

STUDY OF THE EFFECT OF AGE CHANGES ON LIP PRINT PATTERN AND ITS RELIABILITY IN SEX DETERMINATION.

K. Randhawa, R. S. Narang, P. C. Arora.

Sri Guru Ramdas Institute of Dental Sciences and Research, Amritsar, Punjab, India.143006

ABSTRACT

Cheiloscopy, a forensic investigation technique, deals with the study of elevations and depressions which form a characteristic pattern on the external surface of the lips. The objective of the study was to determine the most common lip patterns in North Indian population, to evaluate whether sex determination is possible on the basis of lip prints and to ascertain if there is any co-relation between advancing age and its effect on lip pattern. A total of 600 subjects, 289 males and 311 females were selected and divided into three age groups (group 1: 1-20 years, group 2: 21-40 years, group 3: 40 years and above). Statistical analysis (applying Chi square test) showed very highly significant difference for different lip patterns ($p < 0.0001$) in males and females in group 2 and no significant difference in group 1 and group 3. The most predominant pattern in the entire study population was Type I (32.33%). Age changes like immaturity of lips in younger age and diminished anatomic details and tonicity in older age can have a considerable effect on the lip pattern, thereby making the correct identification of sex in these age groups debatable.

(J Forensic Odontostomatol 2011;29:2:45-51)

Key words: Cheiloscopy, lip prints, sex determination, forensic odontology.

Running title: Lip prints and its correlation with age and sex.

INTRODUCTION

The positive identification of living or deceased persons using the unique traits and characteristics of the teeth and jaws forms a cornerstone of forensic science.¹ Investigators often gain information and evidence through the use of odontology, anthropometry, fingerprints and other techniques that help determine, for example; gender, approximate age and height. Today, however, investigators may also rely on lip prints to identify possible suspects or to support evidence gained in specific investigations.²

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 cheiloscopy.^{3,4} Fischer was the first to describe it in 1902.⁵ Use of lip prints in personal identification and criminal investigation was first recommended in France by Locard.⁶ In 1950, Synder also suggested the idea of using lip prints for identification.⁷

Lip prints are considered unique to an individual and analogous to fingerprints.⁸ It has been verified that lip prints recover after undergoing alterations such as minor trauma, inflammation and herpes. 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, thereby, altering the pattern and morphology of the grooves.³

A lip print found at the scene of a crime can be a basis for conclusions as to the character of the event, the number of people involved, sexes, cosmetics used, habits, occupational traits and the pathological changes of lips themselves.² Lip prints, as one of the dermatoglyphics, have been used as genetic markers in many congenital and clinical diseases.⁹

Very few studies have been conducted in the North Indian population with a large sample size. This study was designed with the prime objective of determining the most common lip pattern, differences in lip prints between males and females and to evaluate co-relation of lip prints with advancing age.

MATERIALS AND METHODS

The present study was undertaken amongst 600 subjects (289 males and 311 females). The subjects were divided into three age groups:

Group 1 (1-20 years) - 150 subjects; 72 females and 78 males

Group 2 (21-40 years) - 300 subjects; 159 females and 141 males

Group 3 (above 41 years) - 150 subjects; 80 females and 70 males.

All the participants were briefed about the purpose of the study and their lip prints were

obtained with their consent. Those with any inflammation, trauma, congenital deformity or any other disease of the lips were excluded from the study. Those with any known hypersensitivity to the lipstick that we would use were also excluded from the study. The materials comprised:

1. Lipstick of a dark, bright colour and non-glossy.
2. Transparent cellophane tape, glued on one side
3. Scissors
4. White bond paper
5. Magnifying lens.

The subject was asked to open the mouth and lipstick was applied in a single motion, evenly on the lips. The subject was asked to gently rub his/her lips together to spread the lipstick evenly. A strip of cellophane tape, ten cm long was cut with scissors. The subject was asked to relax the lips and to keep the mouth stationary and closed during the procedure. The glued portion of the cellophane tape was applied on the upper and lower lip together. It was held in place, applying gentle and even pressure for a few seconds. Then the tape was carefully lifted from the lips, from one end to the other, avoiding any smudging of the print. The strip of cellophane was attached to a piece of white bond paper. This served as a permanent record. The subjects' serial number was written on the back to serve as a record.

The print was subsequently visualized with the use of a magnifying lens. The number of lines and furrows present, their length, branching and combinations were noted. The lip prints obtained, were coded while noting the name and sex of the respective individuals. At the time of analysis the sex of the patient was not disclosed to the observer (two of the authors).

For classification, the middle part of the lower lip (ten mm wide) was taken as a study area because this fragment is almost always visible in any trace and as this is the part most frequently found at a crime scene.⁴ In this study, we followed the classification of patterns of the lines on the lips proposed by Tsuchihashi, which is the most widely used classification in literature.¹⁰ It was found to have a clear description of nearly all of the commonly encountered lip patterns and was easy to interpret as follow:-

Type I: Clear-cut vertical grooves that run across the entire lips

Type I': Similar to type I, but 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 type I - IV and cannot be differentiated morphologically (undetermined).

The sex of the individual was determined as per the descriptions given by Vahanwala et al.^{6,7}

Type I, I': Patterns dominant - Female

Type II: Pattern dominant - Female

Type III: Pattern dominant - Male

Type IV: Pattern dominant - Male

Type V: (varied patterns) Pattern dominant - Male

Same patterns in all quadrants: Pattern dominant - Female.

The frequency of each type of lip print was tabulated and the percentage of each type was calculated. The data was compiled and analyzed with Chi - square test and a p - value less than 0.001 was considered as significant and less than 0.0001 as very highly significant.

RESULTS:

The examination of lip print patterns revealed that no two lip prints matched with each other, thus establishing the uniqueness of the lip prints. The most predominant pattern in the entire study population was Type I (32.33%). This was followed, in order, by Type III (26.1%), Type II (9.83%), Type IV (7%), Type I' (6.1%) and Type V (2.6%).

In females Type I (59.48%) lip pattern was most commonly found followed by Type II (12.54%) and Type III (11.89%). In males, Type III (41.52%) lip pattern was predominant, followed by Type I (37.71%) and Type IV (9.68%). So the most common lip pattern for females is Type I and the most common lip pattern for males is Type III.

In group 1: (90.27 %) 65 out of 72 were correctly identified as female and 23 out of 78 (29.48 %) were correctly identified as male. In age group 1, Type I was the most common pattern in both males and females (Table1).

In group 2: (84.9 %) 135 out of 159 were correctly identified as female and 93 out of 141(65.9 %) were correctly identified as male. In age group 2, Type I was the most common

pattern in females and Type III in males (Table 2).

In group 3: (65 %) 52 out of 80 were correctly identified as female and 40 out of 70 (57.14 %) were correctly identified as male. In age group 3, Type I was the most common pattern in females and Type III in males (Table 3).

The accuracy of cheiloscopy in sex determination was 58.67 %, 76% and 61.33 % in group 1, 2 and 3 respectively.

The Chi square test applied to test significant difference between males and females for different types of lip patterns in different age groups, showed a significant difference at 1% significance level for group 1, very highly significant difference for the patterns in group 2 and highly significant for group 3.

DISCUSSION

Human identification is one of the most challenging subjects that man has been confronted with. Identification of an individual is a pre-requisite for certification of death and for personal, social and legal reasons. Lip prints can be instrumental in identifying a person positively.^{3,4}

A series of forensic odontological studies on the morphology of the lips and the pattern produced when they are impressed onto a variety of surfaces forms a worthy additional weapon for personal identification.¹⁰ The vermilion border of the lips together with an individual structure of lines may constitute a source of circumstantial evidence. Cheiloscopy is applicable mostly in identifying the living, since lip prints are usually left at crime scenes and can provide a direct link to the suspect. Lip prints can be found on surfaces such as glass, clothing, cutlery or cigarette butts. Even the invisible lip prints can be used and can be lifted using aluminium and magnetic powder.^{11,12} The edges of the lips have sebaceous glands with sweat glands in between, therefore, secretions of oil and moisture enable development of 'latent' or persistent lip prints, analogous to finger prints.¹³

In the present study, the lip prints were recorded in relaxed and closed position. Sivapathasundharam et al, stated that the uniqueness of patterns depended on the way the lip muscles are relaxed to produce a particular pattern.⁴ Lip print pattern depends on whether the mouth is opened or closed. In

closed mouth position the lip exhibits well defined grooves; where as in the open position the grooves are relatively ill defined and difficult to interpret.¹⁴

In our study, the middle portion of the lower lip was used for classifying the pattern. It was also found that the lower 1/3rd portion of the middle part of lower lip, almost always had a type III or IV patterns, irrespective of the sex (Fig.1). Therefore, to avoid misinterpretation of results, it was decided to study only the upper two thirds of the middle part of the lower lip. Lévêque and Goubanova¹¹ suggested that the furrows and grooves on the lips seemed to facilitate 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. Lévêque and Goubanova also noted that some continuity appeared to exist between the lips and adjacent skin lines and suggested a common origin.¹¹ The predominance of Type III and IV patterns, especially in the lower one third of the lower lip could be attributed to continuity of the lines on the skin adjacent to the lips intersecting with the grooves on the lips.

In the present study, the most predominant lip pattern in females was Type I followed by Type II and Type III whereas in males, Type III lip pattern was predominant, followed by Type I and Type IV.

In the present study the most predominant pattern in the entire study population was Type I, however other studies on Indian subjects have yielded varying results. Vahanwala and Parekh in their study in Mumbai also found that Type I was the most frequent.¹⁵ Sivapathasundharam et al studied the lip prints of Indo-Dravidian population and noted that Type III was predominant.⁴ Verghese et al studied lip prints in the population of Kerala and found that the most common pattern was type IV.¹⁶

The overall accuracy of cheiloscopy in sex determination was 58.67 %, 76% and 61.33 % in group 1, 2 and 3 respectively. In group 1: 90.27 % were correctly identified as female and only 29.48 % were correctly identified as male (Fig. 2). This may be attributed to the fact that the lips reach their maturity in late adolescence. Women arrive at maxillary lip maturity at 14 years of age and mandibular lip maturity at 16 years of age. Men reach

maxillary and mandibular lip maturity around 18 years of age.¹⁷⁻¹⁹

In group 2: 84.9 % were correctly identified as female and 65.9 % were correctly identified as male. Beginning in the mid to late thirties, age changes occur in the upper face first. The lips still have significant tonicity to them and do not show effects of ageing.²⁰

In group 3: 65 % were correctly identified as female and 57.14 % were correctly identified as male (Figs. 3 and 4). This can be attributed to the occurrence of wrinkles on the adjacent skin and thinning of lips in old age which affects the lip pattern. Volume is lost in lips and the perioral area as age advances and definition of lip anatomy diminishes. The intercommissural distance increases with age, whereas lip height decreases.²¹

In our study it was observed that in age group 1, Type I was most predominant pattern followed by Type II and Type III. In age group 2 Type I was most common followed by III and IV. Type I was most common in group 3 followed by III and II (see Figs. 5, 6 and 7 for varying types and location). This is in accordance with previous studies which also indicate the diversity in pattern of lip prints among individuals of different age groups. Thus, age groups have no relevance for any similarity of lip prints.²²

We observed that no lip prints matched with each other and that lip print pattern was unique to every individual. This is in accordance with the results of previous studies.²³ In addition, every quadrant in each individual did not have only one pattern, but appeared to have a mixture of different patterns. It was also observed that Type III and Type IV were the most commonly superimposed patterns, and were difficult to differentiate at times. These findings were consistent with previous studies.^{22, 24}

Cheiloscopy is a relatively new field among the large number of identification tools available to the forensic expert. Work on this subject has already elicited useful information, however; limitations still exist in the use of lip prints (Figs. 8, 9, 10). A method of standardization has to be developed to assess and accurately measure the lip patterns. The effect of age and seasonal influences on the groove pattern remains a problem which needs further study. Further studies are also required to confirm that they remain stable over time.

CONCLUSIONS

In conclusion, it can be said that the lip print pattern may have some use as an additional means for sex determination but there are limitations. In this study, analysis of lip print patterns revealed that no particular pattern was specific to any quadrant or any age group. The most common lip pattern in the entire study population was Type I, Type I being most common in females and Type III in males.

Although, the lip print patterns showed better reliability for sex determination in the 21-40 years age group, differentiation of gender was uncertain in young and late age. This showed that age changes related to the size, shape of the lips and skin surrounding the lips can influence the lip print patterns.

Address for correspondence:

Dr. Kawar Randhawa
Senior Lecturer, Dept. of Oral Medicine, Diagnosis and Radiology
Sri Guru Ramdas Institute of Dental Sciences and Research
Amritsar, Punjab
India.143006
Mobile No: 9872527749
E- Mail: kawarrandhawa@yahoo.com

REFERENCES

1. Sweet D. Why a dentist for identification? *Dent Clin North Am* 2001;45:237-51.
2. L Vamsi Krishna Reddy Lip prints: An Overview in *Forensic Dentistry Journal of Advanced Dental Research* 2011;2 (1):17-19.
3. Rajendran R, Sivapathasundharam B. *Shafer's Textbook of Oral Pathology*. Sixth Edn, New Delhi, India, Elsevier; 2006:896-897.
4. Sivapathasundharam B, Prakash PA, Sivakumar G. Lip prints (Cheiloscopy). *Indian J Dent Res* 2001;12:234-7.
5. Kasprzak J. Possibilities of cheiloscopy. *Forensic Sci Int* 1990;46:145-151.
6. Thomas CJ, van Wyk CW. The palatal rugae in identification. *J Forensic Odontostomatol* 1988;6:21-7.
7. Synder L.M.: Personal identification by means of lip prints. Quoted from Suzuki K. and Tsuchihashi Y. *J. Forensic Med* 1970; 7:52.
8. Caldas IM, Magalhães T, Afonso A. Establishing identity using cheiloscopy

- and palatoscopy. *Forensic Sci Int* 2007;165:1-9.
9. Afaf TY, Abd Elwanees S and El-Awdan A. The inheritance of lip print patterns. *Tanta Medical J.* 1987;1(1):26.
 10. Tsuchihashi Y. Studies on personal identification by means of lip prints. *Forensic Sci* 1974;3:233-48.
 11. Utsuno H, Kanoh T, Tadokoro O, Inoue K. Preliminary study of post mortem identification using Lip prints. *Forensic Sci Int* 2005; 49:129-32.
 12. Castello A, Alvarez-Segui M, Verdu F. Luminous lip prints as criminal evidence. *Forensic Sci Int* 2005;155:185-7.
 13. Alvarez Segui M, Miquel Feucht M, Castello Ponce A, Verdu Pascual F. Persistent lipsticks and their prints: New hidden evidence at the crime scene. *Forensic Sci Int* 2000;112:41-7.
 14. Shailesh M, Gondvikar A I, Shirish Degwekar, Rahul Bhowate. Cheiloscopy for sex determination. *J Forensic Dent Sci* 2009;1(2):56-60.
 15. Vahanwala SP, Parekh BK. Study of lip prints as an aid to forensic methodology. *J Forensic Med Toxicol* 2000;17:12-18.
 16. Dr. Annie J. Verghese, Dr. M. Somasekar, Dr. Umesh Babu R. A Study on Lip Print Types among the People of Kerala. *J Indian Acad Forensic Med* 2009; 32(1):6-8.
 17. Mamandras AH. Linear changes of the maxillary and mandibular lips. *Am J Dentofacial Orthop* 1988;94:405-410.
 18. Genecov JS, Sinclair PM, Dechow PC. Development of the nose and soft tissue profile. *Angle Orthod* 1990;60:191-198.
 19. Subtelny JD. A longitudinal study of soft tissue facial structures and their profile characteristics, defined in relation to underlying skeletal structures. *Am J Orthod* 1959;45:481-507.
 20. Gordon RW. Age grouping to optimize augmentation success. *Dent Today* 2010; 29(5):128-31.
 21. Gordon RW. *Vermillion Dollar lips: lip and perioral augmentation for the cosmetic dentist*. Tampa, Fla: Vermillion Dollar Publications; 2008.
 22. 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.
 23. Saraswathi TR, Gauri Mishra, Ranganathan K. Study of lip prints. *Journal of Forensic Dental Sciences* 2009;1:28-31.
 24. Suman Jaishankar , Jaishankar N , Shanmugam S. Lip prints in personal identification. *JFADS* 2010;1(4):23-26.

FIGURES



Fig. 1: Type I lip pattern in a female patient



Fig. 2: Type I' lip pattern in a female patient



Fig. 3: lip pattern Type II in female patient.



Fig. 4: lip pattern Type III in a female patient



Fig. 5: lip pattern Type IV in a male patient

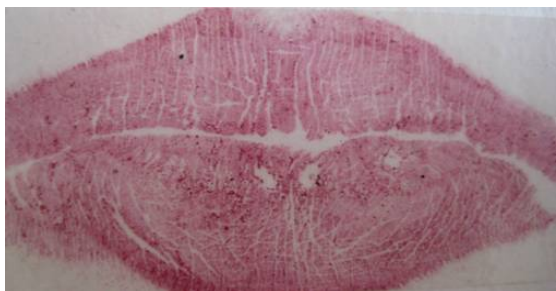


Fig. 6: lip pattern Type V in male patient.

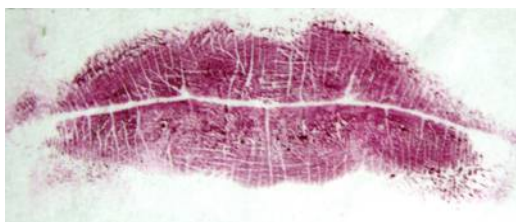


Fig. 7: Lip print pattern of a 9 year old female with a reticular pattern in the lower 1/3rd of the middle portion of the lower lip.



Fig. 8: Type I pattern in a 6 year old male incorrectly recognised as a female

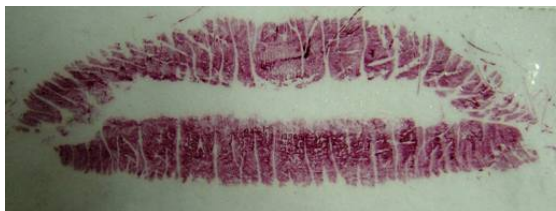


Fig. 9: Type I pattern in a 60 year old male incorrectly recognised as a female.



Fig. 10: Lip print of a 50 year old female patient with Type III pattern incorrectly recognised as a male. Note the increased intercommissural distance and thinning of lips

TABLES

Table 1. Group 1 (Age 1-20 Yrs)

Type	Female	Male	Total
I	48	40	88
I'	6	4	10
II	11	11	22
III	3	16	19
IV	0	7	7
V	4	0	4
Total	72	78	150

p = 0.001; Significant at 1% significance level

Table 2. Group 2 (Age 21-40 Yrs)

Type	Female	Male	Total
I	102	39	141
I'	19	5	24
II	14	4	18
III	14	71	85
IV	7	18	25
V	3	4	7
Total	159	141	300

p < 0.0001; Very Highly Significant

Table 3. Group 3 (Age 41Yrs & above)

Type	Female	Male	Total
I	35	30	65
I'	3	0	3
II	14	0	14
III	20	33	53
IV	7	3	10
V	1	4	5
Total	80	70	150

p < 0.001; Highly Significant

Table 4. Intra and Inter- observer kappa value

		Kappa value
Intra-observer	Observer 1	0.82
	Observer 2	0.91
Inter-observer		0.95