Original Research Paper

Cheiloscopy: A Forensic Aid for Personal Identification and Sex Determination

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Abstract:

Background: Establishing a person's identity is a mammoth challenge, being confounded by the science of criminology. Dental records, fingerprint and DNA comparisons are probably the some of the most common techniques that are used in this context, allowing fast and reliable identification processes. However, under certain circumstances, they cannot always be used so freely and sometimes it is necessary to apply very less known techniques. In forensic identification, lip print patterns can lead us to important information and help in a person's identification. **Objective:** This study aims to ascertain the use of lip print patterns in personôs identification and sex differentiation in Odisha population. **Materials and Methodology:** A total of 140 subjects, 70 males and 70 females were selected from Odisha population. The materials used to record lip prints were lipstick, bond paper, cellophane tape, charcoal powder, an ostrich brush for sprinkling the powder to develop latent print, alginate impression material, cold cure powder and liquid, dental stone to cast lip print and a magnifying lens**. Results:** Statistical analysis (applying chi square test for proportion) showed significant difference for type I, I', II, III, IV and V lip patterns ($P < 0.05$) in males and females. **Conclusion:** This study not only revealed that the lip prints are unique to an individual, but also that they have significant reliability for identification of the sex of an individual.

Key Words: Cheiloscopy, Identification, Sex Determination

Introduction:

One of the mammoth challenges in the study of criminal science is to establish the personal identification in the earlier days .The concept of ñidentityò[1,2] is a set of physical characteristics, functional or psychic, normal or pathological, that define an individual. Identification of humans is a prerequisite for personal, social and legal reasons. Complete identification means the absolute fixation of the identity[2-4] of a person beyond any doubt.

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The most successful approach utilizes a combination of more than one method. From among these methods, dactylography[5-7] and DNA profiling[8] are the most accurate methods of identification. However, even they have their own disadvantages. In such a situation, it is necessary to find a less known technique such as cheiloscopy[9-11] which is otherwise competitive, comparative, reliable and permanent to provide the evidences as per the need .

Cheiloscopy, as derived from the Greek words cheilos means lips, eskopein means see; is a forensic investigative technique that deals with identification of humans based on lip traces.[12-14] Wrinkles and grooves present on the labial mucosa called as ñSulci Labiorumò form a characteristic pattern called ñLip Printsò[15,16] the study of which is known as Cheiloscopy.

Characteristics of Lip Prints:

A lip print may be revealed as a stratified surface trace with visible elements of

lines, namely the furrows. If the lines are not clear, only the shape of the lips is printed. Lip prints are unique and genotypically determined;[17] they do not undergo any change from birth until the body undergoes decomposition. Like finger prints, lip grooves are permanent and unchangeable[18] bearing the valor and dexterity in its disposition. The patterns of the lip can be identified as early as in the sixth week of intrauterine life.[19,20] The purpose of the present study was to ascertain the use of lip print pattern for personal identification, as a sex determinant, to determine the most common pattern in the population of various parts of Odisha, revealing the ethnic dominance .

Materials & Methodology:

Materials used;

Red coloured non glossy lipstick, bond paper, cellophane tape, scissors , magnifying lens (10X), pen for labeling the individuals details, black and white coloured powder taken from forensic science laboratory(FSL), ostrich brush , alginate impression material , cold cure acrylic powder and liquid for making custom tray, dental stone.

Methodology:

This study was carried out in the Department of Oral pathology and Microbiology, S.C.B Dental College & Hospital, after obtaining due consent of the participating subjects. Approval from the Institutional Ethics Committee was taken .

The participants constituted equal number of males and females, in the age group of 1-70 years. They were grouped separately in to seven sets with 10 males and 10 females each, and coded to hide their sex according to the age groups, as follows, set A - age 1 to 10 years, set B - 11 to 20 years, set C - 21to 30 years, set D - 31 to 40 years, set E - 41 to 50 years, set F- 51 to 60 years, and set G - 61 to 70 years.

Exclusion criteria were as follows;

1. Participants with any active or passive lesions on the lips.
2. With any known hypersensitivity to lipstick components.

Red coloured non glossy lipstick was applied with a single stroke, evenly on the vermilion border. The participants were then asked to rub both the lips to spread the applied lipstick evenly. One set of lip-imprints were then taken on a bond paper by simply rolling the lips from one corner of mouth to the other, by gentle touch until the lip print faded. Then cellophane tape was attached over lip prints to prevent smudging. The name and the sex of the respective individuals were encoded on the paper. Lip prints (latent) were obtained from the individual without applying lipstick on a bond paper. Carbon dust was sprinkled with the help of ostrich brush, then excess was removed by holding and gently shaking the paper. The developed lip print was lifted by glue portion of cellophane tape and fixed to contrast paper. Lip print was also taken by alginate impression material with a custom tray and then poured with dental stone. The casts thus produced were taken for the study of lip prints.

All the lip prints were analysed with the help of magnifying lens. The lip prints were then scanned for digital analysis by using Adobe Photoshop - 7 software. An attempt was made to trace each and every line, quadrant-wise, taking 10mm on either side of the imaginary line passing through the middle part of the lower lip and upper lip. This fragment is almost always visible in any trace, as the determination of the pattern depends on numerical superiority of properties of the lines in these study area. Most lips contain more than one type of patterns and hence, the lips were divided into four quadrants. Each quadrant was studied and various types of lip prints were recorded. Each quadrant was read from the center of the lip outward toward the corner of the lip. The upper and lower lips were divided through the center by an imaginary vertical line, thus producing left and right upper and lower quadrants [Figure-1,2,3,4,5].

Figure 1 - Lip print pattern

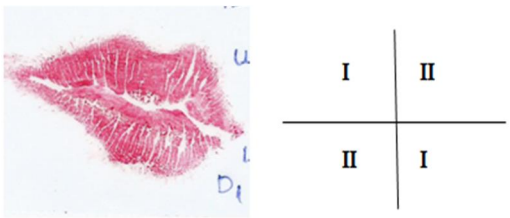


Figure 2 - Lip print pattern

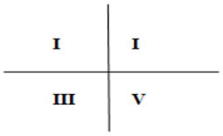


Figure 3 - Lip print pattern

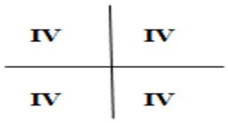
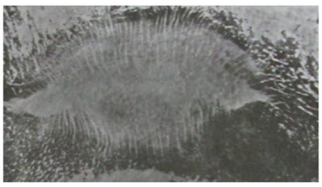


Figure 4 - Latent lip print



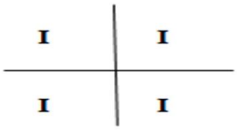
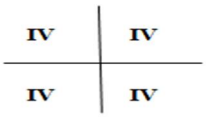


Figure 5 - Cast showing lip print



In this study, the classification of patterns of the lip prints proposed by Y. Tsuchihashi and T. Suzuki[21] was followed as given under:

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

Type INj 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 types from 1-4 and cannot be differentiated morphologically (undetermined).

The sex of the individual was determined as per the descriptions given by Vahanwala, et al.[22]

Type 1, 1NjPattern dominant ï Female

Type 2 : Patterns are dominant ï Female

Type 3 : Pattern present ï Male

Type 4 : Male

Type 5 : (varied patterns) ï Male

Same patterns in all quadrants ï Female

Observation and Results :

The distribution of lip print types in males and females in each quadrant was compared. Results were tabulated with a principle that, where lip pattern were found similar in all 4 quadrants, they were called common. Similarly, where similarity was found in 3 quadrants, excepting one, they were also designated as common. Where the similarity was observed in 50% of the quadrants the result of the lower lip was taken into consideration and designated as common due to the reason that the latter was more commonly and widely touched during contact than the upper lip. This has been supported by many authors.[22,23]

Discussion:

Lip prints have been with us since the beginning of human civilization. R Fischer in 1902[24] was the first anthropologist to describe the lip prints. Two Japanese scientists, namely, Y. Tsuchihashi and T. Suzuki,[25] during the period 1968-71, established that the arrangement of lines on the red part of the human lip is individualistic and unique for each human being. Apart from identification and evidential use, lip prints may also be used in detection work, as being the referential source of tactical and criminalistic information. A lip print at the scene of crime can be a basis for conclusions as to the nature of the event, the number of the people involved, their sexes, cosmetics used, habits, occupational traits, and the pathological changes by themselves.

Criminals make attempts to conceal their identity through finger prints by wearing gloves during crime or they try to destroy the finger skin pattern either by self-inflicted wounds, application of corrosives or by abrading the skin. Such kind of manipulations are unlikely to be inflicted on their lips. Hence, taking lip prints of all the suspected individuals and comparing

them with the items found at the scene of crime could provide conclusive evidence about the presence of a person at the crime scene. Thus, the other modes of investigation become easier, once the involvement of a suspect at the crime scene is confirmed. 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. Lipsticks are complex substances which have in their composition containing several compounds , oils, or waxes. While searching for lip prints, one must always consider that, not all lipstick smears are coloured. In fact, in recent years, the cosmetic industry has been developed new persistent lipstick which does not leave a visible smear or mark when they come in contact with different items such as glass, clothing, cutlery, cigarette butts or food items etc. However, all lip prints are important, even the ones that are not visible. 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 charcoal powder and aluminum powder. The edges of the lips have sebaceous glands and sweat glands. Thus, secretions of oil and moisture from this area enable the development of "latent" lip prints, analogous to latent finger-prints. Identifiable lip prints can be obtained within 30 days[25] after they are imprinted. Use of lip prints as evidence in Indian courts has not attained wide popularity till date, despite their high performance of objective accuracy.

In our study, lip prints of 140 individuals in the age range of 1-70 years were observed by using magnifying lens and analysing further distinct lip patterns by utilizing Adobe Photoshop software -7 and comparing the lip grooves from the median line towards the corner of the mouth, as the lip does not contain only one type of groove, but a mixture of varieties of the same. **(Table-1)** They differ from individual to individual, according to their position or distance from the median line towards the corner of the mouth in respect of type of lip print pattern and character of each type of print.[26] Similar observations were also recorded in work of other authors.[27,28]

It was found that of the 140 participants, type ï I lip print pattern was found to be the predominant pattern, with 37.9 %, the second most common was type-IV with 25.7 %, type - III pattern of lip prints were found in 23.6% and the type ï II in 8.6 %. Similarly, type-I in 3.6% and type-V was the least, 0.7% **(Table-2).** Of the 70 females, the type-I pattern was found as the predominant pattern in 48 individuals (68.6%), while 9 (12.9%) showed type-IV pattern, 7 (10%) showed type-II pattern and type-I and type-III

Table-1: Common lip print pattern among males and females

Type	Sex	RUQ	LUQ	LLQ	RLQ	COMMON LIP PRINT PATTERN
Type I	Males	14	5	16	12	5
	Females	44	40	47	50	48
Type I'	Males	3	5	7	5	2
	Females	4	5	3	3	3
Type II	Males	3	4	12	14	5
	Females	5	10	10	8	7
Type III	Males	21	26	23	24	30
	Females	2	6	4	4	3
Type IV	Males	29	29	11	14	27
	Females	15	9	6	5	9
Type V	Males	0	1	1	1	1
	Females	0	0	0	0	0
"p" value		0.0001	0.0001	0.0001	0.0001	0.0001

Table-2: The common lip print pattern of males, females and total

Lip print patterns	Male(70)	%age(70)	Females(70)	%age(70)	Total(140)	%age(140)
Type- I or Long vertical grooves	5	7.14%	48	68.57%	53	37.86%
Type – I' or Short vertical grooves	2	2.86%	3	4.29%	5	3.57%
Type – II or Branching grooves	5	7.14%	7	10%	12	8.57%
Type – III or diamond grooves	30	42.86%	3	4.29%	33	23.57%
Type – IV or reticular grooves	27	38.57%	9	12.86%	36	25.71%
Type – V or other types of grooves	1	1.43%	0	0%	1	0.71%

were found in 3 females, each. **(Table-2)** Of the 70 males in our study, type-III pattern was found to be predominant pattern in 30 persons (42.9%), followed by type-IV in 27 persons (38.6%). The above results were found similar in some studies[29] and dissimilar in other studies, as in the literature.[30-32] Such variation could be explained due to the different sampling of subjects in different groups, expressing ethnic variation. The analysis of lip line in 4 different quadrants of individuals showed that 49 females showed similar lip line in all the 4 quadrants, being a dominant feature with 70%. Other studies found similar results.[31] Whereas, in males, 7 showed similar lip line patterns in the 4 quadrants and 63 showed dissimilar patterns in the same, which were found to be predominant one. The features were similar to that as found in other researchers work.[31,33] Our study also showed 83% accuracy in identifying males and 90% accuracy in identifying females. The overall accuracy of sex identification was 87%. (Table-3).

Table-3: Table of accuracy in sex determination

	Males(70)	Females(70)
Diagnosed correct %age	58 82.86%	63 90%
Diagnoded wrong %age	12 17.14%	7 10%
Undecided	0	0

Summary & Conclusion

Any process that possesses the possibility of assisting the forensic field in identifying the suspect should be pursued and if discovered pertinent, utilized in the act of criminal investigation and legal proceedings. The use of lip prints falls into this category. Its proven testimony of reliability is trustworthy to link a suspect to a crime with substantial high degree of accuracy and hence emphasis should be given to this field. Lip print analysis is a process that provides both qualitative and quantitative analytical results. Thus its application in the forensic field may be widely accepted as a contributory tool for law enforcement and the legal professionals. Lip prints are unique to the individual which can be explained on the basis that no two individuals in the studied group have an exactly matching lip print in all four quadrants. No significant difference was found in the change of pattern in lip print images collected after 12 months from the same individual, even after exposure of the lips to the seasonal variations and minor or superficial trauma.

The technique followed for collection of the lip prints using lipstick as recording media and bond paper as transferring media with proper stabilization of the lips, while recording, can be adopted as a good technique to obtain a definable lip print image. In case of non lipsticks user or lip sticks that gives no trace on contact, latent lip print can be developed, which gives same result with visible lip print.

The digital method of analyzing the lip print images using Adobe Photoshop-7 software serves as a convenient method that provides better visualization and ease in recording and identification 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. Lip prints are similar to finger prints with a high level of accuracy.

Lip prints can be used as an evidence or a positive means of personôs identification just like fingerprints. They can also be used for sex determination. They are easy and unbiased

unlike the presentation of dental evidences. It is permanent, sustainable and the factors for distortion like self infliction or other means are less likely. Although it is widely acceptable in other countries round the globe, but is yet to be popular and acceptable in Indian court of law. This study is an honest approach with a novel method of personal identification and to facilitate the criminal justice system converging the credential of prima facie evidence for support.

Future Prospects

Similar to the finger print banks, lip print banks may be made available in all police stations for matching the lips for the purpose of identification. However, the process is technique sensitive due to high flexibility of lips and their smudging offering great difficulty in taking appropriate lip print. Larger sample study may still be required to determine the predominant type as well as their subtypes to revise the classification.

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