

Cheiloscopy – An insight into the past literature

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Abstract

Establishing the identity of an individual has become a major task both in legal medicine and also in criminal investigations. Identification of an individual, living or dead is based on the theory that all individuals are unique. Forensic investigations dealing with personal identification incorporate the application of fingerprints, anthropology, odontology and other techniques like DNA profiling. Recent advances in forensics have provided new dimensions in this field. Cheiloscopy is one among them which is fast emerging and can be used as an effective tool. Cheiloscopy is a forensic investigation technique that deals with the identification of humans based on lip traces. The present article will provide an insight of cheiloscopic history and subsequently about various studies on cheiloscopy that have been mentioned in literature.

Keywords: Human identification, Forensic investigations, Cheiloscopy

Introduction

Cheiloscopy is a forensic investigation technique that deals with the identification of humans based on lip traces.¹ Lip mucosa has grooves and wrinkles on its

surface that forms a characteristic pattern and the study of these patterns is referred to as cheiloscopy.^{1,2}

Lip patterns can be identified as early as in 6th week of the intrauterine life.³ They are permanent and are unchangeable. However, they show differences with respect to the race and ethnic origin of a person.⁴

The importance of cheiloscopy is based on the fact that lip prints are unique to an individual except in monozygotic twins.^{4,5} Apart from individualization, many studies conducted in the past, revealed the immense role of lip prints in determining the gender.⁶

Moreover, lip patterns remain the same throughout life and are uninfluenced by environmental changes, diseases and trauma. However, major trauma to the lips may lead to scarring, pathosis and the surgical treatment rendered to correct them may affect the size and shape of the lip thereby altering the pattern and morphology of the grooves.⁷

Lip prints are considered as most important forms of transfer evidence and are analogous to finger prints. They are usually left at crime scenes and can provide a direct link to the suspect. It has been proved that lip prints are as good as finger prints in criminal identification and can be

definitely used when any other means of traditional methods are unavailable.⁸

Conventional lip prints refers to the lipstick smears that are left as trace evidence and can link a suspect to a crime scene. But, cosmetic industry, with time, has been advancing at a greater pace and today there are lipsticks available which upon contacting a surface will not leave any visible smears. These lipsticks are referred to as persistent lipsticks or long lasting lip sticks and the print produced by them is called as latent lip print.⁹

Both the forms of evidence can be used for identification if it is possible to compare the lip prints with the lip print of the suspect. Also there is a possibility of existence of epithelial cells in the latent lip print which can be a source of DNA that can be used for a more precise identification. However the use of latent lip prints is more restricted because of the limited availability of databases.¹⁰

Historical Background

The biological phenomenon of systems of furrows on the red part of human lips was first noted by anthropologists and **R.Fischer** was the first person to describe it in **1902**.¹¹ Later in **1932**, **Edmond Locard**, a criminologist in France had acknowledged the importance of cheiloscopy. In the year **1950**, **Le Moyer Snyder**, in his book titled "Homicide Investigation" had mentioned the possibility of using lip prints in human identification.⁴

Santos in **1960** suggested that the fissures and the criss-cross lines on the lips can be divided into different groups and further into subtypes.⁴ It was in Hungary during **1961** that the first research in Europe was carried out on the subject of lip prints. The examination started after the lip traces had been found on a glass door at the crime scene. It is at this time when the usefulness of lip traces for criminalistic identification was proven.⁹

Two Japanese scientists, **Suzuki and Tsuchihashi**, based upon their research in the period of **1968-71**, have

established that the arrangement of lines on the red part of human lips is unique to an individual. They named the grooves existing on the labiorum rubrorum as sulci labiorum rubrorum and the lip prints consisting of these grooves as *Figura linearum labiorum rubrorum*.¹²

As cited by **Aggarwal A (2004), Suzuki and Tsuchihashi** described a remarkable case in **1970**. An anonymous letter marked "confidential" was sent to the Lord General Director of Tokyo Metropolitan Police Department, warning about blowing Police Headquarters, with two very luscious lip-marks imprinted in lipstick on the envelope. Two suspects were arrested and a great amount of explosives confiscated. However it was found that their lip prints did not match with those found at the envelope. It could not be determined how those lip prints were made. Had the lip prints indeed been made by the suspects and had the doctors succeeded in making a perfect comparison, it would indeed have been very good for the new science of cheiloscopy.¹³

Aggarwal A (2004) was able to use the lip prints for positive identification when he investigated a case of burglary in Japan. He reported that a burglar had broke open the safe and he left behind his lip prints on the glass when he drank water from it using gloved hands. Lip prints were lifted from the glass and were matched with the prints of the suspect and he was then handed over to the police.¹³

In the same year, **Aggarwal** reported a remarkable murder case where lip prints were used in the case for investigation. Lip prints were found on the door frame at the murder scene. Lip prints of the suspect were taken and were analyzed using various methods like photography and impressions of the suspects lips taken with rubber base impression material but no similarities could be demonstrated in the fissures and grooves except for the general outline and dimensions of the lips.¹³

An insight into the past literature

Literature reveals numerous research works that have been done in the field of cheiloscopy to project the uniqueness of lip prints and their potential role in personal identification thus proving their role in forensic investigations. A brief note of few of those studies is mentioned hereunder.

Tsuchihashi Y (1974) conducted a study on lip prints on 1364 Japanese subjects which comprised of 757 males and 607 females aged between 3-60yrs. The study sample also included 49 pairs of uniovular twins and their parents in order to evaluate the similarities in patterns among the twins and also between the twins and their patterns and check for the inheritance of the lip print patterns.

To prove that the lip prints remain unchanged throughout the life, 3 male and 7 female subjects were selected for the study of their lip print patterns at regular monthly intervals for a period of 3yrs. They adopted photography method to record the lip prints. They observed that the lip print patterns were not comprised of single type but are rather a combination of various types and also no two lip prints were found identical. Also the lip prints of the twins and their parents were not absolutely identical. The permanence of the patterns was also proved as the seven subjects chosen for the study did not show any changes.¹⁴

Hirth L, Gottsche H, Goedde HW (1975) conducted a study on 500 individuals that included 76 families with 133 children, 22 monozygotic twins and 17 dizygotic twins. Lip prints were recorded to study variability and genetic basis of ridge pattern in the region of mucous membrane of lips. It was observed that the branched pattern frequently occurred on the upper lip and simple pattern frequently occurred in lower lip. Investigations during several months showed stability against environmental factors. Application of cheiloscopy to

genetical investigation were reported based on the results of twins and families.¹⁵

Sivapathasundharam B, Prakash PA, Sivakumar G (2001) studied 200 individuals of Indo-Dravidian population including 100 males and 100 females aged between 20-30yrs in order to evaluate the incidence of particular lip print patterns. They followed the classification proposed by Tsuchihashi. The middle part of lower lip was taken as the study area. They found that intersecting pattern was predominantly seen and reticular pattern was least commonly seen. They also stated that the uniqueness of patterns depends on the way the lip muscles relax to produce a particular pattern.¹⁶

Utsono H, Kanoh T, Tadokaro O, Inoue K (2005) studied the lip print characteristics on cadavers with various causes of death in order to determine the effects of fixation on post mortem changes in lip impressions and the extent of shrinkage/enlargement of the lips. The cadavers were fixed in 10% formalin and maintained at a constant temperature of 21⁰ C. Impressions were taken from 20 cadavers. Lip stick was applied and impressions were made on cellophane tape. Analysis of morphological measurements indicated that no significant enlargement/shrinkage occurred. Lip prints taken before fixation matched with those taken after fixation in 6 of 20 cases, representing 30% identification rate.¹⁷

Augustine J, Barpande SR, Tupkari JV (2008) studied the lip prints of 600 individuals comprising of 52 families. The age of study population ranged from 3 to 83yrs. Lip prints were obtained using a lipstick and adhesive tape. They were interpreted in accordance with Tsuchihashi classification using adobe photoshop software. They observed that lip patterns occurred in diverse combinations. They were similar between males and females and varied among different age groups. Some hereditary resemblance was observed between parents and

offspring. They concluded that the predominant pattern in the entire population taking both the upper and lower lips together was Type III which constituted 48.2% of all patterns. They also observed that the positive resemblance of lip prints was found to be greatest between fathers and sons (69.35%) followed by that between mothers and sons (63.17%)¹⁸

Saraswathi TR, Gauri Mishra, Ranganathan K (2009) conducted a study on 100 individuals which comprised of 50 males and 50 females to study the patterns in different areas of lip and analyze the incidence of any particular pattern in a given age group. They observed that the intersecting pattern was most common and reticular pattern was least common in both males and females with the former constituting 39.5% and 36.5% respectively and the latter constituting 11% and 13% respectively. When individual lip compartments are concerned, males showed predominance of intersected patterns in compartments 1-4. Reticular pattern and branched patterns were least in compartments 1-4 and 3 respectively. Among females, intersected and branched patterns were predominant in 1-3 and 4th compartments respectively. Reticular and vertical patterns were least common in compartments 1, 3, 4 and compartment 2 respectively.¹⁹

Bindal U, Jethani SL, Mehrotra (2009) conducted a study with an aim of evaluating the permanence of lip prints. The study sample included 300 (150 males and 150 females) North Indian individuals in the age group of 18-65yrs. Of the total sample, 100 individuals comprising of 50 males and 50 females were studied to evaluate the permanence of lip prints. Upon analysis, they observed that the most frequent pattern among all the males was Type II and the least frequent pattern observed was of Type III. Similarly, among females, Type II pattern was most common and Type III pattern was least common. Most common single pattern among all the individuals

studied was Type II and Type III was least common. The lip prints of the above mentioned 50 individuals were recorded at the beginning of the study and again after 1yr duration. Their observations didn't reveal any change in the lip print patterns with change of time indicating their permanence.²⁰

Patnaik VV, Gopichand, Kaushal S, Kaur G (2010) conducted a study on 500 Punjabi females above the age of 19yrs with an aim to classify lip prints, study their variations and determine the most common pattern in the study population. The lip prints of the individuals were divided into four quadrants, two each in upper and lower lips. Each quadrant was further subdivided into medial and lateral halves. Lip print patterns were analyzed in all the 8 segments following the classification proposed by Suzuki and Tsuchihashi. It was observed that the right and left parts of the lips frequently exhibited different patterns. The results suggested that the most predominant pattern in the entire study population considering both upper and lower lips was Type III pattern.²¹

Verghese AJ, Somasekar M, Babu RU (2010) had done a study to determine the predominant lip print type in Kerala population. The study sample included 100 individuals comprising of 50 male and 50 female individuals each. The age group of the study population ranged between 25-40yrs. Middle 1 cm of the lower lip was taken as the study area. Analysis of the results showed that Type IV pattern was most frequently observed in both the genders.²²

As stated by **Reddy LVK (2011)**, a project was launched in **1982** in the Forensic Institute of **Warsaw University Criminal Law Department**, in cooperation with the former Forensic Institute of Militia in Warsaw. The study material was collected from the former military training center at Minsk Mazowiecki. Lip prints were collected from 1500 persons who came from different locations

around the country. The age of the study group ranged from 5 to 60yrs. Altogether more than 7000 traces of the red part of the lips were examined. Based on the result obtained, it was proved that the lines on the red part of lips exhibited individuality and were also unchangeable. They then suggested that lip prints can be used for identification purpose.¹¹

Rastogi P, Parida A (2011) conducted a study on 200 randomly selected medical students belonging to age group of 18-25yrs. The sample consisted of 100 north Indians (50 males and 50 females) and 100 south Indians (50 males and 50 females). The results suggested that Type II was the most commonly observed lip print pattern and Type V was the rarest. It was also observed that Type I and Type I' patterns were more common in males and Type II, III, IV & V patterns were more common in females. Type III and Type IV patterns were predominant in north Indians while Type II was predominant in south Indians. They concluded that lip prints are individualistic and bear a relationship with sex and geographic distribution of the individual and can be used as evidence in the court of law.⁸

Nagasupriya A, Dhanapal R, Reena K, Saraswathi TR (2011) conducted a study on 200 individuals comprising of 100 male and 100 female subjects in the age group of 18-27yrs with an aim to analyze the predominant pattern of lip and finger prints in males and females and to correlate those patterns for gender identification. They observed that the male subjects with branched type of lip print patterns showed arch, loop and whorl type of finger pattern and female subjects with vertical lip pattern showed arch finger pattern and those with reticular lip pattern showed whorl finger pattern and concluded that these patterns will be useful in forensic science for gender identification.²³

Vats Y, Dhall JK, Kapoor AK (2011) carried out a study on 1399 individuals in the age group of 8-60yrs with the sample comprising of 80 Brahmin families, 80 Jat families and 60 Scheduled caste families from Delhi and Haryana each. 8 monozygotic twin pairs were also included. The aim of the study was to investigate the heritability of lip patterns, to determine the percentage resemblance of lip patterns among parents and their children and association of lip print patterns among twins. Upon analysis it was observed that the maximum percentage of resemblance of lip patterns was shown by the Brahmin mothers and the daughters in the lower lip quadrant and minimum percentage of resemblance was exhibited by Scheduled caste fathers and sons in the upper left quadrant. They did not observe any significant association of patterns among the monozygotic twin pairs which suggests that the patterns were unique. They depicted that similarity of lip print patterns persist among parents and their offsprings.²⁴

Xu NX, Osman K, Hamzah SPAA, Hamzah NH (2012) conducted a study with an aim to determine the differences in lip print between sexes or races, differences in lip measurement between sexes or races and to determine a way of estimating sex and race using lip print or lip measurements from main races in Malaysia. The study included 134 subjects in the age group of 20 to 26yrs. The sample comprised of 44 males and 44 females (Malay), 18 males and 18 females (Chinese) and 5 each of Indian males and females. Sample selection done on the basis of population ratio in Malaysia.

Lip prints were taken using lipstick and transparent cellophane tape. Lip measurements were taken using electronic digital calipers. Lip prints were analyzed according to the classification given by Tsuchihashi. The results showed significant difference in lip prints between sexes but not in the races. Width of the oral opening and height of the lower lip showed significant differences

between sexes. Overall percentage of accuracy in sex determination was found to be 77.5%.²⁵

Prabhu RV, Dinkar A, Prabhu V (2013) conducted a study on a sample which comprised of 100 students with an aim to evaluate the uniqueness of lip patterns and also to define a standard method for the analysis of lip prints. The obtained prints were scanned and then by using Adobe Photoshop 7 Software, they tried to trace each and every line. They followed the classification given by Suzuki and Tsuchihashi. Upon analysis of the results they observed that none of the lip prints had exactly matching scores in all the four quadrants. They concluded that lip prints are unique to an individual and also stated that the digital method of analyzing lip print images serves better visualization, ease in identification and recording of the patterns. They suggested that weighted value coring system can be considered as a standard method for determining the uniqueness of the lip prints.²⁶

Dwivedi N, Agarwal A, Kashyap B, Raj V, Chandra S (2013) conducted a study with an aim to develop latent lip prints on glass surface and compare them with standard lipstick print and also to determine the effectiveness of this technique. The study included 100 subjects comprising of 50 males and 50 females in the age range of 17 to 38yrs. Latent lip prints were developed using black finger print powder and were transferred on to bond sheets. Subsequently, standard lipstick prints were developed from the same subjects. All the samples were coded and graded. They observed that only 29 of 100 latent prints showed patterns in all the quadrants. The percentage matching with self lipstick print of good latent prints ranged from 25 to 100% and those of random prints ranged from 8% to 92%. Statistically significant difference was observed between males and females. They concluded that lip prints are useful in personal identification.²⁷

Koneru A, Surekha R, Shreekanth G, Vanishree M, Ramesh DNSV, Patil RS (2013) conducted a study on 60 subjects which included 30 subjects each from Kerala and Manipur. The aim of the study was to determine the predominant lip print patterns in males and females of the above mentioned areas and also to compare the lip print patterns between these populations. They observed that Type IV and Type V patterns were predominant in males and in females, Type I and Type I' patterns were predominant. Type I pattern was most common in both the populations with an incidence of 28.33%. Type I pattern was found more in Kerala females and Manipuri males when compared to their counterparts. They concluded that subtle differences existed between the lip print patterns of the two mentioned population.²⁸

Rao B, Srinivasan SR, Natarajan M (2014) conducted a study with an aim to compare the lip print patterns among the subjects of Indian, Chinese and Malay origin. The study included 185 students comprising of 61 individuals of Chinese origin, 63 of Malay and 61 of Indian origin. Lip prints were analyzed according to the classification given by Tsuchihashi. It was observed that reticular pattern was most common among subjects of Chinese and Malay origin and branching pattern was common among subjects of Indian origin. They concluded that lip prints were not similar between individuals of different ethnic races.²⁹

Research on various methods of recovering latent prints (finger prints and lip prints) from various surfaces present in and around the crime scenes had begun since long back but the role of latent lip prints and methods of their recovery were not much stressed when compared to finger prints. Here are the few studies that have been reported in the literature till date in which different dyes and light sources have been used to develop latent lip prints on different surfaces.

Segui MA, Feucht MM, Ponce AC, Fernando A, Pascal V (2000) conducted a study on development of latent lip prints on different surfaces following storage for different periods of time using aluminium powder, cobalt oxide powder and magnetic powder. Persistent lipstick was applied on volunteers and the impressions were made on different supports like white ceramic, black ceramic, transparent glass, green glass, white cotton fabric and white paper.

The prints obtained were developed after varying time intervals ranging from 2hrs to 30days. It was observed that aluminium powder gave positive development for prints on ceramics and glass. Development on paper was possible only upto 24hrs following impression making. Development was negative on fabric. Development with cobalt oxide powder was positive only on white ceramics and negative on paper or fabric. Development with magnetic powder was same as with that of aluminium powder. They concluded that aluminium and magnetic powders were found to be effective developers for this type of prints.³⁰

Castello A, Segui MA, Verdu F (2004), conducted a study on development of latent lip prints on colored porous surfaces like color paper napkins, colored cotton and satin clothes. Latent lip prints were made by applying permanent/protective lipsticks on volunteers. The lipstick was allowed to fix for 5min as recommended by the manufacturers. Lip impressions were then made by applying sustained pressure for 3 seconds. The prints obtained were left unprotected and were developed at various time periods ranging from a minimum of 370days to a maximum of 580days using Nile red, a fluorescent dye both in powder and solution forms.

The prints developed were visualized using UV light and Bluemaxx alternate light source. They observed that all the prints showed good development and were very

promising for identification. Both the forms of the dye were found equally effective for development and both the light sources were found equally effective for visualization. They concluded that Nile red is highly efficient and can be used to develop prints that are as old as upto 1yr.³¹

Castello A, Segui MA, Verdu F (2004) conducted a study with an aim to analyze the effectiveness of two fluorescent dyes, Nile red and Nile blue, in developing both recent and older latent lip prints on porous and multicolored surfaces. Long lasting and protective lipstick each were applied to volunteers and a recommended time of 1min was allowed for fixation. Lip impressions were then made on dark blue napkin papers using sustained pressure for 3seconds. The impressions obtained were labeled and allowed to stand in the room environment. They were developed by using Nile red and Nile blue after storing for varying durations ranging from 1-75 days. Both powder and solution forms of the dyes were used for development. The developed prints were visualized using UV light and Bluemaxx light.

They observed that both the dyes showed positive results with both the light sources with an only difference that Bluemaxx light required a lower quantity of reagent than the UV light. Also, they produced different colors of fluorescence when illuminated under the two lamps. Both the dyes gave white-silver fluorescence under Bluemaxx light and red fluorescence under UV light. Nile blue was effective as solution than as powder and high quality development could be achieved with prints upto 30days old. Nile red was equally effective both in powder and solution forms and high quality development could be achieved with prints upto 75days old.³²

Castello A and Verdu F (2006) conducted a study with an aim to assess the usefulness of fluorescent reagents to develop latent lip prints on very dark or multicolored

surfaces. The study included 6 volunteers. Protective and long lasting lipsticks were applied and impressions were made on white and multicolored surfaces. Impressions received on white surfaces served as controls for positive development of Sudan black. The process was repeated on successive days until adequate no. of prints were obtained. The obtained impressions were stored at room temperature for a period of 450 days and were then processed in 50 day increments.

The impressions were developed using three different dyes namely Sudan black, Yellowescent fluorescent and Nile red dyes. Prints developed on colored surfaces were visualized in dark room using UV light and Bluemaxx light. Upon analysis they found that Sudan black produced good quality prints with protective lipstick and low quality prints with permanent lipstick. However, prints developed on multicolored surfaces could not be visualized because of contrast problems.

Development with Yellowescent fluorescent powder was classified as low quality development. The prints were better visualized with Bluemaxx light than with the UV light and no development was observed with older prints. Nile red produced good quality impressions and development was better visualized with Bluemaxx light source than with the UV light source. They concluded that Nile red was a very effective reagent for developing older lip prints deposited on porous surfaces and was especially useful for developing prints deposited on dark or multicolored surfaces.¹⁰

Navarro E, Castello A, Alfaro JAL, Verdu F (2007) attempted a study to determine the efficiency of fluorescent reagents to develop invisible lipstick contaminated lipmarks on human skin. The study was conducted on the skin surface of 40 cadavers and the areas selected to form the prints were the right side of neck and the anterior region of forearm. Lip prints were made by

applying protective lipstick on the mould which can reproduce the shape and outline of the lips along with the lip lines and wrinkles. Reagents used for development of the prints were REDescent fluorescent latent prints powder and Nile red powder. The developed prints were visualized using UV light that works in the wavelength range of 320-400nm.

They observed positive development for all the lipmark prints developed using REDescent fluorescent latent prints powder but the development with Nile red was positive only in three cases. They concluded that REDescent fluorescent latent print powder was effective for obtaining recent invisible lipstick contaminated lipmark on corpse skin. Nile red was very effective for developing on other surfaces and was not useful on skin surface.³³

Kumar P, Mastan KMK, Patil S (2010) conducted a study on a sample of 200 individuals with an aim to analyze and compare the effectiveness of lysochrome dyes (Oil red O) and fluorescent dyes (Nile Blue) in developing latent lip prints. Lip prints of all the individuals were recorded by applying colored lipstick and the prints obtained were used as standards for comparison with the latent prints developed from the same individuals using lysochrome and fluorescent dyes following the same methodology except for the application of lip stick. They observed that latent lip prints were visualized better with fluorescent dye. Ineffective development with lysochrome dye was correlated with its property of their ability to bind with fatty acids which are components of long lasting lipsticks which were not actually used in this study. They finally concluded that fluorescent dyes produced better positive results than lysochrome dyes.³⁴

Conclusion

Extensive research has been done to test the potential usefulness of cheiloscopy in forensic investigations to establish the identity of an individual. Various parameters

have been studied to check for the uniqueness of the lip patterns and also to verify the reliability of cheiloscopy in forensic investigation procedures. It was proved beyond doubt that lip prints are unique to an individual and hence their analysis (Cheiloscopy) beholds the potential for establishing the identity of an individual.

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