ORIGINAL ARTICLE

Comparison of lip prints in two different populations of India: Reflections based on a preliminary examination

Anila Koneru, Surekha R, Ganesh Shreekanth Nellithady[1], Vanishree M, Ramesh DNSV[2], Ramesh S Patil[3]

Department of Oral and Maxillofacial Pathology, Navodaya Dental College, [1]Department of Oral and Maxillofacial Pathology, Srinivas Institute of Dental Science, Mangalore, [2]Department of Oral Medicine and Radiology, Navodaya Dental College, [3]Department of Community Medicine, Navodaya Medical College and Research Center, Karnataka, India

Address for correspondence:
Dr. Anila Koneru, Department of Oral and Maxillofacial Pathology, Navodaya Dental College and Hospital, Raichur - 584 101, Karnataka, India.
E-mail: anila.koneru@gmail.com

Abstract

Background: Dental records, fingerprint, and DNA comparisons are probably the most common techniques used for a person's identification, allowing fast and secure identification processes. However, sometimes it is necessary to apply different and less known techniques such as lip prints. The potential of lip prints to determine sex has been well exhibited and documented. However, very few studies have been conducted using lip prints for population identification. **Objective:** To determine the predominant lip print patterns in males and females in relation to Kerala and Manipuri population and also to compare the lip print patterns between these populations. **Materials and Methods:** The sample comprised of 60 subjects, which included 30 each from Kerala and Manipuri. Lipstick was applied evenly, and the lip print was obtained by dabbing a strip of cellophane. The classification scheme proposed by Tsuchihashi was used to classify the lip print patterns and the data were statistically analyzed using the *z*-test for proportions. **Results:** Type 4 and Type 5 lip print patterns were predominant in males, whereas in females it was Type 1 and Type 1′. Type 1 pattern was most common in both the populations, with an incidence of 28.33%. Furthermore, Type 1 pattern was found to be more in Kerala females and Manipuri males when compared to their counterparts. Type 1 was most common in upper right, upper left, and lower left quadrants whereas in lower right quadrant, Type 1′ and Type 4 were predominant in Kerala and Type 5 in Manipuri population. **Conclusion:** Difference between the lip print patterns in two populations exists, although subtle. However, larger sample size is necessary to derive concrete conclusions.

Key words: Kerala population, lip prints, manipuri population, population identification, sex identification

Introduction

With the ever-increasing demands placed upon law enforcement to provide sufficient physical evidence linking a perpetrator to a crime, it makes sense to utilize any type of physical characteristic to identify a suspect of an offense. Establishing a person's identity can be a very difficult process.[1] Dental records, fingerprint, and DNA comparisons are probably the most common techniques used in this context, allowing fast and secure identification processes. However, since they cannot always be used, sometimes it is necessary to apply different and less known techniques such as lip prints.[2]

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The study of lip prints is known as cheiloscopy. Cheiloscopy (from the Greek words *cheilos* meaning "lips" and *e skopein* meaning "to see") is the name given to the lip

print studies. The importance of cheiloscopy is linked to the fact that the lip prints are unique to one person, except in monozygotic twins. Like fingerprints and palatal rugae, the lip grooves are permanent and unchangeable. It is possible to identify the lip print patterns as early as the sixth week in uterine life. From that moment on, the lip groove patterns rarely change, resisting many afflictions and hence lip prints aid as a tool in human identification.[2,3]

In recent years, the potential of lip prints to determine sex has been well exhibited and documented.[2,3] However, very few studies have been conducted using lip prints for population identification. In India, some studies have shown that the patterns formed reveal a population-wise dominance, that is, a particular population will show predominance of a particular lip print type. This is a potentially useful tool for identification. Vahanwalla and Parekh in their study from Mumbai reported that Type 1 was predominant, males had different patterns in all the quadrants whereas females had the same patterns in all the quadrants.[4]

Hence, the aim of this research was to study lip print patterns of different individuals in different parts of the lip and to evaluate in depth the predominant lip print pattern seen in relation to sex and population.

Material and Methods

Subjects

The total sample consisted of 60 students enrolled in Navodaya Educational trust, Navodaya Dental College, Raichur, Karnataka, comprising of 30 (15 males and 15 females) subjects born and brought up in Kerala (a state in Southern India) and 30 (15 males and 15 females) Manipuris, who are born and brought up in Manipur (a state in Eastern India), in the age group of 18-21 years. While people of Kerala are predominantly of the Dravidian (traditional South Indian) stock, those of Manipur are of the Tibeto-Burman stock. The populations of each state are heterogeneous in nature, but belong to a common linguistic heritage. Informed verbal consent was taken from each of them. The subjects were selected whose lips were free from any pathology such as inflammation, mucocele, cicatrization, and deformities such as cut marks or lesions. Those with any known hypersensitivity to the lipstick that was used were also excluded from the study.

Recording the lip prints

The materials used were lipstick of a dark, bright color and nonglossy, transparent cellophane tape (glued on one side), scissors, white chart paper and magnifying lens.

Lips of the subjects were cleaned, and participants were requested to part their lips when the lipstick was applied in a single motion and to gently rub the lips together so as to spread the lipstick evenly [Figure 1]. Lip "impressions" were recorded in the normal rest position of the lips by dabbing a strip of cellophane tape, 10 cm long, in the center first and then pressing it uniformly toward the corners of the lips. The cellophane strip was then stuck on to the white chart paper for permanent record purpose [Figure 2] and then the recorded lip prints were visualized with a magnifying lens. The subjects' serial number was written on the back to serve as a record.

Examination of the lip prints

While studying the various types of lip prints, each individual's lips were divided into four compartments (i.e., two compartments on the right and left-hand sides of each lip), and were allotted the digits "1" to "4" in a clockwise sequence starting from the upper right side of the lips [Figure 3].

In order to classify the lip prints in this study, the classification scheme proposed by Tsuchihashi was used [Figure 4]:[5,6]

Figure 1: Application of lipstick on Manipuri and Kerala female subjects

Figure 2: White chart paper with recorded lip prints

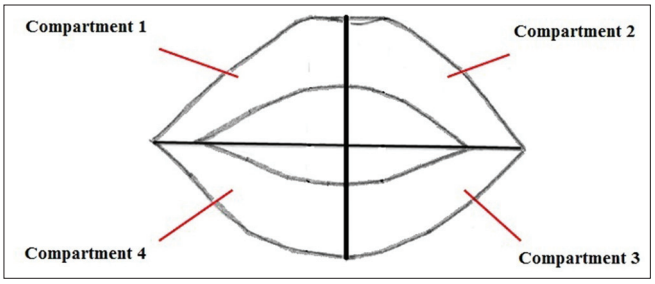

Figure 3: Lips divided into four compartments, i.e., two compartments on each lip, and were allotted the digits 1-4 in a clockwise sequence

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).

The data were analyzed using the *z*-test for proportions. This test is used to compare proportions from two independent samples and *P* value < 0.05 was considered as significant.

Results

Overall, no individual had a single type of lip print in all the four compartments and no two individuals had a similar type of lip print pattern.

When sex was evaluated in both the populations combined, males showed predominantly Type 4 (29.2%) and Type 5 (21.7%) whereas, females showed predominantly Type 1 (43.3%) and Type 1′ (30%). Comparison of all lip print patterns between males and females using the *z*-test showed a significant difference ($P < 0.05$) except for Type 2 lip print pattern [Table 1]. When the *z*-scores of all the lip print patterns were compared, Type 1, Type 4, and Type 5 lip print patterns were most sexually dimorphic.

In the Kerala population, Type 1 lip print pattern was found to be predominant (27.5%), followed by Type 1′ (20%), Type 4 (15%), Type 2 (13.3%), Type 3 (12.5%), and Type 5 (11.6%). In Kerala males, Type 4 (28.3%) and Type 5 (21.6%) lip print patterns were predominant, whereas Type 1 (45%) and Type 1′(31.6%) lip print patterns were predominant in Kerala females. Statistical comparison of all lip print patterns between males and females in Kerala population showed significant differences ($P < 0.05$) except, again, for Type 2 lip print pattern [Table 2].

In the Manipuri population, Type 1 lip print pattern was found to be predominant (29.2%), followed by Type 4 (18.3%), Type 1′ (16.7%), Type 2 (12.5%), Type 5 (12.5%), and Type 3 (10%). In Manipuri males, Type 4 (30%) and Type 5 (21.6%) lip print patterns were predominant, whereas Type 1 (41.67%) and Type 1′ (28.3) lip print patterns were predominant in Manipuri females. Statistical comparison of all lip prints between males and females in Manipuri population showed significant sex dimorphism, except for Type 2 and Type 3 lip print patterns [Table 3].

When the overall patterns were evaluated among all the lip compartments of the entire study subjects (in both Kerala and Manipuri subjects), Type 1 was found to be the most common lip print pattern having 28.33% when compared to other types of lip print patterns. The *z*-test comparison of all lip print patterns between Kerala and Manipuri population revealed no significant differences [Table 4]. Further, Type 1 pattern was found to be more in Kerala females and Manipuri males when compared to their counterparts [Tables 2 and 3].

On analysis of predominant lip print pattern in each compartment in both the populations, Type 1 was most common in compartments 1, 2, and 3, whereas in compartment 4, Type 1′ and Type 4 were predominant in Kerala and Type 5 was predominant in Manipuri population [Table 5].

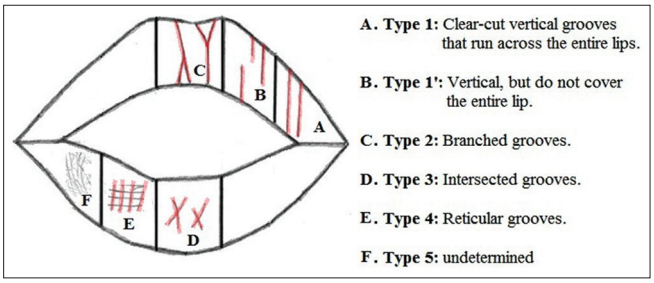

Figure 4: Various types of lip print patterns

Table 1: Comparison of lip print patterns between males and females across both populations of the study

Patterns	Males (%)	Females (%)	*z*-score	*P* value
Type 1	16 (13.3)	52 (43.3)	5.47	<0.0001
Type 1′	8 (6.7)	36 (30)	4.9	<0.0001
Type 2	14 (11.7)	17 (14.17)	0.58	>0.05
Type 3	20 (16.7)	7 (5.83)	2.7	<0.007
Type 4	35 (29.2)	5 (4.17)	5.52	<0.0001
Type 5	26 (21.7)	3 (2.5)	6.22	<0.0001

P>0.05 is not significant, while *P*<0.05 is significant

Table 2: Comparison of lip print patterns between males and females of Kerala population

Patterns	Males (%)	Females (%)	Total (%)	*z*-score	*P* value
Type 1	6 (10)	27 (45)	33 (27.5)	4.67	<0.0001
Type 1′	5 (8.3)	19 (31.6)	24 (20)	3.34	<0.001
Type 2	8 (13.3)	8 (13.3)	16 (13.3)	0.0001	>0.05
Type 3	11 (18.3)	4 (6.7)	15 (12.5)	1.96	<0.05
Type 4	17 (28.3)	1 (1.7)	18 (15)	4.41	<0.0001
Type 5	13 (21.6)	1 (1.7)	14 (11.6)	3.59	<0.0001

P>0.05 is not significant, while *P*<0.05 is significant

Table 3: Comparison of lip print patterns between males and females of Manipuri population

Patterns	Males (%)	Females (%)	Total (%)	*z*-score	*P* value
Type 1	10 (16.6)	25 (41.67)	35 (29.2)	3.13	<0.002
Type 1′	3 (5)	17 (28.3)	20 (16.7)	3.61	<0.0001
Type 2	6 (10)	9 (15)	15 (12.5)	0.83	>0.05
Type 3	9 (15)	3 (5)	12 (10)	1.85	>0.05
Type 4	18 (30)	4 (6.7)	22 (18.3)	3.46	<0.001
Type 5	13 (21.6)	2 (3.3)	15 (12.5)	3.16	<0.002

P>0.05 is not significant, while *P*<0.05 is significant

Discussion

A series of forensic odontological studies on the morphology of the lips and the pattern produced when they are impressed onto a variety of surfaces forms a worthy weapon for personal identification.[1] Work on this subject has already elicited useful information; however, limitations still exist in the use of lip prints.[7] Most common difficulty that we encountered during the sample collection is smudging of lip prints, and this error was rectified by using a better quality lipstick.

Lip prints can be found on surfaces such as glass, clothing, cutlery, or cigarette butts. Even the invisible lip prints can be used and can be lifted using aluminum and magnetic powder. The vermillion border of lips have sebaceous glands with sweat glands in between, therefore, secretions of oil and moisture enable development of "latent" or persistent lip prints, analogous to finger prints.[7,8]

Table 4: Comparison of lip print patterns between Kerala and Manipuri population

Patterns	Kerala population (%)	Manipuri population (%)	Total (%)	*z*-score	*P* value
Type 1	33 (27.5)	35 (29.2)	68 (28.33)	0.29	>0.05
Type 1′	24 (20)	20 (16.7)	44 (18.33)	0.67	>0.05
Type 2	16 (13.3)	15 (12.5)	31 (12.9)	0.19	>0.05
Type 3	15 (12.5)	12 (10)	27 (11.25)	0.61	>0.05
Type 4	18 (15)	22 (18.3)	40 (16.7)	0.69	>0.05
Type 5	14 (11.6)	15 (12.5)	29 (12.1)	0.2	>0.05

P>0.05 is not significant, while *P*<0.05 is significant

Table 5: Predominant lip print pattern (average) in each lip compartment of Kerala and Manipuri population

Lip compartment	Lip print pattern	Kerala population	Manipuri population
1	Type 1	10	11
	Type 1′	4	5
	Type 2	4	4
	Type 3	5	2
	Type 4	5	5
	Type 5	2	3
2	Type 1	8	9
	Type 1′	5	8
	Type 2	4	2
	Type 3	4	3
	Type 4	4	4
	Type 5	5	2
3	Type 1	9	9
	Type 1′	8	1
	Type 2	4	4
	Type 3	2	4
	Type 4	2	8
	Type 5	3	3
4	Type 1	6	6
	Type 1′	7	6
	Type 2	4	5
	Type 3	4	3
	Type 4	7	5
	Type 5	4	7

In the past, some researchers have worked extensively on lip prints with the intention of proving that sex difference does exist in lip prints and thus useful in sex and personal identification.[9-11] However, studies on lip prints in population identification are scanty. In addition, on extensive review of the literature, no studies that compared lip print patterns between two populations exists (which contrasts with palatoscopy that has been explored in various population-based studies). Hence, in this study an effort is been made to compare the lip print patterns in two geographically different parts of India (i.e., Manipur and Kerala) to observe if any predominant pattern exists in these populations.

On analysis of lip print pattern in males, Type 4 and Type 5 patterns were found to be predominant, where as in females it was found to be Type 1 and Type 1′. Our results are in accordance with that of Vahanwalla and Parekh[4] and Sharma *et al*.[6,11] but these results do not coincide with of Saraswathi *et al*.[10] Comparison of lip print patterns between males and females in both the populations showed a statistically significant difference except for Type 2 lip print pattern.

In Kerala males, Type 4 and Type 5 were found to be predominant, whereas in Kerala females Type 1 and Type 1′ were predominant. In contrast to our study, Verghese *et al*.[12] observed Type 4 to be predominant in *both* the sexes in a Kerala population. Further, in our study, comparison of lip print patterns between Kerala males and females showed a statistically significant difference except in Type 2 lip print pattern.

In both the study populations, Type 1 lip print pattern was found to be predominant; however, other studies on Indian subjects have yielded varying results. Vahanwalla and Parekh[4] in their Mumbai study also found that Type 1 was the most frequent. Sivapathasundharam *et al*.[9] studied the lip prints of Indo-Dravidian population (from Tamil Nadu) and noted that Type 3 was predominant. Verghese *et al*.[12] studied lip prints in the population of Kerala and found that the most common pattern was Type 4. Further in our study, there was no statistically significant difference seen on comparison of lip print patterns between Kerala and Manipuri population. However, the reason for subtle difference *only* could be attributed to smaller sample size. This signifies that lip prints have no racial differences and hence may not be used for population identification.

Conclusion

Cheiloscopy is a relatively new field among the large number

of identification tools available to the forensic expert. In our study, in general in males Type 4 and Type 5 patterns were predominant and Type 1 and Type 1′ in females. Type 1 lip print pattern was most common in both the populations but differed only in sex (i.e., Type 1 was more in Kerala females than Manipuri females and Manipuri males had more Type 1 lip print patterns compared to Kerala Males). Difference between the lip print patterns in two populations exists although subtle. This minor difference in two populations of India warrants further research on larger sample and more number of populations.

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