ORIGINAL RESEARCH

Variation Of Lip Print Patterns In South Indians And Iranian Populations – Does It Aid In Personal Identification?

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ABSTRACT

Introduction: The genetic heterogeneity between different populations has been an immense challenge in identifying ethnicity. The variation of lip print patterns in an ethnic group may be a characteristic feature of that population and therefore aid in forensic investigations.

Aim: This study aimed to analyze the differences in the distribution of lip print patterns between two different ethnic groups, South Indians and Iranians to analyze whether lip prints can be used as a method of personal identification by comparison of successive lip prints. The feasibility of available biometric software for lip print analysis was also investigated.

Methods and Material: This study was conducted on 100 individuals aged between 13 years to 40 years, comprising 50 Iranians (25 females and 25 males) and 50 South Indians (25 females and 25 males). Lip prints were classified using the Tsuchihashi and Suzuki classification system.

Results: Tests showed significant differences in the distribution of patterns between South Indians and Iranians. Type III lip prints were more common (34%) in the South Indians followed by Type IV prints (26%). Iranians showed more Type 1 prints (38%) followed by Type 2 (24%).

The study showed a high degree of accuracy (approx. 85%) in identification of individuals by comparing successive lip prints. The biometric software used in the study was not feasible to analyze lip prints.

Conclusion: The differences in lip print patterns between different races and the ability to identify individuals by comparing successive prints point to the potential of these patterns to identify individuals.

Key-words: cheiloscopy, biometrics, ethnicity

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Conflict of Interest: None

INTRODUCTION

The mouth serves as a reservoir of myriad possibilities in forensic investigations. Among these, Cheiloscopy, the study of lip prints, has gained considerable momentum. It has served as a reliable adjunct in forensic investigations since 1932 when Edmond Locard, a French criminologist, recommended the use of lip prints in personal identification. [1]

Lip prints are formed by the elevations and depressions that form a characteristic pattern on the external surface of the lip. Lip can prove to be crucial in establishing personal identification [2]. It can be obtained from the crime scene from clothing, cups, cigarettes, glasses, windows, doors, etc. [3]

The prevalence of different patterns in different populations has been the subject of a considerable body of research in recent times. Vats et al state that the variation in occurrence of particular patterns in a population may be a characteristic feature of that population [4].

Various methods have been used to classify lip prints. Santos proposed a classification in 1967 that divided lip prints into four types- straight, curved, angled and sine-shaped line patterns. The most commonly used classification however, was proposed by Suzuki and Tsuchihashi in 1970. They divided lip prints into 6 types based on the pattern.

Type I- Vertical grooves running along the full length of the lip
Type I'- Vertical grooves running along partial length of the lip
Type II- Branched pattern
Type III- Intersecting pattern
Type IV- Reticular pattern
Type V- Other patterns [5,6]

The increased demand for documentation of individuals in fields of industry and service sectors, along with the ever-growing forensic databases have led to a vast body of research in the field of biometrics. 'Biometrics' refers to the identification of individuals based on their physical characteristics. Fingerprinting, iris scanning and facial recognition are some of the commonly used biometric identification methods. These methods have been greatly aided by the usage of new technology to record data and interpret it [7].

The fingerprint software Verifinger™ was developed for biometric system integrators in 1998 by Neurotechnology[8]. The same software was used by Ramenzoni et al in 2006 for the automated biometric study of Hunter Schreger Bands of the enamel [7] and by Manjunath et al in 2008 for the automated biometric study of enamel rod end patterns [9].

The Verifinger™ software was designed for fingerprint analysis and was successfully employed in analyzing Hunter Schreger Bands of enamel and enamel rod end patterns [7,8]. The efficacy of the software in analyzing lip prints needs to be determined.

The aims and objectives of this study were to analyze the differences in the distribution of lip print patterns between different ethnic groups, to attempt to use lip prints as a method of personal identification by comparison of successive lip prints. The feasibility of available biometric software for lip print analysis was also investigated.

Materials and Methods:

Study Sample:
The study was conducted on 100 individuals. All participants were briefed and informed consent was obtained. The sample consisted of 50 South Indian (25 males, 25 females) subjects and 50 Iranians (25 males, 25 females) aged between 14 years to 40 years.

Inclusion criteria: Individuals with healthy lips between the ages of 14 years to 40 years.

Exclusion criteria: The study excluded individuals undergoing orthodontic treatment, individuals with active lesions on the lip such as herpes labialis, etc, individuals with congenital abnormalities involving the lip such as cleft lip, Van Der Woude's Syndrome, etc, individuals having undergone trauma to the lip region with significant deformation, individuals who have undergone cosmetic lip reconstruction and individuals with known hypersensitivity to lipstick or any other material used in the study.

Technique:
The cellophane method of obtaining lip prints was used in this study. (Figure 2)

The materials used in the study included: (Figure 1)

- Dark coloured lipstick
- Dark coloured lip liner
- Lipstick applicator brush
- Petroleum jelly
- Transparent cellophane tape
- Scissors
- Cotton wool
- White coloured executive bond sheets
- Magnifying glass

First, the lips of the individual were cleaned thoroughly with sterile cotton. Petroleum jelly was applied on the lips as dry lips would hamper the uniform spread of lipstick. After about 2-3 minutes, excess petroleum jelly was wiped off the lip surface using cotton wool. A lip liner was used to first outline the vermillion zones of the upper and lower lips. Then, dark lipstick was applied on the lips uniformly using a lipstick applicator brush.

After about 2 minutes, lip prints were taken using the adhesive side of transparent cellophane tape of a length of approximately 7cm to 8cm, with the adhesive side facing the patient's lips

The cellophane tape with the lip print was then pasted onto white bond sheets. The lips of the subject were thoroughly wiped off the lipstick

colour after completion of the procedure using cotton wool.

For analysis, each lip print was divided into 6 quadrants, three in the upper lip as upper right (UR), upper middle (UM), upper left (UL) and three in the lower as lower right (LR), lower middle (LM) and lower left (LL).

The lip prints were then digitally scanned using a Canon Digital scanner onto a computer terminal and viewed using Adobe Photoshop application.

The prints were then classified according to Suzuki & Tsuchihashi classification of lip prints. Predominant pattern throughout all quadrants were taken to be the Lip Print type of the person.

Successive lip prints from the same subjects were taken after a period of 2 weeks and then compared with previously acquired lip prints by three observers to match the individual lip prints. The scanned lip prints were analyzed using the VERIFINGER™ software to establish whether the software was able to successfully compare lip prints with prints that were previously saved to its database.

RESULTS

The study sample showed statistically significant differences in the distribution of lip prints between South Indians and Iranians (p=0.007). Type III pattern (Figure 3) was found to be the predominant pattern among South Indians (34%). This was followed by Type I (18%), Type II (18%), Type V (16%) and Type IV (14%). (Table 1)

Type I pattern was the most common pattern seen among Iranians (Figure 4) (38%), followed by Type II (24%), Type IV (22%), Type III (10%), Type V (4%) and Type I' (2%).

When Iranian and South Indian males were compared separately, Type III (28%) was the most common pattern observed among South Indians, followed by Type I, Type II and Type V (24% each).

Among Iranian males, Type I (36%) was again the predominant pattern, followed by Type II (28%) and Type IV (20%). (Table 2)

Analysis of the patterns of South Indian and Iranian females also showed differences in distribution of patterns. 40% of South Indian

females showed Type III pattern followed by 28% Type IV, 12% of Type I and 12 % Type II patterns. 40% of Iranian females showed Type I pattern, followed by Type IV (24%), Type II (20%) and Type III (12%). (Table 3)

When three observers were asked to compare successive lip prints with previously acquired lip prints, 84%-86% of prints were successfully matched. (Table 4)

Lip Print Type	South Indian	Iranian	TOTAL
Type I	9	19	28
Type I'	0	1	1
Type II	9	12	21
Type III	17	5	22
Type IV	7	11	18
Type V	8	2	10
Total	50	50	100

Table 1: Distribution of lip prints based on the Tsuchihashi and Suzuki classification among the study population of South Indians and Iranians.

Lip Print Type	South Indian Males	Iranian Males	TOTAL
Type I	6	9	15
Type I'	0	1	1
Type II	6	7	13
Type III	7	2	9
Type IV	0	5	5
Type V	6	1	7
Total	25	25	50

Table 2: Distribution of lip prints among male South Indians and Iranians only showing Type III being more common among South Indians and Type I among Iranians.

Lip Print Type	South Indian Females	Iranian Females	Total
Type I	3	10	13
Type I'	0	0	0
Type II	3	5	8
Type III	10	3	13
Type IV	7	6	13
Type V	2	1	3
Total	25	25	50

Table 3: Distribution of lip prints among female South Indians and Iranians only showing Type III being more common among South Indians and Type I among Iranians.

	Matched	Not Matched	Total
Observer 1	86	14	100
Observer 2	84	16	100
Observer 3	85	15	100

Table 4: Matching of successive lip prints with the initial prints by three observers resulted in successful matching of 84%-86%.

Inter observer variation between the observers showed a kappa (κ) values of 0.886, 0.899 and 0.886, which implied a high degree of agreement between the observers.

The VeriFinger software was unable to match any successive prints with lip prints stored in the database. Thus, the use of fingerprint biometric software in lip print analysis does not result in positive identification of an individual.

DISCUSSION

The present study showed that Type III (34%) pattern was the most common pattern among South Indians and Type I (38%) among Iranians. Saraswathi et al (2009) reported that Type III pattern (38%) was most common among the population in Kanpur and the reticular Type IV pattern was the least observed [1]. Augustine et al (2008) also reported Type III pattern (48%) as the most common pattern in the Delhi population [9]. Simarpreeth et al (2012) found that Type I pattern was predominant among the Punjabi population with over 40% of males and females exhibiting this pattern [10]. A study among Keralite populations by Verghese et al (2010) found Type IV to be the predominant pattern there [11]. No literature is available on the distribution of patterns in Iranian populations.

The variations in the results of the various studies conducted on different populations suggest that populations have a specific distribution of lip print patterns and might help in identification of ethnicity.

Iranians are largely composed of descendants of the Persian people whose ancestors were the early settlers of the Iranian plateau and Central Asia.

Numerous migrations of populations of early Iranians have spread the descendants of that population to much of Central Asia, Iran and the north western portions of the subcontinent [12]

India has served as an important corridor in human migration. Multiple waves of migrations throughout history have been incorporated into the Indian gene pool. Anthropologists have divided early Indian populations as Ancestral North Indian (ANI) and Ancestral South Indian (ASI) populations. ANI populations have genetic affinity toward Central Asian, Middle Eastern and European populations and ASI populations were unrelated to populations outside India [13].

The present study showed a high degree of similarity between multiple prints of the same

Figure-1: Materials used in the study

Figure-2: Cellophane tape method was used to record the lip prints which were then transferred onto white bond paper.

Figure-3: Type III (intersecting patterns were the most commonly seen patterns among South Indians.

Figure 4: Type I Patterns (Vertical pattern) were the most commonly seen pattern among Iranians

individual as compared to prints from another individual, with around 85% of prints being identified correctly by three different observers. Lip prints are produced by a significantly mobile portion of the lip and that is the primary reason why the same individual can produce varied prints depending on the pressure, direction and method used to take the print [3]. In our experience, the facial expression of the subject and the amount of lipstick, if used, also affects the print produced. This variability in the print of the same individual makes analysis of lip prints by common biometric software challenging. The failure of VERIFINGER[TM] software to identify lip prints can be attributed to the variability of the lip print patterns and primarily, the precise calibration of the software algorithm. The feasibility of other biometric software for fingerprint detection such as Secugen[TM] and IDEX Smartfinger[TM] have not been investigated in this study.

Further research among various population groups is necessary for the establishment of the varying distribution of lip print patterns around the world. Comprehensive databases need to be maintained for comparison and forensic personnel need to be trained in collection and identification of lip prints. The method of collecting lip prints from individuals needs to be standardized. This could also aid in creating reliable software for lip print identification.

CONCLUSION

Lip prints show various patterns among South Indians and Iranians. The most common lip print pattern among South Indians is Type IV, while the most common print among Iranians is Type I. Comparison of successive lip prints from the same individual establishes the uniqueness of lip prints and aids in personal identification. The VERIFINGER v6.6 fingerprint software is unable to process lip prints successfully.

The present study was done on a limited sample size to ascertain differences in the lip print patterns between South Indians and Iranians using the cellophane method to record prints. Further studies need to be done on larger sample sizes to validate the results obtained here. Furthermore, alternative methods to record lip prints such as the use of impression materials, photographs, etc. might produce a better reproduction of individual lip prints for analysis.

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