

## Cheiloscropy Vs Rugoscopy - Role in Sex Determination

### Dental Science

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### ABSTRACT

Personal identification is an integral part of forensic investigation. DNA profiling, dental records and finger prints are more commonly used. However, these evidences may not always be obtained or used circumstantially. In such situations, other available evidences like lip prints (cheiloscropy), palatal rugae patterns (rugoscopy) etc may be employed due their uniqueness in different individuals and gender. This study aims to determine variations in patterns of lip prints and palatal rugae and thus ascertain the gender among 60 students of our institution. It also aims at determining the reliability amongst the two methods employed. On doing this study we found that both the methods cheiloscropy and rugoscopy are equally reliable in sex predilection.

### KEYWORDS:

forensic odontology, Cheiloscropy, Rugoscopy

### INTRODUCTION

Sex determination plays an inevitable role in forensic investigations. Various methods are employed for identification of an unknown individual in mass disaster cases or in missing person cases. Visual examination may not help in identification and gender determination especially after severe decomposition of the body. This is when fingerprints, DNA profiling play an important role. However, these evidences may not always be obtained or used circumstantially (1). In such situations, other available evidences like lip prints (cheiloscropy), palatal rugae patterns (rugoscopy) etc may be employed due their uniqueness in different individuals and gender.

Lip prints are characteristic patterns of fissures in the form of elevations and depressions present in the zone of transition between inner labial mucosa and the outer skin. Study of lip prints is called Cheiloscropy. This is considered unique to an individual and analogous to finger prints. Pattern of lip prints is characteristically different in males and females as per Vahanwala's classification (2, 3). They are said to be unique and they can be identified as early as sixth week of fetal stage and also they remain permanent, resisting climatic change, minor traumas, inflammation etc (4).

Palatal rugae are irregular, asymmetric ridges of mucous membrane extending laterally from incisive papilla and anterior part of median palatal raphe. Rugae are unique, unchanging and subject to classification. Characteristically males and females have different rugae patterns in shape, number, branching and unification (2, 3). It appears in third month of embryonic life and remains for several days after his/her death (4).

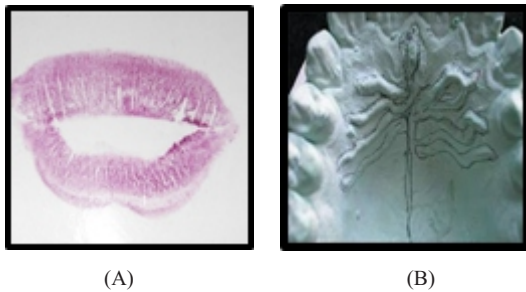
When identification cannot be established by fingerprinting or other methods, lip prints and palatal rugae patterns can be considered for identification of sex. So the present study was undertaken to study the lip prints and palatal rugae patterns, their variations, their role in gender identification and reliability of these methods in sex determination.

### Materials and methods:

A total of 60 subjects, 30 males and 30 females with their ages ranging between 16 to 26 years were selected. All the subjects were free of any congenital abnormalities, inflammation, trauma or orthodontic treatment.

### Methods:

Individuals without any lesions on their lips were selected and those with known hypersensitivity to lipstick were excluded from the study. A dark colored lipstick was evenly applied with a single stroke on both the lips. The subjects were asked to rub both the lips to evenly spread the applied lipstick. After a short while, a lip impression was made on a strip of cellophane tape on the glued portion, it was then stuck on to a white bond paper. (fig:1-A) The lip prints were then visualized using a magnifying lens. The lip prints obtained were coded, while noting the name and sex of the respective individuals. At the time of analysis the sex of the print was not disclosed. The lip prints were analyzed by two more individuals' other than me (author) who were completely blinded by not disclosing the sex of the individuals before analysis and then the results were crosschecked with already coded data.



**Figure:1** A) Lip prints analysis B) Rugae analysis.

In this study, we followed classification of lip prints proposed by Tsuchihashi (5).

- Type 1: clear-cut vertical grooves that run across entire lips
- Type 1': similar to type 1, but do not cover entire lip
- Type 2: Branched grooves
- Type 3: Intersected grooves
- Type 4: Reticular grooves
- Type 5: Grooves do not fall into any of the type 1-4 and cannot be differentiated morphologically (undetermined).

For classification, the middle part of the lower lip was taken as study area in accordance with Sivapathasundaram et al, because this fragment is always visible. The sex of the individual was determined as per the descriptions given by Vahanwala et al (2, 3).

- Type 1, 1': Pattern dominant-Female
- Type 2 : Patterns are dominant-Female
- Type 3 : Pattern present-Male
- Type 4 : Male
- Type 5 : varied pattern-Male

Same patterns in all quadrants- Female.

To record palatal rugae, alginate impressions of the maxillary arch was made and poured with dental stone. A dental plaster base was made and casts were preserved for interpretation. The outline of the rugae was traced on these casts using a sharp pencil under adequate light. (fig:1-B) Rugae pattern were then analyzed on these casts with the help of magnifying lens, using the classification by Lysell (6). Similar to lip prints even analysis of rugae patterns was done by two other individuals other than me (the author) who were blinded by keeping the sex of individual undisclosed and then results were crosschecked with already coded data.

- The rugae pattern was classified based on their length and shape.
- (A) The rugae were classified based on their length as:
  - Primary: - 5 mm or more
  - Secondary: - 3 to 5 mm
  - Fragmentary: - 2 to 3 mm

Rugae less than 2 mm were disregarded. A ruga's length was determined by measuring its greatest dimension regardless of its shape.

(B) The rugae were divided into four types based on their shape as:

*Curved:* They had a crescent shape and curved gently. Evidence of even the slightest bend at the origin or termination of a ruga led to it being classified as a curved ruga.

*Wavy:* If there was a slight curve at the origin or termination of a curved ruga, it was classified as wavy.

*Straight:* They ran directly from their origin to termination.

*Circular:* Rugae that formed a definite continuous ring

In the present study rugae were tested for gender and for both sides of the palate using the following parameters:

- 1) Total number of rugae
- 2) Number of primary rugae

3) Predominant shape

**Results:**

Both lip prints and palatal rugae patterns were analyzed separately by 3 observers and results were interpreted separately by each observer.

The examination of lip prints revealed the following observations:

1. Type 1' & 1 were most commonly seen in females whereas type 3 and 4 were seen most commonly in males [Table 1].
2. The Z-test for proportion, to test the significant difference between males and females for different types of lip patterns, showed no significant difference (P>0.05) [Table-1].
3. The mean of the results obtained by all 3 observers was calculated. On an average 18 males and 21 females were correctly identified on the basis of their lip prints [Table-2].

**Table-1:** Z-test for proportion to assess sex differences in lip print patterns.

Lip print Patterns	Males (total 30)	Females (total 30)	p-value*
Type 1	05	08	0.3472
Type 1'	03	09	0.05238
Type 2	03	04	0.68916
Type 3	09	03	0.05238
Type 4	07	05	0.5157
Type 5	03	01	0.29834
Chi-square test p-value- 0.14721664**			

Note: P>0.05(Not Significant); P<0.05(Significant)

**Table-2:** showing the number of individuals correctly identified as males and females using lip print patterns by 3 observers

Based on Lip prints patterns correctly identified as				
	Males(30)		Females(30)	
	No.	%	No.	%
Observer – 1	19	63.3%	21	70%
Observer – 2	18	60%	23	76.6%
Observer – 3	16	53.3%	19	63.3%
Average (1+2+3)	18	59%	21	70%

The examination of palatal rugae patterns revealed the following observations:

1. The predominant shape in males was wavy followed by curved and straight, whereas in females predominant shape was wavy followed by straight and then curved.[Table-3]
2. The Z-test for proportion, to test the significant difference between males and females for different types of palatal rugae patterns, showed no significant difference (P>0.05)[Table-3]
3. The mean of the results obtained by all 3 observers was calculated. On an average 21 males and 17 females were correctly identified on the basis of their palatal rugae patterns [Table-4].
4. The total number of rugae and number of primary rugae were found to be more in females than in males. On an average total no. of rugae in an individual were found to be 6 in males and 10 in females. On an average number of primary rugae were found to be 6 in males and 8 in females. (Table-5)
5. On an average from the population group of 60 individuals 39 (64%) were correctly identified either as male or female using cheiloscopy and nearly equal number i.e., 38 (64%) were correctly identified using palatal rugae pattern. (Table-6)

**Table-3:** Z-test for proportion to assess sex differences in palatal rugae patterns.

Palatal rugae patterns correctly identified as				
Observer	Males(30)		Females(30)	
	No.	%	No.	%
Observer 1	21	70%	17	56.6%
Observer 2	18	60%	20	66.6%
Observer 3	24	80%	15	50%
Average(1+2+3)	21	70%	17	57%

**Table-4:** Showing the number of individuals correctly identified as males and females using palatal rugae patterns by 3 observers.

Rugae shapes	Males(total 30)	Females(total 30)	P-VALUE
Curved	06	03	0.28014

Wavy	20	19	0.78716
Straight	04	08	0.19706
Circular	00	00	
0.30743242, chi-square p-value			

**Table-5:** Showing total no. of rugae and number of primary rugae:

	Males	Females
Total number of rugae	6	10
Number of primary rugae	6	8

Males and females were identified using lip prints and palatal rugae patterns. Identification was done by 3 individuals separately and the results are tabulated as follows:

**Table-6:** Showing total no. of individuals whose gender was correctly determined using lip prints and palatal rugae pattern:

Observer	Lip prints(60)		Palatal rugae (60)	
	Number	Percentage	Number	Percentage
Observer 1	40	66.6%	38	63.3%
Observer 2	41	68.3%	38	63.3%
Observer 3	35	58.3%	39	65%
Average(1+2+3)	39	64%	38	64%

### Discussion:

Sex determination plays an inevitable role in forensic investigations. Lip prints and palatal rugae patterns are considered to be unique to an individual and hence hold the potential for identification and to convince the court of law. Cheiloscropy is applicable mostly in identifying the living, since lip prints are usually left at crime scenes, and can provide a direct link to the suspect. Although lip prints have previously been used in a court of law, the use is not consensual and some authors believe further evidence is needed to confirm their uniqueness (7).

One must also consider the possibility of post-mortem changes of lip prints from cadavers with various causes of death. Utsuno et al have studied these changes and concluded that a satisfactory identification rate was achieved. However, this study was carried out under a laboratory environment and what actually happens to lip prints obtained from cadavers exposed to the natural environment is still not known. It should also be pointed out that only in very limited circumstances, is there ante mortem data referring to lip prints, which obviously impairs a comparative study where necroidentification is concerned. The main feature for dental identification is the existence of ante mortem data, which cannot be expected in cheiloscropy. Therefore, the only use of cheiloscropy will be to relate lip prints to the lips that produced them (4, 8)

Lip prints were first described by Fisher in 1902. However, it was only in 1930 that de Lille developed some studies which led to lip print use in criminology. Suzuki and Tsuchihashi proposed a classification dividing the pattern of grooves on the lip into six types and also named the wrinkles and groove visible on lips as 'sulci labiorum rubrorum' (5). Lip response to trauma; in fact, these authors observed that after healing, the lip pattern was equal to that before the injury occurred (4).

In the present study, we aimed to find out the variations in lip patterns of 60 individuals. We tried to ascertain whether the lip-print patterns hold the potential to determine sex of the individual. Middle portion of lower lip was taken into account, since this portion is always visible in any trace. In the past, some researchers have worked on lip prints to prove that a gender difference does exist in lip print. According to a study by Vahanwala et al. type 1 and type 1' patterns were found to be dominant in females while type 3 and type 4 patterns were dominant in males.

The results of lip prints in our study are in accordance with those of Vahanwala et al (2, 3) and Saxena et al (7). However, according to a study done by Yogesh et al (1) Type 1' and Type 4 were predominantly seen in females whereas Type 2 and 3 are more common in males.

Palatal rugae, in addition to being unique to an individual, are protected from trauma by their internal position in the head and insulated from heat by the tongue and buccal fat pads, unlike fingerprints that can get destroyed. Once formed, they do not undergo any changes except in length, due to normal growth, remaining in the same position throughout an entire person's life. Even diseases,

chemical aggression or trauma do not seem to change the palatal rugae form (9, 10).

According to Caldas et al. (10) and Shetty et al. (11) palatal rugae were first described by Winslow in 1753; however, Kuppler, in 1897, was the first person to study palatal anatomy to identify racial anatomic features. Lysell, developed the first classification system for palatal rugae (6).

Unlike cheiloscropy, palatoscopy might not be so useful in crime scene investigation in the linking of suspects to the crime scene. In fact, this kind of evidence is not expected to be found in such circumstances. On the other hand, palatoscopy may be used as a necroidentification technique. It is the most valuable technique in aeronautical accidents in order to ensure identification of pilots making use of ante mortem data (4).

Analysis of palatal rugae in our study revealed that the dominant shape both in males and females was wavy which was in accordance with Saxena et al (7). However, in a study conducted by Indira et al (12) curved form was more common. Also in our study total no. of rugae were found to be more in females than males, which was again in accordance with that in previous study by Saxena et al but as per Indira et al (12) and Caldas et al (10) total no. of rugae are said to be slightly more in males.

### CONCLUSION:

Determining the sex of a suspect in crime scenario, dead body of an unknown or missing person which has been severely mutilated is often very difficult and time-consuming process. The present study using simple techniques without any complex armamentarium proves that both lip prints and palatal rugae patterns differ in different individuals and gender. We also opine that both the methods are equally reliable in sex predilection. However, in order to ascertain or consider cheiloscropy and palatoscopy ideal for sex determination it is necessary to carry out a wide range of studies including a large sample size.

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