

Tongue Prints: An Emerging Forensic Tool

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Abstract

Biometric is a real time identification system using physical characteristics. The tongue can be used as a novel identification system and a potential forensic tool. Tongue prints can be captured either by clicking a photograph of the dorsum of the tongue or by obtaining an alginate impression. Tongue printing dates back to the era of traditional Chinese medicine. Tongue prints and their interpretation is also important in diagnosing cases of HIV, upper gastrointestinal problems, etc. Multiple studies have been performed to establish a universal classification of tongue prints. Still, there is a lack of availability of data about the population of different geographical locations. Hence, it also opens up new research avenues for upcoming researchers.

Keywords: Tongue prints, biometric, identification, forensic odontology, tool.

Key Messages: Tongue prints can be used as a reliable new technique for biometrics assessment because of their genetic independence, stability over time, and physical protection from the external environment. Hence, it also opens up new research avenues for upcoming researchers.

INTRODUCTION

In today's world of digitalization, biometric identification has replaced the traditional methods. Biometrics aids in identification and

grants access to an individual under surveillance.¹ Biometric can be defined as a real time identification system using the physical characteristics of a human and comparing it with a library containing characteristics of other people.² Fingerprint, iris scan, skin color, signature verification, voice recognition, and face recognition serve as time tested methods of biometric identification.³ It is necessary to make this system robust and reliable. The search for precision has now led researchers to use the tongue as a method of identification. Through the years of research, it is now established that the tongue can be used as a novel identification system and a potential forensic tool.² Tongue is a muscular organ located in a protected environment inside the oral cavity. It rests on the floor of the mouth. It plays important role in speech, articulation, taste, phonation, and breathing.⁴ This review highlights the progress of tongue prints in the field of forensic

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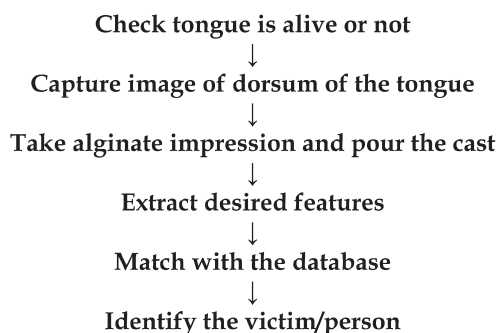
odontology.

Tongue: A Reliable Proof of Life

Just like the oral cavity, the tongue also serves as the mirror of systemic health. Many systemic conditions show tongue manifestations. In traditional Chinese medicine (TCM), the vitality of the tongue is described as the “tongue of life”, where the tongue has a vital color. In contrast, the dark and withered color of the tongue is described as the “tongue of death”.^{5,6} No two tongues are identical even in twins. The tongue is the only strongest internal muscular organ that can be protruded for inspection. The shape of the tongue remains constant and has unique surface characteristics too.⁷ Like any other organ tongue has its specialized system of skeletal muscles, blood supply, and nerve supply. Moreover, the tongue has specialized structures like papillae and taste buds.⁸

METHOD OF COLLECTING TONGUE PRINTS

Tongue prints can be captured either by clicking a photograph of the dorsum of the tongue or by obtaining an alginate impression.



DIFFERENT METHODS TO STUDY^{1,9,10}

- Clinical examination
- Photographs
- Alginate impression
- Computer algorithms
- Sensors
- Spectral analysis,
- Gabor filter, and
- Gabor wavelet opponent color feature (GWOCF) -TCM
- Wavelet transform
- Discrete wavelet transform - Dual tree complex wavelet transform (DT-CWT). \

- Particle swarm optimization (PSO)
- Particle swarm optimization neural network (PSO-NN)
- Genetic algorithm back propagation neural network (GANN)
- Scale-invariant feature transform (SIFT)
- Computerized tongue examination system (CTES)
- Bayesian network classifier

TONGUE PRINTS AS A FORENSIC TOOL

Tongue printing dates back to the era of traditional Chinese medicine wherein they gave a simple classification of the shape of tongue as:

Hammer, Rectangle, Acute Triangle, Obtuse Triangle, Square, And Round. Stefanescu et al (2014), analyzed the lingual morphological aspects and demonstrated their importance and reliability as a forensic tool.¹¹ their findings can be summarized in the table below:

Parameters	Male	Female
Shape	U /v , more common V	U
Texture	Higher no. of deep & Shallow grooves	Lesser no.

Pattern of fissure–single pattern, 2 fissure pattern or 3 fissure pattern is prominent in males than in females.

We also came across various shapes of tongue like ‘V shaped’ (Fig. 1), ‘U shaped’ (Fig. 2), Box shaped tongue (Fig. 3).



Fig. 1: ‘V shaped’ tongue.

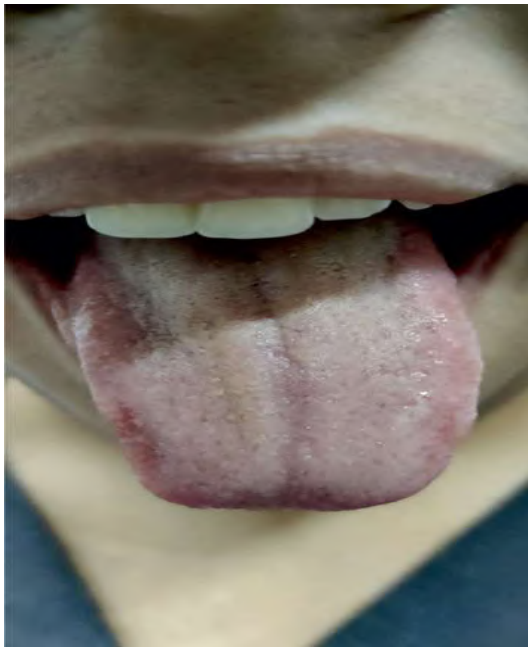


Fig. 2: U shaped' tongue

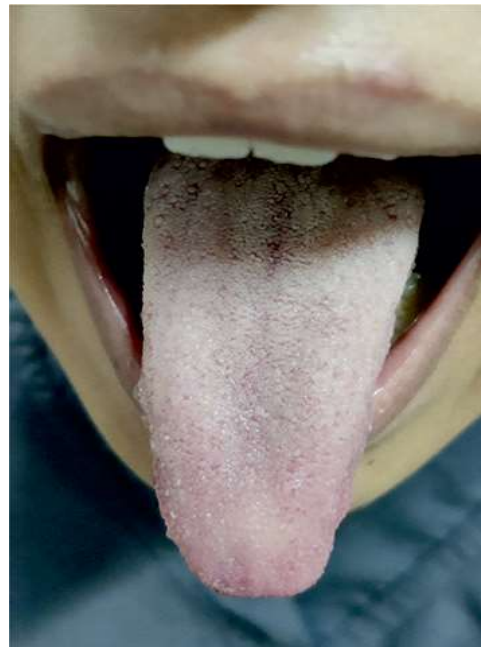


Fig. 3: Box shaped tongue

In 2017, Jeddy N et al did a pilot study on 20 participants 12 males and 8 females, and found that fissures are the most common structural characteristic. They deciphered that central fissures were more common in both males and females. The next characteristic analyzed was the depth of fissure and it was found that fissures were shallow in males and deeper in females. the most common shape was 'U' in both males and females followed by 'V'.⁸

Pradkshana et al formulated a working classification focusing on the size, shape, color, texture, and pattern of the tongue. They also added the shape of margins and the tip of the tongue.⁴

Jayan et al 2019 did a study involving the ethnic Tamil population focusing on the length and width of the tongue and concluded that The mean for the width of the tongue was 3.599. The length of the tongue had a mean value of 4.283.¹² in another metric study by Singh et al, 2020, they formulated a database and found that the mean width of the tongue is more in males than in females.

Kaur et al formulated an excellent database by capturing 50 images of the dorsal tongue and found that tongue prints are equivalent to speech and signature biometric identification.¹³

In another interesting study by Ibrahim et al, a wavelet transformation algorithm was utilized for the extraction of the characteristics of the tongue as well as Bhattacharyya distance was used to distinguish the image of the person's tongue from the other.¹⁴

In this manner, many researchers have been working on identification using tongue traits.^{9,10} However, the lack of a database causes limitations in applying it to day-to-day use. This also opens up new research avenues and an appeal can be made to record tongue prints to add to the database as this system seems to be promising in forensic odontology.¹⁵

The use of this database is not only in biometric identification. We know that tongue is the mirror of systemic health.

In an interesting study by Anastasi et al, in 159 HIV patients and tongue assessment was done for seven characteristics: tongue color, shape, body quality, coat color, weight, surface, and tongue action. They concluded that most patients had swollen and toothmarked tongues with a pink body but with cracks and a thick, dry, white coat.¹⁶

The traditional Chinese medicine (TCM) practitioners observed the tongue color and coating to determine ZHENG (as cold/hot ZHENG). Using this they diagnosed different stomach disorders such as gastritis.¹⁷

Efforts are being made in the direction toward the identification of extra-oral TAS2R agonists as drug agents for muscle relaxation. Bioinformatics-aided screening of bitter compounds in traditional Chinese medicine is therefore the new scope of research.¹⁸

LIMITATIONS

There is a lack of availability of data about the

population of different geographical locations. Hence, it also opens up new research avenues for upcoming researchers.

CONCLUSION

Tongue prints can be used as a reliable new technique for biometrics assessment because of their genetic independence, stability over time, and physical protection from the external environment. So it is required to establish a Global/national level identification database to create an authentic biometric profile. Also, it can be used for forensic identification purposes as an adjunct to rugoscopy, amyloglypics, MCI, and cheiloscopy to achieve the complete biometric profile of a particular person.

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Conflict of Interest: The authors declare that they have no conflicts of interests.

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