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Appraising Cheiloscopy, Rugoscopy and Lingual Impressions as Prospective Tools in Gender Determination in A Bengali Population

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Abstract

Aims and Objectives: To compare the lip print, rugae pattern and tongue prints in a Bengali population**.** To study the predominant type of lip, rugae and tongue patterns in males and females in Bengalis and to evaluate the efficacy of the three parameters in gender determination.

Methods: The study included 100 Bengali subjects, comprising of 50 males and 50 females in the age group of 18 to 25 years. Each individual's lip prints, palatal rugae and tongue prints were recorded and studied using classifications given by Tsuchihashi, Thomas and Kotze and Stefanescu et al. respectively and the results

obtained were statistically analysed using students paired T test.

Results: In our study, the most common lip pattern found in females was Type I, as compared to Type IV in males. The difference in the genders was statistically significant with p value less 0.001. In our study, the most common rugae pattern found in females was straight and curved, as compared to wavy in males. The gender difference was statistically insignificant. It was observed in our study that the predominant tongue shape among in females was U shape and in males was found to be V shape. The difference in between the genders was statistically significant. No significant difference was observed in the tongue grooves among males and females. Superficial grooves were present in both the genders.

Conclusion: In this study lip prints, rugae shape and tongue shape proved to have considerable potential for gender determination in the Bengali population.

Keywords: Forensic Odontology, Chelioscopy, Rugoscopy, Tongue Prints.

Introduction

Forensic science finds immense contribution in identification of individuals in crime investigation, mass disasters, age estimation and so on. Dental records, fingerprints and DNA profiling are the most commonly used methods for identification[1]. Forensic Odontology is the branch of forensic science which deals with evidence from dental and oral structures[2]. It is a specialty in dentistry, which plays a pivotal role within the array of methods applied to medico-legal identification[3]. Teeth serve as an indispensable tool in identification. Along with teeth other oral tissues too aid in the process. In circumstances where identification of an individual by fingerprint or dental record comparison is difficult, it becomes necessary to apply lesser known methods. Amongst them cheiloscopy, rugoscopy, and study of tongue prints are the ancillary methods of identification[4].

Cheiloscopy is a branch of Forensic Odontology, which deals with the scientific study and examination of lip imprints[5]. The word is derived from the Greek words ‘Cheilos’ meaning lip and ‘skopein’ meaning examine[6]. Lip patterns can be determined as early as in the 6th week of intrauterine life[7] and are usually remain the same for an individual throughout his/her life unless any pathological rupture or damage occurs due to any trauma or surgical procedure[6]. Lip prints have been classified into various types by different methods of classification of lip patterns. Among these, the Suzuki-Tsuchihashi method is the most followed one[8].

The Klein’s zone, which is the middle 3rd of the mucosal area of the vermillion border of lip, holds the region of most interest in the study purposes[5]. By analysing the imprints of lips left at the crime scene and their comparison with the suspects, may aid in directly linking the culprit to the suspect[9]. Moreover the potential of lip prints to determine sex has been well documented by different studies.

Rugoscopy involves the study of palatal rugae pattern for human identification. Palatal rugae are transverse ridges of the mucosa located on the anterior portion of the hard palate. They appear in the 3rd month of intrauterine life[3]. Palatal rugae have been shown to be highly individualistic and exhibit consistency in shape throughout life[10]. Due to the stability and uniqueness of the palatal rugae pattern, it has been considered as one of the relevant parameters for human identification in the field of forensic medicine[3] Several studies have shown that rugae patterns can be used as an additive tool for gender determination[11].

Tongue prints are the newly evolving tool in forensic odontology. The dorsal surface of the tongue is unique

for each person in terms of shape and surface characteristics. The characteristic features of the tongue exhibit remarkable difference in individuals even between identical twins[9]. Lingual impressions have been proved to be useful in identification when used in conjunction with other identification methods[12]. In recent years few studies utilizing tongue prints as an adjuvant tool in gender identification have been carried out.

Considering the uniqueness of lip prints, rugae patterns and tongue prints and their growing applications in the field of Forensic Odontology, this study we attempted to utilize lip prints, rugae patterns and tongue prints for gender determination in a Bengali population.

Aims and Objectives

- Assess the use of lip prints, rugae patterns and tongue prints for gender determination in a Bengali population
- To compare the lip print, rugae pattern and tongue prints in Bengali males and females
- To study the predominant type of lip, rugae and tongue patterns in males and females in Bengalis
- To evaluate the efficacy of these three parameters in sex determination

Inclusion criteria

1. People willing to participate in the study
2. No abnormalities in the lips, tongue and palate

Exclusion criteria

1. Subjects with abnormalities of lips, palate and tongue
2. With lesions on any of these sites

Materials and Methodology

This was an institutional study that included 100 Bengali subjects, comprising of 50 females and 50 males in the age group of 18 to 25 years. They were divided into 2 groups. Group 1 comprised of 50 females and Group 2 comprised of 50 males. Institutional Ethical Committee clearance was obtained and informed consent was taken from each subject.

Recording of lip prints

Lipstick was applied uniformly on both the lips of the subject with a cotton swab and the subject was asked to rub the lips together to spread the lipstick uniformly. It was left like that for 30 seconds and then lip impression was taken on the sticky side of a standard 1-inch width cello tape by applying uniform pressure. The tape was then taken out in a single motion and stuck on a white paper. These prints were then examined through a magnifying glass (Fig. 1) and classified according to the Suzuki-Tsuchihashi (1) method of classification, as shown in Table 1 and Figure 2

Figure 1: Recorded lip print

Type I	**Clear-cut lines or grooves that run vertically across the lip**
Type I'	Straight grooves that disappear halfway into the lip instead of covering the entire breadth of the lip
Type II	Grooves that fork in their course or a branched groove
Type III	An intersected groove
Type IV	A reticular groove
	Grooves that do not fall into any of the other categories and cannot be differentiated morphologically

Table 1: Classification of lip patterns according to Suzuki-Tsuchihashi method of classification

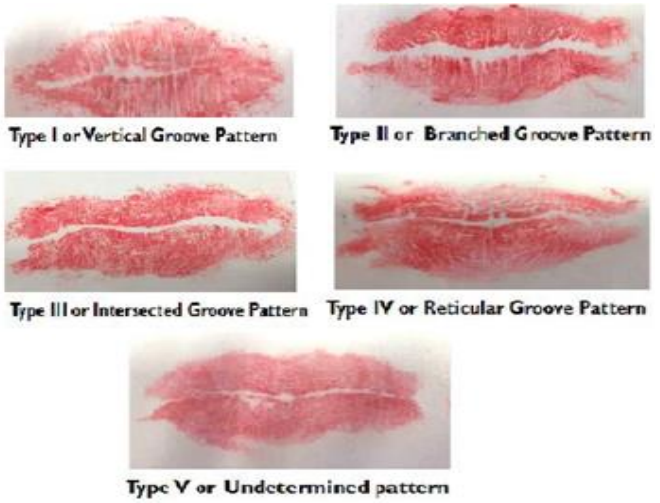


Figure 2: Types of lip patterns according to Suzuki-Tsuchihashi method of classification

Recording of rugae patterns

Alginate impressions of the maxillary arch were made. Casts were then poured using dental stone. Thereafter rugae patterns were traced using graphite pencil. (Fig. 3)

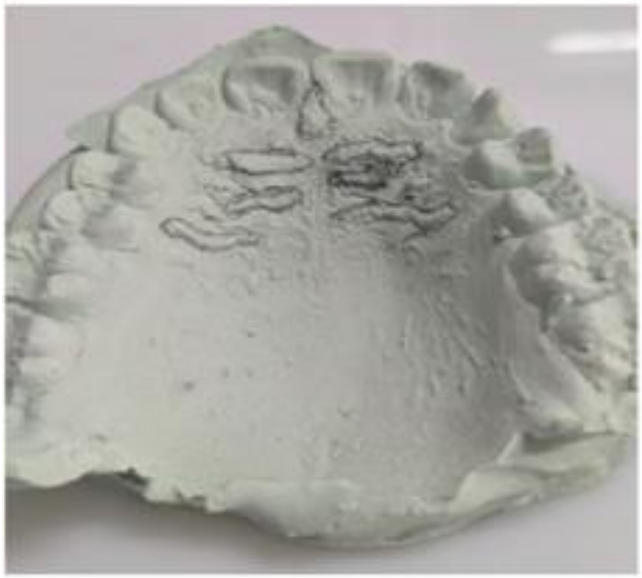


Figure 3: Recorded rugae pattern

The rugae patterns were assessed according to shape using the classification proposed by Thomas & Kotze (13) (Table 2)

Curved	Crescent shaped and curved gently
Wavy	Slight curve at the origin or termination of curved rugae
Straight	Run directly from their origin to termination
Circular	Continuous ring type morphology

Table 2: Classification of rugae patterns according to Thomas & Kotze

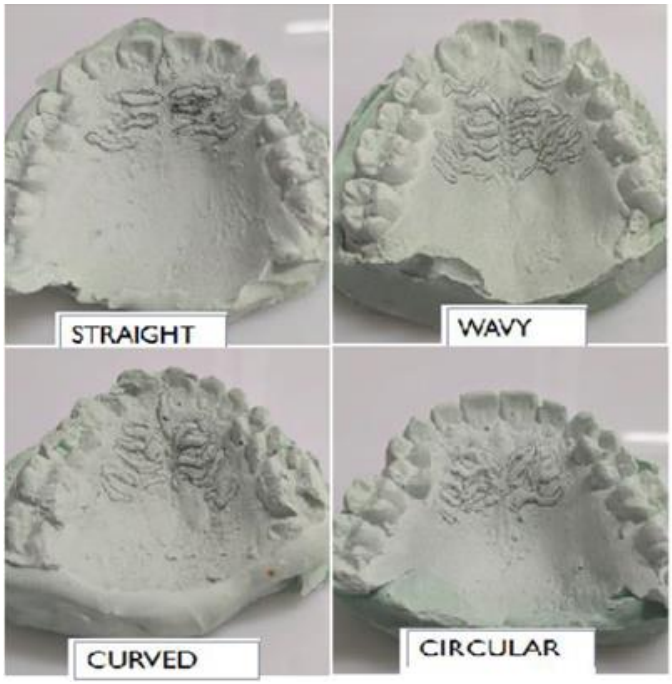


Figure 4: Types of rugae patterns according to Thomas & Kotze classification

Recording of tongue prints

Subjects were asked to protrude their tongue and the DSLR camera was used to capture the images of the tongue. The shape of the tongue was examined from the corner of the mouth to the tip of the tongue. The tongue shape and the longitudinal grooves were categorized using the classification proposed by Stefanescu et al (14)

Based on shape (Fig. 3)

- U shaped
- V shaped

Based on the Grooves

- Superficial
- Deep

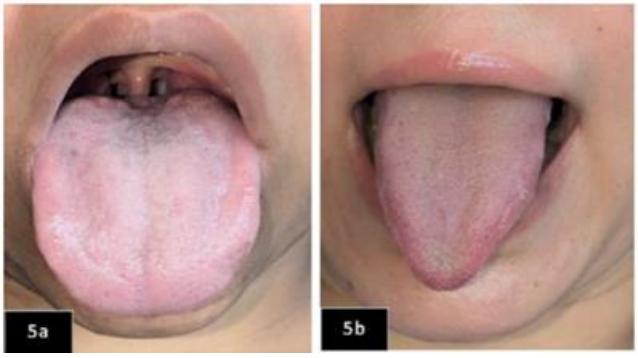


Figure 5: (a) U- shaped tongue (b) V shaped tongue

Results

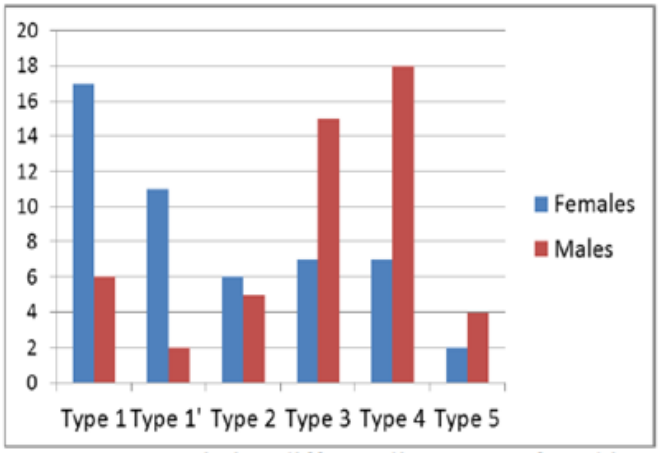
The statistical software, namely, SPSS version 21.0 was used for analysis of the data, and Microsoft Word and Excel have been used to generate tables. A Student's t test (paired) was used to find the significance of study parameters between females and males

Lip prints:

In our study, the most common lip pattern found in females was Type I, as compared to Type IV in males. The distribution of lip print patterns in the two genders in depicted in table 3 and graph 1. Some of the lip patterns obtained in the two genders is depicted in Fig 6. The difference in the genders was statistically significant with p value less 0.001. (Table 4)

	Type I	*Type I'*	*Type II*	*Type III*	*Type IV*	*Type V*	*Total*
Group 1 (females)	17	11	6	7	7	2	50
Group 2 (males)	6	2	5	15	**18**	4	50

Table 3: Frequency of different lip patterns obtained in females and males



Graph 1: Depicting different lip patterns found in females and males

Figure 6: (a) Different lip patterns found in females (b) Different lip patterns found in males

	N	Mean	Std. Deviation	Std. Error Mean	Student's T test	P value
Group 1 (Females)	50	2.64	1.60	0.23	4.4071	**0.0001**
Group 2 (Males)	50	3.98	1.44	0.20		

Table 4: Correlation between lip pattern and gender **Statistically significant**

Rugae patterns

In the above study we observed that the rugae pattern in each individual were distinct. In our study, the most common rugae pattern found in females was straight and

curved, as compared to wavy in males. (Table 5) The gender association was statistically insignificant. (Table 6)

	Straight	Curved	Wavy	Circular	Total
Group 1 (females)	**19**	**20**	9	2	50
Group 2 (males)	14	10	**24**	2	50

Table 5: Distribution of different rugae patterns obtained in females and males

	N	Mean	SD	Std. Error mean	Student's T test	P value
Male	50	2.28	0.93	0.13	t = 5.7155	**0.0001**
Female	50	1.88	0.85	0.12		

Table 6: Correlation between rugae pattern and gender

Statistically significant

Tongue prints

Tongue shape

We observed that the predominant tongue shape among in females was U shape and in males was found to be V shape and (Fig, 7 & 8, Table 7). The difference in between the genders was statistically significant (Table 9)

	U-Shape	V-Shape	Total
Group 1 (females)	**32**	**18**	**50**
Group 2 (males)	21	29	50

Table 7: Distribution of different tongue shapes observed in females and males

Figure 7: Different tongue shapes found in females

Figure 8: Different tongue shapes found in males

	N	Mean	Sd	SEM	Student's T test	P value
Male	50	1.58	0.50	0.07	3.7176	**0.0005**
Female	50	1.36	0.48	0.07		

Table 8: Correlation between tongue shape and gender

Statistically significant

Tongue grooves

No significant difference was observed in the longitudinal grooves among males and females.

Superficial grooves were present in both the genders. (Tables 9 & 10)

		Superficial	*Deep*	*Total*
Group (females)	*1*	37	13	50
Group (males)	*2*	35	15	50

Table 9: Types of grooves observed in females and males

	N	Mean	Std. Deviation	Std. Error Mean	Student's T test	P value
Males	50	1.30	0.46	0.07		**0.1594**
Females	50	1.26	0.44	0.06	1.4289	

Table 10: Correlation between tongue grooves and gender. Statistically not significant

Discussion

In man-made as well as in natural disasters fingerprints and DNA profiling are the most important tools in identification. Dental records too are highly useful for human identification. (15) However along with teeth the supporting structures too provide numerous prospects for the positive identification of individuals. The uniqueness of these structures along with their constancy makes them the ideal tools for forensic identification.

Lip prints have a high degree of evidentiary value whenever they are recovered at the scene of crime. They are considered to be most important forms of transfer evidence, and are analogous to finger prints and can provide a direct link to the suspect. (16) In our study, the most common lip pattern found in females was Type I, as compared to Type IV in males. A significant sexual dimorphism was demonstrated in the lip prints. This is somewhat similar to the findings of Vahanwala et al.[17], and Chaitanya babu et al[18] who recorded that Type I and I' pattern predominantly in females; and in males it was Type III and IV. This was contradictory to the findings of Sivapathasundaram et al[19], Tsuchihashi[20] and Gondivkar et al[21]., who observed that Type III lip pattern predominantly in males and Type II in females. Thus there have been differences in distribution in the patterns in males and females in different studies probably attributed to the ethnic differences and limited sample size. However the point to note is the significant difference in patterns in the two genders in many of the studies.

Palatal rugoscopy was first proposed in 1932, by a Spanish investigator Troban Hermaso. They are unique in form and shape in each individual and can resist decomposition changes for up to seven days after death[22]. Thus they are a convenient and useful tool in identification. In our study, the most common rugae pattern found in females was straight and curved, as compared to wavy in males A significant sexual dimorphism was demonstrated in the rugae shape. This is similar to the findings of Abarnalingam et al[4], Manikya Et al[1] and Hungasi et al[23] All these studies highlight potential role of rugoscopy in gender determination.

Tongue print is the information carried on the dorsal surface of the tongue that is the shape and surface characteristics[24]. The uniqueness of the tongue print is that there are significant differences between two tongues and studies have found that the tongue

of identical twins also does not resemble each other[25]. Advantages of using tongue prints as biometric tool systems are its uniqueness, protection within the oral

cavity and its stability over time[24]. Few studies have been conducted to assess the gender differences in tongue characteristics. It was observed in our study that the predominant tongue shape among males was found to be V shape and in females was U shape. No significant difference was observed in the longitudinal grooves among males and females. This was contrary to the findings of Jeddy et al[24] and Garg et al[26] who noted that u shaped tongue was more common in both genders. Moreover, with respect to grooves on the tongue surface we found shallow grooves to predominate in both the genders. This is unlike the findings of Jeddy et all who opined that deeper grooves were found in females[24].

Conclusion

Lip prints are an invaluable tool in identification of an individual, their role in gender determination promise an avenue yet to be fully explored. Palatal rugoscopy seems to have significant influence for sexual dimorphism. Use of tongue prints as identification tool needs further research. In this study lip prints, rugae shape and tongue shape proved to have considerable potential for gender determination in the Bengali population.

Collation of data from various techniques such cheiloscopy, rugoscopy and tongue prints are thus having potential of playing a major role in criminal investigations and identification at the sites of disaster where they can serve as adjuvant techniques in identification. However more extensive research in these avenues is warranted.

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