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RESEARCH ARTICLE

EXTENT OF LIP PRINT PATTERN VARIATION AMONG PEOPLE OF RAIPUR, CHHATTISGARH, INDIA

***Moumita Sinha, Aditya Kar and Mitashree Mitra**

Pt. Ravishankar Shukla University

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ABSTRACT

Cheiloscopy is the forensic investigation technique that deals with identification of humans based on lip traces. Lip prints are the normal lines and furrows in the form of wrinkles and grooves present in the zone of transition of the human lip between the inner labial mucosa and outer skin, the study of which is known as Cheiloscopy. In the forensic investigation mouth has immense potential for the evidences. Lip prints and palatal rugae are unique to an individual. The present study is an attempt to determine the pattern of lip prints and evaluate its uniqueness in a sample of Chhattisgarh population and also their association with gender and age. In the present work, examination of the pattern of the print in the four quadrants of the lip revealed that no individual had a single type of lip print and no two or more persons had similar features of lip grooves. From the results of the present study it can be shown that lip print patterns in all 101 subjects were distinct and none of the patterns were identical. This finding was in concordance with results obtained in the studies conducted earlier. No significant association were observed which supports that lip print patterns keeps changing during an individual's lifetime and confirms the permanence of lip prints. Lip prints are also capable for individual identification in criminal investigation. In future, studies on samples from different geographical regions and ethnic races will help to determine the geographical origin and probable race of questioned lip prints. Thus, it can be said that lip prints do have potential for use as corroboratory evidence in criminal investigations.

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Pt. Ravishankar Shukla University.

INTRODUCTION

Personal identification is essential for unknown deceased persons in homicide, suicide and accidents. The traditional methods of personal identification include anthropometry, odontology, sex determination, age estimation and differentiation by blood groups, DNA and fingerprints (Tsuchihashi, 1974). Cheiloscopy (from the Greek word cheilos which means lips) is the forensic investigation technique that deals with identification of humans based on lip traces (Kasprzak, 2000). Lip prints are the normal lines and furrows in the form of wrinkles and grooves present in the zone of transition of the human lip between the inner labial mucosa and outer skin, the study of which is known as Cheiloscopy (Sivapathasundharam *et al*., 2001; Caldas *et al*., 2007). In forensic identification, the mouth allows for so many possibilities. Dental surgeon has an active role in various objectives of forensic dentistry like age and sex determination, personal identification of unknown deceased person, analyzing bite marks as evidence, participating in mass disaster, giving evidence in child abuse etc. Collection of information from bite marks, lip prints and teeth in crime scene such as murder and rape can play a major role in criminal investigations (Rastogi and Prateek, 2011). The biological phenomenon of systems of furrows on the red part of human lips was first noted by anthropologist Fischer 1902. The theory of uniqueness is a strong point used in the analysis of fingerprints and bite marks to convince the court of law (Vahanwalla and Parekh, 2000). Likewise even lip prints and palatal rugae patterns are considered to be unique to an individual and hence hold the potential for personal identification. They can be recorded and used as evidence in personal identification and criminal investigation. Like fingerprints they can also be classified as per Suzuki's classification system and identified. They remain same throughout life and are uninfluenced by environmental changes, diseases and trauma. Lip prints could also contribute in evidence seeking process of forensic study. The lipstick marks left over certain objects are characterized by their permanence and persistence.

****Corresponding author: Moumita Sinha,***

They could be utilized for investigations even after lapse of few days. This makes it important evidence in cases of homicide and suicide. The importance of Cheiloscopy linked to the fact that lip prints are genetic, once developed at the 6th intrauterine life they are permanent, unchangeable even after death and unique to each person except in monozygotic twins (Tsuchihashi, 1974).

In 1967, Santos was the first person to classify lip grooves. He divided them into four types namely:

- Straight line
- Curved line
- Angled line
- Sine- shaped curve

Suzuki and Tsuchihashi in 1970 devised a classification method of lip prints which is as follows:

- Type I: Clear- cut vertical grooves that run across the entire lips.
- Type I^{I}: Similar to type I, but do not cover the entire lip.
- Type II: Branched grooves (Branched Y- shaped pattern).
- Type III: Criss-cross pattern, reticular grooves.
- Type IV: Rectangular grooves.
- Type V: Other patterns

The present study is an attempt to determine the pattern of lip prints and evaluate its uniqueness in a sample of Chhattisgarh population and also their association with gender and age.

MATERIALS AND METHODS

The study was conducted on randomly selected 101 postgraduate students of age 18-35 years from Pt. Ravishankar Shukla University, Raipur, Chhattisgarh, India during July-August 2012. Written informed consent lip prints of 50 male and 51 females were collected. Students with known hypersensitivity to lip sticks, with any inflammation of lips, malformation, surgical scars, deformity and lip lesions were excluded from the study. Materials used include mainly dark colored lipstick, bond paper, cellophane tape (two inch wide), a brush for applying the lipstick and a magnifying lens. Complete lip area is divided into four quadrants in clockwise direction namely, quadrant I, quadrant II, quadrant III and quadrant IV. The pattern of lip prints and their combinations were observed and noted in coded form, keeping in account the name and sex of the respective individuals.

Technique

The lips of the individuals were cleaned and brown-colored lipsticks were applied on the lips. The subject was to make a lip impression in the normal rest position of the lips by dabbing them against a bond paper and then pressing it uniformly toward the corners of the lips. While studying the various types of lip prints, each individual's lips were divided into four compartments i.e. two compartments on each lip, and were allotted the quadrants 1-4 in a clock-wise sequence starting from the subject's upper right as per Zsigmondy-Palmer system of dental charting.

RESULTS

Lip print impressions were obtained from both male and female subjects and were classified in accordance of Suzuki's classification. It was found that Type I pattern was dominant among the studied subjects followed by Type II and Type I' pattern while Type V pattern was least frequent (Figure 1). Lip pattern distribution in (all four quadrants) males and females of Raipur district of Chhattisgarh showed that in both sexes Type I was the most dominant lip print pattern (Table 1). The distribution of lip print patterns in males and females in each quadrant were compared. In Quadrant-I and II Type II pattern was dominant in male and in females Type I^{I} pattern was dominant. In Quadrant III and IV, Type I pattern was dominant in both male and female subjects (Figure 2).

Table 1. Lip pattern distribution in (all four quadrants) males and females of Raipur district of Chhattisgarh

Patterns	Males (%)	Females (%)	Total
Type I	60 (n=75)	40 (n=50)	125
Type I^{I}	37.6 (n=29)	62.33 (n=48)	77
Type II	56.9 (n=49)	43.02 (n=37)	86
Type III	43.9 (n=18)	56.09 (n=23)	41
Type IV	41.8 (n=23)	58.1 (n=32)	55
Type V	30 (n=6)	70 (n=14)	20

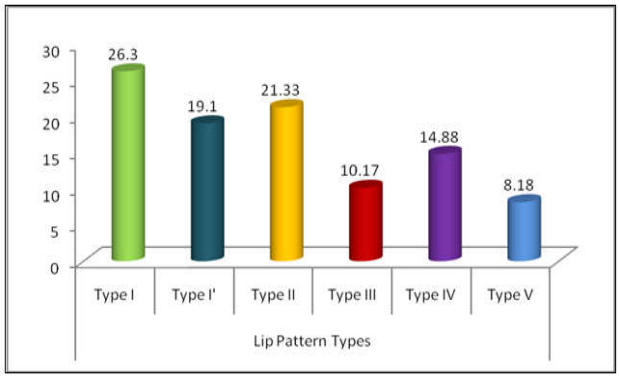

Figure 1. Distribution in subjects shows Lip print pattern

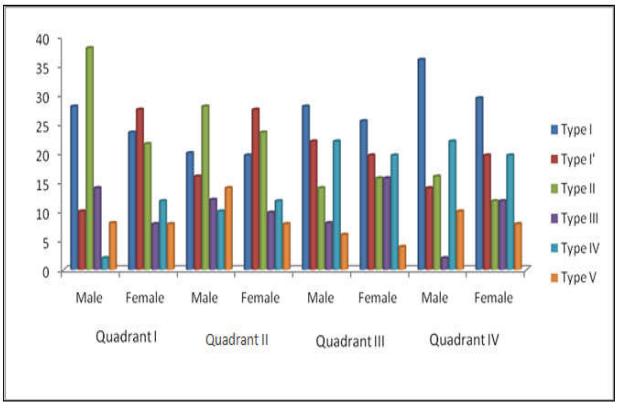

Figure 2. shows distribution of lip print patterns in four different quadrants of male and female subjects

Table 2. Study of lip print pattern by different authors in India

Region of Study	Lip pattern	References	Year of study
Mumbai, Maharashtra	Predominant Pattern: In Males: Type III In Females: Type I	6	2000
Aurangabad, Maharashtra	Predominant Pattern: Males and Females: Type III	28	2008
Meerut, Uttar Pradesh	Predominant Pattern: In Males: Type IV In Females: Type I	29	2009
Dehradun, Uttarakhand	Predominant Pattern: Males and Females: Type II [60.50% / 66.83%]	24	2009
Bangalore, Karnataka	Predominant Pattern: In Males: Type IV In Females: Type I	30	2009
Kanpur, Uttar Pradesh	Predominant Pattern: Males and Females: Type III [39.5% & 36.5%]	31	2009
Udaipur	Predominant Pattern: In Males: Type I In Females: Type II	32	2010
Amritsar, Punjab	Predominant Pattern: In Males: Type III In Females: Type I	33	2011
Raichur, Karnataka	Predominant Pattern Males and Females: Type IV	34	2011
Bangalore, Karnataka	Predominant Pattern: Males and Females: Type II	35	2011
Lucknow, Uttar Pradesh	Predominant Pattern: In Males: Type II In Females: Type III	36	2011
Jaipur, Rajasthan	Predominant Pattern: Males and Females: Type III	37	2011
Modi Nagar, Uttar Pradesh	Predominant Pattern: In Males: Type IV In Females: Type I	38	2011
Delhi & Haryana	Predominant Pattern: In Males: Type III In Females: Type Y	39	2012
Punjab	Predominant Pattern: Males and Females: Type I	18	2012
Pondicherry	Predominant Pattern: In Males: Type III In Females: Type II	13	2012
Lucknow, Uttar Pradesh	Predominant Pattern: Males and Females: Type II [36.3% / 35.5%]	40	2013
Manipal, Karnataka	Predominant Pattern: In Females: Type IV [33.3%]	41	2013
Rohtak, Haryana	Predominant Pattern: In Males: Type III [45%] In Females: Type II [35%]	19	2014
Rajnandgaon, Chhattisgarh	Predominant Pattern: In Males: Type III Females: Type I	21	2014
Raipur, Chhattisgarh	Predominant Pattern: In Males and Females: Type I	Present study	2014

Frequency of lip print pattern in different age groups in relation to gender was studied. It was found that among males of 18-23 yrs. Type II pattern is more frequent (22.2%) and in females Type I^I pattern was more frequent (26.3%). In age group of 24-29 yrs. Type I pattern (35.6%) showed higher frequency in males and Type I^I pattern (22.2%) in females while among age group of 30 yrs. and above Type I was more frequent in both males (33.9%) and females (35%). On studying the frequency distribution of lip patterns among pre-defined age groups it was observed that Type I was frequent among age group of 24-29 yrs. (39.6%) and 30 yrs. and above (39.6%). Among all the age groups Type II was frequent (29.7%) in similar percentage (Figure3). Association of lip patterns with age is determined by performing Chi- square test and it was found that lip patterns do not have statistically significant association with age.

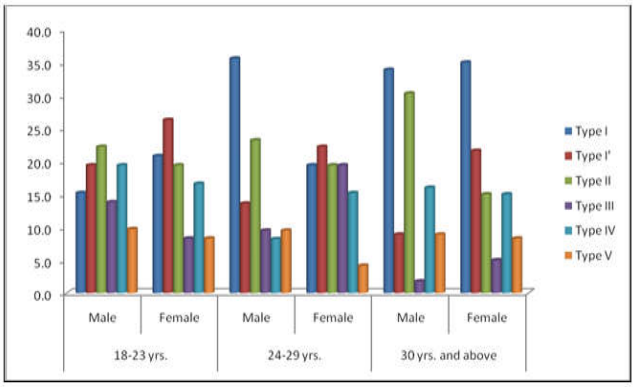

Figure 3. Shows distribution of lip print patterns in three different age groups of male and female subjects

Frequency of repetition of lip print patterns in different quadrants in relation to gender was compared among male and female subjects. It was found that frequency for two quadrants with same lip print pattern showed higher frequency (90%) in male and (94.1%) female subject's while no quadrants with repetition for lip patterns were lower with 8% among both (Figure 4). Association of Gender with various lip print patterns was also seen among studied subjects. Frequency of Lip patterns studied among male and females of studied population showed that Type I was more frequent among both. On determining association of gender with various lip print patterns by performing Chi-square test with SPSS 16.0 and it was observed that Type I^I shows statistically significant association with gender (χ^2= 4.12, p-value= 0.0424) followed by Type II which was also showed statistically significant association with gender (χ^2= 5.730, p-value= 0.0167) . Type I, Type III, Type IV and Type V was found statistically non-significant association with gender.

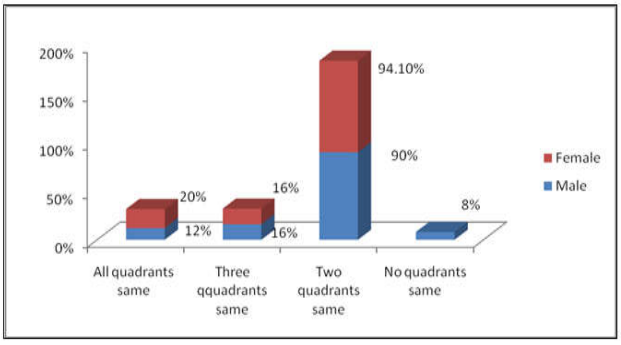

Figure 4. Shows distribution of lip print patterns in four quadrants of male and female subjects

DISCUSSION

Lip prints are considered one of the most important forms of transfer evidence. Lip prints can be a factor in many different kinds of crimes, such as tape when a person has been bound or gagged, prints on a glass that a person drank from, prints on a cigarette butt, and prints on a glass/window if they were pressed up against it. Lip print recognition has some advantages because it requires small data requirement and pattern matching is quick and also it is unique to an individual just like fingerprints (Vahanwala *et al*., 2005; Nagasupriya *et al*., 2011). However, in both civil and criminal cases data

regarding the application of lip patterns in human recognition is scarce (Lee, 2009; Sharma *et al*., 2011). To our knowledge, this is the first study carried out in population of Raipur (Chhattisgarh) describing the pattern of lip prints in a population sample living in Raipur (101 subjects aged 18–35 years including 49.5% males and 50.49 % females). In the present work, examination of the pattern of the print in the four quadrants of the lip revealed that no individual had a single type of lip print and no two or more persons had similar features of lip grooves. Even when two studied subjects exhibited the same type of grooves in the same compartment of the lip, there was specificity in the site, number and pattern of groove branching or reticulation after detailed matching. Regarding the patterns of lip grooves, we found that the highest recorded lip print among the individuals of Raipur, Chhattisgarh is Type I (complete vertical). It was most frequently represented in the Quadrant IV in both males and females. On the other hand, the least common type was the Type III in Quadrant I and IV of male subjects. From the results of the present study it can be shown that lip print patterns in all 101 subjects were distinct and none of the patterns were identical. This finding was in concordance with results obtained in the earlier conducted studies (Suzuki and Tsuchihashi, 1970; Kasprzak, 2000; Vahanwahal and Parekh, 2000; Sivapathasundharam *et al*., 2001). This proves that the lip print pattern is unique to each individual.

Lip print patterns did not simply comprise of one type alone, but appeared as a mixture of varying types as is also the case in a previous study conducted by Tsuchihashi. Earlier studies conducted on Indian populations (Pondichery) observed that Type II and Type III lip print patterns were frequent (Sivapathasundharam *et al*., 2001; Kumar *et al*., 2012). A study based on comparison of lip prints in Manipuri and Kerala showed that Type I lip print pattern was most common in both the populations but differed only in sex (i.e., Type I was more in Kerala females than Manipuri females and Manipuri males had more Type I lip print patterns compared to Kerala Males) (Koneru Anila *et al*., 2013). Among people of Karnataka lip prints studied indicated that Type IV was predominant in them (Verghese *et al*., 2011) while another study on people of north Karnataka reported predominance of Type VI pattern (Patil Devaraj *et al*., 2013). Studies on North Indian peoples showed that Type I, I`& II lip prints are most predominant patterns (Sekhon Jeewanjot *et al*., 2013). In both males and females of Punjab Type I pattern was reported its dominance (Sandhu *et al*., 2012) while among people of Rohtak, Haryana Type III is reported as the most dominant pattern (Verma Kapil *et al*., 2014).

Another study on population of South India reported that Type I is the most predominant pattern in them (Hosmani Jagadish *et al*., 2012). In a recent study on population of Rajnandgaon, Chhattisgarh reported that the most common lip print pattern in them was Type I (Multani Suraj *et al*., 2014). In our study on population of Raipur reported similar findings with population of Manipur, Kerala, Punjab and south Indians also frequency of Type I lip print pattern was commonly seen. To ascertain if lip print patterns change with age they were analyzed in three different age groups and there association was analysed in the present study. Studies revealed that 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 (Randhawa *et al*., 2011) while age changes like immaturity of lips in younger age and diminished anatomic details and tonicity in older age can have a considerable effect on the lip pattern thereby making the correct identification of sex in these age groups debatable (Randhawa *et al*., 2011) while Study on 300 North Indian individuals of 18 to 65 years of age in Dehradun, Uttarakhand reported that lip prints is different in every individual and does not change with time so it can also be used as a method for identification (Bindal *et al*., 2009). In the present study, no significant association were observed which supports that lip print patterns keeps changing during an individual's lifetime and confirms the permanence of lip prints.

Some previous studies on male and female subjects shows that lip print pattern dominance have potential for sex identification (Vahanwalla and Parekh, 2000; Vahanwala *et al*., 2005). A study on 100 north Indians and 100 south Indians belonging to age group of 18-25 years showed that lip prints are unique and are having potential for sex determination (Rastogi and Prateek, 2011). These findings were further confirmed by analysing lip prints of 200 Nepalese students that lip print pattern can be used as an additional tool for personal identification and sex determination (Karki, 2012; Ghimire *et al*., 2013). Although, in some studies it was revealed that the lip print patterns for each individual were unique and there was no peculiar pattern distribution among male and female tool for personal identification and sex determination (Jaishankar *et al*., 2010). Our results also support the above findings that gender of individuals has significant association with dominance of various lip patterns. Study of lip print pattern by different authors in India is given in Table 2 to observe the most frequent lip print pattern in various populations under study. It was observed that no synchronisation is observed in terms of frequency of common lip print pattern which indicates that there is existence of inter- and intra-state geographical variations in lip print patterns.

Therefore, it can be said that like fingerprints, lip prints are also capable for individual identification in criminal investigation. As number of samples are small in the present study for determining the discrimination power of lip prints in identifying the geographical affiliation with accuracy. In future, studies on more number of samples from different geographical regions and ethnic races will help to determine the geographical origin and probable race of questioned lip prints. Thus, it can be said that lip prints do have potential for use as corroboratory evidence in criminal investigations.

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