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Original Research Article

Establishing Identity Using Cheiloscopy and Palatoscopy

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Abstract: Palatoscopy is the study of palatal rugae pattern and cheiloscopy is study of lip print .The appearance of palatal rugae is constant, as they do not demonstrate changes after the completion of growth of the individual, Lip prints don't change even after trauma, inflammation and diseases like herpes, thus increasing their utility as a personal identification. The objectives is to compare the uniqueness of rugae pattern and cheiloscopy. To determine the predominant rugae pattern and lip pattern in different gender. The study comprised 50 healthy (25 males and 25 females) subjects of age between 18 and 30 years, who were randomly selected. In this study we used the classification of rugae patterns suggested by Kapali *et al.* (straight, curved, wavy andcircular), and classification of lip prints according to Suzuki and Tsusuchiashi's. The most prevalent forms in both genders were curved and wavy type followed by straight and diverging types. Most predominant lip pattern in females were Type IV in upper half of lip and Type I in lower half of the lip, in males both upper and lower half showed a predominant Type I pattern. We believe that rugae pattern and lip pattern can be used as a reliable guide in forensic identification. Our study has proved that chieloscopy and palatoscopy hold the potential to identify the sex and identity of the individual, as they remain stable over time and unique to individual.
Keywords: Forensics, palatoscopy, cheiloscopy

INTRODUCTION

Individual identification though challenging forms central criteria in forensic studies, as every individual has distinctive trait with in a human population. It demands an amalgamation of diverse procedures to individualize a person, considering also the type of catastrophe. In a general context, the concept of "identity" can be defined as set of physical characteristics, functional or psychic, normal or pathological that describes an individual. Accurate identification of humans forms a cardinal prerequisite for personal, social and legal reasons in every population [1].

Palatal rugae are epithelial ridges on anterior part of palatal mucosa on each side of mid palatine raphe behind incisive papilla [2].Palatal rugae facilitate oral swallowing and improving the relationship between food and taste receptors in the dorsal surface of the tongue [3]. Differences in the rugae cores have been observed even from human embryo of over 20 weeks [4]. The study of palatal rugae, known as Rugoscopy/Palatoscopy, was first proposed in 1932 by Spanish investigator Troban Hermas [5].Studies have proved palatal rugae to be stable in shape and structure and are not changed by disease, trauma, chemicals or heat [3, 6]. At the same time, they are well protected from head trauma, owing to their internal position as well as insulated from heat by the lips, tongue and the buccal fat pads [7]. Considering the facts of highly individualistic and distinctive structure, palatal rugae based identification can act as an adjunct to other methods of identifications such as dental record, finger prints and DNA comparisons [8].

Identification based on lip prints goes back in early nineteenth century. Describedin the year 1902 by the well-known anthropologist Fischeras the furrows on red part of human lips. Lip print pattern is an anatomical character of the human lips. The applicability of human lips prints in personal identification and criminalization was first made in the year 1932 by Edmond Locard, one of France's greatest criminologists [9].

Cheiloscopy- the study of lip prints is based on the facts that the wrinkles & cracks of the lips specifically maintain the uniqueness and are stable. The methods applicable for the study are easier to perform and are helpful in criminal investigations when other identification methods or parameters are either not available or difficult to analyze. Study shows that lip print pattern does not change even as age advances [10].

It has been observed that lip prints can be identified as early as sixth week of intrauterine life. Lip prints don't change even after trauma, inflammation and diseases like herpes. Some studies shows similarities in the lip print patterns in members of the same family suggestive of hereditary role in formation of lip prints [11].

Considering these above facts such as the importance of individual identification and applicability of rugae pattern and cheiloscopy as potential options, the present study was carried out with the objective to compare the uniqueness of rugae pattern and cheiloscopy. The study was also aimed for determining the predominant rugae pattern and lip pattern in different gender and age groups.

MATERIALS AND METHODS

The study sample consisted of 50 dental casts which included 25 males and 25females in the age group of18–35 years. They belonged to individuals who were free of any diagnosed congenital abnormalities, inflammation, trauma, malocclusions, palatal asymmetries or orthodontic treatment. The rugae were delineated using a sharp graphite pencil under adequate light and magnification using hand lens to enhance the visualization of the palatal rugae on these casts and were analyzed macroscopically

Subsequently, the pattern of palatal rugae was identified according to the classification of Kapali *et al.*[12]who classified palatal rugae according to their length, shape, direction and unification form.

According to Kapali *et al.* three categorieswere identified:

1. Primary rugae: (A: 5–10 mm; B: 10 mm or more).
2. Secondary rugae: 3–5 mm.
3. Fragmentary rugae: less than 3 mm.

The shapes of individual rugae were classified into four major types: curved, wavy, straight and circular (fig 1):

1) Straight: They run directly from their origin to termination.
2) Curved: They had a crescent shape and curved gently.
3) Wavy: There was a slight curve at the origin or terminationof curved rugae.
4) Circular: Rugae that form a definite continuous ringwere classified as circular

Unification occurs when two rugae are joined at their origin or termination. Accordingly, rugae are classified into:

1) Diverging – If two rugae had the same origin from the midline but immediately branched.
2) Converging – Rugae with different origins from midline,but which joined on their lateral portions.

For Cheiloscopy

- Dark colored lipstick
- Cellophane tape
- White bond paper
- Magnifying lens
- Brush for applying lipstick

After taking the consent, lip prints of the subjects (25 males and 25 females)were collected by using the lipstick method in which a thin layer of lipstick was applied on the clean, dry lips uniformly by using the brush. A thin layer of lipstick was applied rather than a thick layer which would fill in the groove patterns. The subjects were asked to rub both the lips to spread the applied lipstick. After this the cellophane tape was applied on to the lips from the glued site very carefully so that no smudge marks were produced. This cellophane tape was carefully removed and then applied on to the bond paper and all the relevant data relating to its identity was written on the paper. Impressions were visualized using magnifying lens. A horizontal line wasdrawn to distinguish the upper lip from the lower lip (y-y'), and another vertical line to divide theeach lip into left and the right side (x-x'), these two lines intersected at right angles making fourquadrants namely

1. Right Upper quadrant. (First Quadrant)
2. Left Upper quadrant. (Second Quadrant)
3. Left Lower quadrant. (Third Quadrant)
4. Right Lower quadrant. (Fourth Quadrant)

The lip prints so obtained were analyzed using the classification of Suzuki and Tsusuchiashi classification.

Suzuki and Tsuchihashi's classification method of lip prints,which was as follows:

- **Type I:** Clear-cut vertical groovesthat run across the entire lips.
- **Type I:** Similar to type I, but do notcover the entire lip.
- **Type II:** Branched grooves (branchingY - shaped pattern).
- **Type III:** intersected grooves
- **Type IV:** Reticular grooves.
- **Type V:** Undetermined

RESULTS

This study however, revealed that no two palates are alike in their configuration, with each presenting an organized pattern of rugae specific to the individual. Our evaluations showed that the wavy, curve and straight patterns were predominantly common while circular and unification of rugae were less common. There was an insignificant ($P>0.05$) gender differences in the total number of palatal rugae, shape and length of rugae among male and female

students except wavy and straight pattern which showed a significant difference between both genders .

The examination of lip print pattern revealed the following observations: No two lip prints matched with each other, thus establishing the uniqueness of the lip prints. Type IV were most commonly seen in females in the upper half and type I in lower half, whereas type I and I' were seen most commonly in males in all four quadrants.

Table 1: T test for comparison of the rugae characteristics

	SEX	N	Mean	Std. Deviation	t	df	P VALUE
TOTAL NUMBER	M	25	10.92	2.12	-0.442	48	0.661
	F	25	11.16	1.7			
PRIMARY	M	25	7.64	1.319	-1.784	48	0.081
	F	25	8.32	1.376			
SECONDARY	M	25	2.44	1.734	1.013	36.554	0.318
	F	24	2.04	0.908			
TERTIARY	M	25	0.84	0.85	-0.534	48	0.596
	F	25	0.96	0.735			
CURVED	M	25	5	1.936	-0.361	48	0.72
	F	25	5.2	1.979			
WAVY	M	25	2.8	1.936	2.794	37.679	**0.008**
	F	25	1.56	1.083			
STRAIGHT	M	25	2.72	1.904	-2.673	48	**0.01**
	F	25	3.92	1.187			
CIRCULAR	M	25	0.4	0.577	-0.436	48	0.665
	F	25	0.48	0.714			

CHEILOSCOPY

Table 2: Common Lip Pattern among Males and Females in upper right quadrants

Crosstab					
			gender		Total
			F	M	
upper right	I	Count	6	12	18
		% within gender	24.0%	48.0%	36.0%
	I'	Count	1	5	6
		% within gender	4.0%	20.0%	12.0%
	II	Count	0	3	3
		% within gender	0.0%	12.0%	6.0%
	III	Count	3	0	3
		% within gender	12.0%	0.0%	6.0%
	IV	Count	11	3	14
		% within gender	44.0%	12.0%	28.0%
	V	Count	4	2	6
		% within gender	16.0%	8.0%	12.0%
Total		Count	25	25	50
		% within gender	100.0%	100.0%	100.0%

Table 3: Common Lip Pattern among Males and Females in upper left quadrant

Crosstab					
			gender		Total
			F	M	
upper right	I	Count	6	12	18
		% within gender	24.0%	48.0%	36.0%
	I'	Count	1	5	6
		% within gender	4.0%	20.0%	12.0%
	II	Count	0	3	3
		% within gender	0.0%	12.0%	6.0%
	III	Count	3	0	3
		% within gender	12.0%	0.0%	6.0%
	IV	Count	11	3	14
		% within gender	44.0%	12.0%	28.0%
	V	Count	4	2	6
		% within gender	16.0%	8.0%	12.0%
Total		Count	25	25	50
		% within gender	100.0%	100.0%	100.0%

Table 4: Common Lip Pattern among Males and Females inlowerleft quadrants

Crosstab					
			gender		Total
			F	M	
Lowerleft	I	Count	9	10	19
		% within gender	36.0%	40.0%	38.0%
	I'	Count	1	6	7
		% within gender	4.0%	24.0%	14.0%
	II	Count	5	5	10
		% within gender	20.0%	20.0%	20.0%
	III	Count	1	3	4
		% within gender	4.0%	12.0%	8.0%
	IV	Count	3	1	4
		% within gender	12.0%	4.0%	8.0%
	V	Count	6	0	6
		% within gender	24.0%	0.0%	12.0%
Total		Count	25	25	50
		% within gender	100.0%	100.0%	100.0%

Table 5: Common Lip Pattern among Males and Females inlower right quadrant

Crosstab					
			gender		Total
			F	M	
lower right	I	Count	17	8	25
		% within gender	68.0%	32.0%	50.0%
	I'	Count	0	3	3
		% within gender	0.0%	12.0%	6.0%
	II	Count	1	7	8
		% within gender	4.0%	28.0%	16.0%
	III	Count	1	3	4
		% within gender	4.0%	12.0%	8.0%
	IV	Count	4	3	7
		% within gender	16.0%	12.0%	14.0%
	V	Count	2	1	3
		% within gender	8.0%	4.0%	6.0%
Total		Count	25	25	50
		% within gender	100.0%	100.0%	100.0%

Fig-1: Palatal Rugae Pattern

Complete vertical

Branched

Incomplete vertical

Reticular

Intersected

Undetermined

Fig-2: Lip Patterns

DISCUSSION

Rugae Pattern was first discovered as a method of identification by Harrison Allen in 1889. The rugaeis considered potential option for individual identification since they are protected from trauma, insulated by heat of the tongue, and can survive post-mortem insults. Even though there are reports of slight alteration in the relationship of the rugae to the teeth can occur during orthodontic tooth movement, no major alteration in shape of rugae is noticed [13]. Taking this into account, analysis of palatal rugae was carried out by only taking the shape or pattern of rugae into consideration. The rugae also provide sufficient information to validate identity beyond reasonable doubt and would serve in any forensic investigation.

The present study evaluated the different shapes of rugae, level of predominance, combination pattern, total number of rugae, and length of rugae. The various rugae shapes were duly represented with varying degrees of predominance. The most predominant rugae pattern curvy and wavy pattern, followed by straight while circular and unification of rugae were obviously less common in both populations.

The high incidence of predominance in wavy and curvy patterns has been reported in several studies Nayak *etal.*[14], Kumar *et al.*[15], Surekha *et al*. [16], Kapali *et al*. [12] and this effect could be regarded as dominant pattern in most populations.

Cheiloscopy, the study of lip prints are very useful in identifying the suspects of crime based on the lip prints left at crime scenes. Suzuki *etal*'[11,17] conducted a study on 107 Japanese women and classified the lip prints into five main types. Sivapathasundharam *etal* [18]stated the physiology for uniqueness of patterns depends on lip muscles relaxation. In the present study, the variations in lip patterns of 50 individuals were assessed and tried to ascertain whether the lip prints hold the potential for gender differentiation and identity of the individual. The labeling of a particular pattern was done based on the numerical superiority of types of lines present viz vertical, intersected, branched or reticular. If more than one pattern predominates, it was typed as undetermined.

In our study we found that in females the predominant pattern was type IV in upper left and right quadrant and type I in both lower quadrants, but the males showed a predominant type I pattern in all the four quadrants. According to Vahanwala *et al*., [19] Type I and Type I' patterns were found to be dominant in females while type III, IV and V were dominant in males. In another study by Vahanwala and Parekh, it was shown that all four quadrants with the same type of lip prints were predominantly seen in female subjects and male subjects showed the presence of different pattern in a single individual. Mutalik *et al*., concluded that the most common pattern of lip print in females was the reticular followed by branched which was similar to our study [20]. The varied presentation of lip prints is perhaps due to difference in sampling methods and inclusion of diverse population groups with varied ethnicity. Nevertheless, this unpredictability in outcome may prove to be ideal for forensic investigation as the likelihood of uniqueness of pattern in individual is higher.

The limitation of our study is the small sample size. Hence, more number of Indian populations should be studied to determine the accuracy of palatal rugae and lip prints in identification

CONCLUSION

Our study has proved that chieloscopy and palatoscopy hold the potential to identify the sex and identity of the individual, as they remain stable over time and unique to individual. However, further studies should be conducted on a large number of individuals of different races, family members, twins, and siblings in order to achieve more accurate results

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