Morphological patterns of lip prints in relation to gender in a defined cohort

Abhishek Karn¹, Rachana Karna², Prava Bajgain², Birendra Kumar Mandal³

ABSTRACT

Objective: The aim was to underline the significance of lip prints in forensic investigation for identification, to document common lip-print patterns, to analyze and evaluate them in relation to the gender from the population under study. Materials and Methods: The present study was conducted on 150 Nepalese medical students, of which 75 were males and 75 were females with age ranged from 18 to 25 year-old, of Universal College of Medical Sciences and Teaching Hospital, Bhairahawa. After applying lipstick evenly, the glue portion of cellophane tape was used to obtain the impression of the lip, which was transferred on to a white bond paper. The data were compiled and analyzed using Z-test for proportion to assess gender differences in lip-print patterns and $P < 0.05$ was considered to indicate statistical significance. Results: No two individuals had similar lip print pattern, the most frequent pattern was Type I (48%), followed by Type II (31%). The predominant pattern of lip print in males was clear-cut grooves running vertically across the lip (75%) and that in females were branched grooves (56%). Type I, Type II, and Type V lip print patterns were significantly associated with sex ($P < 0.001$) hence can be used in the identification of gender among the suspects in defined cohort. Conclusion: This loom of gender and individual identification utilizing lip prints is pertinent in defined group and the authors recommend the practical utilization of this technique, which is virtually absent in Nepali medico-legal system, in routine civil and criminal litigations.

KEY WORDS: Forensic sciences, forensic pathology, lip prints, cheiloscopy, identification, sex determination

INTRODUCTION

Identification is the determination of individuality of a person. For establishing an individual’s identity, which is crucial in civil and criminal cases, the investigation of lip prints can play a fundamental role as they are unique for each individual. Although DNA comparisons and finger print analysis are common techniques employed to ensure fast and secure identification, there are certain crime scenarios where other supplemental aids become essential [1].

Lip prints are typical lines and fissures in the shape of wrinkles and grooves present in the region of transition of human lip, between the inner labial mucosa and outer skin. This is unique for individuals, as finger prints [2]. The study of lip prints is known as cheiloscopy [3,4]. Like fingerprints, the lip grooves are permanent and is unaltered from 6 week of intrauterine life till death [3,5]. It has been established that they recuperate after undergoing alterations like trauma, inflammation, and diseases like herpes and that the disposition and shape of the furrows does not diverge with environmental factors. Because of being determined genotypically, the significance of using it for forensic investigations is reasonable as the pattern never undergoes changes from birth until the body undergoes decomposition [1]. Research suggests the conclusive evidence that lip prints are suitable for the successful comparison, analysis and identification of a person to a crime [6]. In addition, it also gives an intuition into the type of the event, number of people involved, gender, cosmetics used, any habits, and pathological states associated with the lips [1].

¹Department of Forensic Medicine & Toxicology, Universal College of Medical Sciences and Teaching Hospital, Bhairahawa, Nepal, ²Department of Dental Surgery, Universal College of Medical Sciences and Teaching Hospital, Bhairahawa, Nepal, ³Department of Forensic Medicine & Toxicology, Chitwan Medical College, Bharatpur, Nepal

Address for correspondence: Dr. Abhishek Karn, Department of Forensic Medicine & Toxicology, Universal College of Medical Sciences and Teaching Hospital, Bhairahawa, Nepal. Tel.: +9779842038389, E-mail: dr.abhishekkarn@gmail.com

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The lip-prints were first described by Fischer in 1902 as the furrows on the red part of the human lips [7]; but the use of lip prints in personal identification and criminalization was recommended only in 1932 by Edmond Locard, one of France’s greatest criminologists [8]. Snyder in 1950 reported that the characteristics of the lips formed by lip grooves are as individually distinctive as the ridge characteristics of fingerprint [9]. In 1967, Suzuki made detailed investigations of the measurement of the lips, the use and color of rouge, and the method for its extraction to obtain useful data for forensic application. It is thought that hereditary factors may have some influence on the lip print patterns [10]. Later in 1970, Suzuki and Tsuhihashi, conducted a study on 107 Japanese families and classified lip prints into five types [11]. Mc Donell in 1972 reported that two identical twins who seem to be indistinguishable by every other means can be distinguished by their lip prints [8]. Cottone, in 1981 reported that cheiloscopy is one of the special techniques used for personal identification [12]. The federal bureau of investigation successfully identified a male bank robber in 1987, who used female disguise including lipstick by submitting the photographs and lifts of the lip prints left by the robber on the glass door while robbing a bank, which matched with one of the suspects [13]. In 2000, Vahanwala conducted a study of lip patterns to encourage the significance of cheiloscopy in forensic identification [14].

Augustine, Barpande and Tukpaki suggested that variations in lip print patterns among males and females could facilitate sex determination [15]. According to recent studies in Nepal, lip print pattern can be used for personal identification and sex determination [16-18]. The aim of this study was to highlight the importance of lip prints in forensic investigation for identification, to document common lip patterns, to analyse and compare the lip patterns in relation to gender among Nepalese population under study.

MATERIALS AND METHODS

A total of 150 individuals comprised of 75 males and 75 females were included in this study. The subjects were Nepalese medical students in the age group of 18-25 years with different ethnic backgrounds, but staying together in the campus of Universal College of Medical Sciences and Teaching Hospital, Bhairahawa, Nepal.

Lips without any pathology and having entirely normal transition zone between the mucosa and the skin were incorporated in the study. Subjects who were hypersensitive to cosmetics or presented with any pathology like ulcer or trauma to the lips were excluded due to their unsuitability for this study. The purpose of this study was explained prior to study, and informed consent was obtained from each participant who was also assured about maintenance of anonymity.

For recording the lip prints, lips of the subjects were cleaned by tissue paper (tempo) and non-persistent, non-glossy lipstick applied in a single motion (maroon lipstick for females and brown for males) and were asked to gently rub the lips together for even spread. The glue portion of the cellophane tape (Wondertape™, 36 mm width) was used to obtain the impression of the lip. This record was immediately transferred on to a white bond paper by gently sticking the cellophane tape. Besides serving as patient’s permanent lip record, this method could also be safely preserved for subsequent analysis. For analysis, each print was topographically divided into four quadrants, and only the central portion of the lower lip was considered [19] for analysis by magnifying lens. The analysis of the prints was based on the numerical superiority of the patterns of the line visible in the area of study [20]. If two patterns predominated, then the lip print was regarded as undetermined.

In order to further categorize the lip prints, the classification scheme proposed by Suzuki and Tsuhihashi [11] was followed which is as follows:- [Figure 1]

1. Type I - A clear-cut groove running vertically across the lip.
2. Type I’ - Partial-length groove of Type I.
3. Type II - A branched groove.
4. Type III - An intersected groove.
5. Type IV - A reticular pattern.
6. Type V - Other patterns.

The data entry and statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 17 for windows (SPSS Statistics for Windows, Version 17.0. Chicago: SPSS Inc). The data were compiled and analyzed with Z-test for proportion to assess gender differences in lip-print patterns and a $P < 0.05$ was considered to indicate statistical significance.

RESULTS

Of a total of 150 individuals included in the study, only 144 were considered for analysis because of the unavailability of appropriate prints and impressions in 6 subjects (5 males and 1 female). Hence, a total of 70 cases of males and 74 females were analyzed. The distribution of various lip print patterns in the cohort is listed in Table 1.

When the overall pattern was evaluated among all the study subjects, our observation revealed that no two individuals had

![Figure 1: Various types of lip prints](image-url)
similar lip print pattern and the most frequent pattern of lip print was Type I (70 out of 144 subjects, 48.61%), followed by Type II (45 out of 144 subjects, 31.25%) and Type I’ (18 out of 144 subjects, 12.50%) [Figure 2]. However, the least common pattern seen was Type V which was seen only in 2.08% subjects. The most common pattern of lip print in males were clear-cut grooves running vertically across the lip (53 out of 70, 75.71%) and that in females were branched grooves (42 out of 74, 56.75%). The least common pattern found in males was intersected grooves, which was seen only in 1.42% of males whereas in females Type V pattern of lip print was not seen.

\[Z\] - test for proportion to assess gender differences in lip-print patterns was carried out where \( Z \) - test for proportion to assess gender differences in lip-print patterns was not significantly different for the gender.

**DISCUSSION**

In our present study each individual had a distinctive lip print, no similar lip print pattern appeared in two subjects. This is in accordance with the results of most of the studies which concluded that lip prints are dissimilar among different individuals [1,21-24], thereby confirming the uniqueness of the lip print. Anil Aggarwal has used lip prints in some cases for positive identification and in one such case in Japan, a clever burglar who had not left any fingerprints on the crime scene was identified among five possible suspects by the lip prints left on a glass of water [8]. In their case report, Suzuki and Tsuchihashi reported two cases where lip prints proved useful in identification of the criminal. First case matched the lip prints found on an envelope with those of the suspects and in the second case lip prints were noted on the undergarments and were studied with the help of color test and ultraviolet rays [25]. Lip prints are almost similar to finger-prints and are considered as important forms of transfer of evidence usually left at crime scenes, and can provide a direct link to the suspect.

Attributable to the problem of smudging or spoiling of lip prints leading to unidentifiable marks, six cases were excluded from the study group, which was more in males (\( n = 5 \)) compared to females (\( n = 1 \)). Further thorough examination of these lip prints would be required to ascertain identity, if found identical at this echelon. This was also encountered during the lip print studies by Sivapathasundharam, Ajay Prakash and Sivakumar [19]. The application of lipsticks is not essential for leaving lip prints as the edges of the lips have sebaceous glands, with sweat glands in between whose secretions enable the development of concealed ‘latent’ lip prints, analogous to the latent fingerprints [20]. Although invisible, these prints can be lifted using materials such as aluminum powder and magnetic powder [20].

In our study, Type I lip print was the most frequently observed pattern followed by the Type II pattern, which is in accordance to study by Vahanwalla and Parekh [14] and Ghimire, Ghimire, Nepal, Upadhyay, Buddhathoki, Subba and Kharel [17]. Our study does not have similar results as that of Sivapathasundharam, Prakash and Sivakumar [19] who concluded that Type III was the most predominant pattern in Indo-Dravidian population. This might be because of the difference in the cohort.

\[Z\] - test for proportion to assess gender differences in lip-print patterns showed that Type I, Type II and Type V lip print patterns were significantly associated with gender difference (\( P < 0.001 \)) and thus can be used in the identification of gender among the suspects, whereas Type I’ (\( P = 0.701 \)), Type III (\( P = 0.337 \)) and Type IV (\( P = 0.952 \)) lip print patterns were not significantly different for the gender. Therefore by analyzing the lip prints we can predict the gender in this cohort. This finding of ours is in accordance to few studies where lip prints held potential

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**Table 1: Distribution of various lip-print patterns in the cohort**

<table>
<thead>
<tr>
<th>Pattern of lip print</th>
<th>% of males (n=70)</th>
<th>% of females (n=74)</th>
<th>Males ( % in total)</th>
<th>Females ( % in total)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td>75.71</td>
<td>22.97</td>
<td>36.80</td>
<td>11.80</td>
<td>48.61</td>
</tr>
<tr>
<td>Type I’</td>
<td>11.42</td>
<td>13.51</td>
<td>5.55</td>
<td>6.94</td>
<td>12.50</td>
</tr>
<tr>
<td>Type II</td>
<td>4.28</td>
<td>56.75</td>
<td>2.08</td>
<td>29.16</td>
<td>31.25</td>
</tr>
<tr>
<td>Type III</td>
<td>1.42</td>
<td>4.05</td>
<td>0.69</td>
<td>2.08</td>
<td>2.77</td>
</tr>
<tr>
<td>Type IV</td>
<td>2.85</td>
<td>2.70</td>
<td>1.75</td>
<td>1.75</td>
<td>2.77</td>
</tr>
<tr>
<td>Type V</td>
<td>4.28</td>
<td>0.00</td>
<td>2.08</td>
<td>0.00</td>
<td>2.08</td>
</tr>
</tbody>
</table>

\( \text{n: Number of participants} \)

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**Table 2: Z-test for proportion to assess gender differences in lip-print patterns**

<table>
<thead>
<tr>
<th>Pattern of Lip print</th>
<th>Males (n=70)</th>
<th>Females (n=74)</th>
<th>Z-Score</th>
<th>P value*</th>
<th>Proportion of yes/no for male</th>
<th>Proportion of yes/no for female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td>53</td>
<td>17</td>
<td>6.329</td>
<td>&lt;0.001</td>
<td>0.75</td>
<td>0.23</td>
</tr>
<tr>
<td>Type I’</td>
<td>8</td>
<td>10</td>
<td>-0.378</td>
<td>0.701</td>
<td>0.11</td>
<td>0.13</td>
</tr>
<tr>
<td>Type II</td>
<td>3</td>
<td>42</td>
<td>-6.989</td>
<td>&lt;0.001</td>
<td>0.04</td>
<td>0.56</td>
</tr>
<tr>
<td>Type III</td>
<td>1</td>
<td>3</td>
<td>-0.958</td>
<td>0.337</td>
<td>0.01</td>
<td>0.04</td>
</tr>
<tr>
<td>Type IV</td>
<td>2</td>
<td>2</td>
<td>0.056</td>
<td>0.952</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Type V</td>
<td>3</td>
<td>0</td>
<td>1.799</td>
<td>&lt;0.001</td>
<td>0.04</td>
<td>0.00</td>
</tr>
</tbody>
</table>

\( *P<0.05: \) Statistically significant difference and \( P>0.05: \) Statistically not significant difference

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**Figure 2: Lip print patterns in males and females**

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promise as a supplementary tool along with other modes to recognize the sex of an individual [16-18,20,26].

Research studies regarding the use of lip prints as evidence in personal identification and criminal investigation is inadequate for Nepalese population, moreover a great degree of inconsistency is evident based on the previous study reports.

**CONCLUSION**

This loom of gender and individual identification utilizing lip prints is pertinent in defined group. As they are unique, it seems that an effort should be made to record the lip prints in addition to other identifying features in order to establish a morphologic database that might be of great value in civil and criminal issues of a particular area. However, as far as the legal matters in Nepali judicial system are concerned, practical utilization of this technique is virtually absent and because of its authenticity the authors recommend the application of lip prints as evidence in personal identification in routine civil and criminal litigations.

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**REFERENCES**


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