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# Identification of Latent Lip Prints in Forensics - Review

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## Abstract

Identification plays a major role in crime investigation. One of the most effective methods of identification are fingerprints. Like fingerprints, lip prints are also unique for individuals and remain the same throughout life. They are not influenced by environmental changes, trauma and diseases. The uniqueness of lip has been proven by researchers by using shape analysis and colour information. Lip prints can also provide some important information in crime investigations and have the ability to distinguish individuals and are used in human identification purposes. Human lips recognition is one of the most emerging methods of human identification that originates from forensic and criminal practice. Lip prints are captured by police technicians and further analysis provides valuable evidence. The use of lip prints first started in 1950 and researches were carried out in 1970. The wrinkles pattern on the lips has individual characteristics like fingerprints. Cheiloscopy is a forensic investigation method that deals with the study of elevations and depressions which form a characteristic pattern on the external surface of the lips. This is unique for individuals. Lip print recording is used in forensic investigation that deals with identification of humans, based on lip traces. Lip prints can be a basis for conclusion such as sexes, habits and character of that event. At a crime site lip prints can either be visible or latent. Print produced by a traditional lipstick is easily identifiable. Latent print investigation is important in resolving any criminal act. Latent lip prints are invisible prints and can be identified by using fingerprint powder. Long lasting lipsticks produce prints that are invisible and require reagents to develop the prints. The porous and multicoloured surfaces are the surfaces in which a print is difficult to identify and cannot be easily seen. Cups, glasses, tissue papers and napkins may have imprints of the suspect's lips.

***Keywords :*** *Lip print , cheiloscopy , Forensic identification , latent lip prints.*

## Introduction

Identification is important in any crime investigation. Cheiloscopy is a forensic investigation method that deals with recognition of humans based on lips traces. The wrinkles pattern on the lips has individual characteristics.[1,2] The wrinkles and grooves on labial mucosa, called as sulci labiorum forms a characteristic pattern known as lip prints and the study of this is cheiloscopy.[3] It can be defined "as a method of identification of a person based on characteristic arrangements of lines appearing on the red part of lips or as a science dealing with lines appearing on red part of the lips".[1,2] Like fingerprints, this is unique for individuals.[4] Fischer in 1902 was the first anthropologist to analyse the furrows on the red part of the human lips.[5] However, it was only in 1932 that Edmond Locard, one of France's greatest criminologists, recommended to use lip prints in personal identification and criminalization. LeMoyne Snyder in his book Homicide Investigation, written as early as 1950, mentions the use of lip prints in the identification of individuals. The lip prints are uniform for the whole of life and characteristics of a person can be used to verify the presence or absence

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of a person from the crime, provided there has been consumption of beverages, drinks, usage of cloth, tissues or napkin etc., at the crime scene.[6] Dr. Martins Santos in 1960 proposed that these lip characteristics could be used in personal identification and proposed a simple system for classifying lip prints.[1,2] In 1967, Suzuki made investigation of the measurement of lips, the use and the color of rouge and method of its extraction to obtain data for forensic application.[4] Later in 1971 Suzuki and Tsuchihashi, conducted a study and used their own classification.[1] Analysing in depth and establishing further facts and truth in lip prints will certainly help as useful evidence in forensic dentistry.[2] Previously our team had conducted numerous original studies [7-13] and surveys [14-21] over the past 5 years. Now we are focussing on using this knowledge in writing reviews on recent advancements in various fields. The idea for this review stemmed from the current interest in Forensic Identification. The aim of the study is to assess the identification of latent lip prints in forensics.

**Lip Prints in Forensics**

In the past there were different modalities used for identification like fingerprints, MN blood group system, and DNA fingerprinting: of these, finger printing is most widely used. As knowledge of using fingerprints for identification is increasing in the general population, offenders are taking care not to leave behind fingerprints at a crime scene. So cheiloscopy can also be used as an additional tool for crime investigation. Cheiloscopy is an upcoming tool in crime investigation. Though fingerprints and DNA comparison are most commonly used, additional tools like cheiloscopy and palatoscopy can be used for identification.[22] External surface of the lip has many elevations and depressions forming a characteristic pattern called lip prints, examination of which is referred to as cheiloscopy.

Like the fingerprints, this is unique for individuals. A lip print is a surface with visible elements of lines representing the furrows. This characteristic pattern helps to identify the individuals since it is unique for individuals. If the lines are not clear, individual identification of human beings based on this trace is extremely difficult, unless the trace contains more individual characteristics like scars, clefts etc, and often identification ends with group identification.[23] Lip print patterns appear to be genotypically determined, unchanged from birth.[24] The lips can be horizontal, elevated, or depressed, and according to their thickness, it is possible to identify the following four groups:

- Thin lips (common in the European Caucasian),
- Medium lips (from 8 to 10 mm is the most common type),
- Thick or very thick lip (usually having an inversion of the lip cord and is usually seen in negroes),
- Mix lips (usually seen in Orientals). [25,26]

The importance of cheiloscopy is linked to the fact that the lip prints are unique to one person, except in monozygotic twins.[27] Like fingerprints and palatal rugae, the lip grooves are permanent throughout life. It is possible to identify lip patterns as early as the 6th week of uterine life.[28]

The oily and moist secretions from sebaceous and salivary glands placed at the vermillion border and subsequent moisturization from the tongue enables the formation of a latent lip print whenever there is contact and is likely to be encountered and should be suspected to be present on the scene of the crime.[29,30]

Photographs, cigarette butts, drinking glasses, cups, letters, and windowpanes are among the items that can bear lip prints and should be examined and photographed before any other examination is made. Latent or invisible prints left at the crime scene have been a source of interest for some time. The development or extraction of lip prints is a matter of providing color contrast between the print and its background, so that it can be photographed or otherwise preserved for later comparison. Latent prints are invisible prints and are developed by powders, chemical means, or laser-induced luminescence. The powders most commonly used are aluminum powder, cobalt oxide, and magnetic powder. It may be applied with an atomizer, or by brushing, being the generally accepted method. The material is spread with a brush of soft and extremely fine hair. This brush is dipped sparingly in the powder and a few light taps are given to shake off the excess material. Then the brush is drawn very lightly across the latent print. When sufficient material has adhered to the print, residue is brushed away and the print photographed. If

the latent print cannot be satisfactorily photographed owing to its location, it can be "lifted" using a variety of pliable, adhesive materials. These can be pressed against the latent impression being dusted with powder and then covered with some transparent substance. Alternatively, transparent lifters similar to "scotch tape" may also be used.[26]

CLASSIFICATION OF LIP PRINTS

In 1967 Santos was the first person to describe lip grooves. He divided them in to four types namely

1. Straight line, 2. Curved line, 3. Angled line, 4. Sine-shaped line

**Martin Santos Classification (1966)**

I. Simple Wrinkles

a. Straight lines

b. Curved lines

c. Angled lines

d. Sine shaped curve

II. Compound Wrinkles

a. Bifurcated

b. Trifurcated

c. Anomalous

Suzuki And Tsuchihashi's Classification

Suzuki and Tsuchihashi (1970) have put forward a classification of lip prints also known as Tsuchihashi classification, these are the most widely used classification in literature.[31–33]

Type I: clear cut grooves running vertically across the lip

Type ll: Straight grooves which disappear half way instead of covering the entire. breadth of the lip

Type lll: Fork grooves in their course

Type lV: Intersecting grooves

Type V: Reticulate grooves

Type VI: Undetermined

Renaud's Classification

A. Complete vertical

B. Incomplete vertical

C. Complete Bifurcated

D. Incomplete Bifurcated

E. Complete Branched

F. Incomplete Branched

G. Reticular Pattern

H. X or Coma form

I. Horizontal

J. Other forms (Ellipse, Triangle)

Afchar -bayat Classification (1979)

A1 :Vertical and Straight grooves, covering the whole lip

A2 :Vertical and Straight grooves, but not covering the whole lip

B1 :Straight branched grooves

B2 :Angulated branched grooves

C :Converging grooves

D :Reticular pattern grooves

E :other grooves.[31]

**RECORDING VISIBLE LIP PRINTS**

**Photographs**

When the lips are photographed, proper lighting should be focused on the lips at an angle that accentuates the contrast between the white and dark areas. The resulting Lip Print photographs should be of correct natural size. The photographic method involves photographing the Lip Print (either direct or latent and subsequently developed), and comparing it with photographs of the lips of the suspects or photographs of the Lip Print of the suspects. Photographing of the lips can often be very tricky and subject to errors as

the central area of the lips and the angles of the lips are never in the same plane and leads to focusing errors that result in unsharp or blurred or partial images of the lips. This always calls for recording the Lip Print and then photographing them and then comparing the two photographs. With the advent of digital photography, the trend is to record direct digital imaging using digital cameras. Several courts, particularly those in the U.K. reject the evidence if the very first photograph is a direct digital image. On the grounds that there is no proof that the digital image has not been previously manipulated using any of the available digital imaging software including Adobe Photoshop. The court in the U.K. insists on having the primary records based on conventional photographs and a willingness to accept digital analysis of such photographs.[1]

Traditional Lipstick

In addition to fingerprints, lipstick prints are of forensic interest. Lipstick smears show indirect proof of a relationship or contact between a victim and a suspect or a suspect and a crime scene. Extracting DNA from saliva on a lipstick print is valuable in an investigation. Traditional lipstick produces a print that is easily identifiable.[24] However, the cosmetics industry has developed long-lasting lipsticks that often do not leave visible prints. Different lipsticks have different compositions. During the manufacture of long-lasting lipstick, the oil content is reduced to minimum. It is necessary to find other development methods that are more sensitive to oils and more easily applied.[34]

## RECORDING LATENT LIP PRINT

### Fingerprint Powder

This technique is one of the oldest and most common methods of latent print detection. It involves the application of finely divided particles that physically adhere to the aqueous and oily components in latent print residue on nonporous surfaces. Early practitioners used a variety of locally available ingredients to make their own dusting powders including charcoal, lead powder, cigar ashes[35] powdered "washing blue," powdered iron, and talc. Commercial powder manufacturers tend to label powders by color, such as black, white, silver, gray, and so forth, rather than labelling the ingredients. Particles that serve as good fingerprint powders include carbon black, lamp black, talc, kaolin, aluminium, metal flake, and dolomite.[36]

Other effective and widely used latent print powders are flake metal powders made from aluminium, zinc, copper, brass, stainless steel, iron, cobalt, and nickel. Particle size, shape, relative surface area and charge appear to play roles in it.[37–39]

In recent years, lipsticks have been advanced that do not leave any visible trace after contact with surfaces such as clothing, tissue paper, ceramic, and glass. These are the latent lip prints which can be developed with fingerprint powders such as black powder, gray powder. Fingerprint powder development is a convenient and practical way of collecting latent prints but the quality of latent print is the deciding factor and also the surface and sensitivity of the technique. It is necessary to find other development methods that are more sensitive to oils and more easily applied.[40]

Magnetic Powder

Another kind of powder, called magnetic or magna powder, allows for application with a magnetized rod that has no bristles. This sort of powder can be light, dark, or fluorescent and utilizes the ferromagnetic properties of iron powder mixed with pigment powders. The magnetized applicator (magna brush) is immersed into the powder, picking up a ball of the iron and particle mixture, essentially forming its own brush. This ball serves as an effective carrier for pigment particles and is passed back and forth over the substrate to develop latent impressions. There are two ways to preserve a powdered impression. The most common and simplest method is lifting. The second method is photographic representation of the latent prints.[37]

Lysochrome Dyes

Lip prints are genotypically unique and stable. At the site of crime, lip prints can be either visible or invisible. To develop lip prints various chemicals such as lysochrome dyes, fluorescent dyes (Nile blue, Nile red), etc. are available which are very expensive. Vermilion and indigo dye are readily available, naturally derived, and cost-effective reagents available in India.[34] Lysochrome is a generic term for compounds that have the ability to dye fatty acids. Their molecule contains

a portion that dissolves in contact with fat and another that is responsible for colour. Lysochromes are effective when used on long-lasting lipstick prints on porous surfaces, such as paper or fabric, where detection is usually difficult. Thus, lysochromes are a useful group of compounds for locating and developing recent as well as older latent lip prints. Lysochromes seems to be effective in both powder and solution application forms. Sudan black, has been used as a solvent in ethanol and water to develop latent fingerprints on surfaces contaminated with foodstuffs, oils and other fatty substances. All lip prints contain lipids thereby of the three reagents used, the best results were with Sudan black, followed by Oil Red O and Sudan III. Recently lysochrome dyes are being used for colorless lip prints. Dyes like Nile red are also used to obtain lip imprints. These dyes are visualized under ultraviolet or blue light.[41]

**FACTORS (TRANSFER CONDITIONS)**

Pre-transfer Conditions

These are affected by age, gender, occupation, disease, and the application of lipstick or any other material applied on lips.

Transfer Conditions

These are the conditions of the surface being touched, including texture, surface area, surface curvature or shape, surface temperature, condensation, contaminants, and surface residues. The pressure applied during contact, including lateral force, also contributes to transfer conditions.

Post-transfer Conditions

Environmental factors are forces that affect the quality of latent prints after deposition. Examples of these factors are physical contact from another surface, water, humidity, temperature and time factor.[37,42]

FACTORS (SURFACES)

The type of surface expected to bear a latent print is an important step towards successful development. Three types are

Porous Surfaces

Porous substrates are normally absorbent and contain materials like paper, cardboard, wood, and other forms of cellulose. Porous surfaces (tissue paper and cloth fabric).

Nonporous Surfaces

Nonporous surfaces do not absorb. These surfaces repel moisture and often appear polished. They include glass, metal, plastics, lacquered or painted wood, and rubber. Latent prints on these substrates are more susceptible to damage because the fingerprint residue resides on the outermost surface. Dye stains, powders, and vacuum metal deposition are the best choices to use on these surfaces. Nonporous ones (ceramic tile).[43]

Semi Porous Surface

Type of substrate that does not easily fit into the first two categories but should be mentioned is considered semi porous. Semi Porous surfaces are characterized by their nature to both resist and absorb fingerprint residue. These surfaces contain glossy cardboard, glossy magazine covers, some finished wood, and some cellophane. Semi Porous surfaces should be treated with processes intended for both nonporous and porous surfaces.[37]

The limitation is limited no of articles are available and more molecular level studies are needed.

The future scope is quick identification of the suspects in crime investigation and thereby saving the time in the crime investigation.

## Conclusion

Lip prints thus hold potential promise as a supplementary tool along with other modes in forensics. In latent lip prints, use of lysochrome dyes and fluorescent dyes are very effective. Nile red is a very effective reagent for the development of latent lip prints on difficult surfaces like porous and multicoloured surfaces. Cheiloscopy can also serve as a very important tool in identification of a person. The uniqueness of lip print needed to be confirmed and accepted. A standard and uniform procedure has to be developed for the collection, development and recording of lip prints and the ensuring comparison.

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