study are in agreement with those of Govindkar and Indurkar (2009) who observed lip patterns in 140 subjects (70 males and 70 females) and found that type II pattern (37.06%) was dominant in females while type III pattern (51.05%) was more common in males. However, the results of the present study were contrary to the findings of Aziz *et al.*, 2016 who observed that type III lip print pattern (intersected grooves) was the most common type in both the Egyptian and Malaysian populations. Comparison of the lip print patterns between males and females of the present and the previous studies is presented in **Table 6**. Vahanwala *et al.*, 2000 and Narang *et al.*, 2011 reported in their studies that type III and type I patterns were predominant in males and females among the population of Mumbai and Amritsar respectively. Whereas; Sharma *et al.*, 2009 studied Merrut (Uttar Pradesh) population and reported the predominance of type IV and type I lip print patterns among males and females respectively. The

results of the present study were also similar to the findings of Bindal *et al.*, 2009 where lip print pattern of Dehradun (Uttarakhand) population revealed that the predominant pattern was type II in both male and females. An Another study conducted by Gupta *et al.*, 2011 in Lucknow (Uttar Pradesh) on observed that type II and type III were predominant patterns in male and females respectively. Kapoor and Badiye, 2015 worked among Nagpur population and they reported that type I in male and type III in female was predominant type of lip print pattern. In the present study, significant differences between males and females was observed in quadrant 3 only and are in concordance with the study conducted by Aziz *et al.*, 2016 in Egyptian and Malaysian populations. There was non-significant difference between both sexes in quadrant 1, 2 and 4. These findings were not in agreement with the study conducted on Marathi population of India where, all the quadrants were found to be statistically different from each other among both males and females (Kapoor and Badiye, 2015). A study conducted by Vahanwala, 2000 reported that females exhibited predominant type of pattern in all the four quadrants; however, males demonstrated the presence of different types of print patterns in a single subject (Sharma *et al.*, 2009).

The present study demonstrated the utility of evidential analysis of morphological features of lip prints used in forensic investigations. Lipstick smears can lead to indirect proof of a relationship or contact between a victim and a suspect or a suspect and a crime scene. The lip print appearance may be affected by the pressure, direction and methodology used while taking the impressions. Lip prints bring added evidence to a crime scene that can be of value, especially in cases lacking other evidence. In the present study we found that Type II lip prints were predominated in males and females of the Siwan district of Bihar (India).

Conclusion

Fingerprints and Lip prints can be left at crime scenes and can provide a direct link to a suspect and can be basis for personal identification. A major drawback of the cheiloscopy studies is that there is lack of antemortem data, which obviously impairs a comparative study. This study contributed to the cheiloscopic characterization of an Indian sample. It is established that there is no similarity was depicted in lip print patterns from one individual to another individual and between males and females.

Further studies with a larger sample size need to be performed to confirm specific lip patterns among males and females. Lip patterns are an important form of transfer physical evidence. They

should not be overlooked and can be a supplement to other forensic aid tools for the detection of sex and the identification of individuals, when needed, for investigative procedures.

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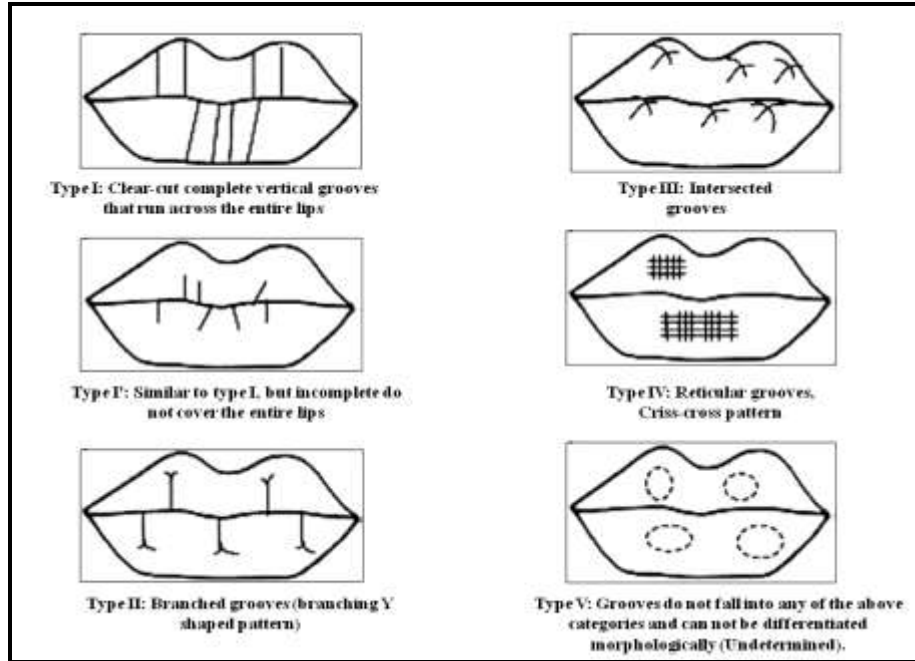


Figure: 1 Classification of Lip patterns according to Suzuki and Tsuchihashi (1971) and Tsuchihashi, (1974)

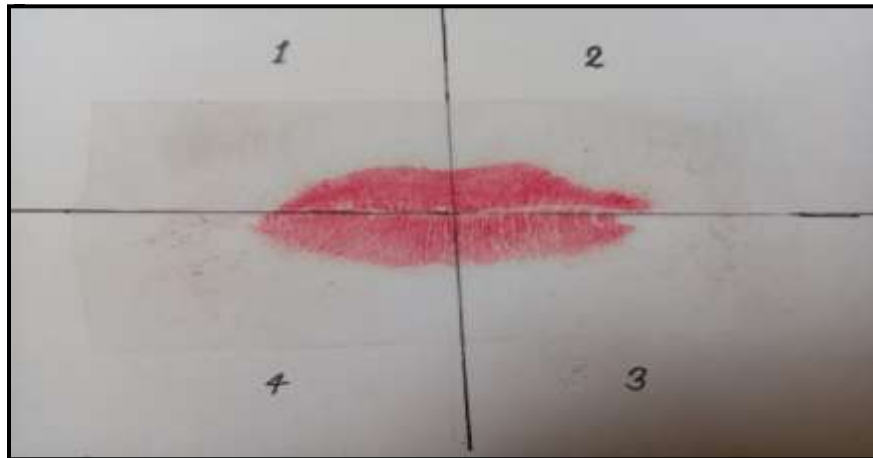


Figure: 2 Lip divisions into four quadrants

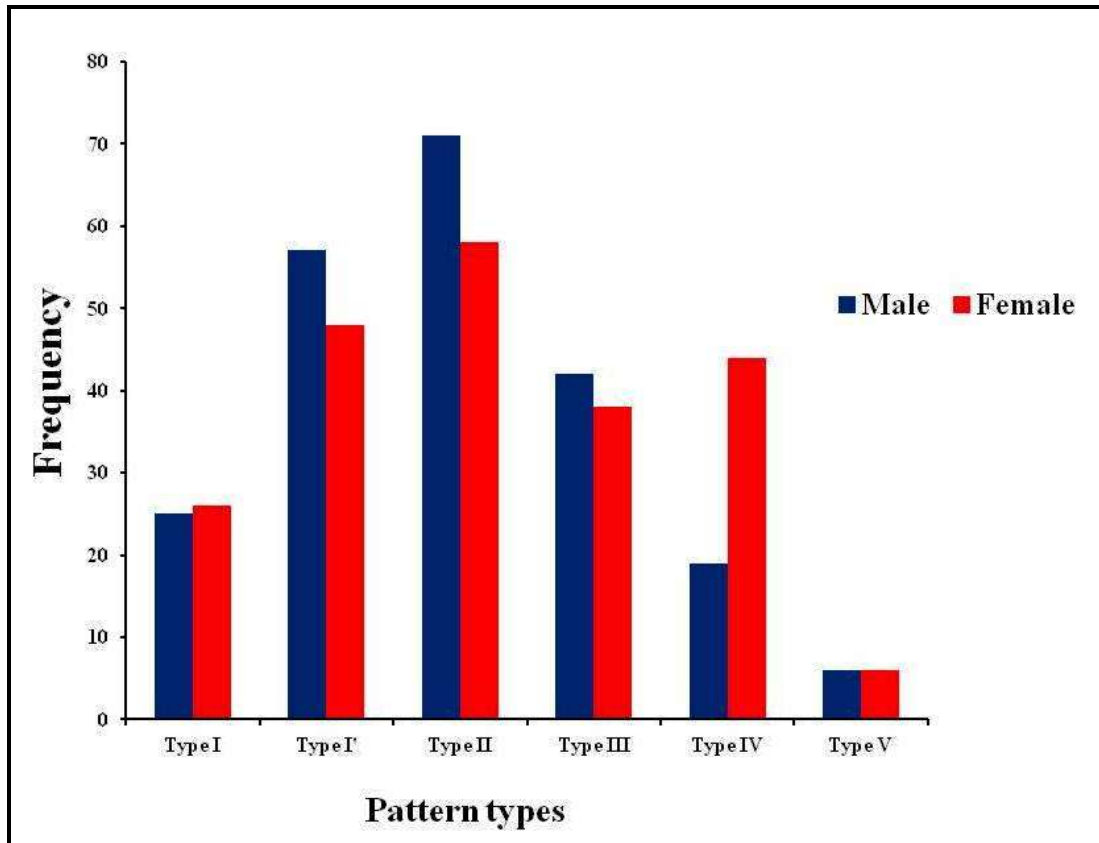


Figure: 3 Percentage Distributions of Lip Print Patterns in the Studied Population.

Table 1. Age Distribution of Study Samples of Studied Population

Age (in Years)	Minimum	Maximum	Mean	S.D.
Male(n=55)	15	30	16.60	3.14
Female(n=55)	15	28	17.27	3.39

S.D: Standard Deviation

Table 2. Percentage Distribution of Lip print Patterns in the Studied Population

Lip patterns types	All quadrants %
Type I	11.61
Type I'	23.86
Type II	29.32
Type III	18.18
Type IV	14.32
Type V	2.72
Total	100

Table 3. Distribution of Lip print Patterns among Males and Females

Patterns	Distribution of Lip Prints			
	Male		Female	
	n	Percentage	N	Percentage
Type I	25	11.36	26	11.81
Type I'	57	25.90	48	21.81
Type II	71	32.27	58	26.36
Type III	42	19.09	38	17.27
Type IV	19	8.63	44	20
Type V	6	2.72	6	2.72
Total	220	100	220	100

Table 4. Quadrant wise distribution of Patterns in Lip Prints of Males and Females in Studied Population

Lip Print Type	Q1				Q2				Q3				Q4			
	Male		Females		Male		female		Male		Female		Male		Female	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
I	6	10.9	4	7.3	6	10.9	4	7.3	4	7.3	8	14.5	9	16.4	10	18.2
I'	14	25.5	12	21.8	9	16.4	9	16.4	17	30.9	14	25.5	17	30.9	13	23.6
II	13	23.6	11	20	21	38.2	17	30.9	22	40	14	25.5	15	27.3	16	29.1
III	12	21.8	14	25.5	12	21.8	14	25.5	8	14.5	4	7.3	10	18.2	6	10.9
IV	6	10.9	10	18.2	6	10.9	10	18.2	3	5.5	15	27.3	4	7.3	9	16.4
V	4	7.3	4	7.3	1	1.8	1	1.8	1	1.8	0	0	0	0	1	1.8

Q- quadrant

Table 5. Statistical analysis results (Applying the Chi square test) of lip print patterns

	Q1	Q2	Q3	Q4
χ^2	1.541	1.864	11.103	4.190
df	5	5	5	5
Probability	0.819	0.761	0.025*	0.381

Q=Quadrant

χ^2 = Value of Chi square, df = Degree of Freedom

*Significant at p <0.05

Table 6 Comparison of Lip Print Patterns of Present Study with Various Studies

References	Year of Study	Region	Lip Pattern
Vahanwalla <i>et al</i>	2000	Mumbai, Maharashtra	Predominant Pattern: In Males: Type III In Females: Type I
Sharma <i>et al</i>	2009	Meerut, Uttar Pradesh	Predominant Pattern: In Males: Type IV In Females: Type I
Bindal <i>et al</i>	2009	Dehradun, Uttarakhand	Predominant Pattern: Males and Females: Type II
Narang <i>et al</i>	2011	Amritsar, Punjab	Predominant Pattern: In Males: Type III In Females: Type I
Gupta <i>et al</i>	2011	Lucknow, Uttar Pradesh	Predominant Pattern: In Males: Type II In Females: Type III
Kapoor and Badiye	2015	Nagpur, Maharashtra	Predominant Pattern: In Males: Type I In Females: Type III
Present Study	2017	Siwan, Bihar	Predominant Pattern: Males and Females: Type II