

# Human identification by means of conventional and digital Cheiloscopy: a study of the literature

Identificação humana por meio da Queilosopia convencional e digital: um estudo da literatura

Lara Maria HERRERA<sup>1</sup>  
Clemente Maia da Silva FERNANDES<sup>1</sup>  
Mônica da Costa SERRA<sup>1</sup>

## ABSTRACT

One of the areas of human identification is Cheiloscopy, the name given to the study of the lips, their characteristics (such as thickness, position of the grooves and grooves) and the record of the impressions left by them. There are variations in the layout of the lines and fissures of the lips, which are unique to each individual, permanent and unchanging. The lip print rarely changes, enduring minor traumas such as inflammation or sores. In criminal investigations, lip prints, visible through the presence of lipstick, can be found on glasses, napkins, clothes, cigarettes, indicating a relationship between the subject and the scene of the crime. Latent impressions may be revealed employing specific chemicals such as powder of silver and aluminum nitrate. Although it is not a very common method, Cheiloscopy may become very useful in forensics due to the extensive amount of valuable information that it brings. The objective of this study was to review the literature on the use of Cheiloscopy in human identification, using traditional and digital methods. It was found that the literature is still in need of studies in this area. The advent of new digital technologies can facilitate the implementation of technical expertise, generating speed and objectivity. New research studies are necessary, especially in the development of digital methods. The application of Cheiloscopy can greatly help with Law, in the identification of living suspects and dead individuals. In the end the benefit will fall to society as a whole.

**Indexing terms:** Forensic anthropology. Forensic dentistry. Lip.

## RESUMO

Uma das áreas da identificação humana é a Queilosopia, nome dado ao estudo dos lábios, suas características (como grossura, posição dos sulcos e estrias) e o registro das impressões deixadas por eles. Existem variações na disposição das linhas e fissuras dos lábios, sendo únicas para cada indivíduo, permanentes e imutáveis. A impressão do lábio raramente se modifica, resistindo a pequenos traumas como inflamações ou lesões herpéticas. Em investigações criminais, impressões labiais visíveis pela presença de batom podem ser encontradas em copos, guardanapos, roupas, cigarros, indicando uma relação do sujeito com o ambiente do crime. Impressões latentes podem ser reveladas empregando-se substâncias químicas específicas como pó de nitrato de prata e de alumínio. Mesmo não sendo um método muito comum, a Queilosopia pode se tornar bastante útil na prática forense devido à extensa quantidade de informações preciosas que carrega. O objetivo deste trabalho foi realizar uma revisão da literatura sobre o emprego da Queilosopia em identificação humana, utilizando-se métodos tradicionais e digitais. Verificou-se que a literatura ainda é carente de trabalhos nesta seara. O advento das novas tecnologias digitais pode facilitar a execução desta técnica pericial, gerando rapidez e objetividade. São necessárias novas pesquisas, sobretudo no desenvolvimento de métodos digitais. A aplicação da Queilosopia pode, em muito, colaborar com a Justiça, na identificação de suspeitos vivos e de indivíduos mortos. Ao final, o ganho será da sociedade.

**Termos de indexação:** Antropologia forense. Odontologia legal. Lábio.

## INTRODUCTION

There are several forms of expert investigation, amongst which are those that seek to establish human identity by means of methods of identification. These are characterized as being comparative, i.e. it is necessary to reach a judgment by comparing one record with another. The methods used vary, the most traditional being fingerprinting, dental records and DNA examination. However, when these cannot be used, it is necessary to resort to different, less well known techniques, such as cheiloscopy<sup>1</sup>. This technique consists of studying the lips

and their features, such as the thickness, the position of the furrows and grooves and their classifications, as well as a record of the prints they leave<sup>2</sup>.

Cheiloscopy may also be used to confirm the identity of subjects that leave their lip prints on some object or other, especially at the scene of a crime. In these cases, the marks found are compared with the suspect's lip lines.

Detailed conventional examinations to compare photographs of lips and lip prints, and between two prints, can involve the aid of magnifying lenses and tracing on cellophane paper. These analyses are applied with the aim

<sup>1</sup> Universidade Estadual Paulista Júlio de Mesquita Filho, Faculdade de Odontologia, Departamento de Odontologia Social. Rua Humaitá, 1680, 14801-903, Araraquara, SP, Brasil. Correspondência para / Correspondence to: MC SERRA. E-mail: <mcserra@foar.unesp.br>.

of ascertaining the features present and to classify them according to types defined by experts on the subject, such as Suzuki & Tsuchihashi<sup>3</sup>, as well as making a more timely identification<sup>4-5</sup>.

With the advancement of technology, there has been a tendency to make use of digital means that facilitate analysis and provide identification in a quicker and more reliable way<sup>6</sup>. In the field of cheiloscropy, the use of digital means as a resource for analysis has already been mentioned in scientific studies. These citations only make reference to the use of software applications for magnifying the photographs of prints for a better view of the details of grooves. However no work has been found to date that addresses the superimposition of images using computer programs so that coincident points between two prints can be determined.

The aim of this study is to perform a review of the literature on cheiloscropy and its use in human identification, using both traditional and digital methods.

### History and classification of lip lines

In 1902, an anthropologist called Fisher observed and described the biological characteristics of human lips in terms of the organization of their furrows. It was only in 1930, however, with Diou de Lille, that these furrows were regarded as potentially useful elements in criminology, using lip prints. Two years later, one of France's most renowned criminologists, Edmond Locard, confirmed the importance of the study of cheiloscropy and its application<sup>1,4,7</sup>.

The concept that wrinkles in the lips could identify people was suggested in 1950 by Le Moyne Snyder, a forensic expert from California, in his book entitled "Homicide Investigation"<sup>8-9</sup>. He presented a case stating that these structures possessed individual features in the same way as fingerprints do. He is now regarded as the father of cheiloscropy<sup>3-5</sup>.

In Hungary, interest in the study of lip prints began in 1961 with a homicide case. The perpetrator of the crime left a delicate lip print on a glass door that he had opened using his head because his hands were covered in blood. Lip prints began to attract attention in Poland in 1966 when this form of evidence was discovered on a glass window at the scene of a robbery<sup>7</sup>.

In 1966, Clauco Martins Santos, professor of Forensic Dentistry at the Federal University of Rio de Janeiro (UFRJ) in Brazil, advocated that a set of lip wrinkles and grooves could be divided into different groups and he proposed a classification. According to the author, there were simple

types (formed by a single element) and composite types (several elements). With the simple type, the element could be a straight line, a curve, an angular shape or a sinusoidal shape. Composite types would include bifurcated, trifurcated or irregular shapes<sup>1,4,7,9-11</sup>.

In Japan, Suzuki & Tsuchihashi<sup>3</sup> conducted studies based on a classification conceived by Martin Santos and discovered an individual peculiarity in the morphology of lip grooves. Suzuki & Tsuchihashi<sup>3,12</sup> called these lip grooves sulci labiorum rubrorum and the image formed by them was called figura linearum labiorum rubrorum, i.e. the "lip print". The authors developed a new classification for lip prints based on groove shape and direction. They gave the description "Type I" to lip prints with patterns of grooves in a straight line, arranged vertically and running along the entire width of the red part of the lip, "Type I'" to prints whose groove patterns were also in a straight line though not covering the entire width of the lip, just one half of it, "Type II" when the grooves were bifurcated or forked, "Type III" for crisscrossing grooves, "Type IV" for reticulate or "web-shaped" grooves and "Type V" for lines with other shapes not matching any of the other types mentioned<sup>1,3,5,11,13-14</sup>.

Using the aforementioned classification, studies were conducted on 280 individuals as well as 18 pairs of monozygotic, or identical, twins, and later on with a sample of 1,364 Japanese; after recording the lip prints, it was established that each of the individuals had his/her own lip print. A relationship was also observed of lip prints with genetic factors and it was concluded that the lip print pattern of monozygotic twins was not perfectly identical, though extremely similar to that of the parents. In addition, the lip prints of 7 individuals were collected every month for three years and no change was noted in the print pattern during this time. Another observation that was reported was that when an individual caught cold during the period of the study, the shape of the furrows was somewhat altered, interfering with the lip prints, but they returned to the original pattern after recovery<sup>2-3,10</sup>.

In 1968, the technique helped the Tokyo police to eliminate the hypothesis of two suspects who had been detained being the owners of lip prints left on a letter in which there was a threat to blow up police headquarters. Also in Tokyo, another case involved the death of a woman: a piece of tissue with a lipstick mark was found at the scene of the crime and was used to identify a criminal and also prove the innocence of a suspect<sup>8,12</sup>.

A study was carried out in 1972 by Renaud with four thousand lip prints, that confirmed their uniqueness

and he formulated a separate classification<sup>1</sup>. The grooves were organized by shape into ten types: "Type A" for complete, vertical grooves, "Type B" incomplete vertical grooves, "Type C" complete bifurcated, "Type D" incomplete bifurcated, "Type E" complete forked, "Type F" incomplete forked, "Type G" reticular grooves, "Type H" grooves in the shape of a comma or "x", "Type I" horizontal grooves and "Type J" grooves for other shapes such as elliptical, triangular, microfurrows<sup>1,11</sup>.

Figures 1 and 2, below, show the lips (and lip lines) and lip print of the same individual. Figure 3 illustrates various types of lip grooves in the same individual, according to the Suzuki & Tsuchihashi classification<sup>3</sup>.



Figure 1. Photograph of lips (and lip lines).



Figure 2. Lip print made on paper using lipstick.

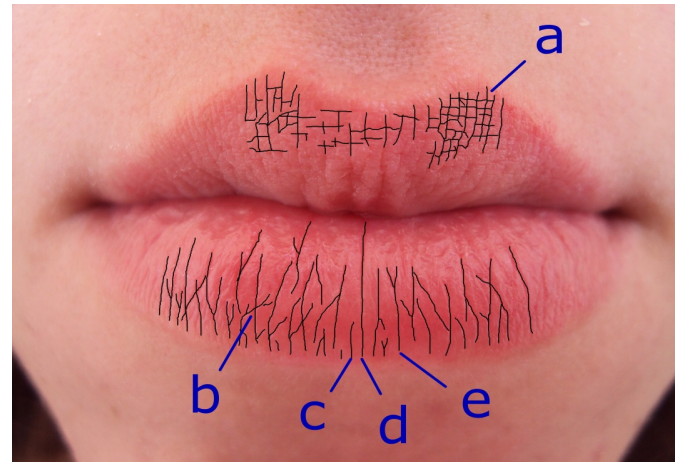


Figure 3. Photograph of lips with delimited lip lines showing different groove patterns, as per the Suzuki & Tsuchihashi classification, in the same individual: (a) Type IV or "reticular grooves"; (b) Type III or "intersecting grooves"; (c) Type I' or "incomplete vertical" grooves; (d) Type I or "complete vertical" grooves; (e) Type II or "forked" grooves.

### Latent lip prints

In criminal investigations, lip prints left on objects such as drinking glasses, paper napkins, cigarette ends, tissues, CDs, DVDs or other objects, will show a link between the subject and the scene of a crime. These prints are usually found as visible lipstick marks. With advancements in the cosmetics industry, the use of lipsticks that do not leave marks is increasingly common; they are called "permanent or long-lasting lipsticks" thus necessitating reagent substances that reveal them for analysis, tested and described in several articles<sup>9,16-17</sup>.

In the middle of the 1970s, a group of researchers in Spain developed a number of studies on lip prints made with lipsticks that do not leave visible marks<sup>9</sup>. In one such study, lip prints were made with this type of lipstick on a variety of surfaces and were developed using specific powders. As a conclusion, they found that the method to develop lip prints was similar to that of fingerprints and that some developers were considered to be more effective than others depending on the surface where the print was found<sup>9,17</sup>.

A lipstick usually consists of a solid base of waxes, oils, dissolved dyes, hydrocarbons and sometimes perfumes. Persistent or long-lasting lipsticks contain minimal quantities of these "fatty substances" and the development of lip prints using conventional powders might not be very effective<sup>1,18</sup>.

Latent lip prints are also produced using the humidity present in lips through saliva, mixed with the oiliness secreted by neighboring saliva glands and sebaceous glands. These substances, particularly the lipids

and fatty acids, transferred to an object through lip contact, can be developed and made visible<sup>1,19</sup>. Therefore another method for developing that is more sensitive to fatty acids is required. Lysochromes are compounds with the ability to stain fatty acids because they display a portion that dissolves in contact with the fat and another that stains, and they therefore help to develop latent lip prints<sup>19</sup>.

In a study by Castelló et al.<sup>19</sup>, the effectiveness was tested of three differently so chromes in the form of powder and solution, versus three fingerprint developing powders. They concluded that conventional powders were less effective for older prints when compared to lysochromes, and that the latter were effective for the two surfaces tested as well as producing good development of both recent and old prints. The best of these was Sudan black.

Navarro et al.<sup>20</sup> studied invisible lip prints using human skin as the target surface. Of the lysochromatic reagents used, Sudan black provided the best results. These results are in respect of recent lip prints and the experts state that the investigation of old prints is very difficult using this type of surface.

Singh et al.<sup>21</sup> used Vermilion and Indigo, which are natural, non-toxic substances available in India, on visible lip prints on different types of surface. The results compared well to those of Sudan black.

Luminescence is another useful property when trying to uncover evidence invisible to the naked eye, such as latent lip prints<sup>15</sup>. The Spanish researchers Castelló et al.<sup>15</sup> studied latent lip print using the reagent Nile Red on different surfaces (colored paper napkins, dyed cotton wool and satin tissue) and light to view the prints. The lip prints were old and were developed on all the surfaces used. They concluded that Nile Red is an effective fluorescent reagent for latent evidence.

Navarro et al.<sup>16</sup> tested the efficacy of the fluorescent reagents Nile Red and REDescent Fluorescent Latent Print Powder, on lip prints made on the skin of 40 corpses. Positive photographs were obtained for all lip prints, developed with REDescent Fluorescent Latent Print Powder and only three prints were developed using Nile Red.

### Lip lines, gender and heredity

Lip prints are unique to each individual and do not change throughout one's lifetime. When lip grooves suffer some type of alteration such as, for example, inflammation, a tiny injury, pathology such as labial herpes, the groove morphology pattern soon reverts. On the other

hand, when the lip is exposed to repeated damage, scars may be left in the location, causing changes in the shape of the groove. Similarities between the grooves of parents and their children were also seen, and recent studies have suggested variations in the patterns between men and women, that helped with gender identification<sup>14,22</sup>.

In this regard, Augustine et al.<sup>14</sup> conducted a study with 600 individuals from India (280 men and 320 women), from whom lip prints were taken and scanned to provide a better view and to ensure records were made without any loss of detail. Adobe Photoshop® 7.0 software was used to analyze the lip prints. These were divided as for the dental formula (four quadrants); they noticed that there was no single type of groove in each part, but in fact a combination of types (using as a basis the groove types in the Suzuki & Tsuchihashi classification<sup>3</sup>). The researchers reported that, in this population, amongst men and women, type III was the most common, while type IV was more common in the upper lateral regions of the lip prints of women and type I more common in the same locations in males.

Another study conducted in India by Sharma et al.<sup>23</sup> verified the potential of lip prints for identifying gender by means of the morphology of the grooves. Lip prints were obtained from 50 women and 50 men. The middle section of the lower lip was the area studied because this fragment is almost always present in lip prints and they used the Suzuki & Tsuchihashi classification<sup>3</sup>. The researchers concluded that types I and I' were mostly observed in females while type IV was observed more often in males. The gender of 44 women and 45 men was correctly determined.

The question of grooves to identify sex aroused the interest of other experts in India. Gondivkar et al.<sup>22</sup> analyzed the lip prints of 70 males and 70 females. Gender was correctly diagnosed in 65 men and 67 women. The predominant groove type for males in the group studied, using the Suzuki & Tsuchihashi classification<sup>3</sup>, was type III, while for females, type II was the most commonly found. One other piece of information observed was that all four quadrants, when presenting the same types of grooves, belonged to the female sex.

In a study conducted by Domiaty et al.<sup>11</sup>, individuals from Saudi Arabia also had their lip prints analyzed. Taking part in the study were 540 women, 426 men, 13 identical twins and 19 families. The researchers divided each lip into three parts with the aim of studying them separately and determining the groove pattern in each each region. The two vertical traces started from the continuation of the

philtrum. They adopted Renaud's classification in the analyses, with just a slight modification to "Type J". The predominant type in each area of the prints was noted. No identical lip print patterns were found amongst the subjects. However, more than one subject exhibited the same groove pattern in the same areas of the lips. In these, this peculiarity was present in the forked or reticular pattern of the grooves. The present study showed that type J (horizontal with other shapes) and type C (complete bifurcated) are the most prevalent types in Saudi men and women. Type I (horizontal) grooves were the least frequent and were only found in the top lips in women.

### Use of cheiloscopia by the Forensic Sciences

Lip prints have been admissible as evidence in courts in the USA since 1923, there being a general acceptance by the scientific community<sup>9</sup>.

The method of identifying people through an analysis of the lips is of little interest in terms of human remains because it is easier to obtain other types of ante-mortem data. However, corpses have been used to study lip prints. Utsuno et al.<sup>24</sup> carried out a study with the aim of evaluating the reduction or enlargement of lip prints and the morphological changes in groove patterns. The lip prints of 20 corpses were collected at two points in time: within 24 hours of death (before being fixed in formaldehyde at 10%) and 48 hours after fixing. The prints taken prior to fixing coincided with those taken after fixing in 6 out of 20 cases. As for the size (width and height) of the prints, no significant changes were observed.

When a lip print is found, the result is a piece of evidence that must be recorded and kept for legal analysis and testing. When the lip print is visible to the naked eye, it is recommended that firstly a photograph of it should be taken on the surface itself, with and without a scale, up close and at distance, and should be tagged<sup>1</sup>. The procedure for cases of latent lip impressions is the use of developers. With this, prints may be photographed and magnified for study.

Human identification through cheiloscopic study is a comparative process. The lip print, whether or not it is visible, which is found in a certain location is compared with the lip print of an individual and coincident points are sought between the grooves in the two records. In general, the two lip prints are placed side by side for analysis and may be photographed and blown up or observed with

the aid of a magnifying glass. Cellophane paper may be used with the aim of establishing an outline of the most characteristic groove layouts in the lip print, for subsequent comparison<sup>4,7</sup>. The format and number of grooves are looked for as well as the coincident points and random characteristics. The search for exact dimensions between the two prints should not be performed because they are produced by the moving part of the lip, which makes it possible for the same lip to produce different prints, depending on the pressure exerted on the object's surface, or because the lip increased in size due to normal growth<sup>1</sup>.

The amount of lipstick applied is also a complication that could alter the lip print<sup>9</sup>. It is recommended that several lip prints be taken until the entire substance is consumed by the surface. Moreover, the method used to obtain the print may affect the recording. As far as the analysis is concerned, according to Caldas et al.<sup>1</sup>, manual records of overlapping prints are a problem due to the subjectivity of the analysis. The use of the overlapping technique using software applications is an alternative that aims to afford greater objectivity to cheiloscopic study.

Although identification by lip print appears in the literature, further studies could provide support for Suzuki's theory of uniqueness of lip grooves and to the lip print collection and comparison methodologies. Andre Moessens, professor of Law at the University of Missouri (USA) and author of a book entitled "Scientific Evidence in Civil and Criminal Cases", believes that, given the scientific base that exists in Cheiloscopia, this should be readily accepted as a method of human identification in all courts of law<sup>9</sup>.

Advances in Information Technology have had a significant impact in the realm of human identification. The use of digital media could, in some cases, provide more objective, quick and reliable ways of identification<sup>6</sup>. Image manipulation software, such as Adobe Photoshop, possesses tools that permit size normalization and improvements in the sharpness, contrast and brilliance of the image of lips and/or lip prints<sup>13</sup>. It is also possible with these tools to analyze photographs and the overlapping of images to help with forensic identification. The freeware known as GIMP (GNU Image Manipulation Program) also provides this possibility. The digital analysis method using GIMP, being free of charge, is an interesting option for Coroners Offices, Institutes of Jurisprudence and other services that may wish to use it, being more economically viable and without the need to pay for software licenses.

## DISCUSSION

Legal Dentistry is a science that establishes a relationship between dental and legal knowledge and applies it in the service of the Law. In the majority of cases, it is only related to cases of identification of deceased individuals. However, the investigation and identification of living people may also be carried out within this area<sup>3</sup>. It is not only hard tissue such as teeth or bones that can provide information on a specific person or situation; other soft tissue structures such as the labial semi-mucous membrane and the hard palate are capable of assisting effectively in the process of identification.

Cheiloscopy is mainly used to investigate crimes against individuals or property in which lip prints are involved. These prints are left by the perpetrator of the crime and/or the victim on objects such as drinking glasses, cigarette butts, envelopes or paper napkins, on the victim's body or even on materials like clothing or cushions used in cases of suffocation, and are used to reconstruct events in order to establish accounts and identify suspects<sup>22</sup>.

The lips are made up of lines that personify and characterize an individual, in other words no two individuals exist with the same number, shape and arrangement of lip grooves; they are unique to each person. The lip print produced, therefore, as with fingerprints, represents a personal uniqueness and Cheiloscopy, as a method for identification via the study of lips, plays an important role in the forensic field.

The huge number of lip print studies carried out by the Japanese researchers Suzuki & Tsuchihashi, between 1968 and 1971, confirm the individuality of the set of lines on the surface of the lips, even between identical twins<sup>10</sup>. In this case, the method of identifying human beings through the analysis of genetic material is not effective because the DNA of twin siblings is exactly the same. Unlike with DNA, lip lines can resolve such cases as they are not identical.

However, the techniques of cheiloscopic identification were mostly explored by a group of Spaniards at the start of the 1970s. These researchers became responsible, in the main, for latent lip prints, i.e. prints that do not leave visible marks and in their studies they used developers of different types to establish the analyses. They found that some developers were more effective than others, depending on two factors: type of surface where the print is located and the time elapsed since the print was made<sup>21</sup>. In order to develop latent lip prints recently made on smoother surfaces, aluminum and

magnetic powders, which are used to develop fingerprints, were more favored. Aluminum powders highlight lip prints on dark surfaces, reflective surfaces (crystal), mirrors, while magnetic powders are very visible on paper<sup>9,17</sup>.

Moreover, when latent prints were old and located on porous surfaces, lysochromatic substances such as Sudan Black were used by some authors. Lysochrome provides evidence of fatty acids of lipsticks, saliva glands and sebaceous glands surrounding the lips, being important in the development of lip prints made using only the oiliness of the lips mixed with the saliva. On the other hand, other authors used natural, non-toxic substances from India, namely Vermilion and Indigo, which provided similar results to those of Sudan Black<sup>19-21</sup>, serving as an alternative resource.

Also on the subject of old latent lip prints on porous surfaces, fluorescent reagents were applied, the most well-known being Nile Red. Nevertheless, its usefulness is far greater when the surface, in addition to being porous, is stained, and the print is revealed by the reagent with the help of forensic ultraviolet light<sup>15-16</sup>.

The lips are made up of several types of grooves and the number of these grooves, their morphology and layout, characterize an individual<sup>11,14,22-23,25-26</sup>. As with Forensic Anthropology, where the differentiation, made by measuring skeletal components (pelvis, glabella, etc.), establishes the most probable identification of the sex of an individual, the existence of different patterns of grooves between men and women in a single population has great value for human identification. The same idea is valid for different arrangement patterns between one population and another, perhaps due to heredity<sup>27</sup>.

Comparative studies are involved in cheiloscopic analysis: the print that is found is compared with the lip print of a suspect, by looking for coincident points between the lip grooves. To this end, it is necessary for these prints to be photographed.

Two analytical methods exist: conventional and digital. The conventional method includes the observation of corresponding grooves through photographs laid side by side, enlarged or examined with magnifying glasses. Cellophane paper may complement this identification process as it helps with tracings of the most characteristic sets of grooves on the print for subsequent comparison. The digital method, currently in the developmental phase, makes it possible to compare lip grooves through the manipulation of images using software applications using overlapping techniques. It is a method that provides objectivity, rapidness and reliability in specific cases, which facilitates the process of identification<sup>1,6</sup>.

## FINAL CONSIDERATIONS

Effective scientific interest in the application of lip lines and prints in the area of forensic science is recent, dating back to the 1970s. Nevertheless, the literature is lacking in work in this field. The advent of new digital technology maybe able to help with the performance of this investigation technique, generating speed and objectivity. New studies are required, particularly with the development of digital methods.

The application of cheiloscopy may be of great help to the Law, in the identification of living suspects and deceased subjects. At the end of the day, it will be society as a whole that benefits.

## Collaborators

LM HERRERA, CMS FERNANDES e MC SERRA participated in all phases of preparation of this article, from conception to the final redaction of same.

## REFERENCES

- Caldas IM, Magalhães T, Afonso A. Establishing identity using cheiloscopy and palatoscopy. *Forensic Sci Int.* 2007;165(1):1-9. doi: 10.1016/j.forsciint.2006.04.010.
- Sivapathasundharam B, Prakash PA, Sivakumar G. Lip prints (Cheiloscopy). *Indian J Dent Res.* 2001;12(4):234-7.
- Suzuki K, Tsuchihashi Y. New attempt of personal identification by means of lip print. *J Indian Dent Assoc.* 1970;42(1):8-9.
- SaraswathiTR, Mishra G, Ranganathan K. Study of lip prints. *J Forensic Dent Sci.* 2009;1(1):28-31. doi: 10.4103/0974-2948.50885.
- Sharma P, Saxena S, Rathod V. Comparative reliability of cheiloscopy and palatoscopy in human identification. *Indian J Dent Res.* 2009;20(4):453-7. doi: 10.4103/0970-9290.59451.
- Fernandes CMF, Serra MC. Novas tecnologias de informação aplicadas à Odontologia Legal no processo de identificação humana. *Odontol Sociedade.* 2010;12(2):87-9.
- Kasprzak J. Possibilities of cheiloscopy. *Forensic Sci Int.* 1990;46(1):145-51. doi: 10.1016/0379-0738(90)90154-Q.
- Lip prints are new criminology tool. *Dent Stud.* 1971;49(7):50-1.
- Ball J. The current status of lip prints and their use for identification. *J Forensic Odontostomatol.* 2002;20(2):43-6.
- Tsuchihashi Y. Studies on personal identification by means of lip prints. *Forensic Sci.* 1974;3:233-48. doi: 10.1016/0300-9432(74)90034-X.
- Domiaty MAE, Al-gaidi SA, Elayat AA, SafwatMDE, Galal SA. Morphological patterns of lip prints in Saudi Arabia at Almadinah Almonawarah province. *Forensic Sci Int.* 2010;200(1):179e1-e9. doi: 10.1016/j.forsciint.2010.03.042.
- Suzuki K, Tsuchihashi Y. Two criminal cases on lip print. *Forensic Sci.* 1975;5:171.
- Coward RC. The stability of lip pattern characteristics over time. *J Forensic Odontostomatol.* 2007;25(2):40-56.
- Augustine J, BarpandeSR, TupkariJV. Cheiloscopy as an adjunct to forensic identification: a study of 600 individuals. *J Forensic Odontostomatol.* 2008;26(2):44-52.
- Castelló A, Alvarez M, Verdú F. Luminous lip-prints as criminal evidence. *Forensic Sci Int.* 2005;155(2-3):185-7. doi: 10.1016/j.forsciint.2004.12.005.
- Navarro E, Castelló A, López JA, Verdú F. More about the developing of invisible lipstick-contaminated lipmarks on human skin: the usefulness of fluorescent dyes. *J Forensic Leg Med.* 2007;14(6):340-2. doi: 10.1016/j.jcfm.2006.10.010
- Seguí MA, Feucht MM, Ponce AC, Pascual FAV. Persistent lipsticks and their lip prints: new hidden evidence at the crime scene. *Forensic Sci Int.* 2000;112(1):41-7. doi: 10.1016/S0379-0738(00)00173-0.
- Andrasko J. Forensic analysis of lipsticks. *Forensic Sci Int.* 1981;17(3):235-51. doi: 10.1016/0379-0738(81)90173-0.
- Castelló A, Alvarez M, Miquel M, Verdú F. Long-lasting lipsticks and latent prints. *Forensic Sci Communic.* 2002;4:2.
- Navarro E, Castelló A, López JL, Verdú F. Criminalystic: effectiveness of lysochromes on the developing of invisible lipstick-contaminated lipmarks on human skin. A preliminary study. *Forensic Sci Int.* 2006;158(1):9-13. doi: 10.1016/j.forsciint.2005.05.002.
- Singh NN, Brave VR, Khanna S. Natural dyes versus lysochrome dyes in cheiloscopy: a comparative evaluation. *J Forensic Dent Sci.* 2010;2(1):11-7. doi: 10.4103/0974-2948.71051.
- Gondivkar SM, Indurkar A, Degwekar S, Bhowate R. Cheiloscopy for sex determination. *J Forensic Dent Sci.* 2009;1:56-60. doi: 10.4103/0974-2948.60374.
- Sharma P, Saxena S, Rathod V. Cheiloscopy: The study of lip prints in sex identification. *J Forensic Dent Sci.* 2009;1(1):24-7. doi: 10.4103/0974-2948.50884.
- Utsuno H, Kanoh T, Tadokoro O, Inoue K. Preliminary study of post mortem identification using lip prints. *Forensic Sci Int.* 2005;149(2-3):129-32. doi: 10.1016/j.forsciint.2004.05.013.

25. Kaur R, Garg RK. Personal identification from lip prints. *Forensic Sci Int.* 2007;4:106.
26. Castelló A, Alvarez M, Verdú F. Just lip prints? No: there could be something else. *FASEB J.* 2004;18(6):615-6. doi: 10.1096/fj.03-0938lfe.
27. VanrellJP. *Odontologia legal e antropologia forense.* 2ª ed. Rio de Janeiro: Guanabara Koogan; 2009.

Received on: 30/8/2011  
Approved on: 6/10/2011