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Evaluation of Various Tongue Patterns in Namakkal District-Role in Forensic Dentistry

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Abstract

Background: Human identification is one of the most challenging areas in forensic field that man has been confronted with. Identification of an individual plays an important role in any crime investigation, mass disaster and in deceased cases. **Materials and Methods:** Sixty healthy individuals, which included 30 males (Group I) and 30 females (Group II) in the age group of 11 to 60 years, were included in this study. An alginate impression of the dorsal surface and lateral borders of the tongue was also made in a pre-customized acrylic tray. Positive replica of the tongue was made by pouring type II dental stone on alginate impression and used for identification purpose. The various parameters that were recorded for each subject include shape of tongue (U/V shape), margins of the tongue (smooth/scalloped) and texture of tongue (normal, fissures, bifid/cleft). **Results:** The data collected was tabulated and statistical analysis was done using SPSS software (version 20). Pearson's chi-square test was performed to compare the results obtained from the different groups, and Cramer's V was determined to assess the relationship between gender and tongue morphological characteristics. **Conclusion:** The morphology of tongue margins, texture and shape showed significant variation among genders which can be reliable for personal identification.

Keywords: Forensic Odontology, Sex Determination, Tongue Prints

1. Introduction

Human identification is one of the most challenging areas in forensic field that man has been confronted with. Identification of an individual plays an important role in any crime investigation, mass disaster and in deceased cases. Forensic identification is a multidisciplinary approach in which the field of forensic odontology deals with the proper handling and examination of the dental findings. Forensic odontology is the branch of forensic science which deals mainly with the evidence from oral hard and soft tissues. A forensic odontologist mainly deals with the identification based on recognition of unique features which are seen in the individual's oral structures. Apart from teeth, soft tissue studies like cheiloscopy, rugoscopy and study of tongue prints are some of the methods of identification in forensic dentistry[1].

Tongue prints are a newly evolving tool in the field of forensic odontology. The tongue exhibits remarkable difference in each and every individual even in case of identical twins and it is well protected from the environmental influences[1]. Tongue is a vital organ which performs multiple actions such as articulation of speech, perception of taste and formation of food bolus which helps in deglutition. It is enclosed in the oral cavity with palate on the superior aspect, floor of the mouth on the inferior aspect, mandibular teeth on the lateral aspects, pharyngeal region posteriorly and the lips anteriorly[2]. Very few studies regarding tongue prints in gender identification have been carried out in recent years, although it is believed to be are liable proof in forensic identification[1,3]. Numerous advantages exist in using tongue prints because lingual morphological aspects are difficult to forge, display stability over time, and are unique, which makes it suitable for identity recognition. So, with this background, a study was designed to determine the various morphological characteristics of

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the tongue in a South Indian population from Namakkal District of Tamil Nadu.

2. Materials and Methods

Sixty healthy individuals, who included 30 males (Group I) and 30 females (Group II) in the age group of 11 to 60 years, were included in this study. Individuals, who were free from any systemic illnesses, or local pathology, only were included. Subjects who showed tongue deformities, or who suffered from contagious diseases or systemic illnesses like gigantism, dwarfism, etc. were excluded.

Informed consent was obtained from all participants. The examination of tongue was carried out after a prior cleaning with sterile gauze piece and subjects were instructed to rinse the oral cavity thoroughly. The subjects were then asked to protract the tongue in a relaxed position to prevent marked contraction of striated lingual muscles which would alter the morphological characteristics. Clinical examination of the tongue was done to emphasize the morphological features such as shape and texture of the tongue. After this, images of the tongue from frontal and profile view were captured from a predetermined distance using a camera to evaluate the morphological aspects of dorsum and lateral aspect of tongue.

An alginate impression of the dorsal surface and lateral borders of the tongue was also made in a pre-customized acrylic tray. Positive replica of the tongue was made by pouring type II dental stone on alginate impression and used for identification purpose. Three reference points were used to determine the shape of the tongue. The reference points included the region of the tongue which is in contact with the commissure of the lips when the tongue is protruded outside the mouth and the tip of the tongue.

The various parameters that were recorded for each subject include shape of tongue (U/V shape), margins of the tongue (smooth/scalloped) and texture of tongue (normal, fissures, bifid/cleft).

3. Results

This study was designed to identify the various morphological characteristics of the tongue as observed on digital photographs as well as on the positive replica of the tongue (cast), to assess the usefulness of tongue replica for personal identification in forensic dentistry. Three different morphological characteristics of the tongue were considered, i.e. shape, margins and texture of the tongue.

The data collected was tabulated and statistical analysis was done using SPSS software (version 20). Pearson's chi-square test was performed to compare the results obtained from the different groups, and Cramer's V was determined to assess the relationship between gender and tongue morphological characteristics.

Out of 30 male patients, 24 subjects (80%) had U shaped tongue, 6 subjects (20%) had V shaped tongue. Among 30 females, 17 subjects (56.7%) had U shaped tongue and 13 (43.3%) had V shaped tongue. This difference in the shape of tongue among the two groups was not found to be statistically significant (Table 1 & Figure 1).

Morphology of tongue margins was categorized as either normal or scalloped. Out of 30 male participants, 21 subjects (70%) had normal margins while 9 (30%) had scalloped margins. Among the 30 females, 28 (93.3%) had normal margins and 2 (6.7%) had scalloped margins. The difference in margins of the tongue among the two groups of participants was statistically significant (p = 0.02) (Table 2).

Table 1. Comparison of shape of the tongue between the two study groups

			Tongue shape		Total	Pearson Chi-Square	p value
			U shape	V shape			
Gender	Male	Count	24	6	30	3.774	0.052
		Expected Count	20.5	9.5	30.0		
	Female	Count	17	13	30		
		Expected Count	20.5	9.5	30.0		

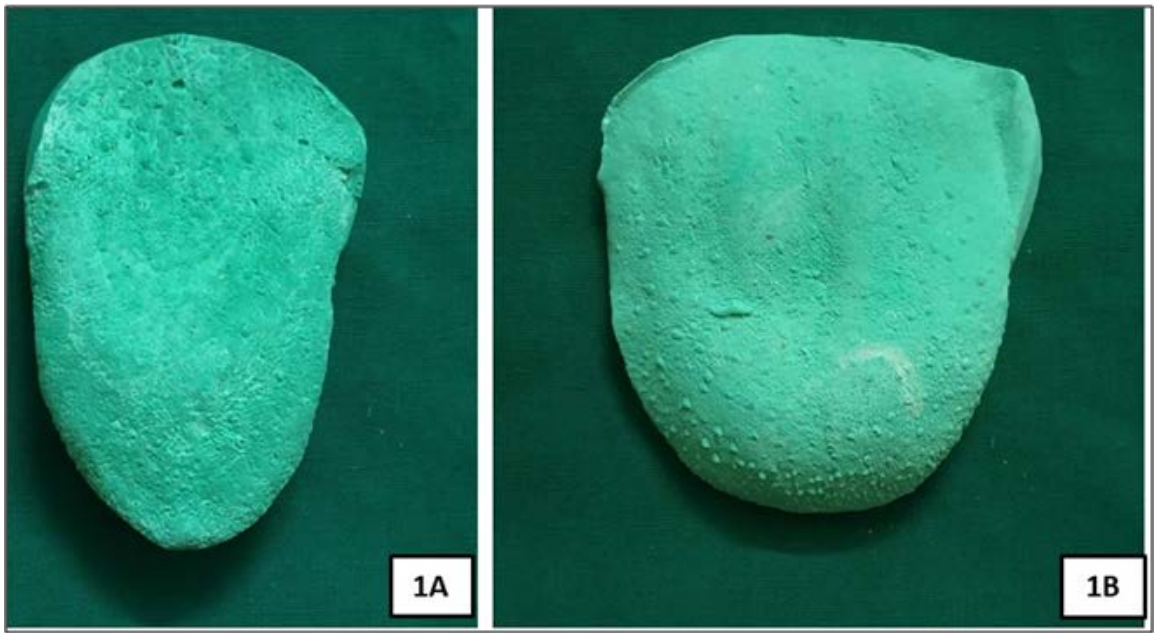


Figure 1. 1A-Photograph showing V shaped tongue, 2B-Photograph showing U shaped tongue.

Table 2. Comparison of margins of the tongue between the two study groups

			Tongue margins		Total	Pearson chi-square	p value
			Normal	Scalloped			
Gender	Male	Count	21	9	30	5.455	**0.020**
		Expected Count	24.5	5.5	30.0		
	Female	Count	28	2	30		
		Expected Count	24.5	5.5	30.0		

We found that out of 30 male participants, 6 subjects (20%) had normal texture of the tongue, 22 subjects (73.3%) had fissures in the tongue and 2 subjects (6.7%) had bifid/cleft tongue. Among 30 females 5 subjects (16.7%) had normal texture of the tongue 25 subjects (83.3%) had fissures in the tongue and none had bifid/cleft tongue. The difference in distribution of different textures of tongue among the two groups was not statistically significant (Table 3).

For tongue fissures, we also recorded the position, number, and directions of the fissures. In male group, 8 subjects(26%) had fissures in the center of the tongue, 2 subjects (6%) had fissures in the lateral position, and 14 subjects (46%) had fissures both in central as well as on lateral positions and 6 subjects (20%) had no fissures at all. In females, 12 subjects (40%) had fissure in the central position, 3 subjects (10%) had fissure in the lateral position, 10 subjects (33%) had fissures both in central as well as on lateral position and 5 subjects (16.7%) had no fissures.

When the number of fissures was assessed, in male group, 8 subjects (26%) had single fissure, 16 subjects (53.3%) had multiple fissures and 6 subjects (20%) had no fissures. In female group, 11 subjects (36.7%) had single fissure, 14 subjects (46.7%) had multiple fissures and 5 subjects (16.7%) had no fissures. When the direction of fissures was analyzed in male group, 15 subjects (50%) had vertical fissures, none had horizontal fissures, 2 subjects (6.7%) had oblique fissures, 3 subjects (10%) had fissures in vertical and horizontal direction, 0(0%) in horizontal and oblique direction, 3 subjects (10%) had vertical and oblique direction and 1 subject (3.3%) had combination of vertical, horizontal and oblique direction of fissure. In female group 14 subjects (46.7%) had vertical

Table 3. Comparison of texture of tongue between the two study groups

			Gender		Total	Pearson chi-square	p value
			Male	Female			
Tongue fissures	No fissures	Count	6	5	11	2.282	0.319
		Expected Count	5.5	5.5	11.0		
	Fissures present	Count	22	25	47		
		Expected Count	23.5	23.5	47.0		
	Cleft present	Count	2	0	2		
		Expected Count	1.0	1.0	2.0		

fissure, 3 subjects (10%) had horizontal fissure, 1 subject (3.3%) had oblique fissures, 1 subject (3.3%) had fissures in vertical and horizontal direction, 0(0%) in horizontal and oblique direction, 5 subjects (16.7%) had vertical and oblique direction and 1 subject (3.3%) had combination of vertical, horizontal and oblique direction of fissure (Table 4). The differences in fissures of the tongue among the two study groups were not statistically significant (Figure 2).

In addition to comparing the various characteristics of tongue between the two groups (males and females), statistical analysis was also done to determine if any correlation between sex of the individual and tongue characteristics exists. Cramer's V value was determined since all the parameters involved (gender, tongue shape, tongue margin and tongue texture) were nominal data. We found that there was a strong correlation between gender and tongue margins (Cramer's V = 0.302; p-value = 0.02). However, no significant correlation could be established between gender and either tongue shape or tongue texture (Table 5).

Table 4. Comparison of different characteristics of tongue fissures between the two study groups

			Gender		Total	Pearson chi-square	p value
			Male	Female			
Number of fissures	None	Count	6	5	11	0.698	0.705
		Expected Count	5.5	5.5	11.0		
	Single	Count	8	11	19		
		Expected Count	9.5	9.5	19.0		
	Multiple	Count	16	14	30		
		Expected Count	15.0	15.0	30.0		
Position of fissures	Central	Count	8	12	20	1.758	0.624
		Expected Count	10.0	10.0	20.0		
	Lateral	Count	2	3	5		
		Expected Count	2.5	2.5	5.0		
	Both	Count	14	10	24		
		Expected Count	12.0	12.0	24.0		
	None	Count	6	5	11		
		Expected Count	5.5	5.5	11.0		

Direction of fissures	Vertical	Count	15	14	29	4.959	0.549
		Expected Count	14.5	14.5	29.0		
	Horizontal	Count	0	3	3		
		Expected Count	1.5	1.5	3.0		
	Oblique	Count	2	1	3		
		Expected Count	1.5	1.5	3.0		
	Vertical and horizontal	Count	3	1	4		
		Expected Count	2.0	2.0	4.0		
	Vertical and oblique	Count	3	5	8		
		Expected Count	4.0	4.0	8.0		
	All three	Count	1	1	2		
		Expected Count	1.0	1.0	2.0		
	No grooves	Count	6	5	11		
		Expected Count	5.5	5.5	11.0		

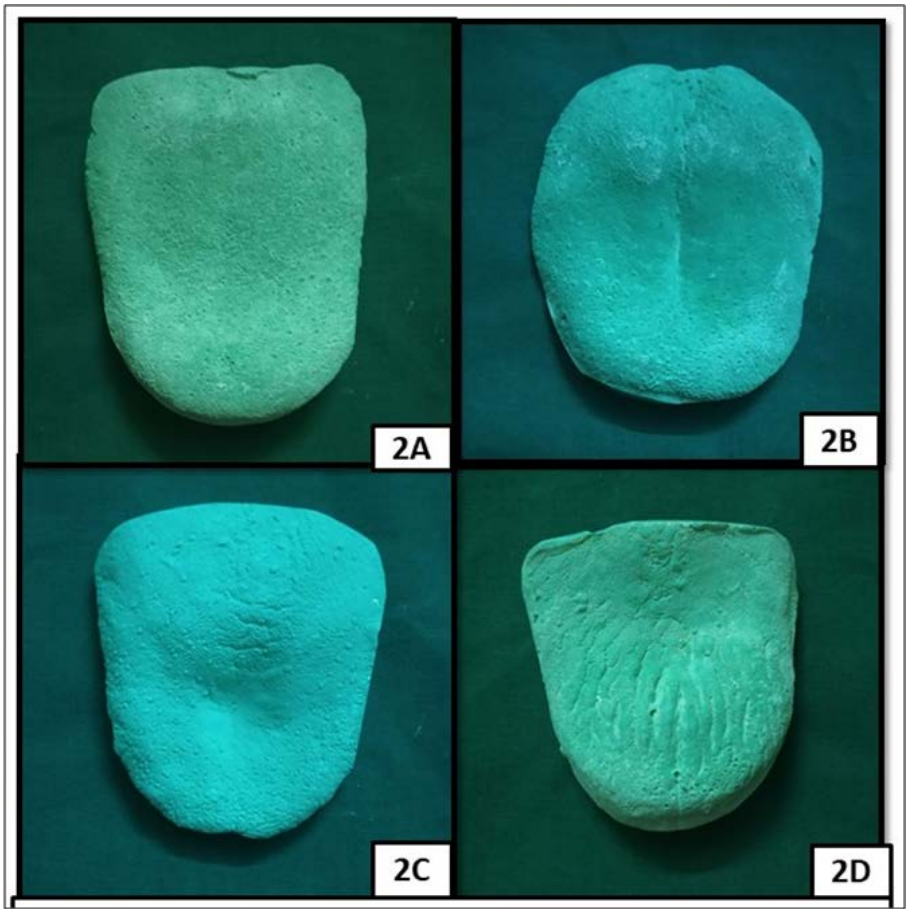


Figure 2. 2A-Photograph showing no fissure in tongue, 2B-Single fissure, 2C-Multiple horizontal fissures, 2D-Multiple vertical fissures.

Table 5. Correlation between gender and various characteristics of the tongue

Correlation between	Cramer's V Value	p-value
Gender vs Tongue shape	0.251	0.052
Gender vs Tongue margin	**0.302**	**0.020**
Gender vs Tongue texture	0.195	0.319

4. Discussion

Dental tissues and the supporting structures provide numerous ways for the positive identification of victims from disasters, crime scenes and in deceased persons. The uniqueness of these structures makes them potential parameters for forensic identification. Compilation of data from other parameters noticeably cheiloscopy, rugoscopy and recently tongue prints are also capable of playing a major role in criminal investigations, where they serve as an adjunct in person identification, sex determination and population sub typing[1].

Identification of human beings based on characteristic physiological parameters plays a main role in biometric authentication which helps in prevention of identity thefts. Verification and authentication are two main tools of any biometric tool. Tongue print is considered to be a unique biometric tool which cannot be forged easily. Advantages of tongue prints over other biometric systems are genetic independence (no two tongue are similar), physical protection (well encased in the oral cavity) and its stability over time. Research on tongue prints is at a preliminary stage. A recent study has validated the use of tongue prints in forensic identification. However, implications of tongue prints and its use as a forensic tool remain unexplored in the field of dentistry[4].

In the present study, when considering the shape of tongue, among males, 80% of subjects had U-shaped tongue, while among females; only 57% subjects had U-shaped tongue. The predominant shape observed in the total sample of our study was U-shape. However, V-shaped tongue was more frequently observed in females. These observations were in agreement with the findings of other studies by Stefanescu, *et al.*, Jeddy, *et al.*, Abraham and Vijay, *et al.*[3-6]. The reason for V-shaped tongue in females could be because of the smaller mandible size in females and increased length and width of the tongue in males when compared to females.

When considering the margins of tongue, among males, 70% had normal margins while 93.3% of female subjects had normal margin of the tongue and 6.7% had scalloped margin. Scalloped margins were more frequently noticed in males. This could be because of the larger size of the tongue in males which causes tooth indentations around the edges of the tongue resulting in scalloped border. We also found a strong correlation between tongue margin morphology and gender, suggesting that this could be a useful tool in gender determination. Our finding was contradictory to the findings reported by Sreepradha, *et al.*[7].

We noticed that when the texture of the tongue was considered, 73.3% of males had fissures in the tongue and 6.7% had bifid/cleft tongue. Among females, 83.3% had fissures in the tongue and there none showed bifid/cleft tongue. Presence of fissures was the frequent finding in both males and females. A majority of our study subjects, irrespective of gender, showed multiple fissures. These observations were in agreement with the findings of study done by Sreepradha, *et al*. We also noticed that the fissure directions were variable among both males and females, although vertical fissures were more commonly noticed in both genders. To the best of our knowledge, no other study has attempted to study the direction of fissures on the tongue.

5. Conclusion

We have made an attempt to compare various morphological characteristics of tongue prints with respect to gender in a south Indian population from Namakkal District. We noticed that the morphology of tongue margins showed a significant correlation with gender. Other characteristics, especially the tongue shape, also showed marked difference in males and females, although they were not significant statistically. The tongue is a unique organ exhibiting many static and dynamic characteristics which differ considerably between each and every individual. Variations in morphology and surface features of the tongue may constitute distinctiveness which can be adopted by dentists as a chair side technique on a regular basis. This could serve as a database and as a guide in personal identification purposes. Limitation of the study includes the smaller sample size; hence studies with larger sample size should be conducted to determine the common presentation of tongue features among both the genders. To conclude, tongue print being a unique record and one that cannot be forged can be used for

forensic identification purposes and it can be used as a biometric authentication tool too.

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