# Correlation of lip print with blood group in forensic science

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## Abstract

**Background:** Cheiloscopy is the study of furrows and grooves present on the red part, or the vermilion border of the human lips. The type of groves is unique for an individual and can be used for person identification.

**Aim:** The aim of this study is to ascertain whether the uniqueness of lip print (LP) can help in identifying a person. In addition to evaluate the comparison of LP types and blood groups was taken up to see if there is any correlation between the two.

**Materials and Methods:** A cross-sectional study was conducted on 200 participants (77 males and 123 females), aged between 25 to 45 years, to determine any correlation between LP types and blood groups. These lip patterns were analyzed and interpreted using Tsuchihashi's classification and later associated blood group matching was performed to determine the predominant LP type with the ABO and Rh blood grouping system.

**Results:** The present study showed a positive correlation between LP pattern and blood group among males and females. Thus, distribution of LP patterns, and ABO blood groups might help in the identification of an individual.

**Conclusion:** Since LP and blood group are unique for a person. Hence, cheiloscopy along with blood group can play a vital role in person identification.

**Keywords:** Blood group, cheiloscopy, identification, lip prints

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## INTRODUCTION

Forensic science is defined as the application of scientific methods and techniques to matters under investigation by a court of law. Forensic science in a broad sense deals with criminal investigations by the identification of the body, cause and manner of death. The identification of person plays an important role in the investigation of the unidentifed body in mass disaster or criminal suspects and also in recognizing missing persons.[1] Various parameters such as fingerprinting, DNA testing, blood examination, body fluids and hair are used for the purpose of identification.[2,3]

Identification plays a vital role in any medico-legal inquiry. Identification is done to determine the individuality of a person. Identification means to confirm the identity of the person beyond any doubt. Partial identification

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determines only some facts about identity of the person while others still remain unknown. The most successful approach utilizes a combination of more than one method.[4]

Study of lines, furrow and fissures which are seen as wrinkles and grooves over the human lip is referred as cheiloscopy.[5,6] It can act as an indispensable tool in forensic odontology. The lip patterns can be recognized as early as the 6th week of intrauterine life and do not alter over time.[4] It is unique in all individuals, even in twins and family members. Henceforth, it can be used in exploring personal identity as it has been proved that they recover after minor trauma, inflammation and can resist even herpetic infections.[7,8] Lip prints (LPs) can act as an vital proof in authenticating a person's individuality in medicolegal cases like sexual assault, murders or rape, etc., at times, the participant unknowingly leaves evidence on clothes, cups, glasses, cigarette butts or on the skin.[9] Thus LPs can build up a sequence in linking crime, suspect and the crime scene.

Yet another biological record that remains unchanged throughout the life of a person is the blood group and Rh factor. Collecting the blood sample of a person from the site of crime helps in identifying a person. Hence, blood itself and along with LPs can play a significant role to unfold different medicolegal practice. Landsteiner classified blood groups under the ABO blood group system.[10]

### Aims and objectives

The present study was performed to ascertain whether the configuration of LPs behold the potential in determining sexual dimorphism and to determine the possibility of any correlation between blood groups and LPs.

## MATERIALS AND METHODS

The present cross-sectional study was conducted in the Department of Oral Medicine and Radiology and Department of Oral Pathology and Microbiology, Hazaribagh Dental College, Hazaribagh, after obtaining approval from the Institutional Ethical Committee. All the participants were formerly informed about the intention and objective of the study and a written consent was obtained prior of taking their prints. A total of 220 healthy controls (88 males and 132 females) coming to the Department of Oral Medicine, with age ranging between 25 to 45 years were randomly selected for the study. Lip impression of all the participants was collected. A total of 20 samples (11 males and 9 females) were rejected because of smudging and poor quality of LP. Thus, a total of 200 participants were fit to be enrolled in the study.

Materials used in the study was cotton and saline, disposable lip applicator, dark red colored frosted lipstick (Maybelline no 906), thin bond paper, cellophane tape, magnifying lens, a pen and for identifying blood group, glass slide and anti-A and anti-B sera was used.

### Inclusion criteria

Participants with lips free from any evidence of active or passive lip lesions and reported no hypersensitivity to lipsticks were included in the study.

### Exclusion criteria

Participants with disease, trauma and scar of the lips that may likely to cause a change in the LPs were disqualified from the study.

### Method of collecting lip impression

The upper and lower lips of the individuals were first cleaned using cotton and normal saline followed by uniform application of the lipstick on both the lips with the help of a disposable lip applicator, starting from midline and moving laterally as suggested by Sivapathasundharam in his study.[2] The participants were then asked to rub both the lips carefully and later allowed them to dry for 2 min so that the lipstick may spread evenly over the entire vermillion border. The first lip impression was made on a strip of a cellophane tape stuck to thin white bond paper for the purpose of making a permanent record so as to evaluate it later using a magnifying lens [Figure 1]. Each LP was recorded with a unique number without revealing the name and gender of the subject to the examiners. The middle portion of both the lip was considered for classification as it was clearly recorded in nearly all the samples and also because of the distinctive superiority of lines and grooves found in this area.

Blood groups of the participants were identified by mixing a sample of blood drop on microscope slides with anti-A and anti-B sera, alone or in combination. A positive reaction (agglutination) of the blood upon treatment with anti-A sera is suggestive of blood group A; a positive reaction with anti-B sera is suggestive of blood group B; no agglutination is suggestive of blood group O, and agglutination upon treatment with a combination of both antisera is taken as blood group AB. Similarly, agglutination with Rh antigen suggested Rh+ or else as Rh− [Figure 2].

### For sex determination

The LPs collected was determined as per following classification based on classification scheme proposed by Suzuki and Tsuchihashi [Table 1, Figure 3].[10]

Abbreviations:

- UM– Upper middle quadrant of the lip

**Figure 1:** Lip print collected on cellophane tape and then stuck to a thin bond paper

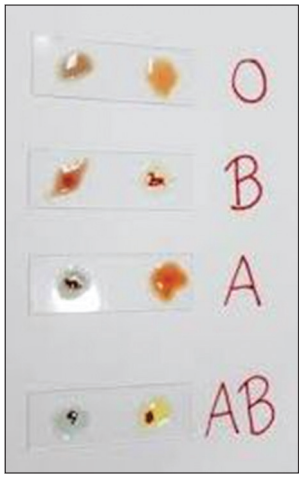



**Figure 2:** Blood slide, anti-A and anti-B sera

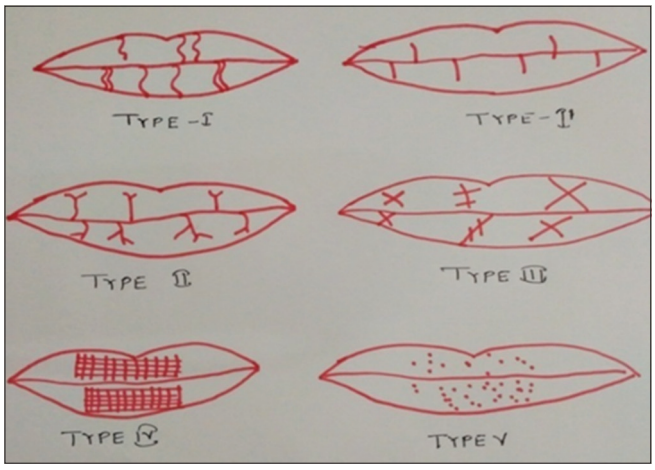



**Figure 3:** The pattern of lip prints as suggested by Suzuki and Tsuchihashi

- LM– Lower middle quadrant of the lip.

### Statistical results

This study was done using Statistical Package for the Social Sciences (SPSS), IBM Statistics for windows, Version 21.0, Armonk, NY: IBM Corp.

The Chi-square ($\chi^2$) was applied to test whether there was any association between the type of LP and blood group of the participants.

It is calculated as:

$$\chi^2 = \frac{\Sigma \left( \text{Observed} \rightarrow \text{ frequencies} - \text{Expected frequencies} \right)^2}{\text{Expected frequencies}}$$

where, $\Sigma$ denotes summation
"p" value is the probability role at 0.05 level of significance for the corresponding degree of freedom (d. f.).
$P < 0.05$ is significant
$P > 0.05$ is not significant.

## RESULTS

Following interpretations are drawn from the present study. First, all LPs are unique and no two lip patterns were alike to each other. Second, the most common LP pattern was Type II (38%) followed by Type IV (35.5%), Type III (17%), Type I' (6%), Type I (2%) and Type V(1.5%) [Table 2 and Graph 1]. Third, the most common blood group found in this study was O+ (37.5), followed by B+ (28.5%), A+ (22.5%), AB+ (8%) and O− (3.5%) [Table 3 and Graph 2]. Type IV lip pattern was predominantly found in female participants and Type II lip pattern was the most common among male participants. On correlating ABO blood group with lip pattern results were significant with $\chi^2 = 65.51$ and $P = 0.0001$ [Table 4 and Graph 3].

On comparing lip pattern with gender and ABO blood group a positive correlation was reported as $\chi^2 = 76.22$ and $P = 0.0001$ [Table 5 and Graph 4] and $\chi^2 = 23.48$ $P = 0.024$ [Table 6 and Graph 5] in female and male participants, respectively.

## DISCUSSION

Forensic science plays a major role in both civil and criminal investigation for person's identification who is missing, victims or some culprits hiding their identity. Cheiloscopy refers to a forensic technique dealing with identification of individual based on their distinctive lip traces.[11,12] A well-known LP pattern develops as early as the 6th week

of intrauterine life. The presence of grooves and furrows on the red portion of the human lip was first described by Fisher in 1902.[13] The LP pattern was first recommended by criminologist from France, Edmond Locard (1932), later Dr. Martins Santos in 1967 classified LP based on the pattern of lip grooves.[14] He classified it into four types: (1) Straight line, (2) Curved line, (3) Angled line and (4) Sine-shaped curve. Another widely accepted classification of LP was proposed by a Japanese doctor Suzuki in 1970, who classified it into five types.[10]

**Table 1: Suzuki and Tsuchihashi's classification for LP**

| Type of LP | Pattern of LP |
|---|---|
| Type I | Clear-cut vertical grooves running across the entire lip |
| Type I' | Similar to type I, but not covering the entire lip |
| Type II | Branched groove pattern |
| Type III | Intersected groove pattern |
| Type IV | Reticular groove pattern |
| Type V | Grooves not falling into any of the above category i.e., undetermined |

**Table 2: Distribution of lip patterns among the study population**

| | Frequency (%) |
|---|---|
| I | 4 (2) |
| I' | 12 (6.0) |
| II | 76 (38.0) |
| III | 34 (17.0) |
| IV | 71 (35.5) |
| V | 3 (1.5) |
| Total | 200 (100.0) |

**Table 3: Distribution of blood groups among the study population**

| | Frequency (%) |
|---|---|
| $A^+$ | 45 (22.5) |
| $AB^+$ | 16 (8.0) |
| $B^+$ | 57 (28.5) |
| $O^-$ | 7 (3.5) |
| $O^+$ | 75 (37.5) |
| Total | 200 (100.0) |

The present study was undertaken to evaluate the relationship of LP with gender and ABO blood group among 200 individuals. It was an attempt to analyze whether the LP and blood group holds the potential for the determination of sex and identity of an individual. In the present study, Type II pattern was predominantly found among both male and female participants. The result was similar to study done by Gondivkar *et al.*[15] but was contradictory with the study done by Multani *et al.*[16] were Type III was a major pattern prevalent among male and Type I among female. Patel *et al.* reported Type I as the most well-known pattern among male participants and Type II among female participants.[7] Sharma *et al.* concluded in his study that Type I and Type I' lip patterns were most frequently seen in female while Type IV was most commonly found in males.[17] Srilekha *et al.* in their study showed that Type I was predominant among females and Types I and IV lip pattern were predominant among males.[9] This variation may occur due to inter-observer variability in the classification of reticular and intersecting types. Previous studies have reported that the LP patterns forms revealed a population-wise dominance that is a particular lip pattern predominance in a specific group of population.[10,18]

**Table 4: Association between blood groups and lip pattern**

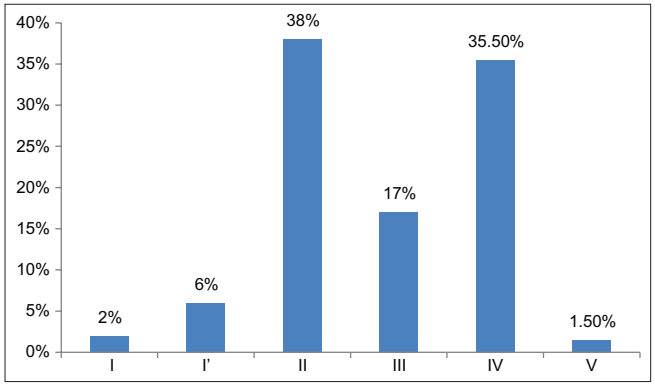
| | Blood groups | | | | | Total, *n* (%) |
|---|---|---|---|---|---|---|
| | $A^+$, *n* (%) | $AB^+$, *n* (%) | $B^+$, *n* (%) | $O^-$, *n* (%) | $O^+$, *n* (%) | |
| I | 2 (50.0) | 0 | 0 | 0 | 2 (50.0) | 4 (100.0) |
| I' | 9 (75.0) | 0 | 0 | 0 | 3 (25.0) | 12 (100.0) |
| II | 19 (25.0) | 5 (6.6) | 11 (14.5) | 3 (3.9) | 38 (50.0) | 76 (100.0) |
| III | 2 (5.9) | 5 (14.7) | 11 (32.4) | 2 (5.9) | 14 (41.2) | 34 (100.0) |
| IV | 10 (14.1) | 6 (8.5) | 35 (49.3) | 2 (2.8) | 18 (25.4) | 71 (100.0) |
| V | 3 (100.0) | 0 | 0 | 0 | 0 | 3 (100.0) |
| Total | 45 (22.5) | 16 (8.0) | 57 (28.5) | 7 (3.5) | 75 (37.5) | 200 (100.0) |
| Chi-square test | | | 65.514 | | | |
| *P* | | | 0.0001, significant | | | |

**Table 5: Association between blood groups and lip pattern Females**

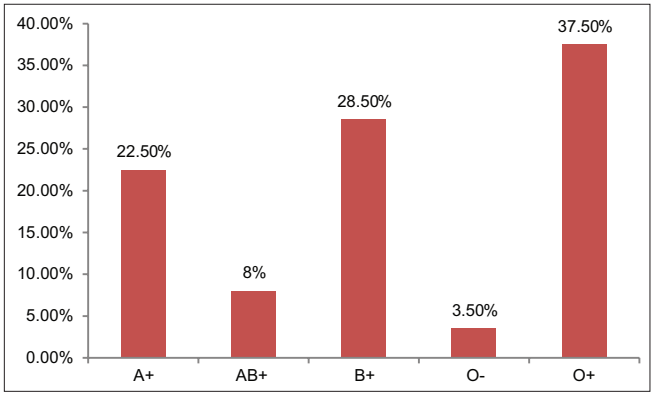
| | Blood groups | | | | | Total, *n* (%) |
|---|---|---|---|---|---|---|
| | $A^+$, *n* (%) | $AB^+$, *n* (%) | $B^+$, *n* (%) | $O^-$, *n* (%) | $O^+$, *n* (%) | |
| I | 1 (100.0) | 0 | 0 | 0 | 0 | 1 (100.0) |
| I' | 9 (75.0) | 0 | 0 | 0 | 3 (25.0) | 12 (100.0) |
| II | 3 (8.8) | 3 (8.8) | 5 (14.7) | 3 (8.8) | 20 (58.8) | 34 (100.0) |
| III | 0 | 3 (11.5) | 11 (42.3) | 2 (7.7) | 10 (38.5) | 26 (100.0) |
| IV | 6 (12.8) | 6 (12.8) | 25 (53.2) | 0 | 10 (21.3) | 47 (100.0) |
| V | 3 (100.0) | 0 | 0 | 0 | 0 | 3 (100.0) |
| Total | 22 (17.9) | 12 (9.8) | 41 (33.3) | 5 (4.1) | 43 (35.0) | 123 (100.0) |
| Chi-square test | | | 76.220 | | | |
| *P* | | | 0.0001, significant | | | |

**Table 6: Association between blood groups and lip pattern Males**

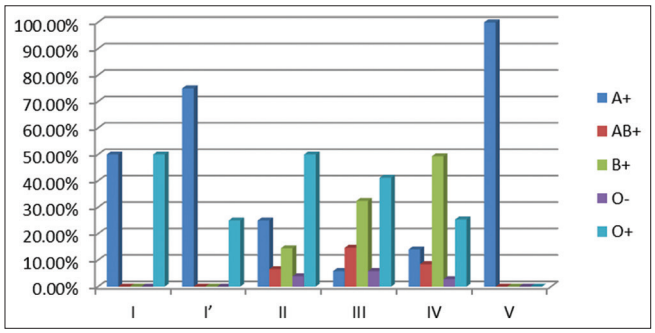
| | Blood groups | | | | | Total, *n* (%) |
|---|---|---|---|---|---|---|
| | $A^+$, *n* (%) | $AB^+$, *n* (%) | $B^+$, *n* (%) | $O^-$, *n* (%) | $O^+$, *n* (%) | |
| I | 1 (33.3) | 0 | 0 | 0 | 2 (66.7) | 3 (100.0) |
| II | 16 (38.1) | 2 (4.8) | 6 (14.3) | 0 | 18 (42.9) | 42 (100.0) |
| III | 2 (25.0) | 2 (25.0) | 0 | 0 | 4 (50.0) | 8 (100.0) |
| IV | 4 (16.7) | 0 | 10 (41.7) | 2 (8.3) | 8 (33.3) | 24 (100.0) |
| V | 1 (33.3) | 0 | 0 | 0 | 2 (66.7) | 3 (100.0) |
| Total | 23 (29.9) | 4 (5.2) | 16 (20.8) | 2 (2.6) | 32 (41.6) | 77 (100.0) |
| Chi-square test | | | 23.480 | | | |
| *P* | | | 0.024, significant | | | |



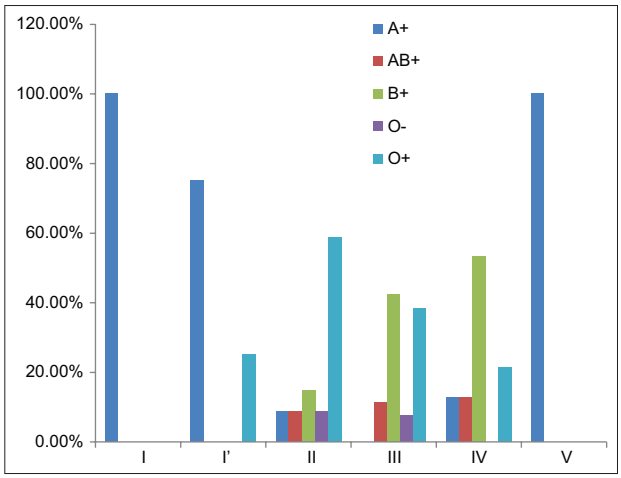

**Graph 1:** Lip pattern among study population




**Graph 2:** Blood groups among study population




**Graph 3:** Blood group and lip pattern




**Graph 4:** Blood group and lip pattern: Females

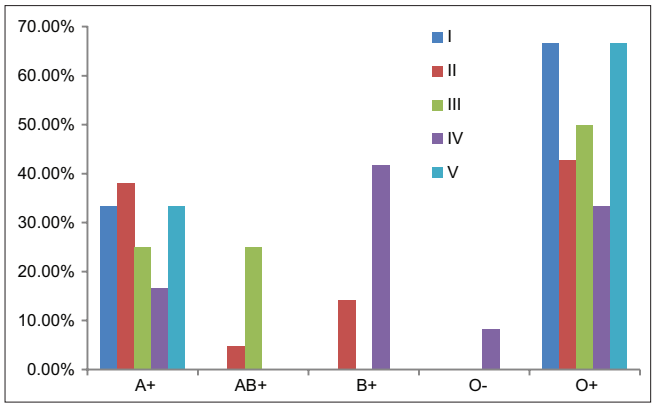
Tsuchihashi reported Type III LP predominant among the Japanese subjects.[8] Vahanwalla and Parekh studied LPs in 50 male and 50 female subjects and they found that Type I was more commonly seen on the lower lip among females while the male subjects tended to have varied types in all quadrants of the lips.[11]

Sivapathasundharam *et al.* in their study on 200 Indo-Dravidian persons, stated that Type III was a leading pattern[2] in contrast Multani *et al.* found Type I pattern as the predominant LP pattern.[16] In the present study the least frequently observed LP types in the total population were Type I and Type V.[2]

Srilekha *et al.* in their study found O +ve as the most common blood group type, followed by B +ve[9] while Verma *et al.* reported B +ve blood group as a principal one in their study.[18] In our study, O +ve, as well as B +ve were the predominant blood groups, which was in accordance with the study conducted by Raloti *et al.* in Gujarat.[19]

In our study, it was found that people with O +ve blood group, Type II was the most prominent lip pattern. Similar result was observed in the study done by Patel *et al.*[7]

The results revealed a significant correlation between LP patterns and ABO blood group and also in the sex-wise distribution of the LPs and ABO blood group.




**Graph 5:** Blood group and lip pattern: Male

Not much previous literature has compared blood groups and LPs but Suzuki and Tsuchihashi have reported that there is some correlation between heredity and LP and that the LP types are inherited in a manner similar as heredity of blood groups.[8,10]

## CONCLUSION

The present study analyzed the LP patterns with blood groups of the individuals and have found a significant association between gender, LPs and blood groups. Thus the present study suggests that the LPs association with blood group behold the potential in recognizing the sex and identity of an individual. Although the present study has certain limitations, due to small sample size, still the results obtained in the present study do open window for similar studies in larger cohorts.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

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