

STUDY OF MORPHOLOGICAL PATTERNS OF LIP PRINTS: APPLICATION IN PERSONAL IDENTIFICATION

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ABSTRACT

Introduction: Personal identification plays an inevitable role in forensic investigations. Objectives of present study were to study various patterns of lip prints and document common patterns and their variations in population under investigation, to evaluate permanency of lip prints by comparing the lip prints from initial pattern after one year.

Materials & Methods: Present study was carried out on 200 individuals of 18 to 65 years of age group (100-males and 100 females). Lip prints were studied in Department of Anatomy, SMS Medical College, Jaipur, Rajasthan. The frequency of each type of lip print was tabulated and the percentage of each type was calculated.

Results: In total study population, Type II was most common pattern present in 676 segments (out of total 1200 segments-56.3%) followed by type III, Type II, Type I, Type IV and the least common pattern is Type V. In males most common pattern was Type III 68%. Followed by Type II, Type II, Type I, Type IV. Least commonly present pattern was Type V. In females most common pattern was Type II-418 segments (out of 600 segments seen-69.7%). Followed by Type II, Type I, Type III, Type V. Least commonly present pattern was Type IV. Segmental distribution and combination of patterns were also studied. Results of incidences of various patterns among males & females show significant differences it was found that there was no change either in size or in shape of the lip print in different periods (after one year).

Conclusion: Dominance of a particular pattern of lip print can be population-wise. Lip prints are individualistic and bear a relationship with sex and geographical distribution of the individual. However, variance can be explained by the ethnic, racial differences in the subjects studied.

KEYWORDS: Cheiloscropy, Forensic science, Human Identification, Lip prints, Forensic Odontology.

INTRODUCTION

In the present time, crime cases are increasing at a tremendous rate. It's a great challenge for law enforcement agencies and forensic science researchers to look for new methods that could provide better evidences and aid to put a full stop to all inhumane acts.

Personal identification plays an inevitable role in forensic investigations. Personal identification methods are employed for the identification of an unknown deceased in mass disaster cases or in missing-person cases, as well as for inclusion, exclusion, or identification of

the suspect. Visual examination is not always possible, especially after decomposition, facial trauma, and skeletonization. This is when fingerprints, DNA profiling, osteology, odontology, etc play a mammoth role.^{1,2} Identity cannot always be conclusively established by one particular method. In instances where the more common modes of identification fails to be of use, other methods gains significance. One of these is cheiloscropy, also known as queiloscropy.

Fischer was the first anthropologist to describe the furrows on the red part of the human lips in 1902.³ The use of lip prints were first recommended as early as in 1932 by Edmond B Locard, one of France's greatest criminologists.³ The wrinkles and grooves on the labial mucosa (called sulci labiorum) form a characteristic pattern called "lip prints," the study of which is referred to as cheiloscropy.^{4,5}

Lip prints are considered unique to an individual and analogous to fingerprints.⁶ It has been verified that lip prints recover after undergoing alterations like minor trauma, inflammation and diseases like herpes. However, major trauma to the lips may lead to scarring and the surgical treatment rendered to correct the pathology may affect the size and shape, thereby, altering the pattern and morphology of the grooves.⁴

Unlike fingerprints, unanimity still does not exist between investigators to accept cheiloscropy as a method of human identification. Although lip print identification may appear in the field literature, there is very little science or research to support Suzuki's theory that lip prints are individual, or to support a methodology for the collection and comparison of lip prints, which has become accepted within the forensic science community. With this lack of sound scientific basis, the technique would fail to meet any standards of reliability.⁷ The foundations of cheiloscropy, however, are the same as that of dactyloscopy, that is to say, lip prints are invariable, permanent and allow establishing a classification.

Although a number of studies have been taken up on cheiloscropy, very few of them have been performed on Indian subjects. The present study was taken up to fill this lacuna. Thus, the prime objectives of present study were to study various patterns of lip prints and document common patterns and their variations in population under investigation, to determine level of significance of proportion of cases in various lip print pattern groups and to evaluate permanency of lip prints by comparing the Lip prints from initial pattern after one year.

MATERIAL AND METHODS

The present study was carried out on 200 individuals of 18 to 65 years of age group (100-males and 100 females). Lip prints werestudied in Department of Anatomy, Sawai Man Singh Medical College, Jaipur, Rajasthan (INDIA). Individuals were included without any restriction of caste, religion or marital status. Prior consent for this study was obtained from the subjects. Subjects were not chosen on the basis of bodily structure and proportion. Care was taken to avoid measurements of persons with apparent physical deformities. Those with any inflammation, trauma, congenital deformity or orthodontic treatment, disease or deformity of the lips were excluded from the study. Those with known hypersensitivity to the lipstick were also excluded. The armamentarium comprised of dark coloured frosted lipstick (non glossy), Thin Executive bond paper (4" X10"), Magnifying lens, Piece of cardboard (4"x10"), and Tissue paper/Cotton.

Subject was made to sit comfortably on a stool. Lipstick was applied on both of his/her lips in a single motion evenly on the upper lip, then on the lower lip. Then the person was asked to rub the lips together to spread the lipstick evenly. Now the person was asked to slightly stretch his/her

lips and then fold them slightly inwards with open mouth (to obtain better and clear lip impressions) and then place the folded piece of paper between lips and press the lips against it for 2-3 seconds. Instructions were given not to slide the lips while pressing them against the paper as this can smudge the prints. Upper/ lower lip and right/ left sides of the print were marked on the piece of bond paper. Print thus obtained was observed with magnifying lens for patterns of lip prints.

To simplify the lip patterns, each lip was divided into 3 equal parts. A horizontal line divides upper lip from lower lip and two vertical lines divides each lip into equal 3 parts. As for upper lip there are upper right, upper middle & upper left. Combinations of groove patterns for each part of lip were recorded.

In this study, we followed the classification of lip patterns proposed by Tsuchihashi & Suzuki, which is the most widely used classification in literature.^{8,9} It was found to have clear description of nearly all of the commonly encountered lip patterns and was easy to interpret.

- i) Type I : Clear cut long grooves running vertically across the lip
- ii) Type I! : Short vertical grooves that disappear half-way into the lip Instead of covering the entire breadth. (These are partial length grooves as Type I, so pronounced as "Type I dash")
- iii) Type II : Grooves that Branch or fork
- iv) Type III : Grooves that intersect
- v) Type IV : Grooves that are reticulate (netlike)
- vi) Type V : Grooves that do not fall into any of above categories and cannot be differentiated morphologically.

The frequency of each type of lip print was tabulated and the percentage of each type was calculated. The data was compiled and analysed with Chi- square test and a P value less than 0.05 was considered as significant and less than 0.001 as highly significant. Out of 200 individuals, 50 Subjects chosen randomly comprising 25 males and 25 females were taken for studying the permanence of lip prints. Lip prints of this group were taken in the beginning and was grouped as A1 & B1 and at the end of study i.e. after 12 months and labeled as A2 & B2 and were compared thereafter.

RESULTS

Findings reveal that the lip pattern of an individual consists of a mixture of several patterns. It was observed that the different segments of the lips frequently had different patterns. Each type never occurred singly, but in combination with other types.

In total study population, Type II was most common pattern present in 676 segments (out of total 1200 segments-56.3%) followed by type III -622 segments (51.8%), Type I!-571(47.6%), Type I-501 (41.8%), Type IV-227 (18.95%) and the least common pattern is Type V-201 segments (16.8%). In males most common pattern was Type III (Intersecting Pattern)-408 segments (out of 600 segments seen-68%). Followed by Type II-43%, Type I!- 41.5%, Type I-33.75%, Type IV-28%. Least commonly present pattern was Type V- 119 segments (19.8%). In females most common pattern was Type II-418 segments (out of 600 segments seen-69.7%). Followed by Type I!- 53.7%, Type I-49.8%, Type III-35.7%, Type V-13.7%. Least commonly present pattern was Type IV-59 segments (9.8%). [Table-1]

Results of incidences of various patterns among males & females show significant differences. Most common pattern found in present study in females was Type II-(418 segments-69.7%) and in males Type II present in 43% (258 segments). Chi-Square test was applied. Chi-square = 85.644 with 1 degree of freedom; p value < 0.001 for pattern Type II which is highly significant. For type III in males present in 408 segments (68%). In females, 214 segments (35.7%). Chi-square = 124.330 with 1 degree of freedom; p value < 0.001 for pattern Type II which is highly significant for Type III pattern. Differences in males & females for other patterns were also found highly significant. [Table-1] Segmental distribution of lip prints are shown in Table-2.

Most common pattern found in upper lip in total population was Type II (Branching Pattern)-336 segments (total 600 segments-56%). Followed by Type III-52.3%, Type I!- 47.3%, Type I-43.5%, Type IV-18.8%. Least commonly present pattern is Type V-95 (15.8%). In lower lip, most common pattern in total population was Type II -340 segments (total 600 segments-56.7%). Followed by Type III-51.3%, Type I!- 47.8%, Type I-40%, Type IV-19%. Least commonly present pattern is Type V-106 segments (17.7%). [Table-3]

Most common combination present in total population was type II & III which was present in 181 individuals (out of 200 individuals). IInd common pattern was type I! & II, present in 179 individuals. Least common was type IV & V which was present in only 66 individuals and Ind least common was type I & V which was present in 104 individuals. [Table-4]

In our observation, it was found that there was no change either in size or in shape of the lip print in different periods (after one year).

DISCUSSION

The diversity in lip patterns are in agreement with the lip pattern classification proposed forward by Tsuchihashi and Suzuki^{8,9}. This is the most widely used classification in literature. It was found to have a clear description & interpretation of all lip patterns. Its resemblance to the dental formula was also familiar to the forensic dentist. Occurrences of all the five patterns have been reported in our study. The fact that a minimum number of type V patterns (16.8%) were observed in the present study was evidence to the complete coverage of patterns in this classification. It was observed that the different segments of the lips frequently had different patterns. It was also observed that no two persons had similar lip prints, either the same type or different types. It was further noticed that not even a single person had one particular type of lip print in the upper lip or lower or in both. These results are in accordance with other researches done on different populations which reported that lip prints had different patterns that were apparently unique to the individuals. [Preeti Sharma et al. (2009)¹⁰ El Domiaty *et al.* (2010)¹¹]

Regarding findings in total population (table-1), our findings were consistent with Shailesh M Gondivkar et al. study (2009) which stated that the most common pattern was Type II (28.59%) and followed in order by Type III (27.89%), Type I (19.29%), Type I' (12.80%), Type IV (9.64%).¹² Prateek Rastogi et al. (2011) also found similar results on 100 north Indians (50 males and 50 females) and 100 south Indians (50 males and 50 females).¹³

Various other studies on lip print patterns show varying results. Ramandeep S Narang et al. (2011) studied lip patterns in the population of Punjab and found Type III (22.8%) as most predominant pattern.¹⁴ Sivapathasundharam et al. (2001) observed that Type III was predominant (41.33%) and that the least common was Type IV which was 10.71% in the Indo-Dravidian

population.⁵ Annie Joseph Verghese et al. (2011) obtained Lip prints from 100 male and 100 female subjects from the state of Karnataka, India. The most frequent pattern was type IV.¹⁵ El Domiaty et al. (2010) studied Saudi Arabian population. They divided the print into six topographic regions and reported type J (horizontal with other forms) to be the most frequent type in the upper middle area of both males and females and groove I (horizontal) to be the least frequent.¹¹

Certain patterns are in higher percentages in one population and very low in others, may lead to the conclusion that these patterns are unique characteristics of these populations. However, variance can be explained by the ethnic, racial differences in the subjects studied. Also Type V pattern was seen least common in present study in total study population which is consistent with other studies.

Patterns found in males & females (table-1) correlate well with N. Chaitanya Babu et al. (2009) study. They observed that type I and II patterns was predominant in females and type III and IV patterns was predominant in males.¹⁶ Also Harpreet Singh et al. (2011) found that type II was most commonly seen in females, whereas type IV was seen least commonly in females.¹⁷

While according to Preeti Sharma et al. (2009), Type I, I' was most commonly seen in females, whereas Type IV was seen most commonly in males of UP population.¹⁰ Shalini gupta et al. (2011) revealed that intersecting pattern (Type III) was most common in females having 27.7% whereas branching (Type II) pattern was common in males having 28.1%.¹⁸

Above results of the study showed that lip prints are individualistic, and bears a relationship with sex and geographical distribution of the individual. Variance of results of present study with other studies can be explained by the ethnic, racial and gender differences in the subjects studied.

Results of incidences of various patterns among males & females (table-1) show significant differences in present study. Statistically significant differences in lip patterns in males & females were also reported by other workers J. Augustine et al. (2008)¹⁹, Ramandeep S Narang et al. (2011)¹⁴.

There was no difference found in occurrence of patterns in upper and lower lips, although incidence of patterns varies (table-3). Our findings resemble partially with Shalini gupta et al. (2011) study. They reveal that intersecting pattern (type III) was found to be most common among the upper lips of both males and females. The branching pattern (type II) was found to be most common among the lower lips of both males and females.¹⁸

While in J. Augustine et al. (2008) study, the upper lip showed a predominance of type III pattern followed in order by type II, type IV, type I, type I' and type V. This pattern differed from that seen in the lower lip. While type III pattern was even more predominant in the lower lip, it was followed by type IV, type I, type II, type I' and type V in that order.¹⁹ Variance of results can be explained by the ethnic, racial differences in the subjects studied.

Table 4 shows distribution of combinations of patterns of lip prints. Most common combination present in total population was type II & III and least common was type IV & V. Combinations of patterns in males & females were also studied; these can be helpful in identity determination. Sivapathasundharam et al stated that the uniqueness of patterns depended on the way the lip muscles relaxed to produce a particular pattern⁵. Lévêque and Goubanova suggested that the furrows and grooves on the lips seemed to be privileged routes for saliva to spread over the lips and maintain good hydration. They also found the upper lip to be more hydrated than the

lower one. The variations in pattern between the upper and lower lip may be attributed to these factors and might have a functional significance. They also noted that some continuity appeared to exist between the lips and adjacent skin lines and suggested a common origin²⁰.

A common feature of the lips in this study was the presence of peeling off the superficial layers of the skin. This could be due to the dry weather in this area, which dried the lips and made the people accustomed to bite away the dried skin. However, this did not mask the pattern of the lip print as it appeared after taking the print many times. This phenomenon could help a great deal in identification of subjects as the lip pattern is permanent and does not change due to differences in climate or any illness present around the mouth.

In our observation, it was found that there was no change either in size or in shape of the lip print in different periods (after one year) establishing the permanency of lip prints. Our results agree with that of the study carried out by Tsuchihashi and his statement “in a criminal search, where the unchanged pattern even for a 6 months period would be helpful” is justified. Thus the present study has established the fact that alterations of lip print during the life time does not occur and the lip print present at the end of fully matured lip, remains as it is throughout life, although they have physiological function of cell exfoliation.

From the results of the present study it can be concluded that each lip print is unique, hence can be used as evidence for identification in a court of law. Frequencies of occurrence of various lip prints and their predominance pattern can help in determining gender and geographical origin of the donor, to a certain extent.

To state the importance of cheiloscropy in forensic science identification, Ball stated that latent lip prints would be available at all crime scenes as the vermilion borders of lips have minor salivary glands and sebaceous glands with latter being principally present around edges of the lip associated with hair follicles, sweat glands in between and secreting oils. It is these secretions and continual moisturizing by the tongue due to occasional sebaceous glands present on the lip, there are chances for the presence of the latent lip prints on items such as glass⁷. These lip prints can be obtained up to 30 days after being produced.

To establish the identity between evidential and comparative trace, the common properties are to be determined. The determination of nine individual properties is necessary worldwide to establish the identity. A catalogue of 23 types of individual properties had been prepared by Kasprzak J.²¹ He stated that an average of 1145.5 individual properties could be established for one lip print trace whereas in one trace of finger print only 100 individual properties could be differentiated. Lip print identification methodology, although seldom used, is very similar to finger print comparison.

Through the research carried out by Petersen, it was evident that lip prints at crime scenes are more prevalent than one thinks. Articles such as drinking glasses, letters, cigarette butts, clothing, napkins and even skin may possess lip prints that could eventually lead to the identity of a suspect, victim or a witness of a crime.²²

Great strides have been made in the collection, analysis and interpretation of lip prints. Lip prints have been studied in post-mortem identification.²³ Advances have been made in the techniques and dyes for developing lip prints. Software has been developed for the analysis of lip prints. However, limitations still exist in the use of lip prints. The permanent nature of lip prints requires more long term studies to be substantially documented. Full utilization of lip depends to a high degree on the skill of members of law enforcement agencies. The problems involved in

cheiloscopies are relatively little known and thus, so far lip prints have been used only occasionally despite their frequent occurrence at the scene of crime. The only possible solution is to place cheiloscopies within the scope of criminalistics, side by side with dactyloscopy and other means of person identification and to introduce it into the syllabus of training of forensic odontology.

Although lip print identification has been utilized by courts in isolated cases, further studies need to be carried out on a larger sample size, preferably of different races, family members, twins and siblings to find the pattern of lip print distribution among individuals of different races and nations and for gender determination.

CONCLUSION

Present study showed that lip prints are individualistic, and bears a relationship with sex and geographical distribution of the individual. Variance of results of present study with other studies can be explained by the ethnic, racial and gender differences in the subjects studied. Alterations of lip print during the life time do not occur. Combinations of lip print patterns can be used for personal identification. In order to completely utilize the mammoth role of cheiloscopies in forensic investigations, it is mandatory to carry out more studies on different population groups to analyze the variations and establish a database. There is a dire need to standardize the protocols for lip print collection, development, preservation, and examination. It is essential to throw more light on the aspects of personal identification by using cheiloscopies.

ETHICAL CLEARANCE: Study has been approved by Institutional ethics committee (SMS Medical College and Hospital, Jaipur).

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TABLE I: Percentage occurrence of patterns of lip prints

| S. N | PATTERN | TOTAL POPULATION | MALES | FEMALES | Chi Square with 1 degree of freedom | P-Value | INFERENCE |
|------|----------|-----------------------------|----------------------------|----------------------------|-------------------------------------|---------|--------------------|
| | | Present in (Segments =1200) | Present in (Segments =600) | Present in (Segments =600) | | | |
| 1. | TYPE I | 501 | 202 | 299 | 31.580 | < 0.001 | Highly significant |
| 2. | TYPE II | 571 | 249 | 322 | 17.320 | < 0.001 | Highly significant |
| 3. | TYPE II | 676 | 258 | 418 | 85.644 | < 0.001 | Highly significant |
| 4. | TYPE III | 622 | 408 | 214 | 124.330 | < 0.001 | Highly significant |
| 5. | TYPE IV | 227 | 168 | 59 | 63.371 | < 0.001 | Highly significant |
| 6. | TYPE V | <i>201</i> | <i>119</i> | 82 | 7.745 | < 0.001 | Highly significant |

*Highest figures are shown as Bold and lowest figures are in italics in all tables.

TABLE II: Distribution of lip prints patterns (segmental distribution)

| S. No. | PATTERN | Present in UPPER LEFT | Present in UPPER MIDDLE | Present in UPPER RIGHT | Present in LOWER LEFT | Present in LOWER MIDDLE | Present in LOWER RIGHT |
|--------|----------|-----------------------|-------------------------|------------------------|-----------------------|-------------------------|------------------------|
| 1. | TYPE I | 73 | 104 | 84 | 73 | 99 | 99 |
| 2. | TYPE I! | 100 | 102 | 82 | 91 | 94 | 94 |
| 3. | TYPE II | 116 | 102 | 118 | 116 | 96 | 96 |
| 4. | TYPE III | 99 | 123 | 92 | 89 | 125 | 125 |
| 5. | TYPE IV | 22 | 57 | 34 | 28 | 64 | 64 |
| 6. | TYPE V | 31 | 36 | 28 | 27 | 43 | 43 |

TABLE III: Distribution of lip prints patterns in upper & lower lip

| S. no. | PATTERN | UPPER LIP | | | LOWER LIP | | |
|--------|----------|------------------|--------------|--------------|------------------|--------------|--------------|
| | | Total population | Males | Females | Total population | Males | Females |
| | | Segment =600 | Segment =300 | Segment =300 | Segment =600 | Segment =300 | Segment =300 |
| 1. | TYPE I | 261 | 104 | 157 | 240 | 98 | 142 |
| 2. | TYPE I! | 284 | 123 | 161 | 287 | 126 | 161 |
| 3. | TYPE II | 336 | 129 | 207 | 340 | 129 | 211 |
| 4. | TYPE III | 314 | 204 | 110 | 308 | 204 | 104 |
| 5. | TYPE IV | 113 | 88 | 25 | 114 | 80 | 34 |
| 6. | TYPE V | 95 | 58 | 37 | 106 | 61 | 45 |

TABLE IV: Distribution of combinations of patterns

| S. No. | Combination of patterns | Present in total population cases=200 | Present in males cases=100 | Present in females cases=100 |
|--------|-------------------------|---------------------------------------|----------------------------|------------------------------|
| 1. | I & I! | 164 | 74 | 90 |
| 2. | I & II | 169 | 76 | 93 |
| 3. | I & III | 160 | 78 | 82 |
| 4. | I & IV | 107 | 64 | 43 |
| 5. | I & V | 104 | 53 | 51 |
| 6. | I! & II | 179 | 84 | 95 |
| 7. | I! & III | 171 | 87 | 84 |
| 8. | I! & IV | 113 | 72 | 41 |
| 9. | I! & V | 112 | 57 | 55 |
| 10. | II & III | 181 | 94 | 87 |
| 11. | II & IV | 120 | 76 | 44 |
| 12. | II & V | 119 | 64 | 55 |
| 13. | III & IV | 116 | 78 | 38 |
| 14. | III & V | 112 | 66 | 46 |
| 15. | IV & V | 66 | 48 | 18 |

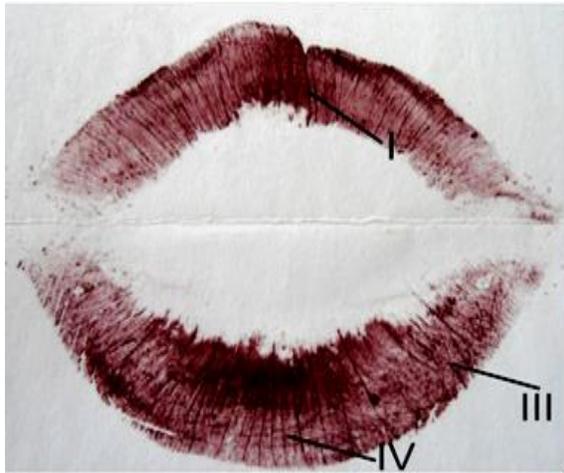


Fig 1: Various lip patterns.

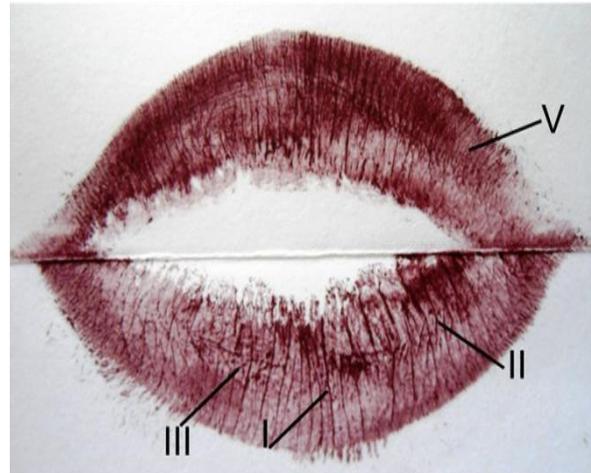


Fig 2: Various lip patterns.

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