Cheiloscopy: Evolution and Recent Trends

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Abstract

Cheiloscopy i.e. study of lip prints was initially used as a technique of identification as they are as specific as fingerprints. Although the technique was described in middle of last century it is yet to be used routinely for investigative purposes. Recent studies are showing relation of lip prints with various clinical conditions like inheritance of cleft lip and increased incidence of certain cancers.

Keywords: Identification; Cheiloscopy; Lip Prints; Classification; Recent Trends.

Introduction

Medicolegally, Identification refers to the determination of individuality of individual. There are many techniques of identifying an individual, living or dead, like Anthropological Parameters, Hair, Dactylography, Poroscopy, Footprints, Rugoscopy, Tattoo marks, Scars, Occupational Stigmata, Complexion and Physical Features. One other method which is used relatively scarcely in forensic investigations is cheiloscopy. Cheiloscopy (derived from the Greek words cheilos - lips, e skopein - see)[1] a.k.a quiloscopy[2] is the study of the patterns formed by the wrinkles and grooves of the labial mucosa (sulci labiorum) forming a characteristic pattern described as "lip prints"[3-5]. The creases on the vermillion border of the lips, which appear as white areas in lip prints, and the raised reddish areas outlined by these creases, which appear as dark areas, are analogous to the furrows and ridges of friction ridge skin. The creases on the vermillion border are also referred to as grooves, furrows, wrinkles and valleys [6]. Therefore Cheiloscopy is also described as method of identification of a person based on characteristic arrangement of lines appearing on the red part of lips or as a science dealing with lines appearing on the red part of lips [7]. They are identifiable as early as sixth week of intrauterine life [1,8]. This biological feature was first described by Fisher in 1902 [3,7,9]. The use of Cheiloscopy in criminology was first done by Locard (1932)[3]. Forensic Cheiloscopy is the study of lip prints for the purposes of law and administration of justice[10]. Cheiloscopy is analogous to fingerprint analysis, and is a genuine subspeciality of forensic odontology[11]. The lip prints are unique in characteristics and have been found to be analogous to fingerprints [4]. Their role in identification has been underutilized. This is mainly because of the lack of knowledge of this scientific technique. Cheiloscopy is not only useful for forensic purposes but also for the clinical information that can be gained from it. Just like fingerprints, lip prints are found to be associated with different clinical conditions like cancer [12-14] and cleft lip [15,16].

Historical Overview (Table 1)

Cheiloscopy technique has been used successfully in many cases over time proving its value similar to other methods of forensic identification. It has also been included as evidence in courts [7,9,23-25].

Anatomical Landmarks of Lips

Lips

The lips are two fleshy folds surrounding the oral orifice. The centre of each lip contains a thick fibrous strand, consisting of parallel bundles of skeletal

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muscle fibres (orbicularis oris, together with incisivus superior and inferior, and the direct labial tractors), and their attachments to skin, mucosa or other muscle fibres. The free external surface of each lip is covered by a thin keratinized epidermis, and is continuous with the mucosa at the vermilion (red) zone of the lip. The internal mucous surfaces are lined with a thick non-keratinizing stratified squamous epithelium. Between the skin and mucosa, the vermilion zone is covered with a specialized keratinized stratified squamous epithelium which is thin near the skin, increases in thickness slightly as the mucosa is approached, and then thickens abruptly when true mucosa is reached. The vermillion border of the lips has minor salivary and sebaceous glands. The epithelium is covered with transparent, dead squames and its deep surface is highly convoluted, interdigitating with abundant long dermal papillae [26]. The anatomical landmarks of the lip include chelion (the lateral most point in mouth opening), stomion (the contact of upper and lower lips in mid-sagittal plane), and labrale superius and labrale inferius (the highest and lowest points of upper and lower lip margins in the mid-sagittal plane, (respectively) [27]. The size and curvature of the exposed red lip surfaces is subject to considerable individual, gender, and ethnic variation [26].

In identification the mucosal area, also known as Klein's zone [28], is of greatest interest. It is covered with wrinkles and grooves that form the characteristic lip print. Lips can be divided into four groups according to the thickness of lips (1) thin lips (Seen in European Caucasian); (2) medium lips (most common type, from 8 to 10 mm); (3) thick or very thick lips (usually having an inversion of the lip cord, seen in negroes); (4) mix lips (seen in Orientals) [1,28,29].

Characteristics of Lip Prints

- They are Unique [5,19,30].

- They remain stable over time. No changes have been seen with environmental factors [31].

- They recover after undergoing alterations like minor trauma, inflammation [19] and diseases like herpes [1,32].

- Major trauma or surgery of the lips may lead to scarring thus altering the pattern and morphology of grooves [33] which is itself helpful in identification.

Classifications of Lip Prints

A. According to the Lip Print Pattern

1. Martin Santos Classification [2]

In this classification the author has divided lip grooves into two groups based on the number of elements forming the grooves (Table 2).

Table 1: Historical Overview

1902	Fisher described the characteristic pattern on lips as a biological feature[3,7,9].
1932	Locard suggested the role of cheiloscopy in criminology[3]
1950	Le Moyne Snyder first suggested using lip prints for identification[17]
1960	Dr. Martins Santos proposed use in personal identification
1960	Dr. Martins Santos devised the first system for classifying lip prints[2]
1961	In Hungary (Europe) - the first research was carried out in the subject of lip prints (lip traces had been found on a glass door at the scene of a murder)[9]
1966	In Poland – research on lip prints started (lip traces had been found on a window glass at the scene of burglary)[9]
1968 -71	Yasuo Tsuchihashi and Kazuo Suzuki classification[3,9,10,18,19].
1972	Renaud classification[20]
1975	José Maria Dominguez classification[21]
1976	First personal identification by means of a lip print was made[7].
1979	Afchar-Bayat classification[22]
1982	Research carried out in Forensic Institute of Warsaw University, Criminal Law Department in association with Former Forensic Institute of Militia in Warsaw. (Research carried our using 1500 subjects)[9]
1987	Lip prints and association with Cleft palate[15]
1990	Kasprzak's classification[7]

Table 3: Suzuki and Tsuchihashi classification

S. No.	Classification	Groove Type
1.	Simple (formed only by one element)	Straight line (R-1), Curve (C-2), Angular form (A-3), Sinusoidal (S-4)
2.	Compound (formed by several elements)	Bifurcated (B-5), Trifurcated (T-6), Anomalous (An-7).

Suzuki and Tsuchihashi Classification [3,9,10,18,19].

In this the authors have studies 107 Japanese families, considered six different patterns and classified lip prints according to the shape and course of groove. This classification is most commonly followed for recording the patterns on the lips. (Table 3).

These authors studied relations of the female lips and lipstick. They proved that there is individual specificity in the morphology of the lip grooves. Their results added the strength to the theory of the heredity of lip prints. They found that the lip prints did not change over a period of time. They found that following trauma to a lip, it resumed its groove pattern after healing.

Renaud Classification [20]

This is, probably, the most complete classification. Renaud studied 4000 prints and found that all were different except in case of uniovular twins. In this classification the lips are studied in halves (left and right), and every groove, according to its form, has a number. This is then put in a formula by using capital letters to classify grooves in lower lip and using small letters to separate the left (l) and right (r) sides. In the upper lip the sides are mentioned as capital letters (left – L, right – R) and the grooves are denoted as small letters (Table 4).

Jose´ Maria Dominguez Classification [21]

This classification further improves upon the classification made by Suzuki and Tsuchihashi. The authors introduced a Type II' in the present classification wherein they observed that the branched grooves mentioned in type II of Suzuki and Tsuchihashi often branched the other way around i.e. instead of branching upwards in the upper lip they may branch downwards.

Afchar-Bayat Classification [22] *(1979)*

This classification is mainly based on the pattern of grooves and partly on the distribution of grooves. (Table 5).

Table 4: Renaud classification

Classification	Groove Type
Type a	Complete vertical
Type b	Incomplete vertical
Type c	Complete bifurcated
Type d	Incomplete bifurcated
Type e	Complete intersecting
Type f	Incomplete intersecting
Type g	Reticulated
Type h	In the form of sword
Type i	Horizontal
Type j	Other types

Table 5: Afchar-Bayat classification

Classification	Groove Type
A1	Vertical and straight grooves, covering the whole lip
A2	Like the former but not covering the whole lip
B1	Straight branched grooves
B2	Angulated branched grooves
C	Converging grooves
D	Reticular pattern grooves
E	Other grooves

Table 6: Kasprzak's classification

S. No	Pattern	Feature
1.	Linear - L	If lines are dominant
2.	Bifurcate – R	If bifurcation is dominant
3.	Reticular – S	If the lines cross
4.	Undetermined - N	No superiority can be established

Kasprzak's Classification [7]

This author has given a working classification for lip prints after examining 1500 persons over five years. The middle part of lower lip 10 cm wide is taken and the pattern of lines is established. Pattern

is determined by the numerical superiority of the properties of lines present on fragment. 23 types of individual properties were differentiated by kasprzak, namely, an eye, closing bottom bifurcation, hook, delta-like opening, bridge, simple opening, line, closing top bifurcation, dot, pentagonal arrangement, rectangle-like, branch-like top bifurcation, triangle-like, star-like bifurcation, group of dots, fence, simple top bifurcation, branch-like bottom bifurcation, simple bottom bifurcation, double fence, double eye, hexagonal arrangement and crossing (Table 6).

According to Discovery at Crime Scene

1. Latent prints – these are the prints that cannot be seen with naked eyes and require certain special techniques/ chemical for visualization.

They can be caused by:-

a. Secretions from minor salivary and sebaceous glands on the vermillion border of lips.

b. Smear of saliva on lips by tongue.

a. Persistent lip sticks [34] (these do not leave a visible mark on coming in contact with an object)

2. Visible prints - these are the prints that can be seen with naked eyes and require no special techniques/ chemical for visualization.

They can be caused by:-

a. Colour lipsticks

b. Other agents like blood, dye etc.

Lip prints are unique to an individual and therefore their presence proves the presence of a person at crime scene or near the object on which the print is found like shirt, glass, cup, cigarette butts, photographs, letters, tape used for binding lips or gagging (torture) etc. In the case described by Lemoyne snyder[17] in his book 'Homicide Investigation', a lip print was removed from the left front fender of a car and compared with those of the injured woman. This proved beyond question that the car was the vehicle which had caused the injury. Even though there may be no traces of lipstick, latent lip prints should always be considered while examining a crime scene [30]. The identification of latent print evidence is often considered the key in solving a crime.

Technique of Cheiloscopy

In the Living,

a. Photographs can be taken after smearing the lips with dye/ lipstick.

b. After cleaning the lips thoroughly, lipstick/ dye should be smeared uniformly over lips with a single stroke of dark coloured lipstick. The impression can be taken on a butter paper or cellophane paper. Impressions should be taken until the entire transfer medium is exhausted. Lip prints can then be traced or visualized using magnifying lens. Care should be taken to avoid smudging of prints.

At the crime scene,

1. Observation of crime scene.

    Care should be taken that the latent prints are not missed. Use of white or ultraviolet light can be done to visualize prints.

A. Make the prints visible

Latent Pprints can be Visualised using [1,30,32,34-37].

i. Compounds such as aluminium powder, silver metallic powder, silver nitrate powder or cobalt oxide.

ii. Lysochrome dyes (Sudan III, Oil Red O, Sudan Black) – useful for detecting lipids especially useful in detecting persistent lipstick mark.

iii. Fluorescent reagents – in case of old brands/ marks.

iv. Depending on surface.

1. Smooth, polished, metallic or plastic surfaces (black background) - Plumb carbonate.

2. Smooth, polished, metallic or plastic surfaces (white background) - Marphil black powder or fat black aniline dye.

3. Untreated wood or cardboard - Silver nitrate.

4. Porous surfaces - DFO (1,8-Diazafluoren-9-one) and Ninhydrin.

5. Plastic or waxed surfaces or on vinyl gloves - Cyanoacrylate dye.

v. For photographing latent prints – prints can be developed using Cyanoacrylate dye or an Iodine spray reagent.

B. Photography of latent/ visible prints.

a. All prints should be scaled, photographed individually.

b. Each step in detection should be photographed sequentially.

C. Tracing of prints - Prints should be traced on a

butter paper by overlaying.

Number of Characteristics for Positive Identification

The identification is similar to fingerprints. Establishment of seven to nine fine characteristics leads to positive identification [7].

Duration of Recovery

Latent prints can be recovered till 30 days from crime scene [34]. However, if the crime scene is not contaminated, then lip prints can be recovered till a long time.

Problems with Cheiloscopy [5,30]

1. Same person can produce different prints as their production depends on the force and direction of force applied by person.

2. Amount of lipstick/dye used can also affect the print.

3. The lip prints may not form clearly at crime scene i.e. there may be smudging or spoiling of prints, which limits readability of lines and hence prevents identification.

4. Subjectivity because of manually performing overlay for lifting and analysing prints.

5. Existence of some pathological conditions (Merkelson–Rosenthal syndrome, lymphangiomas, lip sclerodermia, syphilis, lip cheilitis, congenital lip fistula) can result in erroneous results in cheiloscopic study.

6. Possibility of post-mortem changes of lip prints from cadavers with various causes of death like burns, accidents etc.

7. Limited amount of antemortem data referring to lip prints which prevents identification after death.

Scope of Cheiloscopy [8,23,25,30,35,38-51]

1. Lip prints are useful in detecting the following at a crime scene:-

a. The number of individuals involved,

b. The crime committed,

c. Gender of the persons involved,

d. Cosmetics or a specific substance used or present in cosmetic (like lipsticks),

e. any specific habits and occupational traits,

f. pathological changes of lips.

2. From lip prints trace biological evidence like saliva can be recovered which can be used for

a. determining blood group in the ABO System,

b. DNA typing.

Recent Trends in the Field of Cheiloscopy

1. Since the lip prints develop early in intrauterine life, researchers have extended the scope of cheiloscopy and used it as a successfully as a marker for skeletal malocclusion [41,52].

2. No significant correlation has been established between ABO blood groups and lip prints [39,53,54].

3. Research has been carried using digital technique to analyse lip prints[31].

4. Association of occurrence of cancer with lip prints were studied by different researchers wherein it has been found that the female cancer risk is statistically significantly related with lip prints [12-14].

5. Studies have been performed showing ethnic diversity in lip prints [13,44,55-59].

6. Lip prints have been used to determine gender by many researchers [7,8,23,40,42,43,45,46,48,60].

7. Study has been conducted to identify a person after death using lip prints [61] .

Conclusion

Cheiloscopy is a technique that has great clinical and forensic significance. Its application in various fields is restricted due to limited knowledge of this technique. It is important that the clinicians and investigation authorities utilize this relatively less used and neglected technique routinely in practice. Criminal take precautions regarding leaving fingerprints at crime scene. However since this method of identification is relatively unknown even to criminals, it can be useful in solving many crimes that go undetected. Clinically this technique can be used in preventing conditions like cervical cancer and malocclusion. Further research may show the utility of this technique in many other fields.

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