Innovations

"Tongue Prints: A Potential Tool for Gender Estimation"

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Abstract

Background and Objectives: Biometric authentication plays a crucial role in identifying and verifying individuals for security purposes. Unlike other biometric methods, tongue prints are highly individualized, making forgery difficult. The use of lingual impressions or tongue prints for biometric authentication is an emerging area of research. This study aims to evaluate common morphological features of the tongue and their variations between males and females. Additionally, the utility of alginate impression and dental cast in obtaining lingual impressions will be assessed. **Materials and Methods:** The present study was conducted in Sardar Patel Institute Of Dental and Medical Sciences, Oral & Maxillofacial Pathology and Oral Microbiology Department. The study was carried out on 200 individuals (100 males and 100 females) in the age range of 20-50 years of age exclusively of Lucknow population. The subjects underwent a visual assessment, after which digital pictures of the tongue's dorsal surface were captured. The tongue was imprinted with alginate, and dental stone was used to create castings. Two observers independently examined the castings and photos to determine the surface morphology, including shape, the presence or absence of fissures, and the distribution pattern of those fissures. **Results:** It was found that the U shaped tongue was more prevalent among males while the V shaped tongue was more commonly prevalent among females. Among males, multiple fissures were more common while among females, single fissure was more common Over all among both males and females, vertical pattern of groove was found to be the most commonly found pattern. **Conclusion**: The usage of tongue prints for biometric verification is beneficial. Dentists can easily implement the study's straightforward methodology on a regular basis.

Keywords: Authentication, biometric, fissures, forensic, tongue print

Introduction

Odontology, a branch of anatomical science, explores the intricate structures, developmental processes, and pathological conditions of teeth. Embedded within dentistry, Forensic Odontology (FO) plays a pivotal role by integrating dental expertise into legal proceedings.

Forensic science applies scientific principles to legal matters, playing a crucial role in criminal investigations and disaster management. Within this realm, forensic odontology emerges as a specialized branch, offering insights into person identification and criminal case resolution[31]. Its approach involves examining both hard and soft tissue injuries, assessing human abuse, and analyzing bite marks.

By combining dental science with legal procedures, forensic odontology provides essential expertise and evidence for justice. The durability of dental tissues post-mortem makes it a valuable tool in identifying the deceased. Unlike traditional biometrics, the tongue offers a promising avenue due to its unique characteristics.

The tongue holds promise as a biometric identifier, with its shape and texture remaining relatively unchanged over time. Recent advancements in tongue print recognition systems highlight its significance in forensic science[10].

Beyond individual authentication, the tongue's role extends to forensic dental identification through lingual impressions, capturing detailed surface features. Additionally, research on gender-based variations in tongue morphology opens new avenues for human identification research and application.

Materials and Methods

The present study was conducted in Sardar Patel Institute Of Dental and Medical Sciences, Oral & Maxillofacial Pathology and Oral Microbiology Department, with approval of ethical comitee, The study includes 200 individuals (100 males and 100 females) in the age range of 20-50 years of age exclusively of Lucknow population.

Using a combination of visual examination, photography, and alginate impressions, researchers uncovered distinct patterns in tongue grooves and shapes, with implications for forensic identification.

A clinical visual assessment observed and documented tongue characteristics. Chromatic alginate was used for tongue imprints, applied directly onto the tongue and then transferred to an impression tray(Figure 2). Dental stone powder was mixed with water to achieve a creamy consistency and poured onto the impression. After solidifying, the dental model was carefully prepared, taking around 45 minutes to an hour per model. All models were kept for records.

Figure 1 : Armamentarium Used.

Figure 2: (a) Clinical Photograph Of Dorsum Of Tongue.
(b) Cleaning Of Tongue With Gauge Piece.
(c) Mixing Of Impression Material.
(d) Application Of Aliginate Material

Evaluation Parameters:

Genderwise comparison of the shape of the tongue, the different types of the fissure the different pattern of groove was devaluated from the impression casts.

Statistical analysis :

Statistical analysis was done with software spss version 21 by applying chi- square test and t test.

Results:

Mean age of males & females was compared using Independent t test. No statistically significant difference was found in the mean age of males and females.

Table 1: Gender wise comparison of mean age

	Sex	N	Mean	Std. Deviation	P value
Gender	Males	100	26.69	4.86940	0.379, NS
	Females	100	27.30	4.91647	

Independent t test

Mean age of males & females was compared using Independent t test. No statistically significant difference was found in the mean age of males and females.

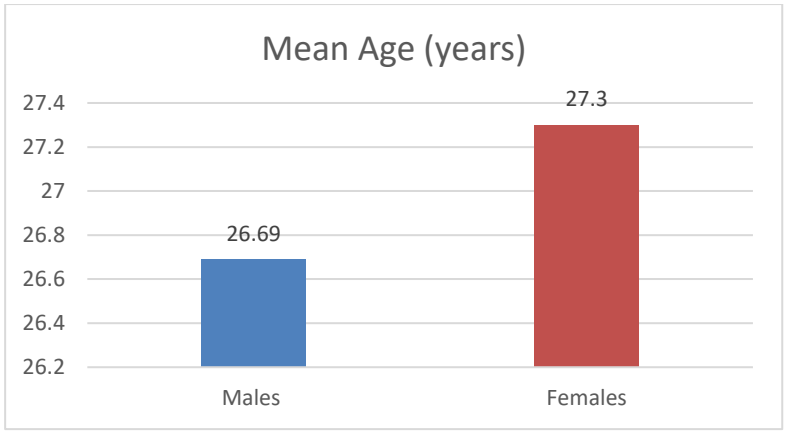


Table 2: Gender wise comparison of the shape of the tongue

			SHAPE of the Tongue		Total
			U shaped	V shaped	
SEX	Males	N	59	41	100
		%	59.0%	41.0%	100.0%
	Females	N	35	65	100
		%	35.0%	65.0%	100.0%
Total		N	94	106	200
		%	47.0%	53.0%	100.0%
P value			0.001, S		

Chi square test

Genderwise comparison of the shape of the tongue was done using chi square test and a statistically significant difference was found. It was found that the U shaped tongue was more prevalent among males while the V shaped tongue was more commonly prevalent among females .

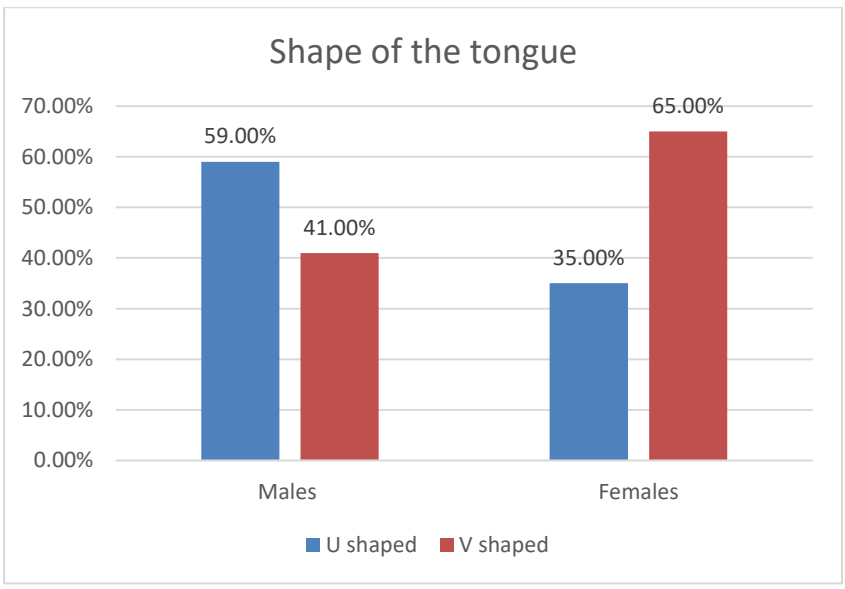


Table 3: Genderwise comparison of the type of the fissures

			FISSURE		Total
			Single	Multiple	
SEX	Males	N	42	58	100
		%	42.0%	58.0%	100.0%
	Females	N	53	47	100
		%	53.0%	47.0%	100.0%
Total		N	95	105	200
		%	43.0%	44.0%	100.0%
P value			0.686, NS		

Chi square test

Genderwise comparison of the different types of the fissure was done using chi square test and the difference was not found to be statistically significant. Among males, multiple fissures were more common while among females, single fissure was more common. But the difference failed to reach the level of statistical significance.

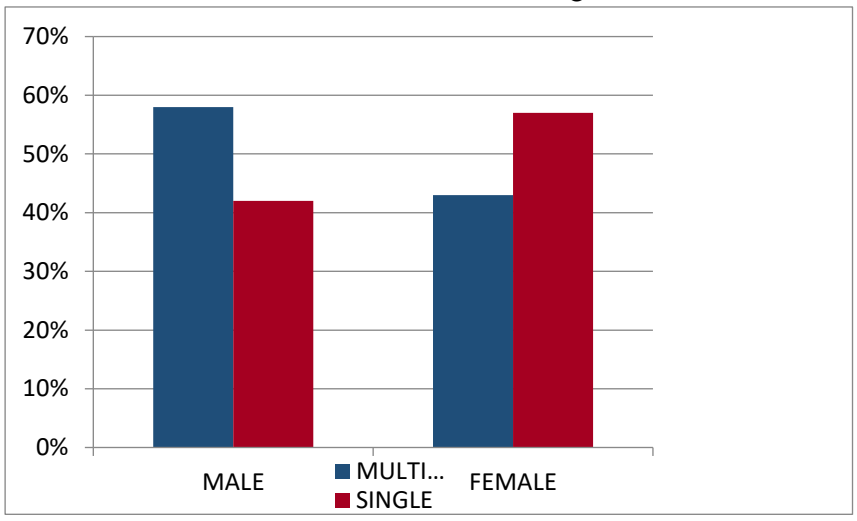
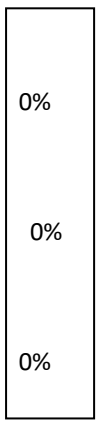


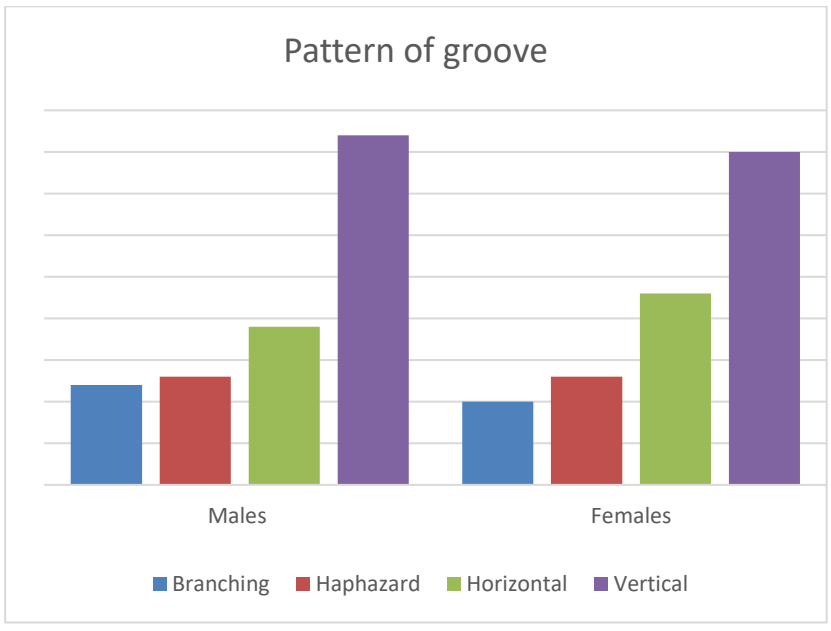
Table 4: Gender wise distribution of pattern of groove

			PATTERN of Groove					Total
			Branching	Haphazard	Horizontal	Vertical		
SEX	Males		12	13	23	52		100
			12.0%	13.0%	23.0%	52.0%		100.0%
	Females		10	13	27	50		100
			10.0%	13.0%	27.0%	40.0%		100.0%
Total			22	26	50	102		200
			11.0%	13.0%	21.0%	52.0%		100.0%
P value			0.962, NS					

Chi square test

Genderwise comparison of the different pattern of groove was done using chi square test and the difference was not found to be statistically significant. The distribution of different patternswere not found to be significantly different among males and females. Overall among both males and females, vertical pattern of groove was found to be the most commonly found pattern.





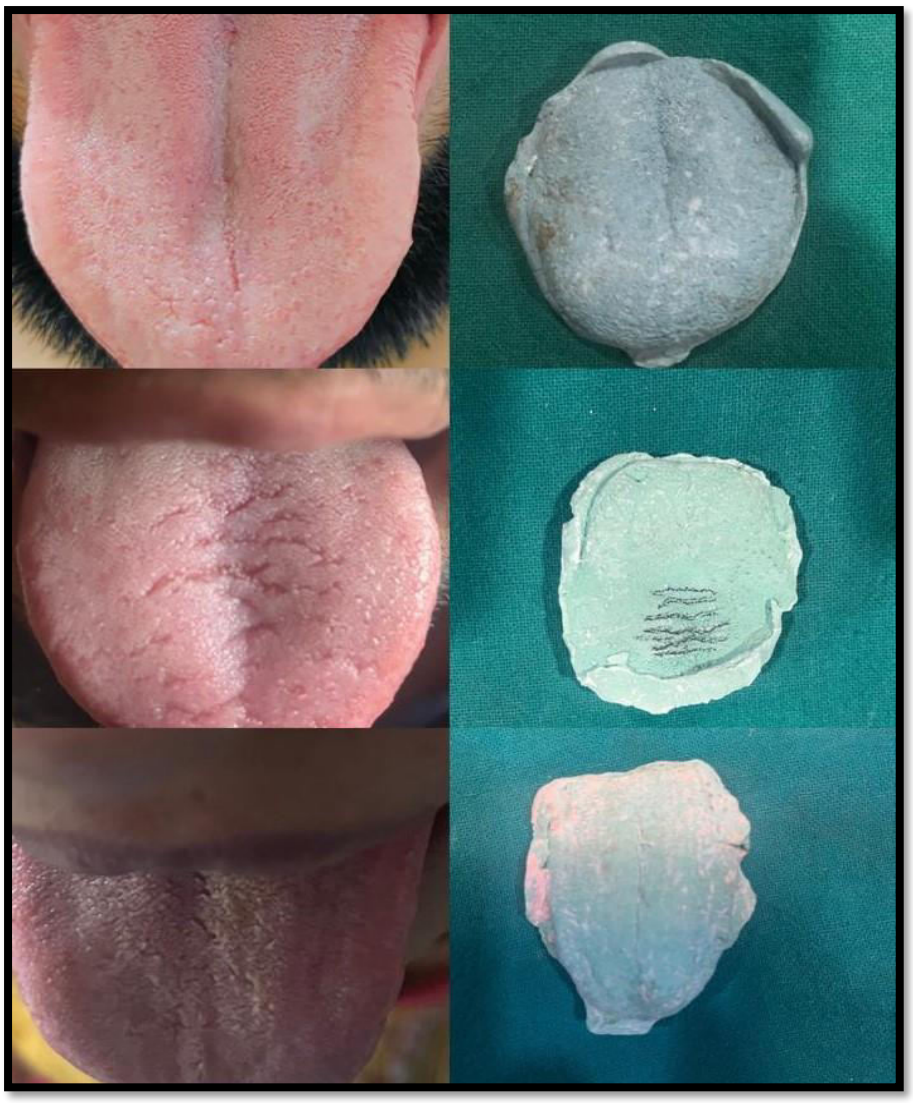


Figure 3 : (a) Single Verticle Groove
(b) Multiple Horizontal Fissures
(c) Branched Fissures

Discussion

The tongue, a versatile muscular organ, plays crucial roles in various oral functions such as taste perception, swallowing, phonation, and sucking. Beyond its functional significance, the state of the tongue often serves as an indicator of overall health, with its color and texture being used in traditional Chinese medicine for diagnostic purposes.

In forensic examinations, the tongue holds particular importance due to its resilience to decomposition in confined oral spaces, making it valuable for identification purposes, especially in cases involving individuals without teeth or other dental records. With advancements in technology and lifestyle, individuals are increasingly susceptible to various unfortunate events, including mass casualties, where traditional identification methods may prove challenging.

Recent studies have investigated the association between tongue morphology and sexual dimorphism. Findings suggest that men tend to have a square-shaped Discussion [35] tongue, while women exhibit a more V-shaped morphology. Groove patterns on the tongue vary, with the vertical pattern being the most common, followed by horizontal, random, and branching patterns. These patterns also exhibit differences in prevalence between genders, with certain patterns being more common in females than males.

Research has also highlighted the reliability of alginate as a tool for obtaining lingual impressions, with high rates of matching observed between impressions and tongue features

. The utilization of lingual impressions in forensic dental identification has been established as a valuable technique, encompassing impressions of both the lateral borders and dorsal surface of the tongue

. In our current study, we employed alginate lingual imprinting along with photography to investigate potential correlations between sexual dimorphism and tongue morphology. To segment tongue pictures, Li and Wei proposed an adaptive segmentation technique (9) Additionally, a number of other approaches have been put out by Jeddy et al. (12) and Stefanescu et al. (11) Our findings revealed distinct differences in tongue shape between genders, with men predominantly exhibiting a square-shaped tongue, while women tended to have a more V-shaped morphology. Additionally, we observed significant variations in groove patterns, which we categorized into vertical, horizontal, haphazard, and Discussion [36] branching patterns. Further subdivision of major groove patterns into single and double groove patterns provided additional insights into tongue morphology. The tongue has emerged as a reliable member of the biometrics family, with previous studies showcasing its efficacy in various public-use systems like banking systems.

Consistent with earlier research, our study identified the vertical groove pattern as the most common, followed by the horizontal pattern, while random and branching patterns were less prevalent. Moreover, we found that the occurrence of random and horizontal groove patterns was more common in females compared to males. Males had a U-shaped tongue (59%), whereas females tended to have a Vshaped tongue (41%). P = 0.6) indicates that this observation was statistically significant. These findings differed from those of other research. According to a study by Jeddy et al. (12) on the Indian population, ladies also had a V-shaped tongue with a sharp tip, while the majority of males had a U-shaped tongue. U-shaped tongues are common in the Malay race (52.9%), but V-shaped tongues are more common in the Indian race (54.3%).

Nevertheless, there was no statistically significant difference found indicating that ethnicity influences variations in tongue shape.

On the tongue's dorsum, fissures can occur in a variety of patterns, including horizontal, vertical & haphazard were seen. Individual fissures can also occur in more than one pattern or location. In the current study, the most common fissure pattern was multiple fissures (58%), with 42% having single fissures which is in contrast with study done by Venkatesh S B, Kamath V, Hasbullah N B, Binti Abdul Mutalib N S S , Bin Mohamad Nazeri M S , et al. where single fissures (69.2%) were more commonly observed while multiple fissures only 1.2% were seen. Our study also corroborated previous findings regarding the presence of more Discussion [37] numerous vertical fissures in males, primarily shallow in nature, and deeper in females. Despite variations in groove types, the vertical pattern remained the most prevalent, consistent with previous research by Farman AG and Mathew AL et al. Furthermore, age-related changes in tongue morphology were noted, with advancing age potentially leading to alterations in the dorsum of the tongue, such as a reduction in prominence of foliate or filiform papillae and an increase in fissures.

Conclusion

Forensic odontology, with its focus on dental evidence and biometric authentication, stands at the forefront of modern forensic science. The tongue, with its unique characteristics and reliability, emerges as a promising tool for both individual authentication and forensic identification[5]. As research in this field progresses, dentists continue to play a pivotal role in advancing the frontiers of forensic science.

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