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Forensic Identification through Tongue Print in Bataknese Students

Yendriwati*[1] , Atika Resti Fitri[1] , Minasari[1] , Filia Dana Tyasingsih[1] ,
Wan Nadira Humaira Syaifuddin[2]

[1]*Department of Oral Biology, Faculty of Dentistry, Universitas Sumatera Utara, Indonesia*
[2]*Faculty of Dentistry, Universitas Sumatera Utara, Indonesia*
*Corresponding Author: drg.yendriwati@gmail.com

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ABSTRACT

Tongue print is a novel forensic odontological concept and serves as a conventional biometric device providing basic information on a variety of unique shape and texture of tongue in each individual. Therefore, this research aimed to investigate the dominant pattern of tongue print based on the shape, lingual apex, fissures (location, depth, shape), and texture in Bataknese male and female students from Universitas Sumatera Utara. The experiment was carried out using descriptive-analytic method with a cross-sectional design. The samples were 30 Bataknese male and 30 female students from Universitas Sumatera Utara. Tongue samples obtained were printed by using alginates (irreversible hydrocolloid impression material), filled up with gips stone type IV, and the figure was taken with a digital camera. The data were analyzed based on Stefanescu classification descriptively, using percentage values and tabulation, followed by chi-square statistic test (x^2). The results showed that there were variations in tongue print pattern among Bataknese males and females, but no significant difference was observed except for shape (p<0.05). The dominant pattern was square (U-shape), pointed tip of lingual apex, physiological texture, and absent fissure. These results suggested that tongue print pattern could be used for gender identification.

Keywords: Tongue Print, Forensic Identification, Biometrics, Bataknese Ethnicity

ABSTRAK

Odontologi forensik merupakan cabang keilmuan forensik yang sedang berkembang pesat. Saat ini odontologi forensik menawarkan konsep baru sebagai alternatif biometrik konvensional yakni sidik lidah. Sidik lidah merupakan salah-satu sarana identifikasi yang membentuk informasi pada permukaan dorsal, bervariasi dan unik pada setiap individu. Penelitian ini bertujuan untuk mengetahui dan menganalisis pola sidik lidah dominan berdasarkan bentuk, apeks lingual, fisura (lokasi, kedalaman, bentuk), serta tekstur pada laki-laki dan perempuan etnik Batak di Universitas Sumatera Utara. Studi ini merupakan penelitian deskriptif-analitik dengan desain *cross sectional*, sampel terdiri dari 30 orang laki-laki dan 30 orang perempuan etnik Batak di Universitas Sumatera Utara. Lidah dicetak menggunakan bahan cetak alginate (*irreversible hydrocolloid*) kemudian diisi gips stone tipe IV dan diambil foto menggunakan kamera digital. Data pola sidik lidah dianalisis berdasarkan klasifikasi Stefanescu et al, kemudian diuraikan dalam nilai persentase dan tabulasi, dilanjutkan uji statistika *chi-square* (x2). Pola sidik lidah etnik Batak pada penelitian ini bervariasi. Tidak terdapat perbedaan signifikan pola sidik lidah laki-laki dan perempuan etnik Batak kecuali aspek bentuk lidah (p<0.05). Pola sidik lidah dominan etnik Batak adalah bentuk persegi (bentuk-U), apeks lingual/ujung lidah tajam, tekstur fisiologis dan fisura yang tidak tampak. Pola sidik lidah penting dalam mengidentifikasi jenis kelamin.

Keyword: Sidik lidah, Identifikasi Forensik, Biometrik, Etnik Batak

1. Introduction

Forensic odontology is beneficial when there are challenges in other biometrics such as fingerprint, palm print, cut scanning, and retina identification [1]. These methods possess distinct disadvantages, causing susceptibility to security breaches and complicating identification processes. Fingerprint is generally subject to instability because of deterioration, alteration from occupational activities, modification through surgeries, as well as trauma and blister impacts. Voice quality is influenced by illnesses, including colds and coughs, with extreme emotional states leading to the occurrence of misspoken words. The retinal scan shows high sensitivity and can be influenced by factors such as bright light exposure and medical conditions including cataracts and astigmatism. Although skin color constitutes a biometric system, it shows stability issues due to significant variations arising from factors such as age, burns, diseases, and the application of creams or medications [2].

Due to these numerous disadvantages, the use of tongue print offers several advantages. Generally, tongue has distinct variations in shape and surface textures among individuals. As an internal body part, it can be easily accessed for examination, and the exposed surface provides the necessary information. The physiological texture and shape are maintained consistently, shielded from the external environment, thereby preventing the influence of external factors [3]. Tongue print serves as a biometric device and represents a novel forensic odontological concept providing basic information including a variety of unique shape and texture of tongue in each individual [4,5]. Furthermore, it serves as a potential alternative or supporting data in the process of identification when the corpse has a history of cleft lip and palate [6].

Based on morphological characteristics, Stefanescu et al. categorized tongue print based on texture (physiological, scrotal, and geographic), shape (ovoid, ellipse, pentagonal, square/U shape, and trapezium asymmetrical/V shape), fissure (perceptible and imperceptible), and lingual apex (sharp and septate) [7]. Garg et al. stated that tongue print had the potential as a device for identifying males and females among the Kanpur community. The "U-shape" tongue is predominantly observed in males (74.3%), while the absence of fissures is found in females (61.9%) [8]. The distinctive feature of tongue print is in the dissimilarity properties, including identical brothers [9], offering static and dynamic characteristics for verification purposes [10]. This shows the increasing trend for tongue print as a biometric authentication system. Therefore, this research aimed to investigate the dominant pattern of tongue print according to the shape, lingual aspect, fissure (location, depth, and shape), and texture among Bataknese male and female students at Universitas Sumatera Utara.

2. Materials and Methods

This research was conducted at the Oral Biology Laboratory, the Faculty of Dentistry, Universitas Sumatera Utara, using a cross-sectional design. The ethical approval was obtained from KEPK (Health Research Ethics Commission, the Faculty of Medicine, Universitas Sumatera Utara, through the Letter of Approval of the Health Research Implementation Ethic Committee No. 1114/KEPK/USU/2022.

The subjects were students of Universitas Sumatera Utara (30 males and 30 females) with the inclusion criteria of Bataknese ethnicity, 18 to 22 years old, healthy, and normal tongue. The exclusion criteria were patients with HIV, transmitted and systemic diseases which had the potential to change tongue anatomy. These diseases included diabetes mellitus, iron deficiency anemia, celiac disease, lupus erythematosus, erythema multiform, Sjŏrgen Syndrome, and hypothyroid, smokers (routinely smoking longer than 8 weeks), allergic to impression materials and macroglossia or macroglossia.

All subjects obtained the details of the procedure for tongue print and signed an informed consent. This was followed by cleaning of debris (food remnants) on tongue dorsal surfaces using sterile gauze. Subsequently, subjects were asked to protrude their tongues until maximum protraction but in a relaxed position. Digital photographs were taken twice on the lateral and profile appearance using a professional camera. Tongue impression was performed using irreversible hydrocolloid impression material (alginate) which should be applied from the oral commissure level to the lingual tip. The low-viscosity alginates were used to record soft tissues without compressing due to quick setting, cost-effectiveness, and easy management [11,12].

Tongue impression was performed to avoid regurgitation reflexes such as dorsal surface and lateral limit using an alginate spatula. The result was examined and filling up dental stone type IV was conducted

immediately, followed by giving a number label. The model of tongue print in line with the result of the photography was analyzed to determine morphology characteristics. This was based on the classifications proposed by Stefanescu, et. al and the results were recorded in the observational result sheets [7]. The referential point in assessing the shape was in tongue area which came in contact with the lip commissure after protruding from the mouth and the tip. The data obtained were analyzed using Statistical Package for Social Science (SPSS) and chi-square test (x^2) to determine the difference in tongue print pattern among Bataknese male and female students at Universitas Sumatera Utara.

3. Results

In Table 1, the results showed that 11 subjects (36.7%) had the shape of asymmetric trapezium asymmetrical tongue (V-shape), and 22 males (73.3%) had square (U-shape), as shown in Figure 1. Based on the lingual apex or tip, 27 subjects (90%) had sharp lingualapexes, and only 3 (10%) showed curved lingual apexes, as presented in Figure 2. According to fissures (location, depth, and shape), 14 females (46.7%) had imperceptible (absent) tonguefissures, and 8 males (26.7%) showed the same fissures (Figure 4). The results also showed that 27 females (90%) had physiological tongue textures, comprising 2 (6.7%) geographical and 1 (3.3%) scrotal tongue textures. Meanwhile, 27 males (90%) had physiological tongue textures, where 3 (10%) had scrotal, and there was no geographical tongue texture (Figure 3).

Table 1 shows the *significance < level of significance* (p-value= 0,004 < 0,050). Based on the results, there was a significant difference in the pattern of tongue print, regarding the shape aspects between Bataknese male and female students at Universitas Sumatera Utara. As shown in Table 2, the dominant tongue print pattern was related to specific morphology characteristics, including shape and the tip, texture, and fissure. Subjects with physiological texture had square (U-shape), imperceptible (absent) fissures, and sharp tips.

Table 1. Difference in Tongue Print Pattern for Male and Female Bataknese Students, Universitas Sumatera Utara

| Tongue Morphology	Female		Male		Total		*p-value*
	n	**%**	**n**	**%**	**n**	**%**	
Shape							
Ovoid	8	26.7	4	13.3	12	20	0.004*
Ellipse	2	6.7	0	-	2	3.3	
Square (U shape)	9	30	22	73.3	31	51.7	
Pentagonal	0	-	0	-	0	0	
Trapezium asymmetrical (V shape)	11	36.7	4	13.3	15	25	
	30	100	30	100	60	100	
Fissure							
Imperceptible	14	46.7	8	26.7	22	36.7	0.425
Perceptible	16	53.3	22	73.3	-	-	
Rectilinear (Deep)	5	16.7	5	16.7	10	16.7	
Rectilinear (Superficial)	5	16.7	9	30	14	23.3	
Twisty (Deep)	1	3.3	3	10	4	6.7	
Twisty (Superficial)	5	16.7	5	16.7	10	16.7	
	30	100	30	100	60	100	
Texture							
Physiological	27	90	27	90	54	90	0.148
Scrotal	1	3.3	3	10	4	6.7	
Geographic	2	6,7	0	-	2	3.3	
	30	100	30	100	60	100	
Lingual apex							
Sharp	27	90	27	90	54	90	1.000
Round/bifid/septate	3	10	3	10	6	10	
	30	100	30	100	60	100	

*significant (*p-value* < 0,05)
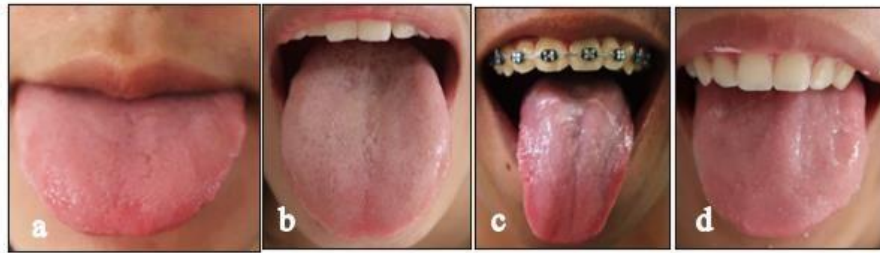
Figure1. Clinical image of tongue shape a. Ovoid, b. Ellipse, c. Trapesium asymmetrical (V shape), d. Square (U shape) (Documentation)

Figure 2. 1.Lingual apex/ sharp tongue tip; 2. Lingual apex/septate/bifid/round (Documentation)

Figure 3. 1. Geographic tongue 2. Scrotal tongue 3. Physiological tongue (Documentation)
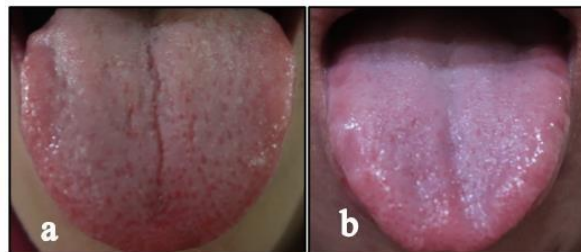

Figure 4. A. Perceptible rectilinear fissured B. Imperceptible/ absent fissured (Documentation)

Table 2. Dominant Tongue Print Patterns in Bataknese Students at Universitas Sumatera Utara

Morphology of Tongue	Dominant Tongue Print	n	%
Texture	Physiologic	54	90
Shape	Square (shape-U)	31	51.7
Fissures	Imperceptible/absent	22	36.7
Lingual Apex	Sharp	54	90

4. Discussion

Forensic analysis of unidentified remains of individuals is essential for determining the identity, cause, and manner of death. This research is important in cases of long-term missing individuals, disaster identification of victims, or humanitarian efforts [13,14]. Based on the results chi-square which showed a significant difference ($p>0.05$), U-shape was dominant in males while asymmetric trapezium (V- Shape) was found in females. Similarly, Garg et. al. [8] conducted research in Kanpur community, India, where the shape

of tongues in females was square (U-Shape)(60%), followed by asymmetric trapezium shape (V-Shape) (23.8%), and (U-Shape) was found in males (74.4%).

The mandibula shape in females was smaller compared to male [15] due to the level of testosterone influencing the development of craniofacial complex [8]. Tongue fissure imperceptible (absent) as shown in Table 1 was often found in females rather compared to males. The characteristics of fissures (visible) were found in Bataknese males with shallow straight-line fissures. Similarly, Garg et al. [8] in Kanpur community, India, reported that the characteristic of fissure often found in females was imperceptible (absent) (61.9%) rather than in males (15.8%). Jayan et al. [16] in Tamil ethnicity, India, also reported that imperceptible (absent) fissure was often found in females compared to central straight lines. The absent fissure on the dorsal surface of female tongue could be attributed to the longer and wider tongue possessed by male.

Tongue texture which is often found in both males and females was physiological. This is followed by scrotal and geographical textures, which are often found in male and female subjects, respectively. Stefanescu, et. al., observed that geographical tongue texture was the specific characteristic print in females (0.3%). Mani et al. [19] in Namakkal community, Tamil Nadu Turtu, found that males (92%) and females (100%) had physiological/normal texture, with scrotal observed in males (8%) [16]. Geographical tongue texture observed in Bataknese females was caused by their habit of eating hot food which became the culinary representation of the community and other ethnicities in Sumatra Utara. This phenomenon played an important role as irritant on the surface of tongue mucosa and papillary foliform, leading to papillary or depapillation [5]. Various systemic diseases or bad habits may affect tongue appearance or morphology. In previous research, tongue lesions were observed in patients with diabetes mellitus [17] and those with the habit of tobacco consumption [18]. Therefore, the subjects with these conditions should be excluded from the experiment.

Lingual tips showed that males and females were dominantly sharp, followed by curved/septate. Mani et al. [19] in the population of Namakkal, Tamil Nadu, showed that females' lingual apexes were dominantly sharper (88%) while males were more dominant in their curved tonguetips (68%). A curved tongue tip is a congenital disease that shows in the occurrence of the crack dividing tongue with complete or a part of separation. Bifid tongue can occur in the case of an infant born from a mother who is affected by diabetes mellitus. An infant with Larsen-like syndrome is also suspected due to a decrease in autosomal dominant gene and recessive [20,21]. The dominant pattern of tongue print in Bataknese is physiological texture in square (U-shape) with imperceptible (absent) fissures and sharp tips. Similarly, Nurmadhini et al [22] found the normal variation of Deutro Malay sub-race tongue, characterized by U-shape with physiological texture, and imperceptible (absent) fissure surface. This is similar to the pattern of Bataknese from the Proto Malay sub-race as a part of Mongoloid race [22,23].

Tongue print serves as a distinctive biometric record and a superior tool for authentication compared to other methods. The dorsal surface of tongue shows individual variability among individuals, including identical brothers [9]. Although the application of this method in natural and anthropogenic disasters remains undocumented, its specificity and stability are suitable for forensic identification applications. This research has some restrictions such as the limited number of subjects and the inclusion of one ethnicity that not representing Proto Malay sub-race. Therefore, further research is required to be conducted in a large-scale population to ascertain the prevalent characteristics of tongue features in Proto Malay sub-race. The establishment of a database is also essential for investigating the application of tongue print in the field of forensic dentistry.

5. Conclusion

In conclusion, this research showed that there were varieties of tongue print pattern among Bataknese students of Universitas Sumatera Utara. A significant difference ($p < 0.05$) was found based on the aspect of tongue shape in the pattern, which was dominated by physiological texture.

6. Acknowledgements

7. Conflict of Interest

The authors declare no conflicts of interest to disclose concerning this research.

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