

# Latent lip print development and its role in suspect identification

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## Abstract

**Aims and Objective:** The study aims to develop latent lip prints on glass surface using fingerprint black powder and its comparison with standard lipstick prints and also determines the effectiveness of the technique. **Materials and Methods:** This study included a total of 100 subjects, comprising of 50 males and 50 females with age ranging from 17 to 38 years. Latent lip print was developed by pressing the lips against a glass slab with lips together and the print formed was developed by sprinkling the black fingerprint powder and transferred to a bond sheet. Subsequently, standard lipstick print was developed from the same subject. All the samples were coded and graded according to the patterns suggested in the literature. **Results:** Out of 100 latent prints only 29 prints showed lip patterns in all four quadrants. The percentage matching with self lipstick print of good latent prints ranged from 25% to 100% and those of random prints ranged from 8% to 92%. Quadrant wise matching ranged from 52.67% to 57.67%. Statistically significant difference was observed between males and females. **Conclusion:** The study demonstrates the usefulness of latent lip print in personal identification.

**Key words:** Cheiloscopy, fingerprint powder, latent lip print, lipstick print

## Introduction

Identification of humans is a prerequisite for personal, social, and legal reasons.<sup>[1]</sup> Traditional methods of personal identification include anthropometry, dactyloscopy, DNS finger-typing, sex determination, estimation of age, measurement of height, postmortem reports, and differentiation by blood groups. These methods have been proved to be successful in many cases.<sup>[2,3]</sup> Criminal investigation involves identification of both murder victim and suspects.<sup>[4]</sup>

Fingerprints and dental record comparison are the most commonly used scientific methods of forensic identification.

The wrinkles and grooves on labial mucosa, known as sulci labiorum, form characteristic patterns known as lip prints, and the study of these lip prints is known as "cheiloscopy."<sup>[5]</sup> Lip prints do not change during the life of a person. It is thought to be unique to a person, just like fingerprints.<sup>[6,7]</sup> It has been verified that lip prints recover after undergoing alterations like minor trauma, inflammation, and diseases like herpes.<sup>[2]</sup> However, major trauma to lips may lead to scarring, pathosis, and the surgical treatment rendered for lip correction may alter the size and shape of the lips, thereby altering the pattern and morphology of grooves.<sup>[5]</sup> The lip prints of parents and children and those of siblings have been shown to have some similarities.<sup>[8,9]</sup> Various studies suggested that variations in patterns among males and females could help in sex determination.<sup>[10]</sup>

Unlike fingerprints, unanimity still does not exist among investigators to accept cheiloscopy as a method of human identification. The present study was carried out to develop latent lip print on glass surface and its comparison was made with the standard lipstick prints of the same individual. Also, it was aimed to assess the reliability of technique in suspect identification at the crime site and investigate its potential role and usefulness in personal identification.

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## Materials and Methods

The study included 100 subjects (50 males and 50 females) with age ranging from 17 to 38 years, in the Department of Oral Pathology and Microbiology, Saraswati Dental College and Hospital, Lucknow, Uttar Pradesh, after ethical clearance. All the participants were briefed about the purpose of the study and an informed consent was taken from them. Participants having any known allergy to cosmetic products or any lesion or scar on the lips were excluded from the study.

### Method for latent lip print

The lips of the subject were first cleaned thoroughly using wet cotton with cleanser and then with sterile cotton. The lips were gently pressed together against a glass slab for 3-4 seconds. The print formed on the glass slab was developed by sprinkling the black fingerprint powder composed of charcoal, lampblack, and graphite [Figure 1]. Gentle dusting using a special “Marabou” feather brush loaded with fingerprint powder was carried out [Figure 2].

The excess powder was removed to visualize the hidden print and the print was transferred to a white bond sheet with the help of a 2-inch-wide lifting tape [Figures 3-7]. Later, standard colored lipstick was applied gently in the entire area of upper and lower lips of the same subject using disposable applicator in a single stroke and then the subject was asked to press the lips against a bond sheet with a firm base [Figure 8].

Samples collected were coded and blindly graded on the basis of lip pattern suggested by Suzuki and Tsuchihashi, 1970.<sup>[2]</sup>

- Type I : Clear cut vertical grooves that run across the entire lips
- Type I' : Vertical grooves do not cover the entire lip
- Type II : Branched grooves
- Type III : Intersected grooves
- Type IV : Reticular grooves
- Type V : Undetermined (grooves do not fall into any type - I-IV and cannot be differentiated morphologically)



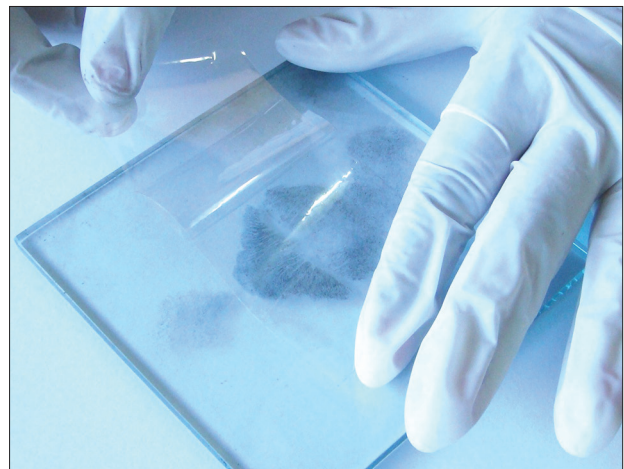
**Figure 1:** Materials used for development of latent and lipstick print: Black fingerprint powder, marabou brush, lifting tape 2" wide lifting take, glass slab, standard company lipstick, lipstick brush, cellophane tape



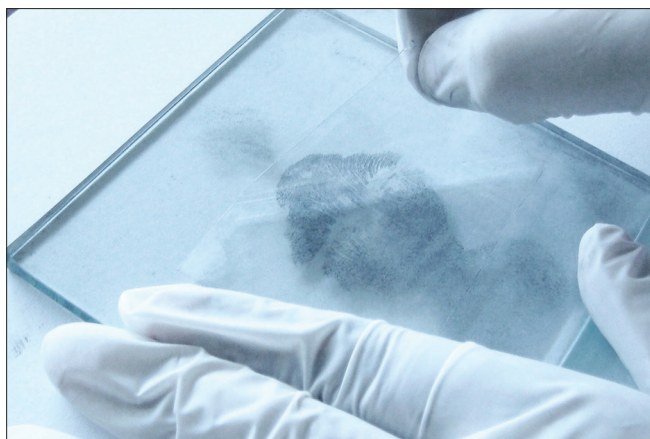
**Figure 2:** Photograph showing sprinkling of black fingerprint powder using Marabou brush



**Figure 3:** Photograph showing removal of excess fingerprint powder and development of the lip print



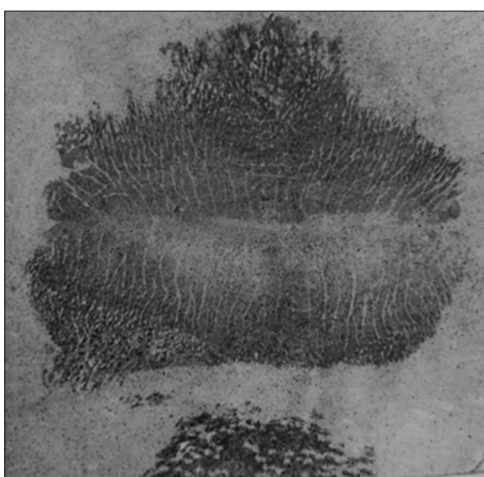
**Figure 4:** Photograph showing application of lifting tape



**Figure 5:** Photograph showing lifting of latent lip print



**Figure 6:** Photograph showing transfer of lip print to the bond sheet



**Figure 7:** Photograph showing developed latent lip print

### Analysis of lip prints

Upper and lower lips were divided into four quadrants and each quadrant was further divided into three parts, i.e., lateral (L), mid-lateral (ML), and middle (M) portions. The lip prints collected were coded by one observer and the pattern of lip print present in each quadrant was recorded by two different observers by using a simple magnifying glass. The lip print that showed patterns in all four quadrants were classified as good prints and the rest were considered as random prints.

All the data was analyzed statistically and  $P < 0.05$  was considered to be statistically significant.

### Results

Out of 100 latent prints, 10 random cases were selected and the percentage matching with self was calculated which ranged from 8 to 92%. Twenty-nine latent prints out of 100 were able to reveal lip patterns in all four quadrants and were regarded as good prints, and among them, 10 good latent print samples were taken and percentage matching with self was calculated which ranged from 25 to 100%.



**Figure 8:** Photograph showing standard lipstick print

The comparison of good print and latent prints was also made. The good prints showed a mean percentage matching with self print of 75.8%, while with that of random prints, the mean value of self print matching was 48.3% [Graph 1]. Each quadrant wise matching was assessed, where in the first quadrant, type II was the common pattern observed. The prominent pattern in middle location showed type IV pattern, mid-lateral showed type III, and lateral location showed type II. Overall percentage matching of latent lip print with self lipstick print was 57.33%.

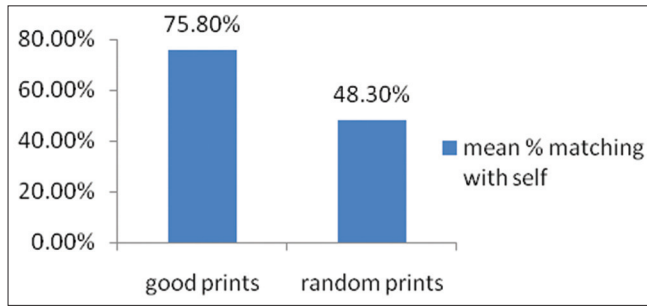
The second, third, and fourth quadrants showed type II pattern as the commonest one. In the second quadrant, the midlateral portion showed type II. Overall matching of latent print with self lipstick print was 57.67%. Type I pattern was observed in the middle locations of the third quadrant and overall matching of latent print with self lipstick print was 52.67%. The pattern in fourth quadrant showed type I in the middle locations with types II and III in midlateral location. Overall matching of latent print with self lipstick print was 53%. Overall, the quadrant wise matching ranged from 52.67 to 57.67% [Graph 2].

Between genders, type II was the most common pattern observed in both males and females. A statistically significant difference was observed between two genders ( $P < 0.001$ ).

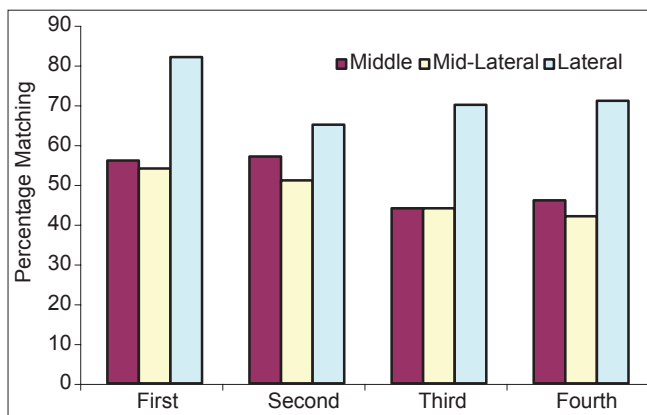
Further, quadrant wise matching of the patterns was assessed; type III pattern was more commonly observed among males, whereas types I' and I were more common among females [Graph 3].

## Discussion

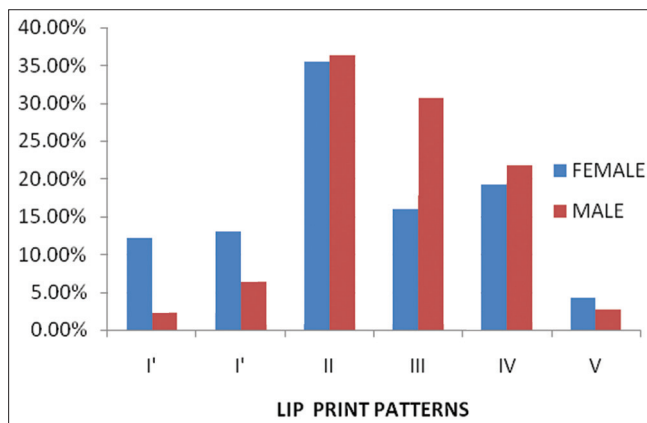
With the ever-increasing demands placed upon law enforcement to provide sufficient physical evidence linking a perpetrator to a crime, it makes sense to utilize any type



**Graph 1:** Comparison of percentage matching with self of good prints and random prints



**Graph 2:** Percentage matching at different locations in different quadrants



**Graph 3:** Statistically significant difference was observed between two genders ( $P < 0.001$ ). Type III pattern was more common among males, whereas types I' and I were more common among females

of physical characteristic to identify a suspect of an offense. Lip prints have unique markings that can be entered into a specific classification. Few studies on lip morphology and patterns they produced, when they are impressed on to a variety of surfaces have shown that chelioscopy has a potential to become an additional weapon for personal identification.<sup>[11]</sup> Most of the crime scene investigators ignore lip prints, but it is a very important suspect identification tool which is rarely used in forensic investigations. Previous studies analyzed the effectiveness of several fingerprint powders and reagents on lipstick prints, i.e., a black fingerprint powder is used for the development of fingerprint. The present study of the latent lip print follows the same technique used for developing fingerprints.

Literature suggests various ways of collection, analysis, and interpretation of lip prints, such as use in postmortem identification, use of magnifying glasses, use of ruler in the software, use of fluorescent dyes, and use of fingerprint powder. Analysis of lip prints was done either by dividing the lips into quadrants or by dividing them into two parts or by division of each quadrant into further middle and lateral portions. All this is done to have a clear description of nearly all of the commonly encountered lip patterns and to make it easy for interpretation.

Sivapathasundaram *et al.* (2001) studied the lip print pattern in the middle part of lower lip up to 10 mm wide, and recommended this fragment as it is almost always visible in any trace.<sup>[6]</sup> They also stated that the uniqueness of patterns depended on the way the lip patterns are relaxed. Due to the diverse combination of patterns of the lip print, Augustine *et al.* divided lips into four quadrants and further each quadrant was divided into two equal parts as middle and lateral.<sup>[9]</sup> Lips frequently showed different patterns with combination of other types, but never occurred singly. Most of the areas showed superimposed patterns which were difficult to differentiate in his study. To get the precise and accurate lip print pattern, we divided the lips into quadrants and further each quadrant was divided into three parts as middle, midlateral, and lateral locations. These divisions made us record the complete quadrant with minimal superimposition and clear patterns in all the subdivided portions.

In a study of 100 samples, 29 latent print samples were able to reveal lip patterns in all four quadrants. Among the lip print patterns, types III, II, I, and I' were evident, whereas type IV pattern was not clearly visible. Also, type IV pattern was the most commonly superimposed pattern, which was difficult to differentiate, and this finding is similar to that of Augustine *et al.* Another reason for the unclear and superimposed patterns could be attributed to the faint, smudged, non-identifiable grooves and incomplete patterns, due to uneven pressure applied by the subjects.<sup>[12]</sup>

Twenty-nine samples which showed the lip print patterns in all four quadrants were regarded as good prints and their percentage matching with self lipstick print ranged from 58.3 to 100%, while for random prints it ranged from 8 to 92%. When good latent prints and random latent prints were compared, the results showed mean percentage matching with self print of random prints was 48.3% as compared to 75.8% of the good prints. Hence, we suggest that our method of recording, matching, and developing can be useful to help establish the validity of technique and also more research on the methods of development of latent prints is needed for making it a comparable tool to fingerprints in suspect identification.

Lucas Smacki (2010) in his study compared lip trace with a collection of lip prints stored in a database and observed that automatic identification of lip print traces was a very difficult task as the results obtained by the proposed system were average.<sup>[13]</sup> Similar findings were obtained in our study; the overall matching among different quadrants did not show much difference as it ranged from 52.67 to 57.67% and quadrant wise matching was observed to be average in all four quadrants. These findings are encouraging enough to allow further research in this direction.

The quadrant wise matching showed that different areas of the lip prints showed different matching, with maximum matching of 82% in the lateral location of the first quadrant and minimum matching of 44% in the middle and midlateral locations of the third quadrant. Even though the lines and furrows are present in both upper and lower lips from one corner of the mouth to the other, only the middle lip portion was taken into account in most of the studies as this portion is always visible in any trace. But in the present study, patterns present in all four quadrants in both upper and lower lips were matched. Lateral locations revealed better matching than middle and midlateral locations. Type II was the most common pattern seen in lateral locations in all quadrants, as compared to middle portion which showed type IV to be the most common pattern in first and second quadrants (upper lip) while type I was the most common pattern in third and fourth quadrants (lower lip). The midlateral location showed type III in the first quadrant and type II in the remaining quadrants. Thus, different locations of the lips revealed different patterns and this variation in patterns between upper and lower lips may be attributed to the following factors: a) lip muscles relaxed to produce a particular pattern; b) furrows and grooves on the lips provide privileged routes for saliva; c) upper lip is more hydrated than lower lip; and d) continuity of lips with adjacent skin lines. All these variations might have a functional significance.

In our study, type II was the most common pattern seen in both upper and lower lips in the entire study population,

followed by type III, while according to Augustine *et al.*, type III was the most common pattern observed followed by type II.<sup>[13]</sup> The variations in pattern could be due to the factors mentioned earlier in the literature.

Comparisons of the lip print patterns between males and females have been recorded in various studies and by various authors. Tsuchihashi reported type III to be the commonest in both males and females.<sup>[2]</sup> Sharma *et al.*, suggested undetermined lip pattern (27.5%) in males and vertical and partial vertical lip pattern in females (25%).<sup>[14]</sup> Saraswati *et al.*, reported that intersecting pattern was the most common among males (39.5%) and females (36.5%) and similar findings were reported by Sivapathasundaram *et al.*,<sup>[15]</sup> In the study of Gondivkar *et al.*, criss-cross pattern was reported to be the most common in males (51.05%) and branched lip pattern (37.06%) in females.<sup>[16]</sup> Augustine *et al.*, found type III pattern to be the most predominant pattern in both males and females, accounting for 49.15% and 47.78% of all patterns, respectively.<sup>[12]</sup>

In the present study, type II (branched pattern) was the most common pattern observed in both males (36.3%) and females (35.5%), and a similar finding was reported by Nagasupriya *et al.*<sup>[17]</sup> A significant difference ( $P < 0.001$ ) was observed between males and females. Types I and I' were more commonly seen in females and type III pattern was most commonly seen in males. This was in accordance with Vahawala *et al.* who reported similar findings.<sup>[18]</sup>

The permanent nature of lip prints still requires more long-term studies to be substantially documented. Advanced methods of developing lip prints at a scene of crime are still confined to research laboratories. Full utilization of lip depends to a high degree on the skill of members of law enforcement agencies. Progress in research will contribute not merely to its direct use in personal identification in forensic medicine and odontology, but will also open up a new field that can contribute extensively to criminal investigation and identification.

## Conclusion

The limitation of the study could be the sample size and the technique used, and suggests further refining to develop easy and efficient techniques for development of latent lip prints and their use in suspect identification in order to make it comparable with fingerprint in the crime scene area.

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