

Experimental model of developing and analysis of lip prints in atypical surface: A metallic straw (*bombilla*)

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Abstract

Background: The interaction between the offender and the victim produces visible or latent prints on objects and utensils. The study of lip prints has reportedly stayed away from the basic cinematic concept of the lip-to-surface relationship. **Materials and Methods:** Three regular powders were used to reveal the latent lip prints on a typical metallic straw called *bombilla*, and the revealed prints were photographed, preserved, and analyzed. **Results:** Better definition was observed in the lower lip print, and nine anatomical patterns were identified, but a higher definition of wrinkles was observed with indestructible white powder. **Conclusion:** Knowledge of labial dynamics, the real value of the processed surfaces, and the need for testing in field conditions are discussed.

Key words: Cheiloscopy, criminalistics, forensic odontology

Introduction

The crime scene presents a large amount of information about the perpetrator's actions, and the investigation should be built on the central hypothesis that offenders differ in their actions when committing crimes and that these differences reflect different the interactions between the offender and the victim.^[1] The identification of the characteristics of the offender, the victim, and the situational context or 'attributes' (trivial altercations, jealousy, revenge, romantic triangles, robbery, sexual assault, etc.) allows the distinction between *instrumental*, *expressive*, *premeditated*, and *spontaneous* crimes, which all have qualitative differences between them.^[2,3] Such is the case in house burglaries, where the specific *modus operandi* of the offender can be recognized

without difficulty by the police officer.^[4] It is common to find that delinquents had defecated or urinated in the principal rooms, emptied the refrigerators, or taken some drinks, and during each of these actions, they left prints of their hands, teeth, or lips.^[5] In the case of murders, the relationship between the victim and the offender can be evidenced by the presence of social ritual elements (glasses, cups, appliances, etc.), all fundamental variables of approximation, consent, or sadism.^[4] This means that, just as archaeologists must sift through layers of soil and debris to find the few items of interest at an archaeological site, forensic scientists must sort through all of the items at a crime scene to find the few items of evidence that would help reconstruct the crime. Forensic science is a historical science: the events in question have already occurred and are in the past. Forensic scientists do not view the crime as it occurs; they analyze the physical remains of the criminal actions.^[3,6] This physical evidence functions as a silent witness and guarantees its objectivity, unlike an oral testimony, where the facts can be forgotten, distorted, or hidden.^[6]

Knowing that 'whenever two objects come in contact with one another, there will be an exchange of material from one to the other', the analysis of the 'linkage triangle'

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including the scene, the victim, the suspect, and the search for physical evidence can provide leads, clear suspects, or sufficient cause for arrest or indictment.^[3,7,8] Just like proven fingerprints, the wrinkles and grooves on labial mucosa can be instrumental in identifying a person positively and can be used to verify the presence or the absence of a person at the scene of a crime.^[8-10] The study of these lip prints is known as 'cheiloscropy' (from the Greek words *cheilos*, meaning 'lip', and *skopein*, 'to see'), and since Fischer's anthropologic descriptions in 1902 these analyses have been proposed for human identification through records and classifications.^[11,12]

These lip prints can be found on paper, clothes, glasses, cups, or even cigarette butts, and the surfaces determine the viability or difficulty of their recognition, recovery, or analysis.^[8,12-15] Caldas *et al.*, affirmed that observation and photographic captures should be performed following a strict methodology even if there are no traces of lipstick.^[12] According to Spanish investigators, latent prints can be easily seen using several substances, such as aluminum powder, silver metallic powder, silver nitrate powder, plumb carbonate powder, fat black aniline dye, cobalt oxide, lysochromes dye, or fluorescent dyes.^[12,14,16,17]

Negre said that the perpetrator of a crime can avoid leaving fingerprints by wearing gloves in the scene, but '... it is improbable that he eliminates all the cigarette butts, burns napkins or cleans glasses, cups, etc.,' all of these are objects on which it is possible to find latent lip prints linking the perpetrator to the crime scene. Nevertheless, this author mentioned that a visible quality lip print is capable of being processed, whereas a partial, blurry, or simply vague print makes for difficult cheiloscopy identification unless some individual characteristic can be found.^[17]

Since the lip print is produced by a substantially mobile portion of the lip^[12] the pressure, direction, and anatomical surface will determine its quality as evidence.^[13,18-20] Even the lip print pattern depends on whether the mouth is closed (the lip exhibits well-defined grooves) or opened (the grooves are relatively ill-defined and difficult to interpret).^[12,18,21] Bonfigli *et al.*, mentioned that wrinkled paper napkins, overlapped traces, or smoked wrinkled cigarette butts are potential problematic circumstances.^[22]

The materials left at crime scenes sometimes provide extremely useful data for personal identification, if properly examined,^[23] and the lip prints can link a subject to a specific location.^[24] However, since the surface, the dynamics of lip print production, and procedures of development are bound to influence on the quality of the print^[25] we present a model of development and analysis of lip prints in an unpublished support traditionally used in some specific geographical contexts: A metallic straw for drinking an infusion called *mate* and new paradigms of cheiloscropy are discussed.

Materials and Methods

An experimental model was designed using three exactly identical utensils known as *bombilla*, a sort of metallic straw for drinking *mate*, a traditional infused drink in Argentina, Uruguay, Paraguay, Brazil, southern Chile, the Bolivian Chaco, Mexico, and, to some extent, Syria and Lebanon.^[26] This straw (or 'little pump') is traditionally made from silver, nickel silver (alpaca), stainless steel, or hollow-stemmed cane. A typical *bombilla* has three parts: A pierced bulb (a sieve located inside a gourd nearly filled with the herb called *yerba mate*), a narrow and straight metallic pipe (inside which the liquid rises upon suction), and a beak placed on the lips to realize the above-mentioned suction [Figure 1].^[26] A subject completes the act of drinking the infusion with this implement by placing his mouth on the spout and realizing the suction mechanism. The same subject performed the action with each of the three straws.

Each of the three devices was processed individually to identify the latent lip prints, first with the INOVA™ X5 UV flashlight (Emissive Energy Corp) at 365-400 nm wavelength and then using the following three regular powders to reveal this kind of latent prints:^[14,17]

- Silk Black 'Hi-Fi' Volcano Latent Print Powder, applied carefully with Black Whopping Marabou Feather Duster following the specifications provided by the manufacturer (SIRCHIE® Finger Print Laboratories)
- Indestructible White 'Hi-Fi' Volcano Latent Print Powder, applied carefully with Standard Size Fiberglass Brush following the specifications provided by the manufacturer (SIRCHIE® Finger Print Laboratories)
- Fluorescent Latent Print Powder, PINKescent™, applied carefully with Red Marabou Feather Duster following the specifications provided by the manufacturer (SIRCHIE® Finger Print Laboratories). Fluorescence was excited with a portable, battery-operated long-wave



Figure 1: The bombilla, a sort of metallic straw to drink the traditional infused drink named *mate*

UV light source, the CUV100T (SIRCHIE® Finger Print Laboratories), with a peak wavelength of 365 nm.

All the developed prints were photographed *in situ* using a tripod-mounted COOLPIX™ S3000 camera (Nikon Corp) at a camera-to-target distance of 10" (25.4 cm). Transparent lifting tapes were used for lifting and preserving the developed latent prints (SIRCHIE® Finger Print Laboratories), which were immediately mounted on glass sheets 1.57" × 4.72" (4 × 12 cm) in size. The sheets were scanned at 600 dpi resolution using a flatbed scanner (Hewlett-Packard™ Scanjet 3770), and all the images were analyzed using the software Adobe Photoshop™ CS5 Extended 12.0 (Adobe Systems Inc). Since the wrinkles and grooves are the only useful patterns for comparative analysis (not the deformable contours and form of lips), the developed lip prints were categorized following the modified standards of Castelló Ponce *et al.*:^[14] *High quality* (+++), when the wrinkles and grooves can be appreciated perfectly; *medium quality* (++) , when the wrinkles and grooves are interrupted; and *poor quality* (+), when the wrinkles and grooves cannot be observed.

Results

The results are shown in Table 1.

- Silk Black ‘Hi-Fi’ Volcano Latent Print Powder: Although this powder was considered useful due to its brightness, it was categorized as *poor quality* due to the fact that the wrinkles and grooves were undefined and vague [Figure 2]
- Indestructible White ‘Hi-Fi’ Volcano Latent Print Powder: This powder was considered useful and categorized as *high quality* [Figure 3]
- Fluorescent Latent Print Powder, PINKescent™: This powder was considered useful but was categorized as *medium quality*. Nevertheless, great definition was observed on the edges of the lips and the border of the grooves [Figure 4].

The lifting of the powdered prints with the transparent lifting tape and their scanning allowed an efficient analysis of the images using the software Adobe Photoshop™. In three models, significantly better definition was observed in the lower lip print than in the upper lip print (due to the obvious mechanisms of the placement and suction of the mouth at the beak). Nine anatomical patterns could be identified, compared, and visualized between the three powders, but higher definition of wrinkles was observed with Indestructible White ‘Hi-Fi’ Volcano Latent Print

Powder [Figure 5]. The lips were deformed significantly by the cinematic mechanism of suction [Figure 6]; thus, metric analyses were not realized.

Discussion

The three powders used in this model are commonly used in dactyloscopic practice, and they have been recommended for this purpose in previous studies reported in the literature.^[12,16] The results indicate that White Volcano Latent Print Powder (one of the most affordable in the market) is highly efficient in obtaining latent lip prints; this technical note underlines the need for testing in field conditions (not just in a laboratory) to evaluate the technical conditions in which the powder is selected according to the surface to be processed.^[12,14,16,17] In the same way, the scanning of the images allowed the presentation of a tool not informed for cheiloscopy analysis. Even though, further investigation is necessary to be able to present these findings as categorical elements of identification because of the presence of partial prints,^[17] knowing that the fixed anatomical labial relation with the beak of the straw increases the real value and viability of the revealed lip prints. This fact is impossible to determine with other surfaces (napkins, envelopes, and cigarette butts)^[22] and supports the conduct of similar studies with other utensils of equal labial dynamics, such as spoons, holders, etc.

Cheiloscopy study, previously recommended for criminal identification by some of the greatest criminologists, including Locard and Snyder,^[12] has been dedicated mainly to making classifications and models for the determination of sex, the identification of population groups, and even the transmission of similarities between parents and children.^[8-10,12,20,24,27] All these elements are undoubtedly valuable in taxonomy and anthropology but not for criminal identification in the strict sense.^[3] In crime investigation, the identification is based exclusively on the comparison of traits and patterns between the prints found in the crime scene and those of the suspect, which will result in either the positive identification or exclusion of the subject.^[28]

Several factors have been found to alter lip print recording in cheiloscopy studies: the labial mobility and the distortion of the prints,^[25] the presence of prominent facial hair among men,^[27] an excessive amount of lipstick,^[12] the existence of some pathological conditions,^[12,13] and the possibility of postmortem changes.^[12,13,18,29] A lip print will clearly have increased value if its distortions are minimal and can be explained by dynamically applying associative methodologies focused on qualitative and nonmetric characteristics.^[30] Although the findings from the studied surface point to an evident regionalism, they show an indispensable condition when the investigator processes the crime scene: all the utensils can be useful in obtaining lip prints, and the nature of the objects and their cinematic

Table 1: Results of the experience

Silk black ‘Hi-Fi’ Volcano latent Print powder	Indestructible white “Hi-Fi” Volcano latent print powder	Fluorescent latent print powder, PINKescent™
+	+++	++

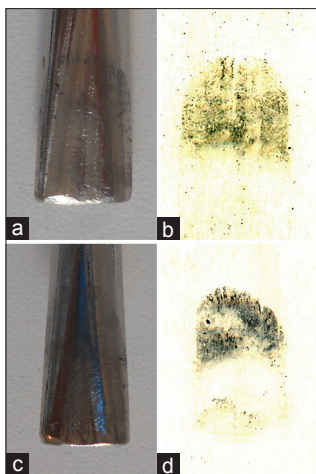


Figure 2: Poor quality of the lip prints developed using Silk Black ‘Hi-Fi’ Volcano Latent Print Powder. (a) Upper side of the beak. (b) Scanned lifting tape of the upper lip print. (c) Lower side of the beak. (d) Scanned lifting tape of the lower lip print (a) and (c) photographs: Daytime ambient lightning, f/3.5 for 1/30 of a second, ISO setting of 160; b and d scannings: 600 dpi using transparency adapter, brightness and contrast adjusted using Adobe Photoshop™)

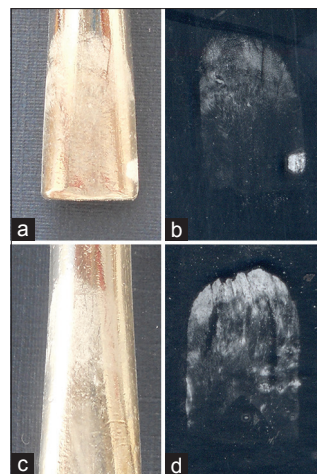


Figure 3: High quality of the lip prints developed using Indestructible White ‘Hi-Fi’ Volcano Latent Print Powder. (a) Upper side of the beak. (b) Scanned lifting tape of the upper lip print. (c) Lower side of the beak. (d) Scanned lifting tape of the lower lip print (a) and (c) photographs: Daytime ambient lightning, f/3.5 for 1/30 of a second, ISO setting of 125; b and d scannings: 600 dpi, brightness and contrast adjusted using Adobe Photoshop™)

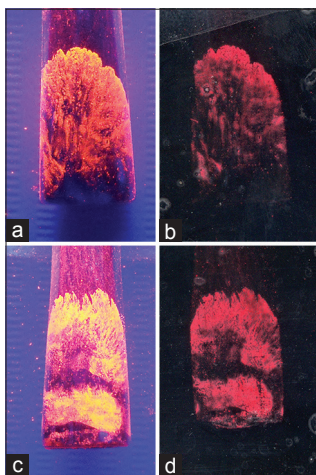


Figure 4: Medium quality of the lip prints developed using Fluorescent Latent Print Powder, PINKescent™. (a) Upper side of the beak. (b) Scanned lifting tape of the upper lip print. (c) Lower side of the beak. (d) Scanned lifting tape of the lower lip print (a) and (c) photographs: UV lightning, f/3.5 for 1/6 of a second; ISO setting of 400; b and d scannings: 600 dpi using UV lightning, brightness and contrast adjusted using Adobe Photoshop™)

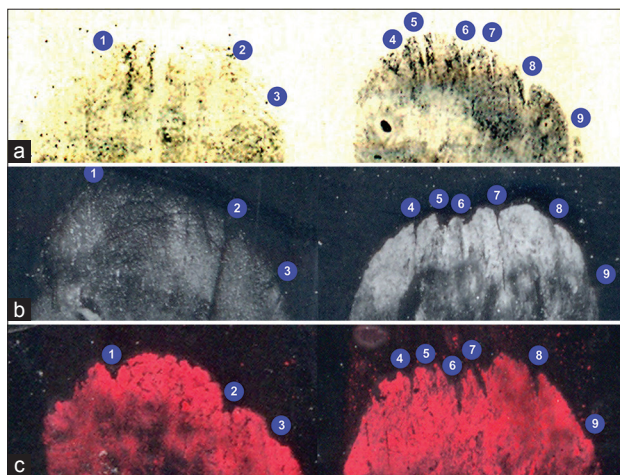


Figure 5: (a) Comparison of the nine anatomical patterns identified on the upper lip prints (left side) and the lower lip prints (right side) developed using Silk Black ‘Hi-Fi’ Volcano Latent Print Powder. (b) Indestructible White ‘Hi-Fi’ Volcano Latent Print Powder and (c) Fluorescent Latent Print Powder, PINKescent™. See the higher definition of wrinkles observed in the B powder

relation with the lips of the offender promote the quality and legibility of these prints. This model shows other dynamic adverse situations, such as a change in the mouth position in cigarette butts, dragging as part of the basic use of the napkins, etc.

Today it is not unusual for an investigation to focus on and prioritize genetics. Although this has originated many controversies about the value of papiloscopia vs. DNA technology, criminal identification uses both of these tools by means of protocols that allow associating them without discriminating against either one. In 2004, Schulz

et al. mentioned the possibility of using ninhydrin-dyed fingerprints as a DNA source for STR typing.^[31] In the same year, Castello *et al.* affirmed that latent prints on paper developed with Sudan Black can be used as a potential DNA source for forensic identification.^[32] Even though all samples were obtained under laboratory conditions (which are radically different from real conditions), this work shows the possibility of obtaining DNA from latent lip prints, which makes these traces doubly useful for identification; besides the traditional analysis of labial lines, it is possible to obtain the print maker’s genetic profile. The potential of cheiloscopy as an authentic technique of crime investigation is insufficiently recognized and even misestimated because



Figure 6: Mouth placed on the beak. Though the lips present an important deformation due to the suction, see that this mechanism does not produce dragging

of the supposed lack of scientific standards of reliability. In fact, a prestigious expert in fingerprint identification, Andre A. Moenssens opined that lip print identification is not recognized as an accepted science, and his research disclosed that no scientific studies have conclusively established the accuracy and reliability of lip print identification.^[33] On the other hand, other authors have found the existence of judicially accepted casuistry, showing this type of investigation as a resource of considerable value.^[15,20,27] During the years 1985-1997, the Fingerprint Department of the Central Forensic Laboratory of Police in Warsaw (Poland) used cheiloscopy techniques in 85 cases, including 34 cases with positive identification.^[18] We concur with Ball,^[34] Kaur and Garg,^[23] and Reddy^[18] that, since cheiloscopy has been proven to be reliable and trustworthy in criminal investigations and legal proceedings, the individualization from lip prints must be used with caution, keeping in mind such variables as season changes and deformities, which need to be examined further.

Conclusion

The results justify that the tasks of scientific investigation should center reasonably on the specific methodology in the context of criminal identification: The observation, photography, development, coverage, recording, and fundamentally, interpretation and comparison, rather than just taxonomical or anthropological studies, which are insufficient. In addition, cheiloscopy techniques were found to be equal in value to other types of forensic evidence and thus need to be acceptable in court as scientifically based evidence.

References

1. Godwin M. Death by Detail: A Multivariate Model of U.S. Serial Murderers' Crime Scene Actions. In: Godwin GM, editor. *Criminal Psychology and Forensic Technology. A collaborative approach to effective profiling*. Boca Raton: CRC Press; 2001. p. 145-6.
2. Miethe TD, Drass KA. Exploring the social context of instrumental and expressive homicides: An application of qualitative comparative analysis. In: Godwin GM (Ed.). *Criminal Psychology and Forensic Technology. A collaborative approach to effective profiling*. Boca Raton: CRC Press; 2001. p. 125-6.
3. Houck MM. *Forensic Science. Modern methods of solving crime*. Westport, USA: Praeger Publishers; 2007. p. 34-5.
4. Green EJ, Booth CE, Biderman MD. Cluster analysis of burglar's modus operandi (M/O). In: Godwin GM, editor. *Criminal Psychology and Forensic Technology. A collaborative approach to effective profiling*. Boca Raton: CRC Press; 2001. p. 173.
5. López-Palafox J. Aplicaciones ignoradas en Odontología forense. Interés de la Queiloscopía en la averiguación de delitos (1st Part). *Maxillaris* 2001;52-9.
6. Guzmán CA. *Manual de criminalística*. La Rocca, Buenos Aires; 1997. p. 39-43.
7. Kou C, Lin CH, Springsteel F. A heuristic approach to reconstruct crime scene based on mark-theory. Dissertation at International Carnahan Conference on Security Technology, Ottawa, Canada, October 13-15th of 1993:228-34. Available from: <http://ieeexplore.ieee.org>, [Last accessed on 2012 Aug 19].
8. Augustine J, Bapande SR, Tupkari JV. Cheiloscopy as an adjunct to forensic identification: A study of 600 individuals. *J Forensic Odontostomatol* 2008;26:44-52.
9. Sharma P, Saxena S, Rathod V. Comparative reliability of cheiloscopy and palatoscopy in human identification. *Indian J Dent Res* 2009;20:453-7.
10. Verghese AJ, Somasekar M, Babu RU. A study on lip print types among the People of Kerala. *J Indian Acad Forensic Med* 2010;32:6-7.
11. Kasprzak J. Possibilities of cheiloscopy. *Forensic Sci Int* 1990;46:145-51.
12. Caldas IM, Magalhães T, Afonso A. Establishing identity using cheiloscopy and palatoscopy. *Forensic Sci Int* 2007;165:1-9.
13. Kavitha B, Einstein A, Sivapathasundharam B, Saraswathi TR. Limitations in Forensic Odontology. *J Forensic Dent Sci* 2009;1:8-10.
14. Castello A, Alvarez M, Negre MC, Verdu FA. Revelado de huellas labiales invisibles con reactivos fluorescentes. *Cuad Med Forense* 2003;34:43-7.
15. Williams TR. Lip prints – Another means of identification. *J Forensic Ident* 1991;41:190-4.
16. Castello A, Alvarez-Sequi M, Verdu F. Luminous lip-prints as criminal evidence. *Forensic Sci Int* 2005;155:185-7.
17. Negre MC. Nuevas aportaciones al procesado de huellas labiales: Los lisocromos en queiloscopía. PhD Thesis Universitat de Valencia, 2004.
18. Reddy VK. Lip prints: An overview in forensic dentistry. *J Am Dent Res* 2011;2:17-20.
19. Clement JG. Role of and techniques in forensic odontology. In: Payne-James J, Busuttill A, Smock W, editors. *Forensic Medicine. Clinical and Pathological Aspects*. London: Greenwich Medical Ltd.; 2003. p. 698.
20. Uma Maheswari TN. Lip Prints. Saveetha Dental College and Hospital, Chennai, India. Dissertation submitted to The Tamil Nadu Dr. M.G.R. Medical University, Chennai in the partial fulfillment of the requirements for the degree of Master of Dental Surgery, Branch VII - Oral Med Radiol 2005.
21. Gondvikar SM, Indurkar A, Degwekar S, Bhowate R. Cheiloscopy for sex determination. *J Forensic Dent Sci* 2009;1:56-60.
22. Bonfigli EA, Trujillo G, Cantín M, Fonseca GM. Procedimientos y aprendizaje significativo en la investigación criminal. Presentación de

- dos experiencias de capacitación interdisciplinaria. FOPJ 2010;1:14-9.
23. Kaur R, Garg RK. Personal identification from lip prints. *Forensic Sci Int* 2007;169:48-8.
 24. Sharma P, Saxena S, Rathod V. Cheiloscopy: The study of lip prints in sex identification. *J Forensic Dent Sci* 2009;1:24-7.
 25. Sivapathasundharam B, Prakash PA, Sivakumar G. Lip prints (Cheiloscopy). *Indian J Dent Res* 2001;12:234-7.
 26. Wikipedia. Mate (Beverage). Available from: [http://en.wikipedia.org/wiki/Mate_\(beverage\)](http://en.wikipedia.org/wiki/Mate_(beverage)), [Last accessed on 2012 Aug 19].
 27. Saraswathi TR, Gauri M, Ranganathan K. Study of lip prints. *J Forensic Dent Sci* 2009;1:28-31.
 28. Polski J, Smith R, Garrett R. Report of the International Association for Identification, Standardization II Committee. NCJ 233980, March 2011, Grant Report. Available from: <http://www.ncjrs.gov/pdffiles1/nij/grants/233980.pdf>. [Last accessed on 2012 Aug 19].
 29. Utsuno H, Kanoh T, Tadokoro O, Inoue K. Preliminary study of post mortem identification using lip prints. *Forensic Sci Int* 2005;149:129-32.
 30. Bernitz H, Stols G. The application of affine transformations in matching distorted forensic samples with a common origin. *Forensic Sci Int* 2010;201:56-8.
 31. Schulz MM, Wehner HD, Reichert W, Graw M. Ninhydrin-dyed latent fingerprints as a DNA source in a murder case. *J Clin Forensic Med* 2004;11:202-4.
 32. Castello A, Alvarez M, Verdu F. Just lip prints? No: There could be something else. *FASEB J* 2004;18:615-6.
 33. The People of the State of Illinois, Plaintiff-Appellant, vs Lavelle L. Davis, Defendant-Appelle. Appellate Court of Illinois, Second District, Case No. 94-CF-76, November 20, 2007. p. 6-7.
 34. Ball J. The current status of lip prints and their use for identification. *J Forensic Odontostomatol* 2002;20:43-6.

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