TPM Vol. 32, No. S5, 2025
ISSN: 1972-6325
https://www.tpmap.org/

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CHEILOSCOPY AND HIDDEN LIP PRINT ANALYSIS – A REVIEW

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Abstract: Identification is important in any crime and forensic investigations. Lip print patterns are unique, like the fingerprints. Lip prints or Cheiloscopy is a forensic investigative method for person identification based on lip traces. Lip-print investigations have sparked the interest of many experts in recent decades as a novel technique for person identification in criminal and civil matters. Lip print evidence (LP) may be a valuable tool in human forensics. LPs have traditionally been created with indigo dye, lysochrome dyes, aluminium powder, fluorescent dyes, and silver metallic powder. In practice, methods and techniques for enhancing lip prints on various substrates remain inconsistent and lack standardization. Lip prints have often been seen in murders, burglaries and rape incidents. Since smart notorious criminals started taking precautions to avoid the possibility of leaving behind any fingerprints at the crime scene, the lip print has proven to be useful supporting evidence.

Key words: Cheiloscopy, latent lip print, hidden lip print, lip print analysis, forensic dentistry.

INTRODUCTION

The identification of live or dead individuals using the morphology of hard and soft tissues of the oral cavity is an essential aspect of forensic odontology. Investigators often employ odontology, anthropometry, fingerprints, and lip prints to gather information and evidence. Not just finger prints, DNA, and body fluids may be used as criminal identifiers in current crime scene investigations. Other manifestations of human biometric features, such as lip, nose, foot, ear, palm and forehead imprints can give useful evidence. Lip prints present at a forensic investigation or crime scene, if properly retrieved and analyzed, may include significant information that can lead to criminal identification.

Although DNA profiling is the most reliable way of forensic identification, fingerprints and lip prints may be used as a supplement. Each person has their own distinct lip groove pattern, which is comparable to fingerprints. The study of these lip-area furrows or grooves is known as cheiloscopy.[1]

Cheiloscopy is the study of lip print patterns for person identification. Greek word "lip" is the source of the term "Cheilos," while "scopy" means "to examine." Person identification is always most challenging. The lip print of each and every individual is unique. The Lip print pattern provides vital information in forensic identification and aids in individual identification. Lip prints are often hidden or latent and must be produced using some powders or chemical procedures (depending on the condition of latent print and surface type). Latent lip prints are visible after development and may be digitalized for further analysis using a scanner or digital camera. This review article describes the classification, types of lip print and various methods of identification of latent lip print in a crime scene for forensic investigation.[2]

Classification of lip prints

The classification of lip prints according to various authors are listed below. (Table 1)

Table 1: Table showing classification of lip prints according to various authors

Martin Santos Classification (1966)[3]	I. Simple wrinkles ● Straight lines ● Angled lines ● Sine-shaped curve. II. Compound wrinkles ● Bifurcated ● Trifurcated ● Anomalous.
Suzuki and Tsuchihashi Classification (1970)[4]	● Type I: Clear-cut grooves running vertically across the lip ● Type I': Straight grooves which disappear half way instead of covering the entire breadth of the lip ● Type II: Fork grooves in their course ● Type III: Intersecting grooves ● Type IV: Reticulate grooves ● Type V: Undermined
Raynaud's Classification:[4]	● Complete vertical ● Incomplete vertical ● Complete bifurcated ● Incomplete bifurcated ● Complete branched ● Incomplete branched ● Reticular pattern ● X or coma form ● Horizontal ● Other forms (ellipse, triangle)
Afchar–Bayat Classification (1979)[3]	● 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
Vahanwala et al. (sex of the	● Type I and I' pattern dominant: Female

individual was determined)[5]	• Type I and II pattern dominant: Female • Type III pattern dominant: Male • Type IV pattern: Male • Type V varied patterns: Male
Recently for the basis of the classification, only a 10 mm portion of the middle part of the lower lip is used.[3.5]	• Linear "L" – if the lines prevail • Bifurcation "R" – if the bifurcation is dominant • Reticular "S" – if the lines cross • Undermined "N" – when no superiority can be established.

Types of lip prints found on crime scene

There are three types of lip prints that are most typically seen at crime scenes[6] (Table 2)

Table 2: Table showing types of lip prints seen at crime scenes

Visible lip prints	The visible lip prints are those prints that are visible to the human eye and do not require further development techniques. They are mainly seen on body parts or clothes.
Latent lip prints	These are prints that are not visible to the naked eye and need developing processes to make them visible.
3D lip prints	These are the prints that may be found on soft wax, butter, or fruits. They also require particular development methods in order to be clearly seen.

Types of surfaces

Surface are commonly divided into three categories.

a. Porous Substrates: Examples of Porous substrates include wood, cardboard, paper, and other cellulose-based materials. The porous substrates are often absorbent.

b. Nonporous Surfaces: Nonporous surfaces, on the other hand, do not absorb. These surfaces are basically water resistant and usually appear polished. Metal, polymers, glass, painted wood, and rubber are among them. Because the fingerprint residue is present on outer surface of non-porous substrates, the latent prints on them are more susceptible to damage. On these surfaces, dye stains, vacuum metal deposition, cyanoacrylate (CA) and powders are usually the best options.

c. Semi Porous Surface: Semiporous surfaces may both reject and absorb fingerprint residue. Varnished wood, glossy magazine covers, cellophane and Glossy cardboard, are among these surfaces. The process for recording lip prints on Semi Porous surfaces are the same for porous and non-porous surfaces.

Lip Print Recording in crime scene

For both civil and criminal purposes, lip prints are taken from both suspects and non-suspects. During recording, the lips should first be carefully cleaned with a moist cotton, dust or other material can distort the imprint of the lips.

The following are many methods for documenting tip impressions:

Photography Lip prints

Lip prints are photographed precisely using ABFO (American Board of Forensic Odontologists) No. 2 Scale. Suitable lighting is used, and they must be of natural size. It is necessary to adjust the lighting so that the contrast between the light and dark areas is highlighted.[7]

Transferring medium

Williams introduced the idea of applying a transfer media such as lipstick and taking numerous sets of lip prints. Numerous prints are taken to guarantee that every portion of the lip is inked. After applying the appropriate amount of transfer medium to the lip, the subject is told to press his or her lips against a glass sheet, glossy paper, matte, etc. Then the lip print is created using ferromagnetic powder or dyes and then recorded. Cellophane tape is another way to record such prints. After applying a transferring medium, such as lipstick, to the lips, the person presses their lips against a piece of cellophane tape. Then the tape is sticked onto a paper.[7, 8]

Methods used for the development of latent lip prints

Powder methods

To enhance and visualize latent LPs on surfaces, it uses finely split powder particles that physically attach to the aqueous (moisture) and sebaceous components of the latent print residue. The pigments for contrast (antimony trisulfide, mercury sulfide, and lead iodide) and a resinous polymer for adhesion (kaolin, starch, silica gel, and rosin) make up the powders. The physical procedures used to enhance latent LPs are similar to those used to produce and see latent fingermarks. Numerous studies have demonstrated the application of powdered silver metallic, powdered silver nitrate, powdered aluminum, and powdered cobalt oxide in the creation and visualization of latent LPs. The development technique involves dusting the hidden or latent lip print with powder using a magnet or a bristle brush and then the print is lifted with an adhesive tape.

Fonseca et al. conducted an analytical strategy in which a metallic straw is used as a substrate while recording lip print.[9] The most effective powder for creating lip prints was white volcanic powder, which was followed by fluorescent powder and Silk Black volcanic powder. On the other hand, traditional powder methods frequently smear and streak traces that could unintentionally aid in individual identification, making them unsuitable for processing LPs.

After thirty days, Segu et al. were able to obtain clear prints from their tests of the efficacy of magnetic, aluminum, and cobalt oxide powders in recording hidden lip prints from nonporous surfaces like ceramics and glasses. Sudan III dye and aluminum powder were also used by Dolly et al.[10] to create noteworthy lip prints in a different investigation. Digital photography was employed by Kapoor and Badiye to characterize the lip print patterns of the Indian populace.[11] Although this process is quite simple and eliminates the time-consuming phases of traditional procedures, it is not suitable to Lip print samples. Nonetheless, this strategy is ideal for collecting probable, noninvasive examples from suspects.

Dye methods

Lysochrome and fluorescent dyes (Nile red) are the most often used lipophilic chemicals for LP formation. The term "lysochrome" refers to a group of chemical substances that, when they come into contact with fat, dissolve one portion of fatty acids (lyso) and produce a color that reveals the print patterns.

In a study by Khanna et al., when collecting visible and latent lip prints from white cotton fabric, white satin fabric, and bone China cup, natural dyes like vermilion and indigo dye demonstrated the same enhancement as lysochrome dyes like Sudan Black. Therefore, he said that natural dyes like indigo and vermilion would be preferable because they are less expensive and non-toxic. Because cotton fabric absorbs more lipstick components, the resulting Lip print quality was found to be less efficient as compared to satin fabrics. Castello et al. evaluated the effectiveness of three lysochrome dyes (Sudan III, Red O, and Sudan Black) in the creation of old and new lip prints from long-lasting lipsticks on cotton fabric and tissue paper. They found that lysochrome dyes showed better enhancement than ninhydrin and other fingerprint powders.[12] The order of enhancement efficiency was as follows: Sudan III > Sudan Black > Oil Red O. The quality of the lip print improved on both substrates, but the pattern quality changed with the age of the lip print and was dependent on the substrate. Ninhydrin provided a negative outcome because the Lip print residues lacked amino acids, which serve as a precursor for its reaction. In another study, dyes like Sudan III, Sudan Black and Oil Red O were efficient for acquiring recent Lip prints on the skin of a corpse in the development of undetectable Lip prints. Because of the contrast concerns with lysochrome dyes, fluorescent dyes outperform lysochrome dyes in enhancing Lip prints on colourful or multicoloured surfaces.[13]

Other methods

Additional techniques for creating latent lip prints that are similar to latent fingerprint imprints are the Ninhydrin Meth Indanedione Method, the Cyanoacrylate / Super Glue Fuming Method, the 5-Methylthio Ninhydrin Method (5-MTS), Vac Deposition, and the DEO Method (VMD).[14]

CONCLUSION

Cheiloscopy, in combination with other conventional methods, may be a highly useful tool in identifying a person. A systematic and uniform technique for collecting, developing, and documenting lip prints, as well as ensuring comparability, must be established. The search for invisible or latent prints at a crime scene requires more simple, sensitive, and efficient techniques. It is important that the approach adopted allows for further studies. The approach and procedures for detecting latent lip prints should be standardized, and novel techniques should be investigated to broaden its scope and match its usage with fingerprints.

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