

Morphological patterns of lip prints in Mangaloreans based on Suzuki and Tsuchihashi classification

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Abstract

Introduction: Cheiloscopy is the study of the furrows or grooves present on the red part or vermilion border of the human lips. The present study aims to classify the characteristics of lip prints and to know the most common morphological pattern specific to Mangalorean people of Southern India. For the first time, this study also assesses the association between gender and different lip segments within a population.

Materials and Methods: A total of 200 residents of Mangalore (100 males and 100 females) were included of age ranging from 18 years to 60 years. Materials used to take the impression of lips included red lipstick, A4 size white bond paper and cellophane tape. The prints obtained were scanned using a Canon Image Scanner and stored in a folder on a personal computer. The images were cropped and inverted in gray scale using Adobe Photoshop software. Each lip print was divided into eight segments and was examined. Suzuki and Tsuchihashi's classification (1970) was used to classify the types of grooves, and the results were statistically analyzed. Six types of grooves were recorded in the Mangalorean's lips.

Statistical Analysis: Association between gender and different lip segments was tested using Chi-square analysis in the given population.

Results: In males, the groove Type I' was the highest recorded followed by Type III, Type II, Type I, Type IV and Type V in descending order. In females, Type I' was the highest recorded followed by Type II, Type III, Type IV, Type I and Type V in descending order.

Conclusion: Males and females displayed statistically significant differences in lip print patterns for different lip sites: lower medial lip, as well as upper and lower lateral segments. Only the upper medial lip segment displayed no statistically significant difference in lip print pattern between males and females. This shows that the distribution of lip prints is generally dissimilar for males and females, with varying predominance according to lip segment.

Key Words: Cheiloscopy, forensic odontology, lip prints, personal identification

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INTRODUCTION

Personal identification is of great importance in forensic investigation. It is based on the theory that all individuals are unique and can be identified on the basis of individual characteristics.^[1] Dental, fingerprint and DNA comparisons are probably the most common techniques used for this purpose. However, there is still a need for reliable alternative methods of establishing identity in cases where the above techniques are unavailable.^[2]

Cheiloscopy is one such technique. It studies the furrows or grooves present on the red part or vermilion border of human lips. These furrows or grooves form a characteristic pattern over the external surface of lip, referred to as lip prints. The importance of cheiloscopy is linked to the fact that lip prints are unique to each individual, except in monozygotic twins. Lip prints are identifiable as early as the 6th week of intrauterine life, and from then on, their pattern rarely changes, resisting many afflictions such as herpetic lesions.^[3] Lip prints can be obtained directly from a body or indirectly at a crime scene from a number of sources such as clothing, cups, cigarette butts, letters, windows and doors.^[4]

In 1902, Fischer first described the biologic phenomenon of characteristic patterns of furrows on the vermilion border of human lips. But not until 1950, when Synder suggested the idea of using lip prints for identification, did cheiloscopy gain a useful purpose. Since then, Japanese scientists, Tsuchihashi and Suzuki have carried out the most extensive research in this field. Based on that research, it was established that lip print patterns are unique for each human being. Tsuchihashi and Suzuki also proposed a classification of lip prints, that is the most widely used classification in literature to date.^[1]

For the first time, the present study intends to report on the morphological patterns of lip prints specific to Mangalorean people in Southern India. The study also intends to assess the association between gender and different lip segments within this population and confirms that lip print patterns are unique to each individual.

MATERIALS AND METHODS

The participants included in the present study were 100 females and 100 males, all residents of Mangalore, a coastal city along the West coast of South India of age ranging from 18 years to 60 years. Informed consent was obtained prior to taking the lip prints. Participants with any evidence of disease and injury of the lips, dry lips, cleft lip, laceration and scars were excluded from the study.

Recording the lip prints

The lips of the participants were thoroughly cleaned with cleansing milk and gauze for hygienic purpose. The lipstick

was cleaned with tissue paper. Lipstick was applied in a single motion, evenly on the upper lip, then on the lower lip. The participants were asked to rub his or her upper and lower lips together, which would help to spread the lipstick evenly on all segments of the lips and were allowed to dry for 3 min. The lip prints of each lip were taken separately using (Wonder-555 Tape) cellophane tape 2.4 cm in width, cut out into 10 cm strips. The participants were asked to open the mouth slightly and to keep the mouth stationary during the procedure. The glued portion of the cellophane tape was applied on the lower lip and held in place, applying gentle and even pressure for a few seconds, to allow the print to mark the tape. Then, the tape was carefully lifted from the lip, from one end of the strip to the other, avoiding any smudging of the print. The tape was then stuck carefully on A4 size white bond paper taking care to avoid stretching or folding of the tape. In the same way, the upper lip was also recorded.^[5] The lip prints obtained were scanned, using a Cannon Image Scanner set at a resolution of 600 ppi and viewed using Adobe® Photoshop® 7.0 software. The scanned images were cropped, inverted in gray scale and each side was further divided into equal grids using the ruler in the software and stored in a separate folder as a PSD (Adobe Photoshop Image) file [Figure 1].^[6,7]

Examination of lip prints

The lip print was divided into two quadrants at the midline and then, each quadrant was further divided into two equal parts as medial and lateral. Each segment was named according to the side they expressed as upper right lateral, upper right medial, upper left medial, upper left lateral, lower right lateral, lower right medial, lower left medial and lower left lateral [Figure 2].^[7] The lip prints were classified using the classification proposed by Suzuki and Tsuchihashi in 1970 [Figure 3]. During the analysis of lip prints, the most dominant pattern was considered for the classification

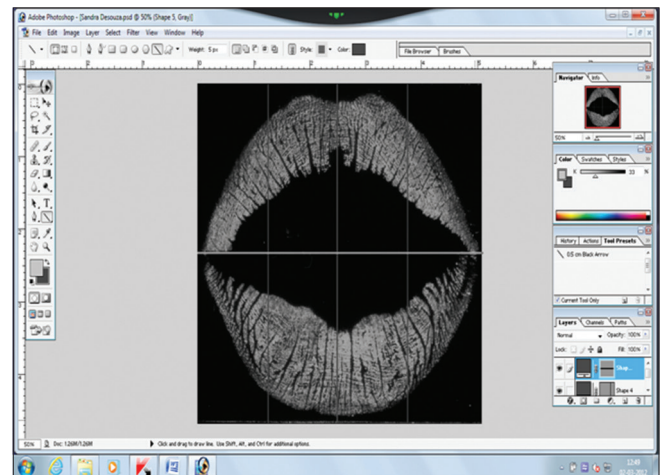


Figure 1: Adobe Photoshop software used for the analysis of lip prints

in each quadrant. Therefore, the used classification was as follows: Type I: a clear-cut groove running vertically across the lip [Figure 4], Type I': a partial length groove of Type I [Figure 5], Type II: a branched groove [Figure 6], Type III: an intersected groove [Figure 7], Type IV: a reticular groove [Figure 8] and Type V: other patterns [Figure 9].^[8]

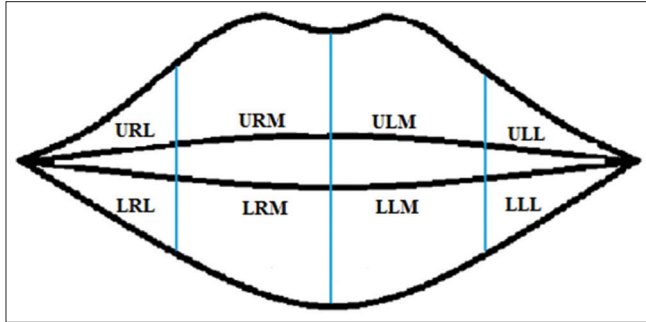


Figure 2: Diagram showing the quadrants and segments of the lip. URL: Upper right lateral, URM: Upper right medial, ULM: Upper left medial, ULL: Upper left lateral, LRL: Lower right lateral, LRM: Lower right medial, LLM: Lower left medial and LLL: Lower left lateral

Statistical analysis

All data were analyzed statistically using a current SPSS® Inc statistical package (version 13) for determining the frequencies of the pattern types in each quadrant of the lip, frequencies of the pattern types in each gender and for comparison between the entire upper and lower lip of male and females, and also

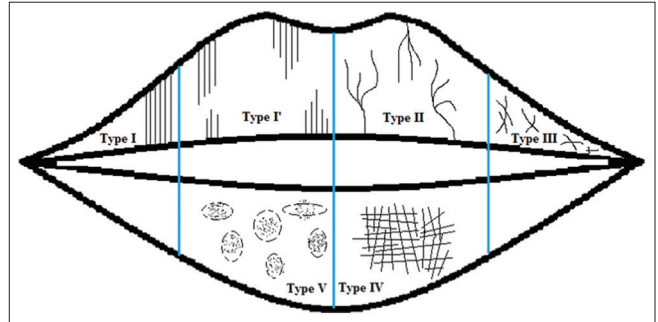


Figure 3: Diagram showing the Suzuki and Tsuchihashi classification of lip prints. Type I vertical grooves, Type I' partial length groove of Type I, Type II branched groove, Type III intersected groove, Type IV reticular groove and Type V other patterns

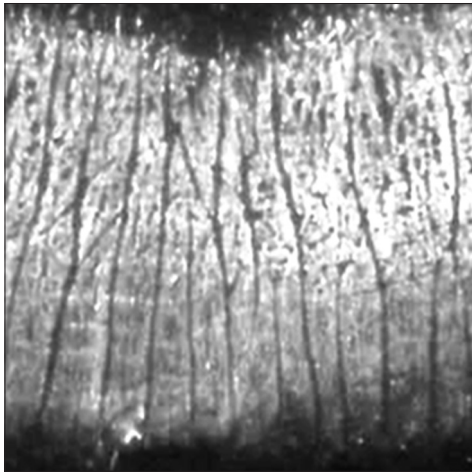


Figure 4: Type I: vertical grooves

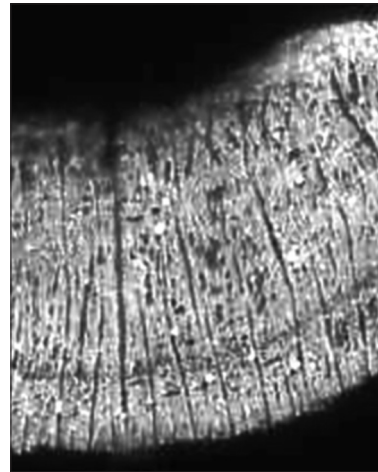


Figure 5: Type I': partial length groove of Type I

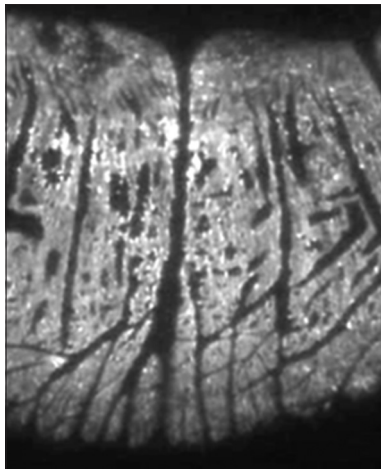


Figure 6: Type II: branched groove

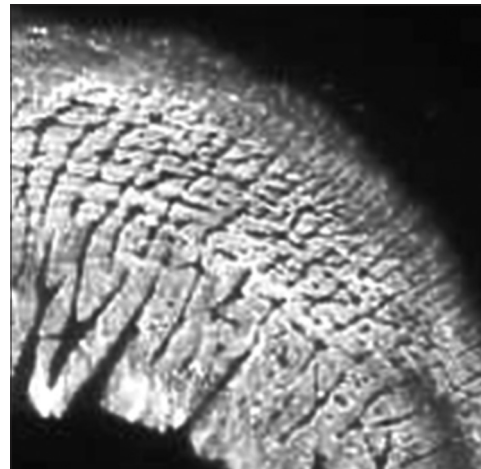


Figure 7: Type III: intersected groove

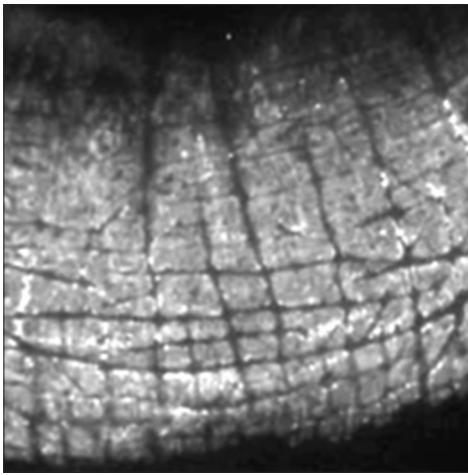


Figure 8: Type IV: reticular groove

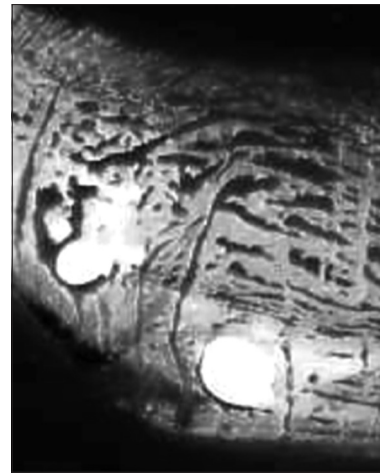


Figure 9: Type V: other patterns

the medial and lateral segments of the upper and lower lips were done. Chi-square tests were applied to the sum total of lip print patterns in the upper, lower, medial and lateral segments separately.

RESULTS

The participants were 200 residents of Mangalore (100 females and 100 males) of age ranging from 18 to 60 years. Lip print patterns of 100 males and 100 females revealed Type I: (5%) male, (1%) female; Type I': (57%) male, (35%) female; Type II: (5%) male, (31%) female; Type III: (15%) male, (22%) female; Type IV: (1%) male, (4%) female; Type V: (1%) male, (1%) female; and combination Types I and I' (16%) male, I and I' (6%) female.

Upper lip of males

It was observed among 100 males that the upper lip showed a predominance of Type I' pattern constituting 46.25% of all the patterns, this was followed in the occurrence by Type II (18.25%), Type III (15.5%), Type V (8.5%), Type IV (7.75%) and Type I (3.75%). Type I' was more predominant in lateral and medial quadrants of upper lip as it was uniformly distributed. Type II pattern showed slight predominance in the left medial quadrant, followed by Type IV, Type III, Type V and Type I patterns. Type I' was more common in lateral segments, followed by Type III, Type II, Type V, Type I and Type IV. Type V pattern was slightly more common in the lateral segments compared to medial segments [Table 1]. Chi-square test was applied to the distribution of different patterns in different areas of the upper lip of males. The test result revealed that the difference was statistically significant ($P \leq 0.033$).

Lower lip of males

The lower lip of males also showed a predominance of Type I' pattern which constituted 38.5% of all the patterns.

Table 1: Lip print patterns in different segments of the upper lip of 100 females and 100 males

Types	Segments (gender)	LRL	LRM	LLM	LLL	Total	Percentage	P
Type I	Male	6	4	3	2	15	3.75	≤ 0.033
	Female	5	2	4	3	14	3.5	≤ 0.001
Type I'	Male	42	51	44	48	185	46.25	≤ 0.033
	Female	35	39	33	26	133	33.25	≤ 0.001
Type II	Male	16	16	23	18	73	18.25	≤ 0.033
	Female	22	24	32	39	117	29.25	≤ 0.001
Type III	Male	19	10	12	21	62	15.5	≤ 0.033
	Female	29	13	12	20	74	18.5	≤ 0.001
Type IV	Male	4	13	12	2	31	7.75	≤ 0.033
	Female	3	18	13	1	35	8.75	≤ 0.001
Type V	Male	13	6	6	9	34	8.5	≤ 0.033
	Female	6	4	6	11	27	6.75	≤ 0.001
Total	Male	100	100	100	100	400	100	
	Female	100	100	100	100	400	100	

URL: Upper right lateral, URM: Upper right middle, ULM: Upper left middle and ULL: Upper left lateral

This was followed by Type III (23%), Type II (17.25%), Type I (11.75%), Type IV (5.5%) and Type V (4%) patterns. On the other hand, Type I' was the most common pattern in the medial part of the lower lip. This was followed by Type III, Type IV, Type V, Type II and Type I patterns. While Type III and Type II pattern predominated in the lateral segments as compared to the medial segments. This was followed by Type I', Type I, Type V and Type IV patterns [Table 2]. Chi-square test was applied to the distribution of different patterns in different areas of the lower lip of males. The test result revealed that the difference was statistically significant ($P \leq 0.001$).

Upper lip of females

Among 100 females, the upper lip showed a predominance of Type I' pattern constituting 33.25% of all the patterns. This was followed in the occurrence by Type II (29.25%), Type III (18.5%), Type IV (8.75%), Type V (6.75%) and Type I (3.5%). Type I' pattern was the most common in the medial segment of the lower lip followed by Type II, Type IV,

Type III, Type V and Type I patterns. The lateral segments were composed predominantly of Type I' and Type II followed by Type III, Type V, Type I and Type IV patterns. Type III pattern was slightly more common in the lateral segment than in the medial segment [Table 1]. Chi-square test was applied to the distribution of different patterns in different areas of upper lip of females; the test result revealed that the difference was statistically significant ($P \leq 0.001$).

Lower lip of females

The lower lip of females also showed a predominance of Type I' pattern (27.75%). This was followed by Type II (25.75%), Type III (24.5%), Type IV (10.75%), Type I (8.75%) and Type V (2.5%). Type I' pattern was the most common in the medial segments of the lower lip followed by Type IV, Type II, Type III, Type I and Type V patterns. The medial segments were composed predominantly of Type III pattern followed by Type II, Type I, Type I', Type V and Type IV patterns. Type IV and Type V patterns were more common in the medial areas of the lower lip than the lateral areas [Table 2]. Chi-square test was applied to the distribution of different patterns in different areas of the lower lip of females. The test result revealed that the difference was statistically significant ($P \leq 0.001$).

Upper lip and lower lip of males and females combined

Among males and females, the upper lip showed a predominance of Type I' (39.75%) of all the patterns. This was followed in the occurrence by Type II (23.75%), Type III (17%), Type IV (8.25%), Type V (7.625%) and Type I (3.625%) [Table 3]. The lower lip also showed a

Table 2: Lip print patterns in different segments of the lower lip of 100 females and 100 males

Types	Segments (gender)	LRL	LRM	LLM	LLL	Total	Percentage	P
Type I	Male	22	6	4	15	47	11.75	≤ 0.001
	Female	14	2	4	15	35	8.75	≤ 0.001
Type I'	Male	17	54	61	22	154	38.5	≤ 0.001
	Female	7	43	53	8	111	27.75	≤ 0.001
Type II	Male	29	4	7	29	69	17.25	≤ 0.001
	Female	39	19	11	34	103	25.75	≤ 0.001
Type III	Male	31	19	12	30	92	23	≤ 0.001
	Female	40	15	6	37	98	24.5	≤ 0.001
Type IV	Male	0	10	11	1	22	5.5	≤ 0.001
	Female	0	19	24	0	43	10.75	≤ 0.001
Type V	Male	1	7	5	3	16	4	≤ 0.001
	Female	0	2	2	6	10	2.5	≤ 0.001
Total	Male	100	100	100	100	400	100	
	Female	100	100	100	100	400	100	

URL: Upper right lateral, URM: Upper right middle, ULM: Upper left middle and ULL: Upper left lateral

Table 3: Comparison of entire upper and lower lip of males and females

Types	Type I	Type I'	Type II	Type III	Type IV	Type V	Total	P
Upper lip (%)	29 (3.625)	318 (39.75)	190 (23.75)	136 (17)	66 (8.25)	61 (7.625)	800	≤ 0.001
Lower lip (%)	82 (10.25)	265 (33.125)	172 (21.5)	190 (23.75)	65 (8.125)	26 (3.25)	800	≤ 0.001
Total	111	583	362	326	131	87	1600	

predominance of Type I' (33.125%) among all patterns. This was followed by Type III (23.75%), Type II (21.5%), Type I (10.25%), Type IV (8.125%) and Type V (3.25%) [Table 3]. Chi-square test was applied to the frequency of occurrence in lip patterns in the upper and lower lips of males and females. The difference in pattern between the upper and lower lips was found to be statistically significant ($P \leq 0.001$).

Lateral segments of the upper lip and lower lip of males and females

The lip print patterns of males and females in the lateral segments of upper lip showed a predominance of Type I' (37.75%) followed in order by Type II (23.75%), Type III (22.25%), Type V (9.75%), Type I (4%) and Type IV (2.5%) [Table 4]. The lower lip showed a predominance of Type III (34.5%) among all patterns. This was followed in the occurrence by Type II (32.75%), Type I (16.5%), Type I' (13.5%), Type V (2.5%) and Type IV (0.25%) [Table 4]. Chi-square test was applied to the distribution of different patterns in lateral segments of males and females. The difference in pattern between upper and lower lips was found to be statistically significant ($P \leq 0.001$).

Medial segments of the upper lip and lower lip of males and females

The lip print patterns of males and females in the medial segments of upper lip showed a predominance of Type I' (41.75%) followed in order by Type II (23.75%), Type IV (14%), Type III (11.75%), Type V (5.5%) and Type I (3.25%) [Table 5]. The lower lip also showed a predominance of Type I' (52.75%) among all patterns. This was followed in the occurrence by Type IV (16%), Type III (13%), Type II (10.25%), Type I (4%) and Type V (4%) [Table 5]. Chi-square test was applied to the distribution of different patterns in medial segments of males and females. The difference in pattern between the upper and lower lips was found to be statistically significant ($P \leq 0.001$).

Lateral segments of the upper lip in males

The lip print patterns of males in the lateral segments of upper lip showed a predominance of Type I' (45%) followed in order by Type III (20%), Type II (17%), Type V (11%), Type I (4%) and Type IV (3%) [Table 6].

Lateral segments of the upper lip in females

In females, the predominant pattern was Type I' and Type II (30.5%) of all the patterns. This was followed in the

occurrence by Type III (24.5%), Type V (8.5%), Type I (4%) and Type IV (2%) patterns [Table 6]. Chi-square test was applied to the distribution of different patterns in lateral segments of the upper lip in males and females. The difference in pattern between males and females lip was found to be statistically significant ($P \leq 0.0096$).

Medial segments of the upper lip in males

The lip print patterns of males in the medial segments of upper lip showed a predominance of Type I' (47.5%) followed in order by Type II (19.5%), Type IV (12.5%), Type III (11%), Type V (6%) and Type I (3.5%) [Table 7].

Medial segments of the upper lip in females

In females, the predominant pattern was Type I' (36%) among all patterns. This was followed in the occurrence by Type II (28%), Type IV (15.5%), Type III (12.5%), Type V (5%) and Type I (3%) [Table 7]. Chi-square test was applied to the distribution of different patterns in medial segments of the upper lip in males and females. The difference was not found to be statistically significant ($P \leq 0.199$).

Lateral segments of the lower lip in males

The lip print patterns of males in the lateral segments of lower lip showed a predominance of Type III (30.5%) followed in

order by Type II (29%), Type I' (19.5%), Type I (18.5%), Type V (2%) and Type IV (0.5%) [Table 8].

Lateral segments of the lower lip in females

In females, the predominant pattern was Type III (38.5%) among all the patterns. This was followed in the occurrence by Type II (36.5%), Type I (14.5%), Type I' (7.5%) and Type V (3%) [Table 8]. Chi-square test was applied to the distribution of different patterns in lateral segments of the lower lip in males and females. The difference in pattern between male and female lips was found to be statistically significant ($P \leq 0.0041$).

Medial segments of the lower lip in males

The lip print patterns of males in the medial segments of lower lip showed a predominance of Type I' (57.5%) followed in order by Type III (15.5%), Type IV (10.5%), Type V (6%), Type II (5.5%) and Type I (5%) [Table 9].

Medial segments of the lower lip in females

In females, the predominant pattern was Type I' (48%) among all the patterns. This was followed in the occurrence by Type IV (21.5%), Type II (15%), Type III (10.5%), Type I (3%) and Type V (2%) [Table 9]. Chi-square test was

Table 4: Lateral segments of upper lip and lower lip of males and females

Types	Type I	Type I'	Type II	Type III	Type IV	Type V	Total	P
Upper lip (URL + UL) (%)	16 (4)	151 (37.75)	95 (23.75)	89 (22.25)	10 (2.5)	39 (9.75)	400	≤ 0.001
Lower lip (LRL + LLL) (%)	66 (16.5)	54 (13.5)	131 (32.75)	138 (34.5)	1 (0.25)	10 (2.5)	400	≤ 0.001
Total	82	205	226	227	11	49	800	

Table 5: Medial segments of upper lip and lower lip of males and females

Types	Type I	Type I'	Type II	Type III	Type IV	Type V	Total	P
Upper lip (URM+ULM) (%)	13 (3.25)	167 (41.75)	95 (23.75)	47 (11.75)	56 (14)	22 (5.5)	400	≤ 0.001
Lower lip (LRM+LLM) (%)	16 (4)	211 (52.75)	41 (10.25)	52 (13)	64 (16)	16 (4)	400	≤ 0.001
Total	29	378	136	99	120	38	800	

Table 6: Lateral segments of upper lip in males and females

Types	Type I	Type I'	Type II	Type III	Type IV	Type V	Total	P
Males (%)	8 (4)	90 (45)	34 (17)	40 (20)	6 (3)	22 (11)	200	≤ 0.0096
Females (%)	8 (4)	61 (30.5)	61 (30.5)	49 (24.5)	4 (2)	17 (8.5)	200	≤ 0.0096
Total	16	151	95	89	10	39	400	

Table 7: Medial segments of upper lip in males and females

Types	Type I	Type I'	Type II	Type III	Type IV	Type V	Total	P
Males (%)	7 (3.5)	95 (47.5)	39 (19.5)	22 (11)	25 (12.5)	12 (6)	200	≤ 0.199
Females (%)	6 (3)	72 (36)	56 (28)	25 (12.5)	31 (15.5)	10 (5)	200	≤ 0.199
Total	13	167	95	47	56	22	400	

Table 8: Lateral segment of lower lip in males and females

Types	Type I	Type I'	Type II	Type III	Type IV	Type V	Total	P
Males (%)	37 (18.5)	39 (19.5)	58 (29)	61 (30.5)	1 (0.5)	4 (2)	200	≤ 0.0041
Females (%)	29 (14.5)	15 (7.5)	73 (36.5)	77 (38.5)	0 (0)	6 (3)	200	≤ 0.0041
Total	66	54	131	138	1	10	400	

Table 9: Medial segment of lower lip in males and females

Types	Type I	Type I'	Type II	Type III	Type IV	Type V	Total	P
Males	10 (5)	115 (57.5)	11 (5.5)	31 (15.5)	21 (10.5)	12 (6)	200	≤0.001
Females	6 (3)	96 (48)	30 (15)	21 (10.5)	43 (21.5)	4 (2)	200	≤0.001
Total	16	211	41	52	64	16	400	

applied to the distribution of different patterns in medial segments of the lower lip in males and females. The difference in pattern between male and female lips was found to be statistically significant ($P \leq 0.001$).

DISCUSSION

Over the lips, the Klein's zone is the area usually where the identification is concerned, and is covered with grooves and wrinkles that form a unique characteristic pattern.^[3] The present study is the first to describe the morphological patterns of lip prints specific to Mangalorean people in Southern India. This study also confirms the uniqueness of Mangalorean lip prints as no identical lip print patterns appeared in any two participants, in agreement with the studies of different populations around the world.^[9]

In males, the Type I' lip pattern was the highest recorded followed by Type III, Type II, Type I, Type IV and Type V in descending order. In females, Type I' was the highest recorded followed by Type II, Type III, Type IV, Type I and Type V in descending order. These results are in contrast to a number of other studies that offer varying results themselves.

Tsuchihashi studied the lip prints of 1364 Japanese men and women and found that in both genders, Type III predominated followed in descending order by Types I, II, IV and V.^[10] Sivapathasundharam studied 200 people's lip prints in Chennai, India, revealing Type III pattern as the most predominant and Type IV as least commonly occurring.^[5] Whereas Prabhu *et al.* studied 100 students from Goa, India, finding Type V to be the predominant pattern followed by Type I.^[11] This suggests that lip print patterns may vary geographically.

Hereditary factors have also been suggested as having possible influence on lip prints, some of which were found by the study of twins. The effect of age and seasonal influences on lip print patterns remains an unknown factor, which needs further study, perhaps also contributing to the variability between different studies.^[8]

Every individual's segment did not have just one pattern, but appeared to have a mixture of different patterns. In this study, only the most dominant pattern was considered for the classification for each segment. If the sums of individual lines were used as Prabhu *et al.* had done, then this may have possibly changed our results.^[11]

The present study has also assessed the association between gender and different lip segments within the Mangalorean population. Males and females displayed statistically significant differences in lip print patterns for different lip sites: lower medial lip, as well as upper and lower lateral segments. Only the upper medial lip segment displayed no statistically significant difference in lip print pattern between males and females. This shows that the distribution of lip prints are generally dissimilar for males and females, with varying predominance according to lip segment. However, despite lip print patterns showing dissimilarity from each other, it cannot be used as an identification tool for gender determination, as a particular pattern is not specific to any gender or any lip segment in a particular gender.

Comparing different lip segments (both genders combined), there are statistically significant differences in lip print patterns between upper versus lower lips, upper medial versus lower medial lip segments and upper lateral versus lower lateral lip segments.

Similarly, comparing different lip segments, for males only and females only (genders considered separately), there are also statistically significant differences in lip print patterns between upper and lower lips and also between medial and lateral segments of each lip, respectively. This shows that the distribution of lip prints is dissimilar between different lip segments.

Overall, there appears to be a general spread of lip patterns – no pattern exclusively missing between genders and upper, lower, medial, or lateral parts of the lip, in accordance with other studies such as a study by Vahanwala.^[12]

Analyzing, recording, visualizing and identification of latent lip prints over building evidence is often a key in investigating a crime.^[13] Lip prints on porous surfaces, such as multicolored fabric or paper napkins and lysochrome compounds are quite effective in developing recent as well as older latent lip prints and uses of luminescence will be of immense help as shown by Castelló *et al.*^[14,15] However, a study by Ramakrishnan *et al.* proved that lysochrome dyes could be used in the development of latent lip prints and could be applied in sex determination with an individual at its accuracy.^[16] With regard to the study method, physically recording lip prints is still a labor-intensive and technique-sensitive process. Prabhu *et al.*^[11] presents a digital approach to cheiloscopy, which has been adopted in this study's method. Using Adobe Photoshop 7 software to digitally analyze lip prints has indeed proven to be a convenient

and more accurate way of visualizing, identifying and storing lip print patterns. Digital ante-mortem records can be stored permanently and readily accessed, just as DNA, fingerprint and dental records have been for years already.^[11] Modern digital methods will hopefully continue to develop the field of cheiloscropy and allow for its wider use.

CONCLUSION

Cheiloscropy provides a useful alternative means of identifying individuals due to the consistent variability in lip print patterns. The present study provides detailed information on the morphological patterns of lip prints specific to Mangalorean people in Southern India for the first time. This information is not only useful as a “snapshot” of the Mangalorean population but also its analysis provides useful insights into how these results compare between different segments of the lip, gender and between other populations.

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Conflicts of interest

There are no conflicts of interest.

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