Original Article

Macrophotography: An Innovative Technique to Study Morphological Variations of Lip Patterns

Dhruv Patel, Harsh Jadav, Gargie Rampurkar, Abraham Johnson

Department of Forensic Odontology, School of Forensic Science, National Forensic Sciences University, Gandhinagar, Gujarat, India

ABSTRACT

Background: In the past, certain morphological traits of the human body such as fingerprints, footprints, iris, gait pattern, voice characteristics, and DNA fingerprinting, etc., have effectively been used in forensic circumstances as well as in the identification of perpetrators. As other features of the human body, the lip also exhibits some individualistic trait and is unique owing to variation in the anatomical structure.

Aim: The aim of this study was to introduce a new approach for assessing lip patterns using macrophotography and for assessing the lip patterns for sex determination.

Materials and Methods: The present study was conducted in a total of 200 participants (100 males and 100 females) between 20 and 30 years. The lip patterns of participants were studied under normal conditions using digital macrophotography. The classification scheme suggested by Suzuki and Tsuchihashi was used to classify the lip patterns in the experiment. The lips of each person were divided into four compartments, and the digits "1" to "4" were allocated in a clockwise sequence beginning from the upper right side of the lips.

Result: The most prominent pattern in the whole sample population was found to be Type I (84 [38.2% followed by Type III (72 [32.7%]), Type I (19 [8.6%]), Type II (11 [5.00%]), Type IV (7 [3.2%]), and Type V (7 [3.2%]). The statistical study of lip prints in relation to sex of an individual was conducted using the Chi-square test, and the value was found to be statistically significant ($P \leq 0.001$).

Conclusion: Cheiloscopy using a macrophotographic technique can be used for individual recognition as lip prints are unique to an individual. Macrophotographic technique allows properly imaging, quickly recognizing, and archiving the permanent ante-mortem record of the lip pattern.

KEY WORDS: *Cheiloscopy, digital analysis, forensic photography, macro lens, sex determination*

INTRODUCTION

Morphological features such as fingerprints, footprints, iris, gait patterns, speech traits, DNA fingerprints, etc., have been used for forensic identification. Similarly, the lip and its grooves often maintain many individualistic features that are distinctive due to differences in the anatomical structure.[1] Cheiloscopy (from the Greek words cheilos meaning "lips" and e skopein meaning "to see") is the name given to the lip print studies. Lip print patterns may be traced back as early as the 6th week of uterine life. The patterns of the lip groove remain unchanged and therefore help as a human identification tool.[2,3]

Lip prints can be collected from clothes, glasses, cigarettes, cups, windows, and doors at the crime scene. This approach allows for a clear correlation between an individual and a particular location and hence helps to locate a suspect at the scene of the crime.[4] The aim of this study was to introduce a new approach for assessing lip patterns using macro-photography and for assessing lip patterns for sex determination. The purpose of this study was to establish the predominant patterns of lip print in males and females.

MATERIALS AND METHODS

The present study involved 200 participants (100 males and 100 females) aged between 20 and 30 years. The procedure was explained to the participants, and then, informed consent was obtained from the participants who were able to engage in the study. The participants whose lips had no pathology, such as infection, mucocele, scarring, and deformities, were chosen.

COLLECTION OF LIP PATTERNS

The lip was cleaned, and the participant was asked to stay stationary with the teeth and lips in slight contact during

Address for correspondence:
Dr. Abraham Johnson, E-mail: drabrahamjohnson4000@yahoo.com

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procedure [Figure 1]. Photographs were digitally taken with a digital camera (Canon camera-6D Mark II) with a high-resolution option under standard conditions [Figure 2]. The technical specifics were as follows: resolution of 300 pixels/inch (dots per inch) in true color mode (red, green, and blue–8 bit), working file size of 4–5 Mb, image size of 13 w/5 h inches, the files were saved in Joint photographic experts group (JPEG) format. The photos were centrally positioned to the full front view of the lips.

EXAMINATION OF PRINTS

During the examination of the different types of lip prints, the lips of each participant were divided into four compartments (i.e., two compartments on the right and left sides of each lip), and the digits "1" to "4" were allocated in a clockwise sequence beginning from the upper right side of the lips. The classification scheme suggested by Suzuki and Tsuchihashi was used to classify the lip prints in this study [Figure 3].

- Type 1: Clear-cut vertical grooves that run across the entire lips
- Type 1': Similar to Type 1, but do not cover the entire lip
- Type 2: Branched grooves
- Type 3: Intersected grooves
- Type 4: Reticular grooves
- Type 5: Grooves do not fall into any of the above categories and cannot be differentiated morphologically (undetermined).

Figure 1: Subject and camera position for photography

Figure 3: Classification scheme by Suzuki and Tsuchihashi

Further, in order to study the uniqueness of lip patterns, lines were drawn along the grooves using the Photoshop pencil tool [Figure 4]. Superimposition of lip patterns of two different individuals was done using the Photoshop software. To perform comparative analysis, opacity of the overlayed image was reduced to 50% [Figure 5]. The data were statistically analyzed using theSPSS ® Inc Statistical Package (version 13; IBM®, Armonk-New York, USA) for the assessment of lip pattern patterns for each sex. for the ass essment of lip pattern patterns for each sex.

RESULTS

The present study involved 200 participants, of which 100 were female and 100 were male. Type I (84 [38.2%]), followed by Type III (72 [32.7%]), Type I' (19 [8.6%]), Type II (11[5.00%]), Type IV (7 [3.2%]), and Type V were found to be the most predominant pattern throughout the entire study population (7 [3.2%]) [Table 1].

The frequency of Type I (54%) and Type III (41%) revealed predominance between males and females. This was followed by Type III (31%), Type IV (5%) and Type V (5%), Type II (3%), and Type I (2%) in males. In females, Type I (30%), Type I (17%), Type II (8%), Type IV (2%), and Type V (2%) showed the following phenomenon [Graph 1]. The Chi-square test was applied to the incidence of lip variations in the upper and lower lips of males and females. The disparity in the pattern between the upper and lower lips was seen to be statistically important ($P \leq 0.001$).

In order to assess the similarity, the current study also followed a superimposition approach in which two lip patterns were superimposed over each other and qualitatively contrasted to verify the uniqueness of the actual lip patterns [Figure 3]. No

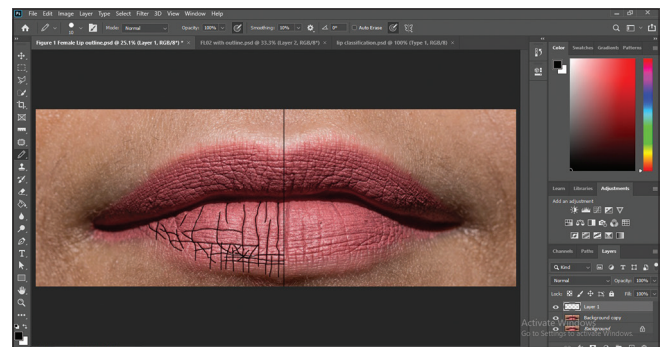**Figure 2:** Camera and additional accessories
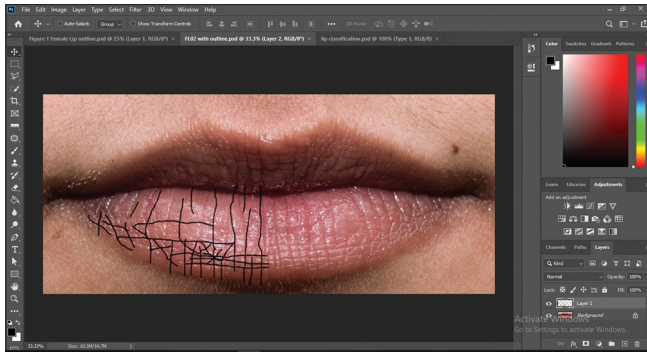

Figure 4: Digital marking of lip groove pattern

Figure 5: Digital superimposition of lip groove pattern

Table 1: Arabic numeral scoring for the individual pattern

| Types of lip pattern	Frequency (%)
Type I	84 (38.2)
Type I'	19 (8.6)
Type II	11 (5.0)
Type III	72 (32.7)
Type IV	7 (3.2)
Type V	7 (3.2)

two lip prints were found to have the identical characteristic patterns and thus showed that each individual had unique lip prints.

DISCUSSION

Identification of an individual (living or dead) is based on the concept of an individual being unique. This study is the first macrophotographic study to identify the different patterns of the lips and to establish its function as a biometric tool for personal identification. While few studies are possible on lip prints, the research conducted by Suzuki and Tsuchihashi presented a new dimension through the traditional classification that provided the basis for several studies in future.[5,6] In the present study, all 200 participants were distinct, and none of the lip patterns were similar.

This finding was consistent with the findings obtained in related studies performed earlier by Tsuchihashi and Suzuki[5,6] and numerous other authors.[7-10] Type I pattern is primarily seen in males and Type III in females, while in Gondivkar *et al.* (2009) Type III analysis, it remained prevalent among females but was popular in male Type-II patterns.[11]

According to Sharma *et al.* and Vahanwala S, Types I and I' were more prevalent in females, while Type IV was male.[8,9] According to a pattern analysis, dominant patterns were seen in females Type I, whereas Type III and Type IV were dominant patterns in males.[12] Lip prints widely seen in photos, cigarette butts, glass cups, window panes, and other objects that may carry lip prints. Further, further experiments need to be carried out to establish lip print trends in the wider population to show that lip printing is a successful method for personal identification.
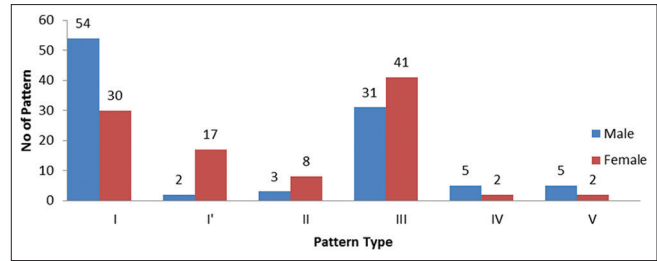
Graph 1: Common lip pattern in male and female

CONCLUSION

Cheiloscopy has become a topic of considerable concern to most researchers as it is noninvasive and readily accessible for the research study. Lip prints are unique to the individual, which can be explained by the fact that no two individuals in the sample group had precisely the same lip score in all quadrants. The macrophotography technique used to capture lip patterns can be used as a successful technique to achieve a definable lip pattern image that will offer improved visualization and ease of lip pattern identification. It also acts as a perfect way of permanently preserving records that can help to preserve an individual's ante-mortem database. Researchers are urged to investigate options for working on other populations around the world so that a contrast and inference can be made on more variability in lip pattern structure in various demographic groups.

CONFLICTS OF INTEREST

There are no conflicts of interest.

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