Determination of sexual dimorphism using tongue prints : A prospective cross-sectional study.

Abstract:

Background: Oral structures are known to have their uniqueness. Among these, the tongue has many characteristics that make it suitable for identity recognition. In this study, tongue imprints through digital photography and tongue impressions were used.
The aim of the study was to determine sexual dimorphism based on tongue morphology and fingerprints.

Materials and methods: The study included 120 subjects (60 males and 60 females) in the age group of 18 to 35 who were excluded from any systemic illness and were reportedly healthy. The tongue photography was recorded using and the impression was made using the alginate material. In the present study, images of the dorsal part of the tongue were taken for 60 males & 60 females and a database was formed which were studied for the features such as tongue shape, tongue tip, dorsal morphological features. The alginate impression (lingual impression) of the dorsal and lateral borders of the tongue was done to study the minute details. The gender dimorphism was evaluated with this respect and the results were compared with fingerprints which were evaluated using Acree's method. The same was compared with their respective blood groups too. The ethnicity of the subject was also noted.

Results: Tongue prints in the assessment of sexual dimorphism with relation to morphology were found to be significant with a p-value of 0.043 and the fingerprint in relation to the assessment of sexual dimorphism was also significant but all the other comparisons were found to be insignificant.

Conclusion: In the present study, it was concluded that tongue prints based on tongue morphology can be a reliable source of identification with respect to sexual dimorphism. However, more studies with a larger sample size with relevance to ethnicity may be useful in bringing out a conclusive result in this aspect.

Keywords: Tongue prints; lingual impression; uniqueness; fingerprints; sexual dimorphism.

Introduction

Human identification is always a strenuous job, and forensic odontologist plays a pivotal role in this. Human beings can be isolated from other mammals based on the uniqueness of the oral cavity in terms of dentition and tongue [1].Forensic Odontology is gaining importance with various tools employed in personal and gender identification. Biometric authentication as a tool for personal identification is also gaining popularity in recent days. Fingerprints, facial recognition, iris and retinal scan recognition are some of the techniques used in the biometric identification [2,3]. Both the hard and soft tissues in the head and neck region have unique characteristics that aid in such identification.The tongue being a vital organ accomplish several tasks like speech, taste perception, articulation and bolus formation of food [4] and above all tongue being the only internal organ can be easily drawn out and displayed for inspection and palpation [5]. As the tongue is well encased in the oral cavity, it is difficult to be forged compared to other evidence and identification systems.

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There are studies that have proven the uniqueness of the tongue where few studies have shown that the tongue prints of identical twins too do not resemble each other [6].Tongue print was firstrecognized and came into existence in the year 2007[7].Visual inspection and digital photography have been the time tested methods that have been adopted so far [8]. It involves the information regarding both geometric shape and physiological texture that are potentially useful in human identification [9].In the present study,images of the dorsal part of the tonguewere taken for 60 males & 60 females and a database was formed which were studied for the features such as tongue shape, tongue tip, dorsal morphological features.The alginate impression (lingual impression) of the dorsal and lateral borders of the tongue was done to study the minute details. The gender dimorphism was evaluated with this respect and the results were compared with fingerprints which were evaluated usingAcree'smethod [10].

The Aims&Objectives of the study was to determine sexual dimorphism using tongue prints, fingerprints and blood group.All the observations (i.e., Tongue morphology evaluated using tongue prints,fingerprints and blood group) were compared.

Materials and Methods:

The study was carried out on 120 subjects (60 males & 60 females) within the age group of 18- 30 years.The analysis was done based on tongue photographs and tongue impressions. Tongue photographs were taken under the same environmental and light conditions and at a predetermined distance. Before carrying out an examination, the tongue was cleansed using sterile compress and subjects were asked to rinse their mouth. Then they were asked to protract their tongue tothe maximum protraction at a relaxed positionto prevent any alterations in shape and characteristics of the tongue.On direct examination morphological features likeshape, type, characteristics of the longitudinal median septum, related grooves, lingual apex type were evaluated. For minute details, alginate impressions of the dorsal surface and lateral border of the tongue were made and casts of the same were prepared using class IV dental stone. For fingerprints, subjects were asked to place their right thumb on white paper and thumb impression was recorded. Impressions were studied by 4 observers for its ridge density. Islands and incomplete ridges were not counted. For fingerprint analysis,

a 5x5mm square was made on an OHP sheet. The sheet was placed on the paper having a fingerprint impression and the upper left corner was selected for the analysis(Acree's method).The quantitative analysis of the same was done using a magnifier lens app (cozy). Blood group was also recorded (through history).

Results:

The 120 subjects formed the sample for the study, out of which 60 were males and 60 were females. The to nguemorphology was highly significant (0.043) in terms of sexual dimorphism, among which rough surface texture was the most observed characteristic feature with 60% in males and 51.7% in females (Table 3). The second most observed feature was rough fissured texture (fig. 1a, 1b).

Fig 1a & 1b: showing the dorsal morphology with prominent fissures (rough) and median septum in female subjects.

On interpretation of tongue shape it was found that p-value was non-significant (0.128) with U, V, W showing following values (u=71.7% v= 20%,w=8.3%) &(u =51.7%,v =31.7%, w= 16.7%) for males and females respectively (fig 2a, 2b & 3a, 3b)

Fig 2a & 2b showing 'U'- shaped tongue in male and female

subject r

Fig 3a & 3b showing 'V'- shaped tongue in male and female subject respectively

The tongue tip which was examined using photographs showed 70% rounded, 21.7% pointed and 8.3% septate tip and 55.0% rounded, 25.0% pointed and 20.0% septate in males and females respectively

Table 1: Statistical analysis with respect to tongue shape

	U	U	W	P value
Male	43	12	5	
	71.7%	20.0%	8.3%	0.128 (Non-Significant)
Female	31	19	10	
	51.7%	31.7%	16.7%	

Table 2: Statistical analysis with respect to Tongue tip

	Rounded	Pointed	Septate	P value
Male	42	13	5	
	70.0%	21.7%	8.3%	0.128 (Non-Significant)
Female	33	15	12	
	55.0%	25.0%	20.0%	

Table 3: Statistical analysis with respect to Tongue Morphology

	Rough	Rough Fissure	Rough Fibrous Band	Smooth	Smooth Fissured	Smooth Fibrous Band	Smooth Geographic	Fissured	Rough Geographic	P value
Male	36	15	1	5	0	0	0	2	1	
	60.0%	25.0%	1.7%	8.3%	.0%	.0%	.0%	3.3%	1.7%	0.043 (Significant)
Female	31	8	5	3	1	2	1	9	0	
	51.7%	13.3%	8.3%	5.0%	1.7%	3.3%	1.7%	15.0%	.0%	

The median septum was also evaluated using tongue photographs for which p-value was non-significant (0.19%)

and it was positively recorded in 81.7% males & 73.3% females showed median septum.

Table 4: Statistical analysis with respect to Median Septum

	Not Visible	Visible	P value
Male	11	49	
	18.3%	81.7%	0.191 (Non-Significant)
Female	16	44	
	26.7%	73.3%	

Blood group which was also taken into account was non-significant (0.429) in terms of sexual dimorphism, but the most frequently observed blood group was B positive

Table 5: Statistical analysis with respect to BLOOD GROUP

	A Positive	B Positive	AB Positive	O Positive	B Negative	AB Negative	O Negative	P value
Male	18	22	4	10	1	2	3	
	30.0%	36.7%	6.7%	16.7%	1.7%	3.3%	5.0%	0.429 (Non-Significant)
Female	15	20	5	16	3	0	1	
	25.0%	33.3%	8.3%	26.7%	5.0%	.0%	1.7%	

As far as fingerprints are concerned which were evaluated using quantitative evaluation (ridge density count) using Acree's method

Fig 4 showing the fingerprint with 25mm2 square used ridge count.

Table 6: Statistical analysis with respect to RIDGE COUNT

gender	Min	Maxim	Mean	Std. Deviation	Std. Error	P value
Male	8.00	14.00	10.216	0.993	0.128	0.001 (Significan
Female	10	16.00	12.700	1.331	0.171	

the p-value was significant (0.001). It was shown that the

maximum number of males showed lesser ridge count (mean value = 10.216) compared to females (mean value = 12.7).

Discussion:

In recent years, forensic odontology is gradually getting its due credit. Oral structures and their role in forensic science are emphasized. Tongue prints as an important tool in personal identification has been often discussed. Tongue morphology in relation to its dorsal surface features, shape and tip has been the matter of concern in establishing the personal identification and determining sexual dimorphism. These features, however, could show certain disturbances in case of any underlying abnormalities/pathology like coated tongue, pregnancy, leprosy, celiac disease, dermatitis, rickets, acromegaly, anaemia, history of scar laceration or allergy to impression material; that being a major cause for limiting the use of tongue prints for personal identification. So the subjects with such disorders were excluded in this study and the healthy subjects were considered and the parameters recorded. These parameters were compared with the fingerprints which are considered to be an age-old authentic technique of individual identification which is of more than a hundred years [11]. It has been proved through many researches that finger-prints remain unchanged throughout the life of an individual unless any permanent deformity alters the same [12]. Forensic value of fingerprints come to play due to its frequent occurrence at the crime scene that is helpful in the identification of the suspect [13]. Various characteristics of finger-prints have been studied so far like ridge density, ridge orientation, DNA analysis through dermatographics, etc. Among these, ridge density counts in determining sexual dimorphism is gaining popularity due to its authenticity, ease in analyzing the same and cost-effectiveness. It has been reported through different studies that ridge density in females is higher as compared to males. Thus recorded data were statistically analyzed using the chi-square test.

Dorsal features like fissures, rough/smooth texture were found to be statistically significant with regard to the sexual dimorphism. The tongue shape and tip features did not add to the conclusion of sexual dimorphism and were found to be statistically insignificant. The comparison in relation to fingerprint was found to be statistically significant. The comparison with the blood group was also found to be statistically insignificant, although, in this study, the most common blood group in the study sample was found to be B positive. In terms of sexual dimorphism, this study showed that morphological features like smooth fissured, smooth with a fibrous band and smooth with geographic tongue were exclusively seen in females. In comparison with males, fissured, rough with fibrous bands were more common in females than males. Abraham Johnson et al in 2018 in their study, on the morphologic study of the tongue, found that geographic tongue was more predominant in their subjects. Among tongue shapes, individuals with rectangular shape were predominant. In terms of sexual dimorphism, with relation to surface morphology, our study was in accordance with the above study with more females showing such features like fissured tongue, geographic tongue. But in contrast with the above study, this study showed the fissured tongue was more common. Madhusudan Astekar et al in 2018[14], in their study on lingual morphology, using various parameters like tongue shape, dorsal surface characteristics, the shape of the tongue tip found that gender identification cannot be assessed and concluded that these features can be used to determine the age of the subject. Our study is in contrast with the above-mentioned study as tongue morphology like dorsal features showed statistically significant results though the sexual dimorphism could not be determined using tongue shape and tongue tip features. Stefanescu et al in 2014[5] studied on the tongue-based forensic identification and concluded that scrotal and geographic tongue was more common in females, thus a useful tool in gender identification. Our study was in accordance with the above study. Vinod C Nayak et al in their study [15] on "Sex differences from fingerprint ridge density in Chinese and Malaysian population" showed that mean ridge density in males was 11.73 in comparison to females with 14.15. In this study, the ridge density in males was 10.216 in comparison with 12.7 in that of females. Hence it was concluded that ridge density is less in males than in females and our study is in accordance with the same.

Conclusion:

Forensic identification based on tongue imprints is a novel study. Very few studies have been carried out on the same. Determination of sexual dimorphism using tongue imprints

has not been very conclusive in these studies. More studies with a larger sample size with relevance to ethnicity may be useful in bringing out a conclusive result in this aspect and hence increasing the role of forensic odontologists.

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