

EFFICACY OF CHEILOSCOPY IN GENDER DETERMINATION – A DIGITAL APPROACH

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Abstract

Cheiloscopy is a method of identification of a person based on characteristic arrangement of lines appearing on the red part of lips. The prime objective of the present study was to ascertain whether lip prints behold the potential for determination of gender of an individual from the configuration and to determine whether digitalization of the lip prints would improve the visualization and evaluation of the same. The study was conducted on undergraduate students, between the age group of 18-24. A total of 160 students were included. Three co-investigators collected the impression of lip prints from each student. Three other co- investigators, who were blinded to the data collected, predicted the gender of the print. The collected data was randomly divided into two groups, Group I: Manual evaluation, Group II: Digital evaluation. The results of the study showed that the overall accuracy of gender prediction from the lip print pattern was 83.75% i.e. 134 of the 160 were correctly identified as males or females. The accuracy of gender determination in Group II (Digital) was better than Group I (Manual) but, this difference was statistically insignificant ($p>0.05$). Lip pattern Type I, I' and II were more common in females and Type III and IV were more common in males, which is in accordance to previous studies. Within the limitations of the study, it can be concluded that lip prints were an invaluable tool in gender identification and also that the use of digital enhancement of the lip print images improved the quality and efficiency of the pattern analysis, ease in identification and recording of the lip print pattern.

Keywords: Lip Prints, Cheiloscopy, Gender.

1. Introduction

Establishment of a person's individuality is important for legal, as well as humanitarian purpose and gender determination is an essential step in identifying an individual. Dental, fingerprint and DNA comparisons are probably the most common techniques used in this context, allowing fast and secure identification processes. However, in certain circumstances related to the scene of the crime, these techniques might be unavailable, so there is still an increasing need for reliable alternative methods of establishing gender. (Caldas et al., 2007)

Cheiloscopy is a method of identification of a person based on characteristic arrangement of lines appearing on the red part of lips. (Kasprzak, 1990) Lip prints were first described by R. Fischer in 1902, while their uniqueness and stability were defined by Suzuki and Tsuchihashi after intense research.(Suzuki & Tsuchihashi, 1970) The unique feature of the arrangement of the lip lines has stirred the researchers to introduce cheiloscopy to forensic odontology for gender determination.

Most of the literature has described a manual method for the lip print analysis which was found to have its own demerits. In this study, a digital method using computer software program, 'Adobe Photoshop 7.0' for the lip print analysis was used for the enhanced and comprehensible visualization of the lip lines. (Prabhu et al., 2012)

2. Aim and Objective

The prime objective of the present study will be to ascertain whether lip prints behold the potential for determination of gender of an individual from the configuration and to determine whether digitalization of the lip prints would improve the visualization and evaluation of the same.

3. Review of literature

Various studies have been carried out to check the most common lip print pattern as per the classification given by K. Suzuki and Y. Tsuchihashi in different groups of population and also with respect to the race and sex of the individual. A study conducted by Prabu (Prabhu et al., 2012) stated that the predominant pattern in all four quadrants was Type V followed by the linear pattern i.e. Type I' in quadrants I, II, and III and Type I in quadrant IV in the studied population. He also concluded that distribution of pattern is not affected by the sex. This study also used the digital method to trace the lip lines and concluded that this method provides better visualization and ease of identification.

Contradictory to that, a study conducted at Mumbai (Vahanwala et al., 2005), observed that Type I and II were most commonly seen in the first quadrant. Type II was common in males in second quadrant, Type I dominant in females in third and fourth quadrants, type II was not seen in lower lip and only if it did, it was in male subjects, on the upper lip; they also noticed that in their studied population, Type III pattern doesn't occur in third and fourth quadrant at all.

4. Materials and Methods

This study was conducted on medical and dental undergraduate students, between the age group of 18-24, studying in Melaka Manipal Medical College, Manipal. A total of 160 students were included in the study. Each student was designated a sample number. Three co-investigators collected the impression of lip prints from each student. Three other co-investigators who were blinded to the data collected, investigated the accuracy of the lip prints in determination of gender.

Inclusion Criteria

- Lips free from any pathology
- Absolutely normal transition zone between the mucosa and the skin

Exclusion criteria

- Subjects with inflammation, ulcers, trauma, congenital developmental defects & malformation, deformity & surgical scars (e.g. operation for cleft lip) and other abnormalities of lips will be excluded
- Individuals with known hypersensitivity to lipstick were not included in this study

Materials used for study

Lipstick, Scotch tape, A4 bond paper, cotton buds

Study subjects:

Dental and medical students of 1st and 2nd year BDS and MBBS

Sample size:

Total of 160 students who volunteered to take part in the study were included. Informed consent was obtained from the students.

Data collection method

Recording of lip prints

A dark coloured lipstick was applied with a single stroke, evenly on the vermilion border. The subjects were asked to rub both the lips to spread the applied lipstick. After about two minutes, a lip impression was made on a strip of cellophane tape on glued portion, which was then stuck to an A4 size white bond paper. This served as a permanent record. The lip prints obtained were coded according to the sample number. At the time of analysis the gender of the print was not disclosed to the co investigators. The co- investigators who were blinded to the data collected assessed the lip prints and determined the gender.

Evaluation of the lip prints and gender determination

The collected data was divided into two groups,

Group I: Manual (n=80)

Group II: Digital (n=80)

In Group I, the evaluation was done manually on paper. Whereas in Group II, the lip prints were scanned for the digital analysis. Using applications of Adobe Photoshop 7 software the digitalized lip prints were enhanced to make it more comprehensible for analysis.

K. Suzuki and Y. Tsuchihashi's classification was followed to define the patterns of the grooves. (Suzuki & Tsuchihashi, 1970)

Type I-Clear-cut grooves running vertically across the lip

Type I'- The grooves are straight vertical but discontinuous not running entirely across the lip.

Type II- The grooves branch in their course in the shape of Y

Type III- Intersecting grooves

Type IV- Reticular pattern

Type V- The grooves do not fall into any of the types I-IV, and cannot be differentiated morphologically and are irregular.

For classification, each of the lip print was divided into six parts, upper right lateral, upper centre, upper left lateral, lower right lateral, lower centre, lower left lateral. The predominant lip pattern in each sextant was analyzed. Depending on the frequency of the type of pattern the gender prediction was made.

The gender of the lip print was determined based on the classification proposed by Vahanwala et al. (2005)

1. Type I, I' pattern dominant: Female
2. Type I and II patterns are dominant: Female
3. Type III pattern present: Male

4. Type IV showing varied patterns: Male

5. Results

It was observed that no two lip prints had exactly matching patterns in all six parts. The following observations were revealed:

Lip pattern Type I' and II were more common in females and Type III and IV and V were more common in males in accordance with previous studies. Type I' showed the highest occurrence in section III, where as type II was in sextant IV, in females. In males, Type III lip print pattern showed the highest occurrence in sextant IV, followed by Type IV in sextant II, and Type V in sextant I. (Table 1)

Table 1: Frequency of lip print pattern in each of the sextants.

SEXTANT TYPES	FEMALES						MALES					
	I	II	III	IV	V	VI	I	II	III	IV	V	VI
Type I	6	5	4	8	18	11	1	2	3	1	7	3
Type I'	28	19	38	15	23	17	15	9	9	2	7	5
Type II	20	14	19	36	7	30	3	4	7	16	7	12
Type III	11	5	9	10	6	10	10	16	14	26	5	18
Type IV	2	28	2	2	19	3	5	25	4	0	18	1
Type V	10	6	14	5	3	5	23	13	19	12	13	16

Considering the accuracy of gender identification using the lip print pattern, 134 of the 160 lip prints were correctly identified as male or female i.e. 83.75%. Among these 160, 73 were males and 87 were females of which 63 males and 71 females were identified correctly.

Comparing the method of evaluation, the digital method was more accurate in identification of the gender compared to the manual method. But, this difference was not statistically significant ($p > 0.05$)

Table 2: Comparison of gender determination between Group I and Group II

		Correct	Incorrect	Total	χ^2 value	.sig
Group I- Manual (n=80)	Males	34 (42.5)	6 (7.5)	40 (50)	1.86	1.72 NS
	Females	29 (36.2)	11 (13.8)	40 (50)		
	Total	63 (78.7)	17 (21.3)	80 (100)		
Group II- Digital (n=80)	Males	29 (36.3)	4 (5.0)	33 (41.2)	0.04	0.836 NS
	Females	42 (52.5)	5 (6.2)	47 (58.7)		
	Total	71 (88.8)	9 (11.2)	80 (100)		

NS - Not Significant; significance at 0.05

6. Discussion

Lip prints are very useful in forensic investigation and personal identification. They are considered to be most important forms of transfer evidence, and are analogous to finger prints. Lip prints are usually left at crime scenes, and can provide a direct link to the suspect. In recent years, lipsticks have been developed that do not leave any visible trace after contact with surfaces such as glass, clothing, cutlery, or cigarette butts. These lip prints are characterized by their permanence and are, therefore, referred to as persistent lip prints. Although invisible, these prints can be lifted using materials such as aluminum powder and magnetic powder. (Segui et al., 2000; Castello et al., 2005)

The gold standard method for the classification of lip prints is the one given by K. Suzuki and Y. Tsuchihashi. Various studies have been carried out to check the most common pattern as per the above classification in different groups of population and also with respect to race and sex of the individual.

Numerous descriptive studies have been conducted to describe the uniqueness of lip prints and the sexual dimorphism present with respect to the same. But, there is a lacuna in literature of analytical studies concerning cheiloscopy and a large sample size. This study is one of the first studies in which the gender prediction was done as an analytical study rather than a description.

Sharma et al. (2009) performed a similar gender determination study on 40 lip prints, 20 males and 20 females and observed that 18 females were correctly recognized as females and 17 males were correctly identified as males on the basis of their lip prints. It was also observed that Type I, I' was most commonly seen in females, whereas Type IV was seen most commonly in males. But, the study cohort in this observation was too small to come to a definitive conclusion. Another similar study on 60 students was performed by Singh et al. (2012) showed that the upper lip showed a predominance of type I pattern (26.7%) followed in order by type III (23.3%) and type IV (23.3), type II (21.7%) and type V (5.0%).

For classification, the middle part of the lower lip (10-mm wide) was taken as study area, as proposed by Sivapathasundaram et al. (2001) Since this fragment is almost always visible in any trace, the determination of the pattern depends on numerical superiority of properties of the lines on this study area. Hence, in our study each lip print was divided into sextants: upper right lateral, upper centre, upper left lateral, lower right lateral, lower centre, lower left lateral.

In the present study, the obtained lip prints were scanned. This digital method was introduced by Prabhu, Dinkar and Prabhu (2012) in a study performed on Goan population. However, the study was descriptive. In the present study, an attempt was made to analyze the lip prints obtained and the accuracy of gender determination was compared with the conventional manual method.

The scanned images could be preserved safely with loss of minimal details, divided into equal parts using the ruler in the software, adjusted for brightness and contrast and magnified as much as necessary for clear visualization of details. These images could be filed systematically and stored as a database for further use as and when necessary.

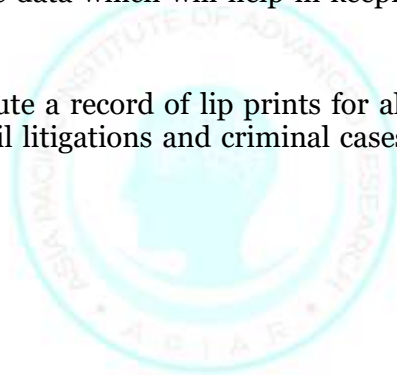
Conclusions

The following conclusions can be drawn from the observations of the current study:

Within the limitations of the study,

1. Lip prints were an invaluable tool in gender identification.
2. The digital method of analysing the lip print images using Adobe Photoshop 7 software serves as a convenient method that provides better visualization and ease in identification and recording of the lip print pattern. It also serves as an ideal method of permanently storing the data which will help in keeping an ante- mortem record of an individual.

Hence, it is suggested to institute a record of lip prints for all individuals in a certain locality, hoping to be a reference in civil litigations and criminal cases. *This will definitely serve as an asset in the future.*



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