

Cheiloscopy: Stability and Role in Personal and Sex Identification

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ABSTRACT

Background: The external surface of lips has many elevations and depressions forming a characteristic pattern called lip prints, examination of which is known as cheiloscopy. Lip prints are unique and distinguishable. Hence, lip prints of an individual can be used as a potential aid for identification purpose. The aim was to study the use of lip prints for human identification, determination of sex of an individual and to determine the stability of lip pattern characteristics over a period of one year.

Materials and Methods: Lip prints were obtained from 100 individuals using lip stick – cellophane tape method. The analysis of the pattern was done using the classification proposed by Suzuki and Tsuchihashi by two observers.

Results: No two lip prints were identical. The percentage agreement between the observers in determining the sex of the individuals was 97% with κ coefficient of 0.853 ($p < 0.001$) and was highly statistically significant. Type II was the most common pattern seen in females. Type III was the most common pattern seen in males. 94% of the lip prints studied were stable and no significant change was observed in their pattern.

Conclusion: In the overall study no two individuals had similar pattern of lip pattern. Type II pattern was common in females and type III pattern was common in males. Lip prints were stable and no marked change was observed. The present study reveals that lip prints are unique tool for determination of sex of an individual and stable over a period of time.

Keywords: Forensic medicine, Humans, Male, Female, Lip/anatomy & histology, lip prints, sex determination.

INTRODUCTION

Every human being carries with him from his birth to his grave certain physical marks which do not change their character and by which he can always be identified. These physical marks are unique to the individual. Human being has come a long way from an early uncivilized caveman to the present civilized social being. His intelligence has led to the increase in crime rate, wars, man-made disasters

and also made him victim to the fury of mother nature through natural disasters. In such circumstances identification of the person becomes important.

Through the speciality of forensic odontology, dentistry plays a significant role in the process of identification.¹ Dental surgeon has to actively involve in various objectives of forensic dentistry like age and sex determination, personal

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identification of unknown deceased person, analyzing bite marks as evidence, participating in mass disaster, studying lip prints and giving evidence in child abuse.

Identification is of paramount importance in any medico-legal investigation. Establishing a person's identity can be a very difficult process. Cheiloscopy is a forensic investigation technique that deals with identification of humans based on lip traces. Cheiloscopy has been a subject of great interest to most researchers, it being the least invasive and easily available mode for study purpose.

Lip prints are the normal lines and fissures in the form of wrinkles and grooves present in the zone of transition of human lip, between the inner labial mucosa and outer skin, examination of which is known as cheiloscopy. The term cheiloscopy is derived from the Greek words "cheilos" which means lips and "eskopein" which means to see.²

The wrinkles and grooves in the ruddy part and the zone of transition of the human lips have not been given anatomical names, later the grooves were named as "*sulci labiorum rubrorum*" and the figure formed by these sulci was called "*figura linearum labiorum*."³

Based on the theory of uniqueness, fingerprints and bite marks are used since long to convince the court of law. Likewise, even the lip prints or the vermillion border is unique of an individual and hence can be used efficiently for identification purpose.⁴

Lip prints are unique and do not change during the life of a person. It has been verified that they recover after undergoing alterations like trauma, inflammation and diseases like herpes and that the disposition and form of the furrows does not vary with environmental factors. The foundations of cheiloscopy, are the same as that of dactyloscopy, that is, lip prints are invariable, permanent and allow establishing a classification.

Cheiloscopy is an interesting and promising new field among the large number of identification methods available to the forensic expert. Work on this subject has already elicited useful information such as lip prints are unique to an individual and can be used to fix the identity of a person; that they

remain stable over a period of time and lip prints show gender difference. Studying in depth and by giving more emphasis to this field will certainly make the use of lip prints as reliable identification method.

Hence, the present study has been aimed to document common lip patterns and their variations in the population under investigation, to evaluate any differences between the sexes, to investigate the role of lip prints in person identification and the stability of lip prints over a period of one year.

MATERIALS AND METHODS

The present study was conducted in Sri Sai College of Dental surgery Vikarabad. 100 individuals comprising of 50 males and 50 females in the age group of 18-30 years were selected for the study. 100 individuals were selected for studying the permanence of lip prints. The lip prints of this group were taken in the beginning and at the end of the study i.e. after twelve months. All the subjects were briefed about the purpose of the study and the written informed consent was obtained from each of the subject.

The subjects were selected on the basis of the inclusion and exclusion criteria as under.

Inclusion Criteria:

- Individuals aged between 18-30 years.
- Lips free from any pathology, having absolutely normal transition zone between mucosa and skin were included in the study.

Exclusion Criteria:

- Individuals with known hypersensitivity to lip sticks were not included in the study.
- In the individuals where there was evidence of disease and injury of the lip that was likely to cause change in the lip prints like dry lips, cleft lip, lacerations and scars were not included in the study.
- Individuals who have undergone lip enhancement surgeries like cheiloplasty for esthetic considerations were not included in the study. All the subjects were given a code number for eg. 1,2,3 to hide the actual sex from the analyzer.



Fig 1: Type I lip pattern - clear-cut grooves running vertically across the lip.

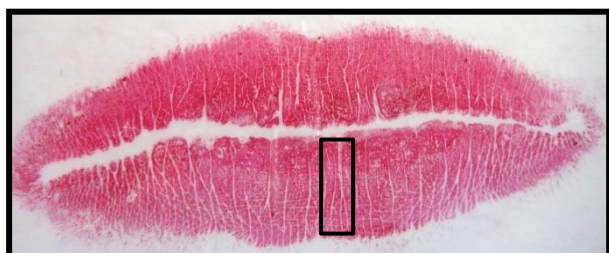


Fig 2: Type II lip pattern - Branched grooves.



Fig 3: Type III lip pattern - Intersected grooves.

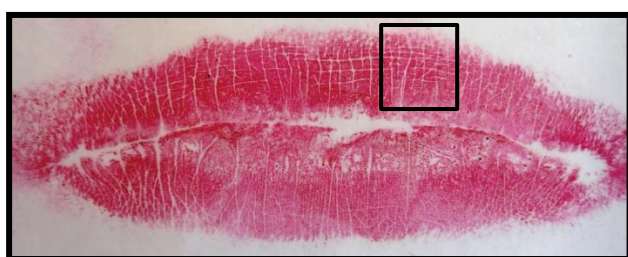


Fig 4: Type IV lip pattern - Reticular grooves.

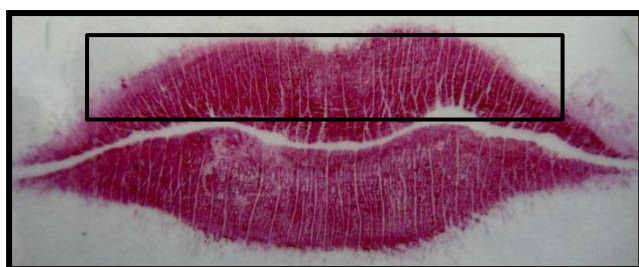


Fig 5: Lip print taken at the beginning of the study in a female candidate (Type II pattern).

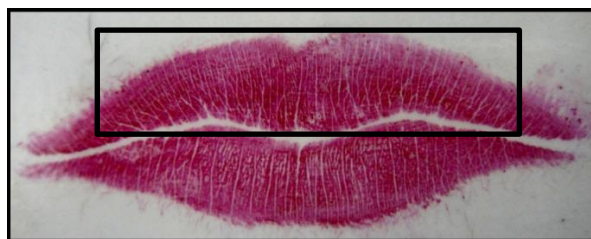


Fig 6: Stability of the pattern observed in the lip print taken after one year in same female candidate as above.

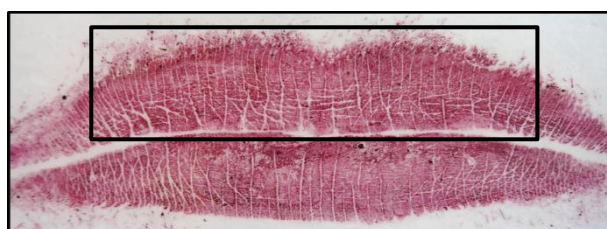


Fig 7: Lip print taken at the beginning of the study in male (Type III pattern).

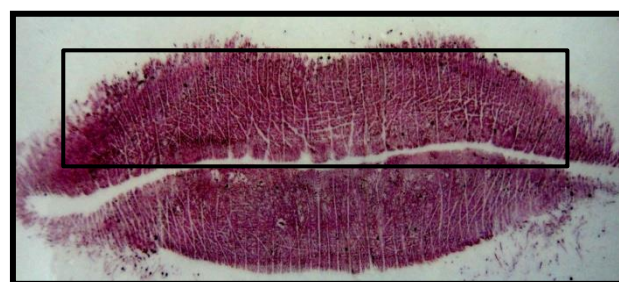


Fig 8: Stability of the pattern observed in the lip print taken after one year in same male as above. (Type III pattern).

METHOD

Before application of the lip stick the subject was asked to thoroughly clean the lips to remove any foreign substances sticking to the lips. The subject was then provided with a dry tissue paper to dry the lips. Lipstick was applied uniformly to the lips using lipstick applicator brushes with a single motion uniformly. The subject was asked to rub his/her lips together to spread the lipstick uniformly. Over the lipstick the glued portion of cellophane tape was placed and lip impression was made in the normal rest position of the lips by dabbing it in the centre first and then pressing it uniformly toward the corners of the lips. The tape was lifted carefully from the lip from one end of the strip to the other avoiding any smudging of the print. The cellophane tape was then stuck to the white bond paper for

Table 1: Shows the percentage agreement between the Observer A and the actual sex of the individuals.

Sex Identification from lip pattern			
Observer A			
	Males	Females	Percentage agreement (Accuracy)
No of cases studied	50	50	89%
No of cases correctly identified	44	45	

$\kappa - 0.78, p < 0.001$

Table 2: Shows the percentage agreement between the Observer B and the actual sex of the individuals.

Sex Identification from lip pattern			
Observer B			
	Males	Females	Percentage agreement (Accuracy)
No of cases studied	50	50	86%
No of cases correctly identified	43	43	

$\kappa - 0.72, p < 0.001$

Table 3: Shows the percentage agreement between Observer A and Observer B.

		B		Percentage agreement
		Correct	Wrong	
A	Correct	87	3	97%
		87.0%	3.0%	
	Wrong	0	10	
		0%	10.0%	

$\kappa - 0.853, p < 0.001$

Table 4: The percentage of incidence of lip pattern types in the total subject population and in females and males.

Lip Pattern	Sex		Total
	Female	Male	
Type I	8	3	11
	16%	6%	11%
Type II	37	3	40
	74%	6%	40%
Type III	5	41	46
	10%	82%	46%
Type IV	0	3	3
	0%	6%	3%

$p < 0.001$

Table 5: Stability of lip patterns over a period of one year.

	TYPE I	TYPE II	TYPE III	TYPE IV	TOTAL
Total number of lip patterns	11	40	46	3	100
Number of Lip patterns stable after 1 year	11	37	43	3	94

permanent record purpose and then visualized by using magnifying lens. After the analysis was done by the observer A, the lip print was given to the observer B who had knowledge of Suzuki's classification. While studying the lip prints each individual's lips were divided into four compartments two compartments on each lip. In order to classify the lip prints in this study, the classification scheme proposed by Suzuki and Tsuchihashi³ was used which denotes the following:

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

Type I': The grooves are straight but disappear half-way instead of covering the entire breadth of the lip.

Type II: The grooves fork in their course.

Type III: The grooves intersect.

Type IV: The grooves are reticulate.

Type V: The grooves do not fall into any of the Types I-IV and cannot be differentiated morphologically.

RESULTS

A study was conducted to study the pattern of lip prints, their possible role in sex determination and their stability over a period of 1 year. The study population comprised of 100 individuals, 50 females and 50 males in the age group of 18-30 years from Sri Sai College of Dental Surgery, Vikarabad. The data obtained from the study was compiled, tabulated and statistical analysis was done. The results obtained are presented in the following manner.

One of the aims of the study was to determine the sex of the individual using lip print patterns. When the percentage agreement (accuracy) between the actual sex of the individuals and the sex determined by the observer A was calculated by applying Kappa statistics, the percentage agreement was 89% with κ coefficient of 0.78 ($p < 0.001$). Hence it was observed that Observer A was in good agreement in determining the sex of the individual. [Table 1]

To rule out the interobserver bias the analysis of lip patterns was done by observer B. Similarly the percentage agreement was calculated by applying Kappa statistics. The percentage agreement (accuracy) was 86% with κ coefficient of 0.72 ($p < 0.001$) and it was found that Observer B was also in good agreement in determining the sex of the individual. [Table 2]

To know the interobserver agreement Kappa statistics was done to compute κ and p value and the percentage agreement between observer A and Observer B. The percentage agreement was 97% with κ coefficient of 0.853 ($p < 0.001$) and it was found that both the Observers were in very good agreement in determining the sex of the individual. [Table 3]

As the observer A and B were in very good agreement further statistical analysis of the lip prints was done by observer A

The analysis of sex-wise distribution of types of lip prints among females and males and in the total subject population was done. By applying Chi-square test, significant gender difference was seen

with respect to type of lip prints ($p < 0.001$). Among females, majority had Type II (74%) while in males majority had Type III patterns (82%). In the total subject population among the different lip pattern types the commonest was Type III (46%), followed by Type II (40%), Type I (11%) and Type IV (3%). [Table 4], [Table 5], (Figure 1, Figure 2, Figure 3, Figure 4)

Analysis of the lip prints for its stability over a period of one year was done in total study population. It was found that in 94% of the cases lip prints were stable and did not show any significant difference over a period of one year, and in 6% of the cases the analysis of lip pattern was difficult. (Table 5, Figure 5 & 6, 7 & 8.)

DISCUSSION

Human identification always has been of paramount importance in forensic science. A number of personal identification techniques are being used since ages with varying results. Recently lip prints are being used as an additional tool in identifying a person positively and used to verify the presence or absence of a person at the scene of crime. Lip prints get registered easily and just like finger prints, if recorded at the vicinity of crime can often be retained on the object.

Lip prints or the vermilion border is unique of an individual and can be used to identify an individual. Lip prints remain as a constant anatomical structure and do not change during the life of a person. However, major trauma to the lips may lead to scarring, pathosis and the surgical treatment rendered to correct the pathosis may affect the size and shape of the lip, thereby, altering the pattern and morphology of grooves. Thus, in the present study only those individuals were selected whose lips had no inflammatory disease, trauma, malformation, deformity or scars. However, it should be remembered these abnormalities themselves can be helpful in identifying an individual.

Lip prints show different patterns in males and females and hence are capable of determining the sex of an individual from their configuration. If the sex of the individual is known, it is easy to identify the suspects with motive of the crime for final consideration.

The present study was aimed to prove the uniqueness of the lip prints and identification of the individual, to evaluate the difference of lip patterns among males and females and determine the sex of the individual and the stability of lip prints over a period of one year.

In the present study, the method for recording the lip prints was the one used by Sivapathasundaram⁵. It was found that using cellophane tape to record the lip print gave better results as compared to using the paper directly on the lip to record the print. This method helped us avoiding the smudging of lip print which is a frequent problem encountered in recording of lip prints. The cellophane tape with a lip impression on its glued portion when stuck on a bond paper serves as a permanent record.

It was also found that the dark brown shade of lip stick on a white bond paper gave the best print visibility.

This study is in accordance with the studies done by Tsuchihashi³, Preeti Sharma⁶, Saraswathi⁷, Bindal⁸, Jaishankar⁹ who concluded that, although lip print consisted of a combination of various types of grooves, no two lip prints were identical. In our study also it was found that no two lip prints were identical, thus emphasizing the uniqueness of lip prints.

In our study, an attempt was made to determine the sex of the individual using the configuration of lip pattern types. It was observed that observers of our study were in good agreement in determining the sex of the individual. Hence, we are of the opinion that the reliability of the lip patterns can be considered in determining the sex of the individual.

The results of our study were similar to the studies done by Vahanwala⁴, Preeti Sharma⁶ and Gondivkar¹⁰ who concluded that they were able to predict the sex of the individuals with high degree of accuracy and hence lip prints can be used as a tool in the determination of the sex of the individual. In our study the percentage of accuracy of the observer A and observer B were 89% and 86% respectively in determining the sex of the study population by analyzing the lip patterns recorded. Hence, making the lip patterns reliable aid in sex identification. The table of accuracy in the above mentioned studies

showed that male and female subjects were identified accurately but in some cases the accuracy percentage fell in identification of the individuals. In the above mentioned studies error was encountered in determining the sex of the individuals though the lip print configurations were correctly recorded. Similar error occurred in our study also and probably the error could be due to the presence of variant types of lip patterns in all the quadrants of lip. Hence, it was concluded that the variations in the lip patterns made decision making for the researchers little difficult.

In the present study it was observed that Type III- intersecting grooves (46%) was most frequently observed in the total subject population followed by Type II- grooves are branched (40%), Type I - Clear-cut grooves running vertically across the lip (11%) and Type IV(3%).

The observations were similar to that of Tsuchihashi⁴, Sivapathasundaram⁷ Gondivkar¹⁰ and Augustine¹¹ where Type III - intersecting grooves was the most frequently observed pattern in the study populations. The observations of the study conducted by Vahanwala and Parekh¹² in Mumbai where Type I was the most frequent pattern followed by Type I' pattern are in contrast to those of the present study where Type III is the predominant pattern. They also concluded that males tend to have different patterns in all quadrants and females tend to have same patterns in all the quadrants.

The observations of the studies done by Manipady¹³ in Manipal in Indian and Chinese population, and Bindal⁸ in Dehradun were also in contrast with the observations of the present study where Type II was the most frequent pattern. The difference in the predominant lip patterns in the above mentioned studies show that different racial and ethnic groups show different lip patterns and this can be a useful adjunct in identification.

In the present study the analysis of stability of lip prints over a period of one year was done. The lip prints of the same individuals were investigated after 1 year to see whether the lip prints were permanent or not. It was observed that most of the lip prints were stable and did not show any significant difference over a period of one year.

Our study is in accordance with the studies conducted by Tsuchihashi³, Coward¹⁴ and Bindal⁸. Lip prints were recorded routinely once a month for three years by Tsuchihashi³ over a period of seven months by Coward¹⁴ and over a period of one year by Bindal⁸ and it was concluded that no significant change was observed in the lip patterns over a period of time thus emphasizing the stability of lip prints.

Out of 100 individuals of the study population, in 6% of the cases the analysis of the lip pattern was difficult due to the cracks on the lips. This could be due to the dry weather which led to the peeling of superficial layers of the lip, improper maintenance of lips and dehydration of lip in the individuals.

The observations regarding the permanence and stability of lip prints established by Tsuchihashi³ revealed that as the lip prints are present on the zone of transition of the lips, which are extremely mobile may differ in appearance and frequently mistaken for that of another person. However, Type I never appears like Type II. Therefore the classification of lip prints is valuable in reducing the number of items to be compared and can be used in establishing the identity. It was also observed that it is difficult to decide the pattern of the lip prints when inflammation is present in the lip. It has been observed, however, that after healing, the lip print reassumes its own pattern in the healthy condition. This fact alone indicates the permanence of lip prints.

CONCLUSION

The present study proves the uniqueness of lip prints in every individual and also its stability. Thus lip prints can be used as a reliable tool in determining the sex of the individuals. Lip prints may differ in appearance according to the pressure, direction and the method used in taking the print, and hence, are frequently mistaken for that of another person. This can be solved by successive recording of the prints and standardization of the pressure to be applied. A standard and uniform procedure has to be developed for the collection, development and recording of lip prints. The future prospective of this study is that, the lip pattern should be studied in depth with larger sample size in both sexes to establish facts similar to finger prints which will help in forensic odontology.

Different methods have to be evolved to trace the lip prints on skin, clothes and other objects to aid in criminal investigation. A newer software has to be developed to accurately assess the lip patterns.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

- 1) Pretty IA, Sweet D. A look at forensic dentistry part 1: The role of teeth in the determination of human identity. *Br Dent J* 2001;190:359-66.
- 2) Caldas IM, Magalhaes T, Afonso A. Establishing identity using cheiloscopy and palatoscopy. *Forensic Sci Int* 2007;165:1-9.
- 3) Tsuchihashi Y. Studies on personal identification by means of lip prints. *Forensic Sci* 1974;3:233-48.
- 4) Vahanwala S, Nayak CD, Pagree SS. Study of lip-prints as an aid for sex- determination. *Med Leg Update* 2005;5:93-8.
- 5) Sivapathasundharam B, Prakash PA, Sivakumar G. Lip Prints (cheiloscopy). *Indian J Dent Res* 2001;12(4):234-37.
- 6) Sharma P, Saxena S, Rathod V. Cheiloscopy: The study of lip prints in sex identification. *J Forensic Dent Sci* 2009;1(1):24-27.
- 7) Saraswathi TR, Gauri Mishra, Ranganathan K. Study of lip prints. *J Forensic Dent Sci* 2009;1(1):28-31.
- 8) Bindal U, Jethani SL, Mehrotra. Lip prints as a method of identification of human being. *J Anat Soc India* 2009;58(2):152-55.
- 9) Jaishankar S, Jaishankar N, Shanmugam S. Lip Prints in Personal Identification *JIADS* 2010;1(4):23-26.
- 10) Gondivkar SM, Indurkar A, Degwekar S. Cheiloscopy for sex determination. *J Forensic Dent Sci* 2009;1:56-60.
- 11) Augustine J, Barpande SR, Tupkari JV. Cheiloscopy as an adjunct to forensic

- identification: a study of 600 individuals. J Forensic Odontostomatol 2008;27(2):44-52
- 12) Vahanwala SP, Parekh BK. Study of lip prints as an aid to forensic methodology. J Forensic Med and Toxicol 2000;17(1):12-18.
- 13) Verghese AJ, Somasekar M, Umesh Babu R. A Study on Lip Print Types among the People of Kerala. J Indian Acad Forensic Med 2010;32(1).
- 14) Coward RC. The stability of lip pattern characteristics over time. J Forensic Odontostomatol 2007;25(2):40-56.