Review Article

Cheiloscopy: Revisited

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Abstract

Identification plays a very important role in any crime investigation. Cheiloscopy helps in identifying the humans based on the lips' traces. The pattern of wrinkles on the lips has individual characteristics like fingerprints. A review of the literature reveals very little research done on lip prints so far. The present article reviews in detail the history, scope of cheiloscopy, and the use of lip prints in crime detection. It also highlights the current research carried out in the field of cheiloscopy. An effort has been made to help the researchers by reviewing in detail the various methods of classifying and analyzing the lip prints. It concludes by enlightening the readers with the fact that the possibilities to use the red part of lips to identify a human being are wider than it is commonly thought.

Key words: Cheiloscopy, forensic odontology, forensic science, identification, lip prints, quiloscopy

Introduction

Identification plays a very important role in any crime investigation. The introduction of fingerprints in the beginning of the past century as the only reliable means of human identification was due to the significant works of three distinguished persons – Sir William Herschel, Sir Francis Galton, and Sir Edward Henry. Fingerprint system was first used in India in 1858 by Sir William Herschel.[1] In individuals, the fingerprint patterns are distinctive and permanent, and hence considered as the guide to identity. Many a time, the materials with which a criminal may come in contact are unlikely to receive fingerprints of sufficient clarity to be useful as evidence. Awareness of the modern techniques of crime detection has alerted the criminals for taking sufficient precautions like the use of gloves. In such circumstances, the identification of criminals using accurate methods like fingerprint analysis fails to establish a positive identity. The investigators can rely on cheiloscopy as supportive evidence in specific investigations.

Thus, today identity can be established by a combination of methods which makes the identification process relatively flawless. The pattern of wrinkles on the lips has individual characteristics as fingerprints. Cheiloscopy (quiloscopy) can be defined as a 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.[2] It is a forensic investigation technique that deals with identification of humans based on lips traces.[3]

History

The biological phenomenon of systems of furrows on the red part of human lips was first noted by anthropologists. R. Fischer[2,3] was the first to describe it in 1902. As early as 1932, Edmond Locard,[4] one of France's greatest criminologists, recommended the use of lip prints for the identification of a person. Until 1950,[2,3] however, anthropology merely mentioned the existence of the furrows without suggesting a practical use for the phenomenon. The idea of using lip prints for identification was first suggested by Le Moyne Snyder.[5-8] He introduced a case in which lip prints helped the crime scientists in an unusual way.

Dr. Martins Santos in 1960[6-8] proposed that these lip characteristics could be used in personal identification and

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devised a simple system for classifying lip prints. It was in Hungary during 1961 that the first research in Europe was carried out in the subject of lip prints. The examination started after lip traces had been found on a glass door at the scene of a murder. At this time, the usefulness of the lip traces for criminalistic identification was proven.[2,3]

Since 1950, the Japanese have carried out extensive research in the matter. Apart from Santos' classification, two Japanese scientists, Yasuo Tsuchihashi and Kazuo Suzuki,[6-9] had been investigating forensic odontological relations of the female lips and lipstick. They said that there was an individual specificity in the morphology of the lip grooves.

In 1971, Kazuo Suzuki and Yasuo Tsuchihashi[5,9] carried out more investigations, which included uniovular twins They divided the lips into four quadrants and devised their own classification of six different types of grooves. They demonstrated that no two lip prints manifested the same pattern, that lip prints of uniovular twins were extremely alike, and that their characteristics may be inherited from either parent. This was further confirmed by Tsuchihashi[5,10] in his longitudinal study which included 1364 persons and the family groups. These results added the strength to the theory of the heredity of lip prints. He found that the lip prints did not change over a period of time. It was observed in his study that no two uniovular twins had exactly identical lip print patterns. He also found that following trauma to a lip, it resumed its groove pattern after healing.

Based upon the research by the two Japanese scientists mentioned above, it was established that the arrangement of lines on the red part of human lips is individualistic and unique for each human being. This statement led to the conclusion that there is the possibility of using the arrangement of furrows (on a trace, in a linear form) on lips for the identification of a person.[2,3]

During the years 1985–1997, cheiloscopic techniques had been used in 85 cases, including 65 burglary cases, 15 cases of homicide, and 5 cases of assault. In 34 cases the identification was positive, which means that cheiloscopic techniques were equal in value to other types of forensic evidence. It has also been included in evidence for presentation in court.[2,3]

It was during the period 2000–2010 that studies were carried out by several researchers in India and other countries.[11-20] Different aspects of the lip prints like stability,[11,12,19] sex determination[16,17] and various morphological patterns[13,15,18,20] using lip prints among different groups of population were studied. A study on postmortem changes of lip prints[21] was also carried out to find out the changes in anthropometric measurements of the lip region before and after fixation. All these studies were in agreement with the Japanese research and thus helped in concluding that the cheiloscopic studies can be implemented as an auxiliary method of identification.

Scope of Cheiloscopy

It is difficult to place the lip prints in the general system of traces. The unique properties of the lip print help in identifying a human being spatially when it is revealed as a stratified surface trace with visible elements of lines.[3]

In the case where the lines are not clear, individual identification of a human being based on this trace is extremely difficult unless the trace contains more individual characteristics, e.g. scars, and often identification ends with group identification. In these cases, it is possible to examine the substance which constitutes the trace, e.g. saliva, as a biological trace and to determine the blood group in the ABO system.[2,3,22] There is a huge potential for DNA typing from the lip print. This process has not yet been attempted. When a lip print is found at the scene of a crime, the character of the event, the number of the people involved, sexes, cosmetics used, habits, occupational traits, and the pathological changes of lips can be concluded.

The Use of Lip Prints in Crime Detection

Just like fingerprints and teeth, lip prints can be used as an identifying tool in forensic sciences as each individual's lips have a specific pattern of fissures.[5-9,11-21] Traces of lips should be looked for on cutlery and crockery items, on the window or door glass, on photographs or letters. Lip prints may also appear side by side with tooth marks on food products. In practice, lip prints have also been revealed on the surface of windows, paintings, doors, plastic bags, and cigarette ends.[3] They can most frequently appear in the scene of murders, rapes, and burglaries. Traces with clear lines and individual elements enable individual identification of a human being. In a sense, lip prints have the same value as dactyloscopic traces. In the case of traces, in the shape of stains, the identification examination terminates with group identification; in their character they are similar to other chemical and biological traces.[2]

Current Research

From the mid 1970s until 2000, research into conventional lip prints was carried out.[2-4,6-12] Conventional lip prints refers to the lipstick smears that are often left as trace evidence and can link a suspect to a crime scene. In recent years, however, the cosmetic industry has been developing lipsticks which do not leave a visible smear or mark in contact and have been called persistent lipsticks.[5,23,24]

A Spanish group[5,23,24] has looked into the latent lip prints (i.e. lip prints from protective lipstick or permanent or long-lasting lipstick that do not leave any visible marks)

left behind by these new lipsticks and their possible use as forensic evidence. They suggested that with the introduction of new smearless or markless lipsticks, the possibility of latent lip prints should be considered.

Fingerprints are developed by a number of methods which rely on the fact that sweat and body oils which have been transferred from the body to an object react with a number of reagents to become visible.[1] Fingerprint powders adhere to sweat and body oils, iodine when heated reacts with sweat, ninhydrin reacts with the amino acids in sweat, heated cyanoacrylate (Super Glue) reveals latent prints, and sweat fluoresces when illuminated by a laser.[22]

Alvarez *et al*.[23,24] tested developing the latent lip prints using a similar method. According to them, the vermilion borders of the lips have minor salivary glands and sebaceous glands. These glands are associated with hair follicles, with sweat glands in between, and secreting oils. With these secretions and continual moisturizing, it makes the latent lip prints available at most of the crime scenes. Williams[8] also stated that lip prints could be recorded without the use of lipstick or other recording medium, provided a suitable (non-porous) surface had been used which was then developed for prints. In the study of Castello *et al*.[25] on luminous lip prints, Nile Red was considered as a potential developer for latent lip prints. They used a property of luminescence for latent lip print development. Luminescence is specially a useful property for the search of invisible evidences at the scene of a crime.

A group of Korean authors, Kim *et al*.,[26] conducted a study to show that a lip print is sufficiently used by the measurements of biometric systems. Lip print recognition has been less developed than the recognition of other human physical attributes such as the fingerprint, voice patterns, retinal blood vessel patterns, or the face. Lip print recognition by a CCD camera has the merit of being linked with other recognition systems such as the retinal/iris, eye, and the face.

A new method using multi-resolution architecture is proposed to recognize a lip print from pattern kernels.[26] A set of pattern kernels is a function of some local lip print masks. This function converts the information from a lip print into digital data.

Classification of the Lip Print

Collection of lip prints from the crime scene and recording the lip print of the suspect plays a very important role. Lip prints can be classified and further analyzed only when a clear image is obtained. Various authors have tried different methods of collection of the lip prints[27] to get an analyzable image. Classification of the lip prints is based on the pattern of wrinkles or grooves on the vermillion border of the lips.

Dr. Santos in 1966[8-10] divided the nature of wrinkles and grooves into simple and compound types. Simple type was further subdivided into four groups, i.e. a straight line, a curved line, an angled line, and a sine-shaped curve. Compound type was further subdivided into bifurcated, trifurcated, and anomalous groups. Santos also classified the lip based on its thickness[14] as thin, medium, thick, and mixed type. Thin lips are generally seen amongst the European people. Medium lips are 8–10 mm in thickness, in which the pink zone is found to be more rounded. This type is more commonly found in the general population. Thick or very thick lips are very big in which the labial string appears inverted. These are the characteristics of Negros. Mixed type of lips was very commonly seen in Oriental people. Santos also reported various types of commissures like horizontal, flat, and elevated.[14]

Suzuki and Tsuchihashi[9,10] 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*," i.e. in general, "lip print," and thus evolved a new classification of lip prints. Lip prints were classified into six types according to the shape and course of the grooves [Table 1 and Figures 1–6]. This classification is most commonly followed for recording the patterns on the lips.

A French scientist, Renaud,[14] studied 4000 prints of the lips and found that all were different except in case of uniovular twins and accordingly gave the classification shown in Table 2.

Kasprzak[3] gave a classification that has been proven in practice, in which he determined the pattern based on the numerical superiority of properties of the lines on the fragment. After the patterns of lines had been established, a first catalog of individual features was prepared and 23 types of individual properties were differentiated[2,3]

Table 1: Suzuki and Tsuchihashi's classification of lip prints

Type I	A clear-cut line or groove running vertically across the lip
Type I'	Straight grooves that disappear half way into the lip instead of covering the entire breadth of the lip or partial-length groove of Type I
Type II	Grooves that fork in their course or a branched groove
Type III	An intersected groove
Type IV	A reticular groove
Type V	Grooves that do not fall into any of the above categories and cannot be differentiated morphologically

Table 2: Renaud's classification of lip prints

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

[Table 3]. As the basis for the classification, the middle part of the lower lip, 10 mm wide, was taken since this fragment is almost visible in the trace.[3,13]

Classification of the patterns of the lines on the red part of the lips given by Kasprzak is as follows:[2,3] If the lines prevail, the pattern is described as linear, "L." If the bifurcation is dominant, it is called bifurcate, "R." If the lines cross, the pattern is dubbed reticular, "S." In the case where no superiority can be established, the pattern is named undetermined, "N" [Figures 7–10].

Analysis

Using the aforesaid classification, Suzuki and Tsuchihashi[10] recorded the lip prints in a way resembling a dental formula,

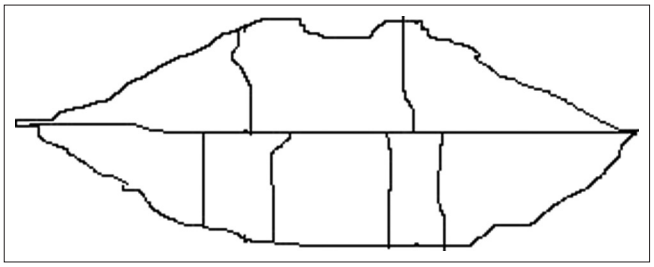

Figure 1: Type I pattern

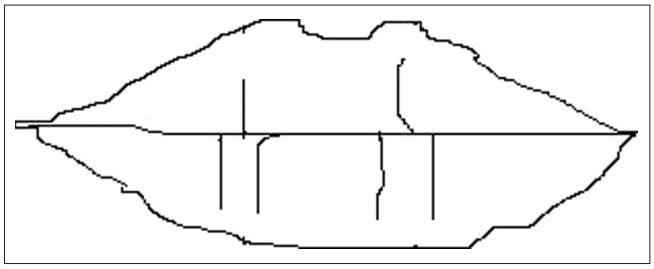

Figure 2: Type I′ pattern

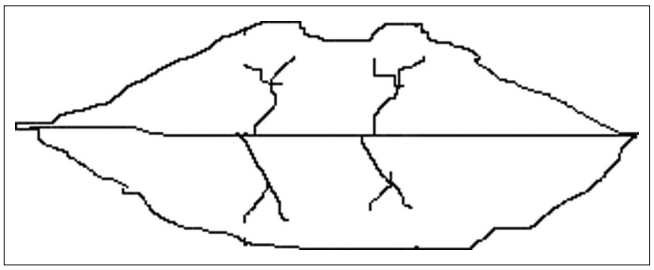

Figure 3: Type II pattern

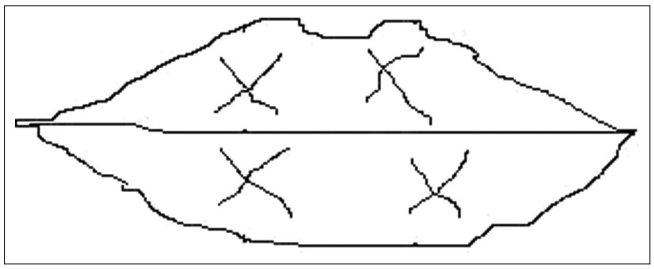

Figure 4: Type III pattern

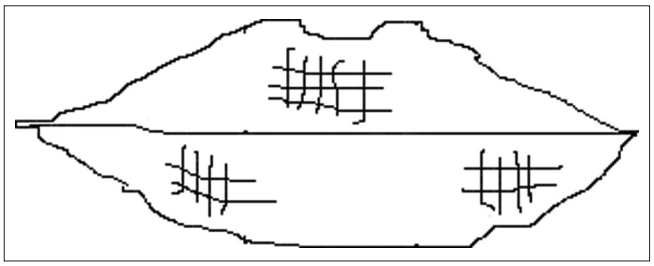

Figure 5: Type IV pattern

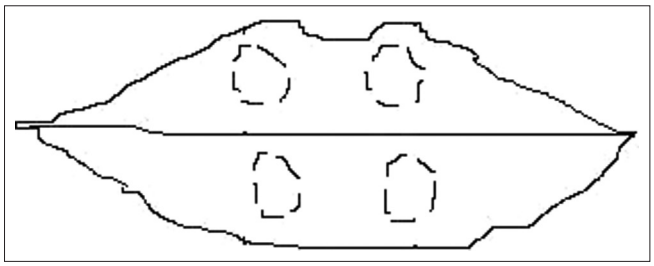

Figure 6: Type V pattern

Table 3: Individual features of line pattern on red part of lips, given by Kasprzak[2]

Sr. No.	Type of features	Graphic symbol	Sr. No.	Type of features	Graphic symbol
1	An eye	⊙	13	A closing bottom bifurcation	⅄
2	A hook	⊦	14	A delta-like opening	⅂
3	A bridge	⊢	15	A simple opening	⊤
4	A line	I	16	A closing top bifurcation	⅄
5	A dot	.	17	A pentagonal arrangement	⏢
6	A rectangle-like	⊟	18	A branch-like top bifurcation	⅄
7	A triangle-like	⊩	19	A star-like bifurcation	✳
8	A group of dots	⁘	20	A fence	⫟
9	A simple top bifurcation	⅄	21	A branch-like bottom bifurcation	⅄
10	A simple bottom bifurcation	⅄	22	A double fence	⫴
11	A double eye	⊙	23	A hexagonal arrangement	⬡
12	Crossing lines	X			

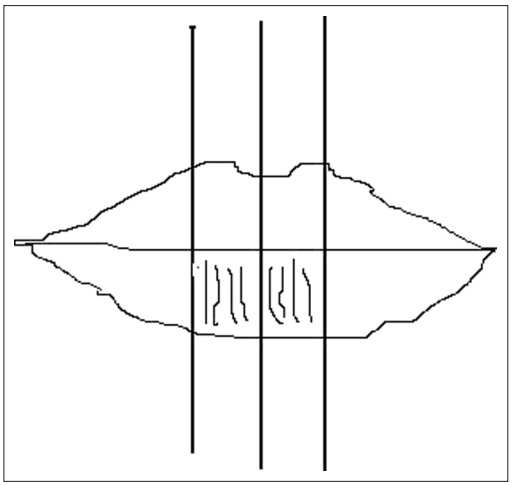

Figure 7: Linear "L" pattern

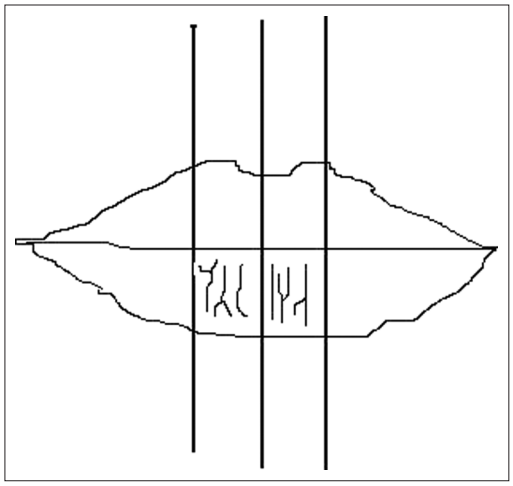

Figure 8: Bifurcate "R" pattern

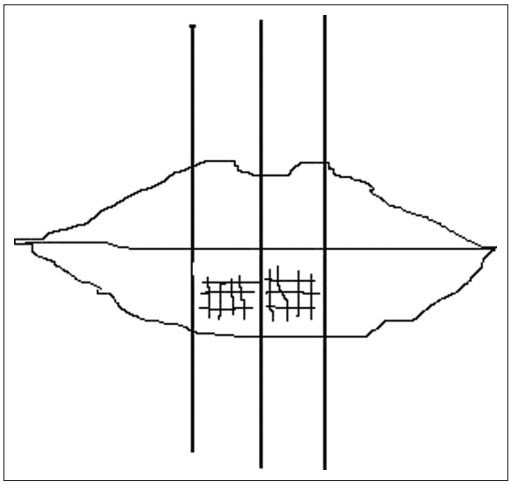

Figure 9: Reticular "S" pattern

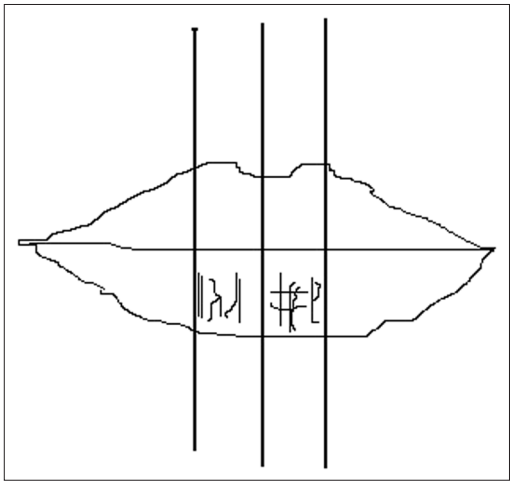

Figure 10: Undetermined "N" pattern

generally used in a dental clinic. A horizontal line was drawn to distinguish the upper from the lower lip (Y – Y′) and a median line was drawn to divide the left and the right sides (X – X′): these two lines intersected at right angles. By noting the classified type of the grooves, the individual's lip print pattern was recorded. Three technical methods can be applied in a cheiloscopic expertise:[2,3]

1. The method of determining common features (similar to dactyloscopy): Establishment of seven to nine fine characteristics leads to positive identification.
2. The method of photographic montage.
3. The contour method.

Determining the common properties is the most basic identification method. The essential part of this method is the hypothesis that in order to establish identity between evidential and comparative material, one should determine the common features, including individual features from the catalog of 23 types of features [Table 3]. The photographic montage method and the contour method supplement and support the method of establishing common properties. In the method of a photographic montage, a fragment of the photograph of a comparative trace is fitted to a photograph of an evidential trace and the conformability of individual properties is examined. In the contour method, contours of the most characteristic arrangements of lines on the red part of the lips are transferred onto transparent foil and are then compared with the lines in the photograph of evidential and comparative traces.[2,3]

Cheiloscopic Expertise

The first cheiloscopic expertise was made in Poland in 1966 when a lip print was revealed on window glass at the scene of a burglary. The examination was carried out and the expert concluded that the trace of lips revealed at the scene did not belong to the suspect.[5]

Kazuo Suzuki and Yasuo Tsuchihashi in 1970[7] reported an extremely rare case in which the materials of criminal identification were drawn from the lip prints. The identification result obtained was that the lip prints on the envelope were not made by the suspects.

The fact remains, however, that in 1976, the first personal identification by means of a lip print was made. During the inspection of the place of burglary in Milanowek, a legible trace of the lips was found on the glazed picture. And behind this picture, the owners of the place had kept the money. After the examination, it turned out that it was the lip print of the daughter of the owners. So, the cheiloscopic expertise itself, in this case, had an eliminatory character.[2]

Since the end of 1985, the Dactyloscopy Division of the Department of Criminalistics of the Civic Militia Headquarters has initiated elaborate methods, previously checked in laboratory conditions, and proved their usefulness in court proceedings. In the year 1986–1987, two methods of cheiloscopic expertise were performed with positive, categorical opinions.[2]

In 1988, till the middle of April, two more methods of expertise were performed and again the opinions were positive and categorical. It concerned a burglary in a grocery store in the vicinity of Plonsk on November 18, 1987. Lip prints were found along with the tooth marks on a piece of cake. Both examinations revealed that the person who had left the trace was one of the burglars. The expertise of tooth marks gave a probable result and the lip print expertise a categorical one.[5]

The example cited above proved the existence of large identifying possibilities of cheiloscopy. What must also be stressed is that lip prints often accompany tooth marks.

Conclusion

The tremendous research done in the field of cheiloscopy and ongoing research on latent lip prints highlights the fact that the possibilities to use the red part of lips to identify a human being are wider than it is commonly thought. One could conclude, therefore, that these traces are rarely found at the scene of the crime. This is not entirely true.

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