ORIGINAL ARTICLE

The connecting link! Lip prints and fingerprints

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Abstract

Background: Lip prints and fingerprints are considered to be unique to each individual. The study of fingerprints and lip prints is very popular in personal identification of the deceased and in criminal investigations. **Aims:** This study was done to find the predominant lip and fingerprint patterns in males and females in the North Indian population and also to find any correlation between lip print and fingerprint patterns within a gender. **Materials and Methods:** Two hundred students (100 males, 100 females) were included in the study. Lip prints were recorded for each individual using a dark-colored lipstick and the right thumb impression was recorded using an ink pad. The lip prints and fingerprints were analyzed using a magnifying glass. The Chi-square test was used for statistical analysis. **Results:** The branched pattern in males and the vertical pattern in females were the predominant lip print patterns. The predominant fingerprint pattern in both males and females was found to be the loop pattern, followed by the whorl pattern and then the arch pattern. No statistically significant correlation was found between lip prints and fingeprints. However, the arch type of fingerprint was found to be associated with different lip print patterns in males and females. **Conclusion:** Lip prints and fingerprints can be used for personal identification in a forensic scenario. Further correlative studies between lip prints and fingerprints could be useful in forensic science for gender identification.

Key words: Cheiloscopy, dermatoglyphics, forensic, gender identification

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Introduction

Forensic odontology is defined by the Fédération Dentaire Internationale as the branch of dentistry that in the interest of justice deals with the proper handling and examination of dental evidence and with the proper evaluation and presentation of dental findings. It primarily deals with identification, based on recognition of unique features present in an individual's dental structures.[1]

In addition to postmortem identification, dental evidence can be crucial in crime investigation, for example bite mark investigation and determination of whether an individual is juvenile or adult.[1] Similarly, the study of lip prints in criminal and forensic practice has been used as a very important identification tool.

Lip print patterns are unique to an individual and are analogous to fingerprints. The wrinkles and grooves on the

Access this article online	
Website: www.jfds.org	Quick Response Code
DOI: 10.4103/0975-1475.195117	

How to cite this article: Negi A, Negi A. The connecting link! Lip prints and fingerprints. J Forensic Dent Sci 2016;8:177-8.

labial mucosa in an individual form a characteristic pattern called the lip print. The study of lip prints is known as cheiloscopy.[2] These wrinkles and grooves seen on lips have been named by Tsuchihashi as "sulci laborium ruborum."[3]

Edmund Locard, famously known as the French Sherlock Holmes, was the first to recommend the use of lip prints in personal identification and criminalization in 1932.[4] Since then, many investigators have worked on these wrinkles and grooves on the lips and confirmed their uniqueness in each individual, suggesting a practical application in forensic science.[3,5] In 1972, McDonell conducted a study confirming that even the identical twins who were indistinguishable in every other respect had different lip prints.[6]

Although many classifications have been proposed for lip prints, it is the classification by Suzuki and Tsuchihashi[3] that is most widely used, and it is as follows:

- Type I: Clear-cut vertical grooves that run across the entire lips
- Type I': Similar to type I, but the grooves do not cover the entire lip
- Type II: Branched grooves
- Type III: Intersected grooves
- Type IV: Reticular grooves
- Type V: Grooves do not fall into any of the types I–IV and cannot be differentiated morphologically (undetermined).

The fingerprints of an individual have been used as one of the vital parts of identification in both civil and criminal cases because of their unique property of absolute identity.[7] A fingerprint is the representation of the epidermis of a finger; it consists of a pattern of interleaved ridges and valleys. Fingertip ridges evolved over the years to allow humans to grasp and grip objects. Like everything in the human body, fingerprint ridges form through a combination of genetic and environmental factors. This is the reason why even the fingerprints of identical twins are different.[8] Fingerprinting remains the best and the most commonly employed method to establish personal identification and for tracking criminals.

Therefore, the present study was conducted to determine the predominant lip print and fingerprint patterns in males and females and also to find out any correlation between the lip print and the fingerprint patterns within a gender.

Materials and Methods

The study sample was comprised of 200 subjects, all from North India (100 males and 100 females). Each subject was examined for any pathology of the lips and fingers that could affect the lip print and the fingerprint. The methods of recording lip and finger prints were explained to the participants, and the consent of all the individuals was obtained.

Each individual was asked to gently clean his/her own lips by rinsing in water and the lips were allowed to dry. A dark-colored lipstick was applied evenly in one stroke and the subject was asked to spread it uniformly by gentle movements of the lips. The sticky side of the cellophane tape was placed over the lips in resting position and then pressed uniformly. Tape was gently removed from the lips without distorting the lip print. Cellophane tape was then stuck to the bond sheet. For recording fingerprint, the imprint of the right thumb was recorded using an ink pad on white bond sheets after cleaning and drying the hand. The thumb print was taken because a thumb print will be present almost always on the object under consideration in a forensic scenario.

The middle-third portion of the lower lip was considered for the analysis as this area is always present in a lip print.[2] A modified classification by Nagasupriya *et al*.[9] was used in the study as it is simple and useful for comparative analysis. In this system, both partial and full vertical lip patterns are included under one category as a vertical lip print pattern, i.e., type I. The branched lip prints are considered as a type II pattern. The intersected and reticular lip prints are unified in type III because these patterns are almost similar. Thus the lip prints were analyzed as follows [Figure 1]:

- Type I - Vertical pattern (Grooves running vertically to full length or partially across the lips)
- Type II - Branched pattern (Grooves exhibiting branching)
- Type III - Reticular pattern (Grooves intersecting or crisscrossing each other).

Fingerprints were analyzed according to the classification by Kucken[10] that categorizes the fingerprint in the following three categories [Figure 2]:

- Loop pattern
- Arch pattern
- Whorl pattern.

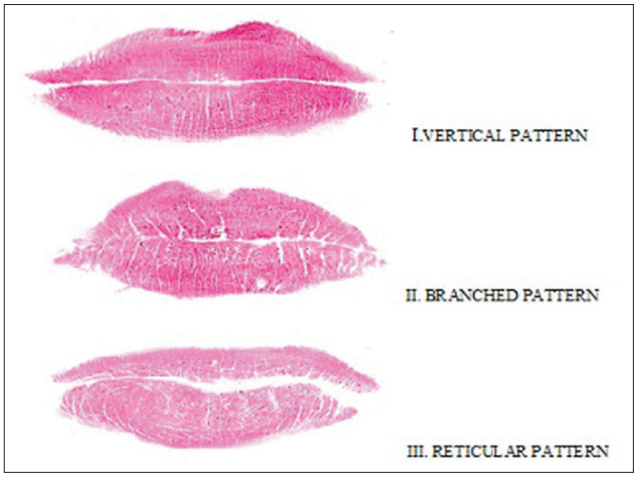


Figure 1: Types of lip prints according to the classification by Nagasupriya *et al*.

The Chi-square test was done to analyze the data statistically; *P* value ≤ 0.001 was considered to be statistically significant.

Results

The predominant lip print pattern in males was found to be the branched pattern, followed by vertical and then reticular. In females, the vertical lip print pattern was predominant, followed by the reticular pattern and then followed by the branched pattern [Graph 1]. The predominant fingerprint pattern in both males and females was found to be the loop pattern, followed by the whorl pattern and then the arch pattern [Graph 2].

Of the total of 100 male subjects, 56 were found to have a branched lip pattern. Out of these 56 subjects, 38 (68%) were associated withthe loop pattern, 2 (3%) associated with the arch pattern, and 16 (29%) associated with the whorl pattern. Thirty out of 100 males had the vertical lip pattern. 14 (47%) were associated with the loop pattern, 2 (6%) with the arch pattern, and 14 (47%) with the whorl pattern. The reticular lip pattern was seen in 14 of 100 male subjects. Out of these, 10 (71%) were associated with the loop pattern, none with the arch pattern, and 4 (29%) were associated with whorl finger pattern.

Of the total of 100 female subjects, 38 were found to have the vertical lip pattern. Out of these 38 subjects, 20 (53%) were associated with the loop pattern, none were associated with the arch pattern, and 18 (47%) were associated with the whorl pattern. Thirty out of 100 females had the branched lip pattern. Eighteen (60%) were associated with the loop pattern, none with the arch pattern, and 12 (40%) with the whorl pattern. The reticular lip pattern was seen in 32 of 100 female subjects. Out of these, 16 (50%) were associated with the loop pattern, 4 (12.5%) with the arch pattern, and 12 (37.5%) were associated with the whorl finger pattern.

The difference in distribution of lip prints in males was found to be statistically significant, with the branched pattern being the predominant pattern. However, the distribution of lip print patterns in females was statistically insignificant [Table 1].

The difference in the distribution of fingerprints patterns in males and females was found to be statistically significant, with the loop pattern being the predominant pattern [Table 1].

The overall correlations of lip prints and fingerprints in males and females are given in Tables 2 and 3, respectively. The results in our study, however, were found to be statistically insignificant in males as well as in females.

Though we did not find any significant correlation between lip prints and fingerprints within gender, we observed that the arch fingerprint pattern in males was associated with vertical and branched lip print patterns, whereas in females it was associated with the reticular lip print pattern. The

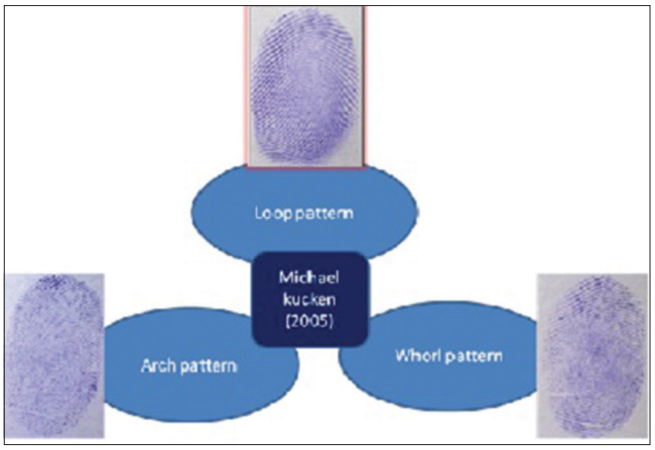
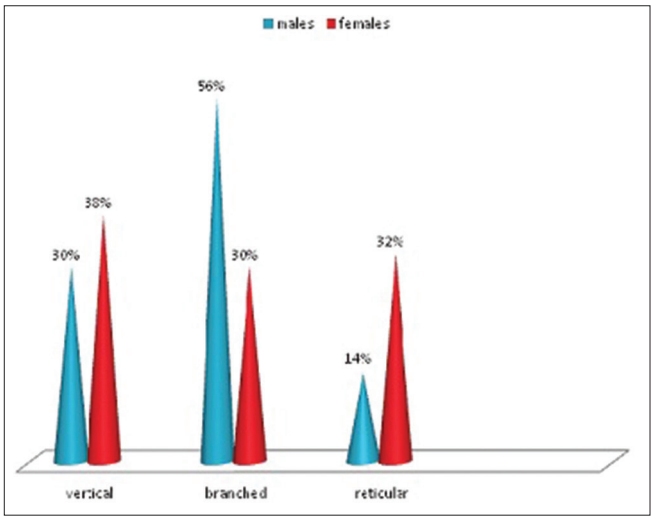
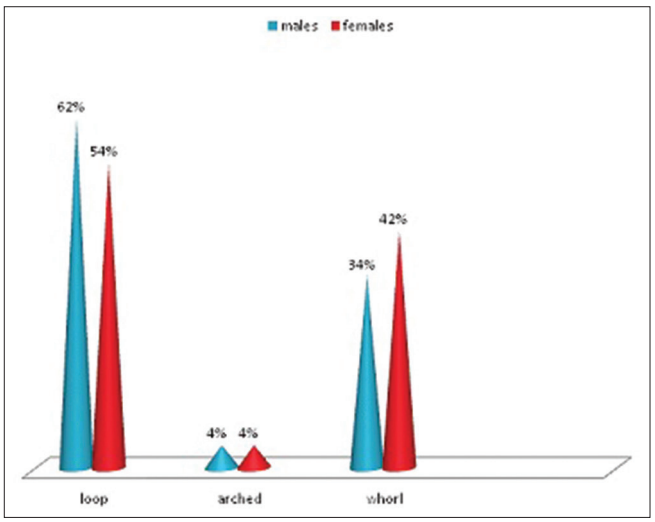


Figure 2: Types of fingerprints according to the classification by Michael Kucken



Graph 1: Distribution of lip print patterns among males and females



Graph 2: Distribution of fingerprint patterns among males and females

Table 1: Distribution of lip print and fingerprint patterns in males and females

	Distribution of lip print pattern among males	Distribution of lip print pattern among females	Distribution of fingerprint pattern among males	Distribution of fingerprint pattern among females
Chi-square	13.480	0.520	25.240	20.440
df	2	2	2	2
P	0.001*	0.771	<0.001*	<0.001*

**P* value significant

Table 2: Correlation of lip prints with finger patterns in males (*N*=100)

	Loop	Arched	Whorl	Total	Chi-sq	*P*
Vertical	14	2	14	30	2.2	0.3329
Branched	38	2	16	56	0.93	0.6281
Reticular	10	-	4	14	0.51	0.7749
Total	62	4	34	100		

Table 3: Correlation of lip prints with finger patterns in females (*N*=100)

	Loop	Arched	Whorl	Total	Chi-sq	*P*
Vertical	20	-	18	38	1.45	0.4843
Branched	18	-	12	30	1.02	0.6005
Reticular	16	4	12	32	4.43	0.1092
Total	54	4	42	100		

arch finger pattern was found to be the least common in males as well as females, but the specific association of this pattern with different lip print patterns among males and females was also observed.

Discussion

It is now a well-established fact that lip prints are unique to each individual, similar to fingerprints. The two are considered to be the most important types of transfer evidences (that is, the evidence obtained from the transfer of material from one surface to another when in contact).

Lip prints are sometimes left at crime scenes and can provide a direct link to the suspect. The vermilion border has minor salivary glands and the edges of the lips have sebaceous and sweat glands in between. The secretions of oil and moisture from these enable the development of latent lip prints in most crime scenes, analogous to latent fingerprints, where there was close contact between the victim and culprit.[11] Although invisible, these lip prints can be developed and visualized using agents such as aluminium powder and magnetic powder.[12]

Fingerprints are one of the most mature biometric technologies and are considered legal proof of evidence in courts of law all over the world. In a fingerprint, the primary dermal ridges are formed during 12–19 weeks of intrauterine life and the resulting fingerprint ridge configuration is fixed permanently.[13] Ridges and their patterns exhibit a number of properties that reflect the biology of individuals. Fingerprints are static and their size and shape change; they may vary with age but the basic pattern of the fingerprint remains unchanged. In addition, the variability of epidermal ridge breadth in humans is substantial.[14]

In the present study, the predominant lip print pattern in males was found to be the branched pattern, which is in accordance with the study by Nagasupriya *et al*.[9] In females, the vertical lip print pattern was predominant, which corresponds with the results from the study by Sharma *et al*.[15] In contrast to our results, Sharma *et al*.[15] had concluded that undetermined lip pattern (27.5%) is more common in males. Saraswathi *et al*.[16] reported that intersecting pattern was most common both in males (39.5%) and females (36.5%), and their finding is similar to that of Sivapathasundharam *et al*.[2] In the study of Gondivkar *et al*.,[17] criss-cross lip pattern was reported in 51.05% of males and branched lip pattern in 37.06% of females.

Our study was performed on the North Indian population, whereas most of the cheiloscopy studies mentioned refer to the South Indian population.

In our study, we observed that the difference in distribution of lip prints in males was statistically significant, with the branched pattern being the most predominating pattern. However, the distribution of lip print patterns in females was statistically insignificant. We also observed that the difference in distribution of fingerprint patterns in both males and females was found to be statistically significant, with the loop pattern being the predominant pattern. The other aim of our study was to correlate the lip print pattern with fingerprints for gender identification. However, we did not find any significant correlation between lip prints and fingerprints within the gender. This may be attributed to the small sample size in our study. Still, we observed that the arch fingerprint pattern, though being the least predominant pattern in both the genders, was associated with the vertical and branched lip print patterns in males, whereas in females it was associated with the reticular lip print pattern. This association of the arch pattern with different lip prints among males and females could be further explored with studies consisting of large sample sizes and can thus serve as an important tool for sex determination in the forensic scenario.

Conclusions

In conclusion, we can suggest that identifying lip print patterns could be an important tool in sex determination

and criminal identification. The branched type of lip print pattern was found to be significantly associated with male subjects, whereas females had the vertical lip print pattern predominantly but with no statistical significance. In case of fingerprints, the loop pattern was predominant in both the genders. Although we did not achieve any significant correlation between lip prints and fingerprints, further studies including larger sample sizes may lead us in a positive direction.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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