A study based on lip print pattern and blood group correlation

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Abstract- **Forensic dentistry represents an overlap between dental and legal profession. It plays a major role in the person identification. Several structures of human body abetted with various methods do exist for forensic evaluation. Lip print plays a vital role in transfer of evidence and are considered similar to fingerprints in forensic and personal identification. This study was conducted to ascertain the prevalence of different blood groups in different lip patterns and to identify gender on the basis of lip prints to find a correlation between lip prints with blood group which can further help out in forensic identification. A cross-sectional study was conducted on 50 participants (25 male and 25 female), aged between 18-25 years, to determine the correlation between lip print types and blood groups. Lip print was analyzed using Tsuchihashi classification and associated blood group matching were performed. The results reveals that the study does not show a correlation between lip print pattern and blood group among males and females. Further study should be conduct to validate the results. Since lip print and blood group are unique for a person, chieloscopy along with blood group can play a vital role in person identification.**

Index Terms **— ABO blood grouping, Chieloscopy, Correlation, Lip print, Personal identification.**

I. INTRODUCTION

The word 'Forensic' is derived from the Latin word, 'Forensic' which means the art or public study. The word 'science' can be defined as the systematic knowledge through study using the scientific method. Forensic science refers to the areas of endeavor that can be used in judicial setting and accepted by the court and the general scientific community to separate truth from untruth (Mhaske et al., 2013).

Each and every individual has certain features that make them different from others [Karim & Gupta,2014]. That is, every individual is unique in their own way. This uniqueness forms a fundamental paradigm relevant for individualization. 'IDENTITY' is the set of physical, functional and pathological characteristic that defines an individual [Harsha & Jayaraj,2015]. Identification is done to determine the individuality of a person. It also helps to confirm the identity of a person without any doubt. The identification of a person whether it is living or dead is based on the theory that 'Every Individual Is Unique'. Individual identification is an important and challenging task in forensic investigation.

For the purpose of personal identification; bitemark, dactyloscopy, DNA fingerprinting handwriting, blood groups etc. were the traditionally used methods. Among these, dactyloscopy and DNA fingerprinting were the techniques used commonly. Due to the public awareness of fingerprints, there will be deliberate attempt to not to leave behind the fingerprints on crime scene. This reason justifies the increasing need of alternative method of personal identification.

One of the most emerging methods of personal identification is the use of lip prints. Lips are the two fleshy folds surrounding the oral orifices. They are internally connected by mucosa and externally by skin [Bindal et al.,2009]. It has many elevations and depressions forming a characteristic and unique pattern called as lip print. The study of lip prints is called as 'CHEILOSCOPY' where 'cheilos' means 'lip' and 'scopy' means to 'examine' or 'see'. It was Fischer in 1902 who described the lip print as first. Later the criminologist Edmond Locard recommend the use of lip print in personal identification and criminalization [Thomas ,1988]. Lip print can be recognized early in the sixth week of intrauterine life and they do not change in their lifetime [Caldas,2007]. According to Locard exchange principle, 'Every contact leaves a trace' the participants unknowingly leave the lip impression on cups, cigarettes, glasses,

bottles and even on skin. The comparison of such impression with those collected from the suspects helps to narrow down the criminal investigation. Lip print can be used to verify the presence or absence of a person in a crime scene.

History

In 1902, the biological phenomenon of systems of furrows on the red part of human lip was first noted by an anthropologist named Ronald Fischer. [Saraswathi et al.,2009]. Later in 1932, the criminologist Edmond Locard recommended the use of lip print in personal identification and criminalization [Thomas,1988].

In 1950, the forensic expert, Le Moyne Snyder published a book entitled 'homicide investigation'. In that he suggested the concept of personal identification by means of wrinkles in lips. He is also called as 'The father of cheiloscopy'. In his book, he revealed an interesting case where a woman was struck by an automobile striking her face on the left front fender of the car. The owner of the car denied the incident. Cheiloscopic examination were done on the lip print found in the left front fender of the car and it was concluded that the woman was struck by the automobile.

In 1960, Dr. Martin Santos also suggested the use of lip print for personal identification and he proposed a system of classifying the lip grooves into four types. In Hungary 1961, lip traces were found on glass door at the scene of a murder which led to the lip print examination. At this time, the usefulness of lip print in criminal investigation was proven.

In the period of 1968-1971, two Japanese scientists, T. Suzuki and Y. Tsuchihashi carried out research in 1364 persons at the Department of forensic odontology at Tokyo university. It was found that the arrangement of lines and furrows on the red part of lip was individual and unique to each human being. They also devised a new classification of lip print in the year 1970 [Suzuki and Tsuchihashi classification].

Another research was carried out by Tsuchihashi in the year 1974 including a large number of participants along with family groups. By comparing the lip print of twins with their parents, it was found they closely resembled one parent which add strength to the theory of hereditary of lip prints. In 1981, the scientist Cottone reported in his book that cheiloscopy is one of the unique techniques that can be used for personal identification.

Kasprzak conducted a five-year research program in 1500 persons in 1990 to indicate the practical use of lip print. In 1999, the Federal Bureau of investigation [FBI] and the Illinois state police accepted that lip prints and unique and individual and can be useful for human identification.

Alvarez et al., (2000-2002) and Vahanwahal.et.al (2000) put forward an explanation that the presence of minor salivary glands and sebaceous glands secretions in the vermilion border of human lips along with the moisturizing property of tongue help in the formation of latent lip prints in the crime scene.

Prabhu et al., (2012) stated that lip print can be properly collected without the use of any recording medium with the help of suitable non porous surface. All the studies concluded that cheiloscopy can be effectively used as an additional tool for personal identification in criminal investigation. [Nalliapan et al.]

Classification

1.Santos classification

The mucosal area on the lip which is covered with wrinkles and grooves that form a characteristic lip pattern is called as the 'Klein`s zone'. In 1967, Clauco Martin Santos, the professor of forensic dentistry at the federal university of Rio de Janeiro, Brazil, first classified the lip grooves in to four groups;

Table I: Santos classification of lip prints [Caputo et al.,2018]

SIMPLE TYPES (formed by single element)	COMPOSITE TYPES
Straight line	Bifurcated
Curved line	Trifurcated
Angled line	Irregular
Sine shaped line	----------

2. Suzuki and Tsuchihashi classification

A new classification of lip print was devised by Suzuki and Tsuchihashi in 1970 and it is as follows;

Table II: Suzuki and Tsuchihashi classification of lip prints [Caputo et al.,2018]

TYPES	CHARACTERISTICS
Type I	Clear cut grooves running across the lip
Type I`	Partial length groove of type I
Type II	Branched groove
Type III	Intersected groove
Type IV	Reticulate pattern
Type V	Undetermined

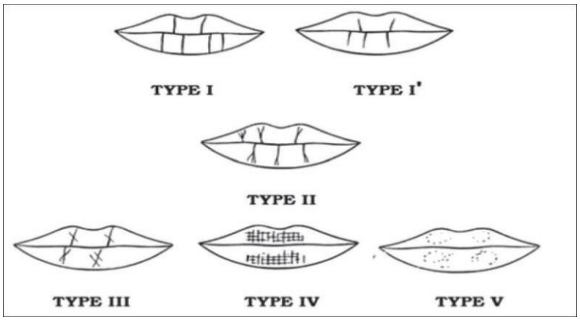


Fig 1: Suzuki and Tsuchihashi classification [Yendriwati et al.,2019]

3. Renaud classification

Renaud, French scientist gave a classification after studying 4000 lip print.

Table III: Renaud classification [Caputo et al.,2018]

TYPES	CHARACTERISTICS
Type a	Complete vertical
Type b	Incomplete vertical
Type c	Complete bifurcated
Type d	Incomplete bifurcated
Type e	Complete branched
Type f	Incomplete branched
Type g	Reticular pattern
Type h	X or Coma form
Type i	Horizontal
Type j	Other form (ellipse, triangle)

4. Afchar -Bayat classification

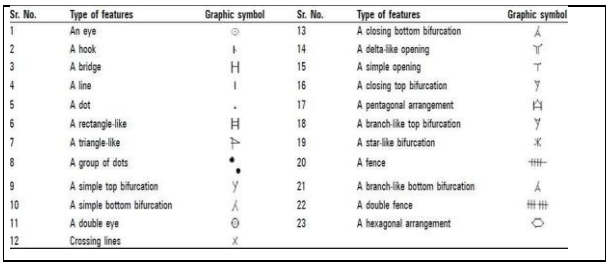
On the basis of groove organization, Afchar-Bayat classified the lip prints in 1979

Table IV: Afchar -Bayat classification [Caputo et al.,2018]

TYPES	CHARACTERISTICS
A1	Vertical and straight grooves, covering the whole lip
A2	Vertical and straight grooves, but not covering the whole lip
B1	Straight -branched grooves
B2	Angulated -branched grooves
C	Converging grooves
D	Reticular pattern grooves
E	Other grooves

5. Kasprzak classification

Kasprzak classified the lip prints in to 23 types of individual features.



Sr. No.	Type of features	Graphic symbol	Sr. No.	Type of features	Graphic symbol
1	An eye		13	A closing bottom bifurcation	
2	A hook		14	A delta-like opening	
3	A bridge		15	A simple opening	
4	A line		16	A closing top bifurcation	
5	A dot		17	A pentagonal arrangement	
6	A rectangle-like		18	A branch-like top bifurcation	
7	A triangle-like		19	A star-like bifurcation	
8	A group of dots		20	A fence	
9	A simple top bifurcation		21	A branch-like bottom bifurcation	
10	A simple bottom bifurcation		22	A double fence	
11	A double eye		23	A hexagonal arrangement	
12	Crossing lines				

Fig 2. Kasprzak classification of lip prints [Prabhu et al.,2012]

Another biological record that remains constant throughout the lifespan of a person is the blood group and Rh factor [kesarswani & Choudhary,2021]. Blood is the most important body fluids that help to circulate the respiratory gases, enzymes, hormones, and nutrients. Blood consists of red blood cells, white blood cells, and platelets. In 1901, Karl Landsteiner classified the blood groups in to A, B, AB, & O according to the presence of different types of antigens in RBC and antibodies in the plasma. The Rhesus system can be classified as Rh+ve and Rh -ve based on the presence and absence of RhD antigen respectively.

Table V: ABO blood groups

Abo groups	Antigen Present	Antigen Missing	Antibody Present
A	A	B	Anti B
B	B	A	Anti A
O	None	A and B	Anti A and B
AB	A and B	None	None

Lip print and blood group are the important parameter in forensic science for personal identification. The presence of minor salivary glands and sebaceous glands in the vermilion border of lip along with the moisturizing property by tongue leads to the possibility of latent lip print in the crime scene. Correlating the lip print along with blood group helps in accurate identification than with the use of lip print alone. Lip print can be a vital proof in authenticating persons due to its permanence and uniqueness.

METHODOLOGY

A cross-sectional study was conducted in the Kerala students in the department of Forensic science and Department of petroleum engineering, GIET college, Rajahmundry, Andrapradesh. All the participants were formerly informed about the intention and purpose of the study and the consent of the subjects were obtained prior to the sample collection. A total of 60 samples (30 males and 30 females), with age ranging between 18 to 25 years were randomly selected for the study. A total of 10 samples were rejected (5 males and 5 female) were rejected because of smudging and poor quality of lip prints. So, a total of 50 participants (25 males and 25 females) were fit to be enrolled in this study.

Methods adopted for collection of lip prints:

Both the upper and lower lips of the subject were thoroughly cleaned with the help of a cotton and a thin layer of red colored lipstick (coloressence premia) was applied on the lips of the subjects. The participants were then asked to rub their lips carefully and later allowed them to rest for 1 minutes. A glued portion of a cellophane strip was pasted on the lips of the subjects and a lip impression was made on the cellophane strip by dabbing it in the center first and pressing it uniformly towards the corner of the lips. The participants were asked to refrain their lips from moving to avoid distortion during the procedure of lip print recording. Then the cellophane strip was stuck to a thin bond paper for the purpose of making a permanent record. The recording procedure was repeated in the case of observing any defects to ensure the quality of the lip prints and attention was paid to hygiene during the recording of lip print pattern.

The recorded lip print was divided in to four quadrants (two areas in each lip) such as upper left (UL), upper right (UR), lower left (LL), lower right (LR) by drawing two lines, perpendicular to the transverse line. The lip print pattern present in each quadrant was examined with the help of a magnifying lens and the pattern were identified according to the classification proposed by SUZUKI and TSUCHIHASHI.

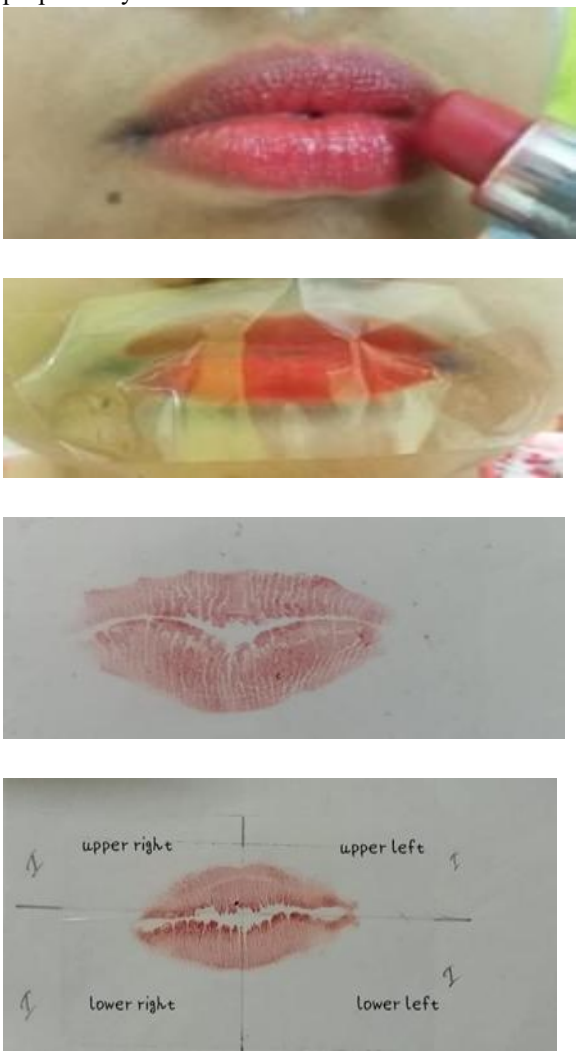


Fig 3: collection and analysis of lip prints

Method opted for blood group analysis:

The subjects were asked to clean their finger by using a cotton and ethanol. A drop of blood was taken to a glass slide by pricking the finger with the help of a lancet. The blood groups of the participants were identified by treating a sample of blood drop on a glass slide with anti-A and anti-B sera. Agglutination of a blood upon treatment with anti- A sera is considered

as blood group A: a positive reaction with anti- B is considered as of blood group B. No agglutination is suggested as O blood group and agglutination with both anti sera- A and B is treated as AB blood group. Similarly, the positive reaction with Rh antigen suggested as Rh +ve or otherwise Rh -ve.

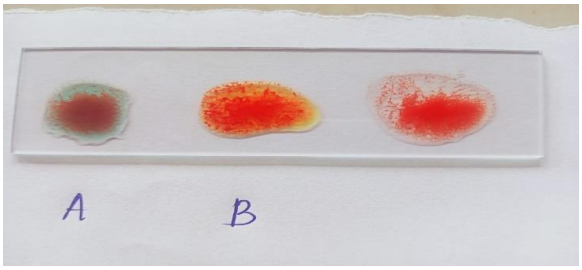


Fig 4: Blood group analysis

RESULTS AMD DISCUSSION

A cross-sectional study on lip print was conducted on 50 Kerala people (25 male and 25 female), age ranging between 18 to 25 years. The following results are drawn from the study;

Distribution of lip pattern among the study population

It was found that Type II (62%) was the prominent pattern in the study population, followed by Type I (36%), Type III (2%). Type I`, Type IV, Type V were found absent in the population.

Table VI: Distribution of lip pattern

PATTERN	NUMBER	PERCENTAGE (%)
Type I	18	36%
Type I`	0	0%
Type II	31	62%
Type III	1	2%
Type IV	0	0%
Type V	0	0%

Distribution of blood group among the study population

The most common blood group found in this study was O +ve (40%), followed by B +ve (34%), A +ve (10%), AB +ve (6%), AB -ve (4%), B -ve (4%) and O-ve (2%)

Table VII: Distribution of blood group

BLOOD GROUPS	NUMBER	PERCENTAGE (%)
O +ve	20	40%
O -ve	1	2%
B +ve	17	34%
B -ve	2	4%
AB +ve	3	6%
AB -ve	2	4%
A +ve	5	10%

Distribution of lip pattern among males in each quadrant

In the present study, it was found that in males Type II (76%) was most prominent pattern followed by Type I (28%) [Table 9 and Graph 3]. Type I`, Type III, Type IV and Type V were found absent in the population.

Table VIII: Percentage distribution of lip print pattern in males

QUADRANT	TYPE I	TYPE I`	TYPE II	TYPE III	TYPE IV	TYPE V
UL	7	-	18	-	-	-
Percentage (%)	28%	-	72%	-	-	-
UR	6	-	19	-	-	-
Percentage (%)	24%	-	76%	-	-	-
LL	7	-	18	-	-	-
Percentage (%)	28%	-	72%	-	-	-
LR	7	-	18	-	-	-
Percentage (%)	28%	-	72%	-	-	-

Distribution of lip print pattern in females in each quadrant

From the present study, it was found that in females, the prominent pattern was Type II (64%), followed by Type I (48%), Type III (8%), Type I` (4%)

Table IX: Percentage distribution of lip print pattern in females

QUADRANT	TYPE I	TYPE I`	TYPE II	TYPE III	TYPE IV	TYPE V
UL	12	-	12	1	-	-
Percentage (%)	48%	-	48%	4%	-	-
UR	11	1	11	2	-	-
Percentage (%)	44%	4%	44%	8%	-	-
LL	11	-	14	-	-	-
Percentage (%)	44%	-	56%	-	-	-
LR	8	-	16	1	-	-

Percentage (%)	32%	-	64%	4%	-	-

Correlation of lip print with blood groups

On correlating the lip prints with ABO blood group, it was found that in all the above blood groups Type II pattern was the most common pattern. In O +ve blood group, 24 % of the population shows Type II followed by Type I (14%) and Type III (2%) where as in B +ve ,18% shows Type II and 16% shows Type I. Likewise in AB +ve, most of the people have Type II pattern (4%) which was followed by Type I pattern (2%). The people having AB -ve blood group shows both Type I and Type II (2% each) whereas the A +ve blood group shows Type II majorly. The O -ve and B-ve blood groups only shows Type II pattern (2% and 4% respectively). No individuals of any blood group didn't show Type I`, Type IV and Type V pattern. From the above table it was found that Type II was more prominent in O +ve blood group and Type I was in B +ve blood group. Also, there is no correlation exist between lip prints and blood groups because the Type II pattern were common in all the blood groups presents in the study population.

Table X: correlation of blood group and lip pattern

LIP	O +ve		O -ve		B +ve		B -ve		AB +ve		AB -ve		A+ve	
PATTERN	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Type I	7	14%	-	-	8	16%	-	-	1	2%	1	2%	1	2%
Type I`	-	-	-	-	-	-	-		-	-	-	-	-	-
Type II	12	24%	1	2%	9	18%	2	4%	2	4%	1	2%	4	8%
Type III	1	2%	-	-	-	-	-	-	-	-	-	-	-	-
Type IV	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Type V	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Correlation of blood group and lip pattern in males

The table shows the correlation of lip prints with blood groups in males. It was found that in all the above blood groups except AB -ve shows the Type II pattern as common where as in AB -ve, only Type I pattern can be seen. In O +ve blood group, 16% of the total male population shows Type II pattern where 12 % shows Type I pattern. Likewise, in B +ve 32 % male participants have Type II pattern and 8% have Type I pattern. O -ve blood groups and A +ve blood groups shows the same result (Type II= 4%) where as in AB +ve, 8 % shows Type II pattern. The people who belong in the B -ve blood group also has Type II the pattern as common. The Type I`, Type III, Type IV, Type V pattern were absent in the male population under study. Also, it was found that Type II pattern is more prominent in B +ve blood group and Type I was in O +ve blood group. It was observed that no correlation exists between the lip print and blood group of the male individuals.

Table XI: Correlation of Lip print with blood groups in males

LIP	O +ve		O -ve		B +ve		B -ve		AB +ve		AB -ve		A +ve	
PATTERN	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Type I	3	12%	-	-	2	8%	-	-	1	4%	1	4%	-	-
Type I`	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Type II	4	16%	1	4%	8	32%	2	8%	2	8%	-	-	1	4%
Type III	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Type IV	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Type V	-	-	-	-	-	-	-	-	-	-	-	-		--

Correlation of lip prints with blood group in females

The correlation of lip prints with blood groups in female participants were shown in the above table. Only O +ve, B +ve, AB -ve and A +ve blood groups were available in the female study population. In the O +ve blood groups, Type II pattern was prominent (32%), followed by Type I (16%), Type III (4%) where as in B +ve blood groups shows the Type I pattern as prominent (24%). Type I and Type II were found commonly in A +ve blood group (8% each) and the AB -ve blood groups only shows Type II pattern among the females. It is also found that there is no correlation exist between the female's blood group and lip prints.

Table XII: correlation of lip prints with blood group in females

LIP PATTERN	O +ve		B +ve		AB -ve		A +ve	
	N	%	N	%	N	%	N	%
Type I	4	16 %	6	24%	-	-	2	8%
Type I`	-	-	-	-	-	-	-	-
Type II	8	32%	1	4%	1	4%	2	8%
Type III	1	4%	-	-	-	-	-	-
Type IV	-	-	-	-	-	-	-	-
Type V	-	-	-	-	-	-	-	-

CONCLUSION

From the study, it concludes that Type II pattern was the most common pattern in the study population as well as in both males and females and Blood group O +ve was most prevalent in the population. It is also found that the lip print and blood group of the individual do not shows a correlation of more than 50%. Thus, there is no significant correlation between the two characters. However, further studies with larger sample size need to be conducted to confirm the result.

Over all, no two-lip print pattern matched with each other. Every individual has a unique lip print, thereby confirming the uniqueness of the lip print. Hence, the chieloscopy aids in the personal identification.

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