



Heritability and Correlation of Lip Prints and Palmprints in South Kerala Population

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ABSTRACT

Background: Forensic dentistry, a branch of forensic sciences, identify suspects with the uniqueness of oral and maxillofacial structures. Lip prints and palmprints are unique.

Aims and objectives: The present study was carried out with the objectives of evaluating the correlation between lip prints and palmprints and heritability of lip prints and palmprints among parents and their off springs. The predominant pattern of lip prints and palmprints were also analyzed.

Materials and methods: The study group comprised of 35 families from South Kerala population. Participants belonging to the same family pedigree—Father, mother, children of each family were selected.

Results: The predominant lip pattern in the entire study population was Type II. The predominant palm pattern in the entire study population was Category 5 in both right and left palm. Lip pattern shows a positive correlation with right palm pattern, but it is statistically insignificant ($p = 0.144$). Lip pattern showed neither positive correlation nor significant association with the left palm. This study results revealed significant association between lip print patterns among parents and children ($p = 0.04$).

Conclusion: The present study was conducted to find out the heritability and correlation of lip and palmprints in the South Kerala population. Lip pattern shows a positive correlation with right palm pattern, but it is statistically insignificant. Significant association between lip print patterns among parents and children were noticed in our study.

Keywords: Cheiloscopy, Dermatoglyphics, Correlation, Heritability.

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INTRODUCTION

Forensic sciences deals with areas of importance pertaining to be used in a judicial makeup approved by the court and scientific community which delineates truth from forgery.^{1,2} Lip prints and palmprints are unique and

do not change during the lifetime of a person.³ Finger prints, DNA profiling, forensic anthropometry are the common techniques employed in personal identification, mass disasters etc. In spite of existing as a methodology in forensic sciences, cheiloscopy and dermatoglyphics have not been successfully utilized.⁴

The characteristic patterns of the wrinkles and grooves (sulci labiorum) present on the labial mucosa constitutes the lip prints. Cheiloscopy deals with the study of these patterns.^{5,6} Lip prints were first described by Fischer in 1902.^{2,3,7-9} In 1930, Diou de Lille developed some studies which led to the use of lip prints in criminology. In 1932, Edmond Locard, one of France's greatest criminologists, acknowledged the importance of cheiloscopy. In 1950, Le Moyer Snyder, in his book, 'Homicide Investigation' mentioned the possibility of using lip prints in the matter of human identification. In 1960, Santos suggested that the fissures and the criss-cross lines in the lips could be divided into different groups.^{3,8,10}

The word dermatoglyphics was coined by Cummins and Midlo in 1926 (dermskin and glyphe-carving).¹¹⁻¹³ A palmprint is defined as prints on a palm, which are mainly composed of palm lines and ridges. Principal lines are defined according to their position and thickness—the heart line, the head line, the life line.¹⁴⁻¹⁶

Palmprint, which is a relatively new biometric feature, has several advantages compared with the currently available features. Palmprints contain more information than finger prints, so they are more distinctive; palmprint capture devices are much cheaper; palmprints contain additional distinctive features, such as principal lines and wrinkles; which can be extracted from low resolution images.¹⁴ Shu et al used the orientation property of the ridges on palms to classify offline high resolution palmprints into six categories.¹⁷ But, this method is unsuitable for low resolution images. Wu et al classified palmprints by taking into account their most visible and stable features, i.e. principal lines.¹⁴⁻¹⁶

The present study was carried out with the objectives of evaluating the correlation between lip prints and palmprints and heritability of lip prints and palmprints among parents and their off springs. Like lip prints, palmprints are also unique. So, they help in forensic crime detection, personal identification of missing persons or culprits hiding their identity.

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AIMS AND OBJECTIVES

1. To analyze the predominant pattern of lip prints.
2. To analyze the predominant pattern of palmprints.
3. To identify the correlation between the palm and lip print patterns.
4. To compare the lip print and palmprint patterns among family members.

MATERIALS AND METHODS

The study group comprised of 35 families from South Kerala population 2 to 88 years of age. Participants belong to the same family pedigree—Father, mother, children. Those who were willing to participate in the study with no known history of allergy to any of material used for recording the lip print were selected. Participants who are suffering from trauma to lips, lip anomalies/pathologies, skin lesions/trauma to palms, physical abnormalities and systemic diseases were excluded. The institutional ethical clearance and consent from all participants was obtained.

The subject was asked to rinse the mouth with water and lips allowed to dry. Brown/dark pink colored lip stick was applied and the subject was asked to spread it uniformly over the lips. Lip impression was made on a transparent self-adhesive tape by dabbing the glued portion of the tape first in the center and then toward the corner of the lips. Lip prints were traced in the normal rest position of the lips. This lip impression was immediately pasted on a white bond paper. While studying the lip prints, the central one third of each subject’s lips was analyzed with the help of a magnifying lens.

Digital photograph of right and left palms were taken using Canon IXUS 125 HS Camera and principal lines were analyzed.

Y Tsuchihashi and T Suzukis’ classification (1950) was used for lip prints.^{3,18}

Wu et al’s classification was used for palmprints.¹⁴

DATA ANALYSIS

Data was compiled and analyzed with Chi-square test, Correlation test using SPSS version 20.

RESULTS

The most predominant lip print pattern obtained in the present study was:

- Type I: Complete vertical pattern (24.6%)
- Type II: Branched groove (33.3%)
- Type III: Intersected pattern (9.6%)
- Type IV: Reticular pattern (27.2%)
- Type V: Other patterns (5.3%) (Figs 1 and 2).



Fig. 1: Correlating our study samples with Tsuchihashi and Suzuki’s categories of lip prints

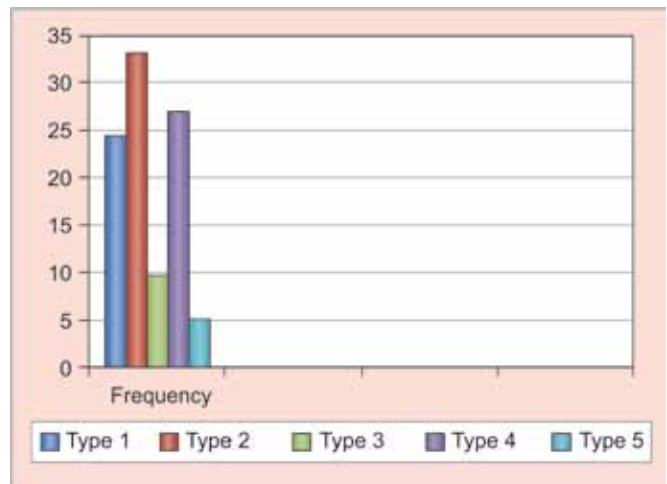


Fig. 2: Frequency of each lip print pattern

The most predominant palmprint pattern in the present study was Category 5:

- 62.3% in the right palm
- 70.2% in the left palm.

Predominant Pattern in Right Palm (Figs 3 and 4)

Category 5 (62.3%) was the most predominant pattern. This was followed by Category 4 (27.2%), followed by Category 2 (6.1%) and Category 3 (4.4%).

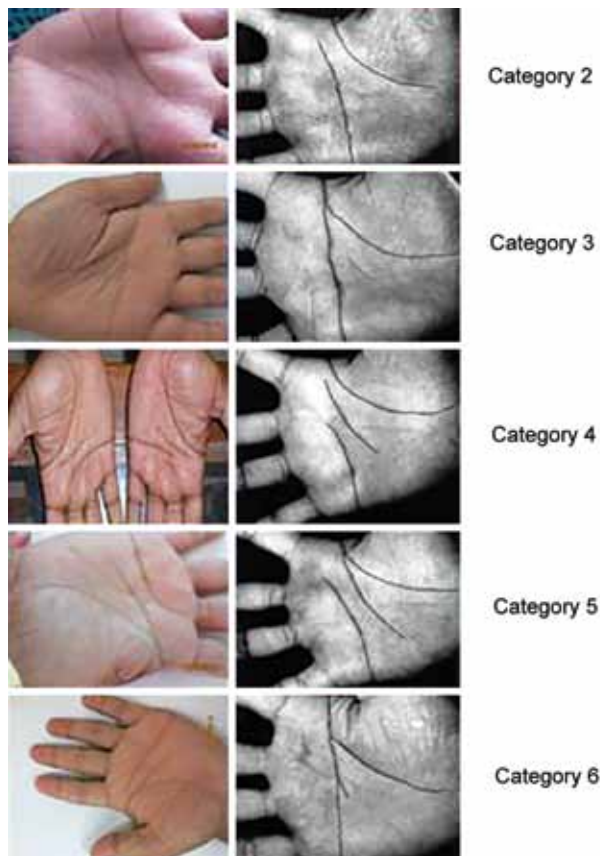


Fig. 3: Correlating our study samples with Wu et al categories of palmprints

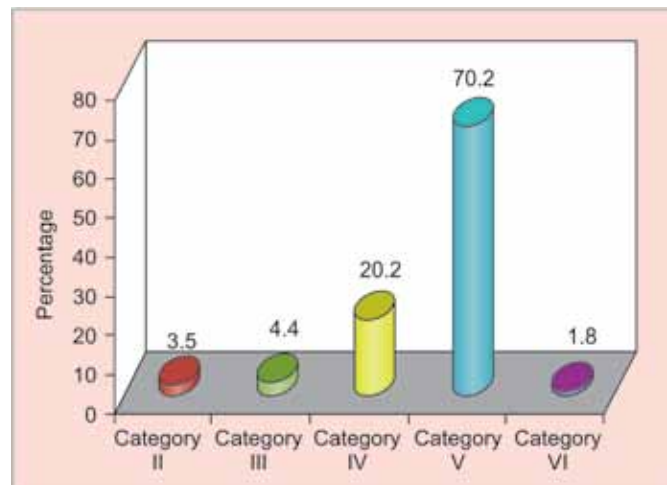


Fig. 5: Frequency of palmprint patterns in the left palm

Table 1: Correlation between lip prints and right palmprints

	Value	p-value
Pearson R	0.138	0.144

Table 2: Correlation of each category of palmprint on the right palm

Category	Type	Percentage
5	IV	18.4
5	I	13.2
4	III	6.1
5	V	4.4

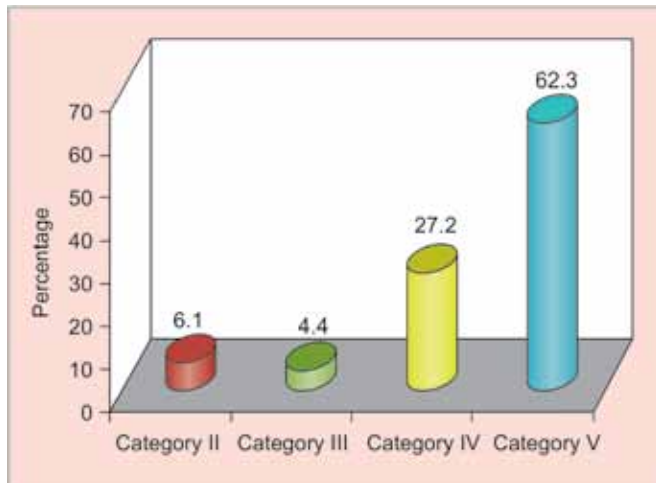


Fig. 4: Frequency of palmprint patterns in the right palm

Predominant Pattern in Left Palm (Fig. 5)

Category 5 (70.2%) was the most predominant pattern. This was followed by Category 4 (20.2%), followed by Category 3 (4.4%) and Category 2 (3.5%) and Category 6 (1.8%).

Correlation between Lip and Palmprint Patterns

Positive correlation was found ($r = 0.138$) between lip prints and right palmprints, but not statistically significant (Table 1).

In our study, in the right palm, Category 5 palmprint is correlated with Type II lip pattern (22.8%) (Table 2).

There was no correlation with lip print and left palmprint.

Comparison of Lip Print Patterns among Family Members

Chi-square test was applied to find the significance of association between lip print patterns among parents and children. The results revealed significant association between lip print patterns among parents and children ($p = 0.04$) (Table 3).

Comparison of Palmprint Patterns among Family Members

Association between palmprint patterns among parents and children.

The results revealed no significant association between right and left palmprint pattern among parents and children ($p = 0.318$ and 0.293 respectively) (Table 4).

DISCUSSION

Lip prints and palmprints form a pattern that is unique for each individual.^{3,6,7,15} The epidermal ridges of the



Table 3: Association of lip prints among parents and children

	Value	df	p-value
Pearson Chi-square	165.107	136	0.04

Table 4: Association of palmprints (right and left) among parents and children

	Value	df	p-value
Pearson Chi-square	108.202	102	0.318
	144.514	136	0.293

fingers and palms as well as the facial structures like the lip, alveolus, teeth and palate are formed from ectoderm during the same embryonic period (6-9 weeks).^{13,19} Comparative study of lip prints and palmprints for the interpretation in personal identification is scanty in the literature.

Personal identification of deceased persons in homicide, mass disasters, accidents, suicides, etc. is done by comparison of an existing antemortem record with the postmortem records. In living persons, like missing people, people with amnesia or persons with hidden identity, identification can be done by using the previously collected records.^{6,20,21}

Along with the teeth and their restorations, soft tissues of oral cavity help for personal identification. Among the soft tissues, lip prints can be recorded and used as evidence in personal identification and criminal investigation. Lip prints identified and traced from the material during investigation, can be compared with the suspected persons. In deceased persons, lip prints have to be obtained within 24 hours to prevent them from postmortem changes. The lipstick marks left over are characterized by their permanence and persistence. They could be utilized for investigations even after a lapse of few days. Alvarez and associates have shown that these prints can be developed and visualized using agents, such as aluminum powder and magnetic powder.^{6,20,22}

The use of lipstick is not inevitable as latent prints are available at all crime scenes because of the presence of minor salivary glands and sebaceous glands. Proper lip stick should be selected to avoid smudging and difficulties in taking the lip prints.^{6,9,22}

In 1950, two Japanese scientists, Y Tsuchihashi and T Suzuki, reported that the arrangement of furrows on the lip is unique and proposed a classification for the same, which is still in use.^{3,18}

Type I: Complete vertical (clear-cut grooves running vertically across the lip)

Type I': Incomplete vertical (the grooves are straight but disappear halfway instead of covering the entire breadth of the lip)

Type II: Branched groove (the grooves fork in their course)

Type III: Intersected pattern (the grooves intersect)

Type IV: Reticular pattern (the grooves are reticular)

Type V: Other patterns (the grooves do not fall into any of the Type I to IV and cannot be differentiated morphologically).

The lipstick-cellophane tape method used in lifting lip print was described first by Bindal et al.⁸ Studies on cadavers with various causes of death and their respective lip print characteristics and subsequently investigated the postmortem changes in the lip impressions. It is reported that eight corresponding features are mandatory for proving or disproving identity.²⁰ Type I was found the most frequently observed pattern followed by the Type II pattern.²⁴ From an Indo-Dravidian population study it was concluded that Type III was the most predominant pattern.⁹ Type III is revealed the most predominant pattern in males and Type II in females.⁷ Manipady in his dissertation in Manipal, 2002 studied Indian and Chinese population and found that Type II was of the highest incidence among the Indian as well as the Chinese. Coward in 2007 has studied the stability of lip print patterns over a period of time. He took the prints of 85 subjects and studied them over a period of 7 months and showed that that lip prints remained unchanged. He also claimed that eight was the number of matching features required to prove concurrence.²⁵ For the purpose of determination of the sex of the person from lip prints, in 2009 Gondivkar SM et al have studied 70 each male and female subjects in Maharashtra and were able to predict the sex with a high degree of accuracy.^{7,25}

The palmprint is one of the most reliable physiological characteristics that can be used to distinguish between individuals.^{4,13-15} Palmprint is preferred over other methods such as fingerprint or iris because it is distinctive, easily captured by low resolution devices as well as contains additional features such as principal lines. It is also nonintrusive and it does not require any personal information of the user.¹⁴

Palmprints have the following characters: (1) The most basic elements of the palmprint and the finger print are the same. Therefore, palmprints are unique and will not change in life. They are impossible to fake, (2) the palmprint is much larger than the finger print. Details can be easily obtained, (3) the palmprints include other characteristics (main palmar flexion creases, triradius) aside from its uniqueness and stableness, (4) certain geometric characteristics can be obtained when palmprints are taken.^{14,15}

'Feature points' were extracted on palm-lines from online palmprint images for verification.¹⁴ 2D Gabor lters were used to extract the texture features from low-resolution palmprint images and employed these features

to implement a highly accurate online palmprint recognition system.¹⁶ Sobel and morphological operations were also used to extract line-like features from palmprints. Line-like features and hand geometric features were integrated for personal verification.¹⁴

All of these palmprint authentication methods require that the input palmprint should be matched against a large number of palmprints in a database, which is very time consuming. To reduce the search time and computational complexity, it is desirable to classify palmprints into several categories such that the input palmprint need be matched only with the palmprints in its corresponding category, which is a subset of palmprints in the database.¹⁴⁻¹⁷ Low-resolution palmprint classification devised by Wu et al: classified palmprints by taking into account their most visible and stable features, i.e. the principal lines. Most palmprints show three principal lines: heart line, head line and life line.

Regarding the number of their principal lines and the number of the intersections of these lines, palmprints can be classified into following six categories, proposed by Wu et al.¹⁴

Category 1: Palmprints composed of no more than one principal line.

Category 2: Palmprints composed of two principal lines and no intersection.

Category 3: Palmprints composed of two principal lines and one intersection.

Category 4: Palmprints composed of three principal lines and no intersection.

Category 5: Palmprints composed of three principal lines and one intersection.

Category 6: Palmprints composed of three principal lines and more than one intersection.

Type II was yielded as the predominant lip pattern [(Rastogi P and Parida A (2011); Verma et al (2013); Maheswari et al (2011))^{8,10,26} is similar to our study results. Type I [Vahanwala and Parekh (2000)];²⁴ Type III [Sivapathasundaram et al (2001)];⁹ Type IV [Varghese et al (2010)]²⁵ were identified as predominant patterns in other studies.

Category 5 was yielded as the predominant palm pattern by Wu et al (2004) which is similar to our study results.¹⁴ Study by Fang et al (2007) also yielded Category 5 as the predominant pattern.¹⁵

Studies depicted that there persists similarity of lip print patterns among parents and their offsprings [Vats et al (2011); Venkatesh R et al (2011)]^{2,4} which is similar to our study results. Study by Maheswari et al (2011) observed no familial or genetic similarities of lip print pattern between parents and children, but Type II as the predominant pattern.¹⁰

Correlation studies between lip print and palmprint patterns and studies on heritability of palmprint patterns among parents and offsprings are scanty in literature. Egle Zarakauskaitė et al (2004), in their case control study, suggested that there are some significant dermatoglyphic peculiarities in persons with cleft lip and/or cleft palate (CLP) in comparison with control group. The patterns on the thenar eminence in hands of those with CLP were six times rarer than in controls.²⁷ Rajbhongsi et al (2000) in their study indicated a strong genetic component in the formation of dermatoglyphic patterns.²⁸ Temaj G et al (2012) concluded that the heritability patterns sharply distinguish highly heritable dermatoglyphic traits (patterns on the thenar and I interdigital area, II interdigital area and all the digits) and the traits with weak genetic component (patterns on the III and IV interdigital area, the hypothenar and the axial triradius position).²⁸

CONCLUSION

The present study was conducted to find out the heritability and correlation of lip and palmprints in the South Kerala population. The predominant lip pattern in the entire study population was Type II. The predominant palm pattern in the entire study population was Category 5 in both right and left palm. Lip pattern shows a positive correlation with right palm pattern, but it is statistically insignificant. Lip pattern showed neither positive correlation nor significant association with the left palm. Significant association between lip print patterns among parents and children were noticed in our study. In this study, palmprint pattern showed no association among parents and children. Further studies with large samples involving more study parameters may add to the findings of our study.

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