The Unrevealed Truth about the Tongue in Forensic Identification

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Abstract

Background: Forensic odontology, a branch of dentistry includes identification of individuals in various crime scenes, natural calamities, and mass disasters. The identification is possible because every individual body is unique and so is our tongue due to its morphological variations. The primary objective of the study was to assess the morphological features of the tongue and its use in sex determination.

Methods: The study included a sample size of 100 individuals (50 males and 50 females) in the age range of 20-50 years old. Photographs were taken of front and side view of the tongue; visual inspection was done and lastly impressions of the tongue were made with help of alginate and then poured with the help of dental stone. IBM SPSS statistics 20.0 (IBM Corporation, Armonk, NY, USA) was used for the analyses of the data. Microsoft word and Excel were used to generate graphs, tables etc. Females presented with triangular shape, presence of shallow fissures more commonly and a sharp lingual apex of tongue. Males presented with rectangular shape, presence of deep fissure/absence of fissures more commonly and septate/ sharp lingual apex of the tongue.

Conclusion: Tongue exhibits various unique characteristics and can be used in sex determination.

Keywords: *forensic odontology, morphological characteristics, sex determination, tongue impressions*

Introduction

Forensic odontology, a branch of dentistry comprises of various aspects dealing with diagnostic and therapeutic evaluation and examination of various parts of oral cavity, identification of individuals and evaluation of bite marks in criminal investigations, sexual assaults, child abuse cases, mass disasters and in personal defence circumstances[(1)]. Various components of the oral cavity like teeth, saliva, pulp, dentin, lips etc. can be used in forensic odontology for age estimation, sex determination, DNA analysis and identification of the criminal.

The human tongue is a muscular organ covered by a thin mucous membrane which lies partly in the oral cavity and partly in the oropharynx. The tongue is well protected from the external environment and has its own skeletal muscles, nerve supply and blood vessels[(2)].

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The human tongue serves many purposes like being the organ of taste, articulation of speech, mastication, and intimacy. It is an internal organ which can be used for inspection thereby offering proof of life.

According to the Traditional Chinese Medicine, the tongue is a unique vital organ, and its vitality is well scored as, 'Tongue of Life' in the same[3]. This muscular organ plays a very significant role in forensic identification due to its unveiling portion encompassing information with diverse visible changes from one individual to the other called as lingual impression thereby making it unique[2].

It possesses numerous characteristics presenting both geometric shape and physiological texture information which indeed can be useful in identity verification applications[4]. The shape of tongue of an individual is unswerving and the physiological texture of tongue is immutable[2]. In respect of shape and surface textures, everyone has unique pattern of tongue[5]. The lingual morphological aspects are scrutinized with the help of alginate moulding technique which is the most reliable method for recording minute details of tongue; this in turn helps the forensic investigator to identify the person[2].

Materials and Methods

The present study was conducted in DY Patil Dental College and Hospital, Oral Pathology and Microbiology Department on June 17 for over 2 months. The study was carried out on 100 individuals (50 males and 50 females) in the age range of 20-50 years of age exclusively of Navi Mumbai population.

The inclusion criterion for the study is:

1. Individuals who are clinically healthy.
2. Individuals with clinically healthy tongue.

The exclusion criterion for the study is:

1. Individuals possessing any medical illnesses like HIV, diabetes, thyroid problems, hypertension, Down syndrome etc.
2. Individuals possessing any developmental anomaly or pathology of the tongue.

Institutional Ethics Research committee approval for the study and a written consent from each study participant was obtained prior beginning the study.

Fig-1 shows a disposal tongue cleaner.

Before the examination of the tongue, the patient was requested to clean his tongue with a disposable tongue cleaner and rinse his oral cavity [Fig 1]. The examination process of the present study was divided into three categories: 1) Photographs, 2) Visual inspection and 3) Impressions. The study participants were requested to protract their tongue in a relaxed position to prevent any contraction of the striated lingual muscles which would thus alter various characteristic features.

Fig-2a fig-2b shows the front and the side view of the tongue.

Fig-3a fig-3b shows making of impression, the alginate impression, and the cast of the tongue.

Photographs of the front and side view of tongue were then taken in the same setting using DSLR camera [Fig-2a and fig-2b]. Later, visual inspection was done i.e., clinically all the characteristics of the tongue such as the shape, colour, surface texture, type of lingual apex etc. that were visible were noted down on the performa. Lastly impressions of the tongue were made with the help of chromatic alginate impression material (Tropicalgin) [Fig-3a]. Chromatic Alginate was chosen as the choice of impression material as it has got an excellent property of duplicating minute details and it can be easily removed. To prevent the regurgitation reflex, impression was made from the level of the oral commissures up to the lingual tip of tongue and was then poured with the help of dental stone [Fig-3b].This helped us obtain a relevant positive image for identification.

At the end of the examination, all the characteristic features of the tongue that were obtained using the above three methods were cross checked and evaluated.

Statistical Analysis

Descriptive and inferential statistical analyses were carried out in the present study. Results on categorical measurement were presented in number (%). Level of significance was fixed at p=0.05 and any value less than or equal to 0.05 was statistically significant.

Chi square analysis was used to find the significance of study parameters on categorical scale. The Statistical software IBM SPSS statistics 20.0 (IBM Corporation, Armonk, NY, USA) was used for the analyses of the data and Microsoft word and Excel were used to generate graphs, tables etc.

Results and Discussion:

In the current study, various features of tongue like shape, fissures and type of lingual apex were included.

Based on the study participants, the shape of tongue was categorised into1) Triangular, 2) Ovoid, 3) Rectangular and 4) Square. Fissures of tongue was categorised into 1) Absence of fissures, 2) Shallow fissures and 3) Deep fissures. Lastly, the lingual apex was categorised into1) Septate and 2) Sharp.

Table 1: Comparison of tongue shape among males and females using chi square test

Group	Shape		Total N (%)
	Triangular n (%)	Rectangular n (%)	
Female	49 (98)	1 (2)	50 (100)
Male	2 (4)	48 (96)	50 (100)
Total	51 (51)	49 (49)	100 (100)
Chi square value: 88.395 p value: <0.001**			

(p< 0.05 - Significant*, p < 0.001 - Highly significant**)

Table 1 shows comparison of tongue shape among males and females. There was a significant difference seen in the tongue shape of males and females. 98% of females presented with triangular shape of tongue and only 2% females presented with rectangular shape of tongue. In comparison, 96% of males presented with rectangular shape of tongue and only 4% of males presented with triangular shape of tongue. When these results were statistically analysed using chi square test, highly significant results were obtained.

Table 2: Comparison of fissures among males and females using chi square test

Group	Fissures			Total N (%)
	Deep n (%)	Shallow n (%)	None n (%)	
Female	3 (6)	45 (90)	2 (4)	50 (100)
Male	30 (60)	0 (0)	20 (40)	50 (100)
Total	33 (33)	45 (45)	22 (22)	100 (100)
Chi square value: 81.818 p value: <0.001**				

(p< 0.05 - Significant*, p < 0.001 - Highly significant**)

Table 2 shows comparison of fissures among males and females. There was a significant difference seen in the fissures of tongue among males and females.60% of males presented with deep fissures, 40% of males presented with absence of fissures. In comparison, 6 % of females presented with deep fissures, 90% of females presented with shallow fissures and 4% of females presented with absence of fissures. When these results were statistically analysed using chi square test, highly significant results were obtained.

Table 3: Comparison of lingual apex among males and females using chi square test

Group	Lingual apex		Total N (%)
	Sharp n (%)	Septate n (%)	
Female	50 (100)	0 (0)	50 (100)
Male	43 (86)	7 (14)	50 (100)
Total	93 (93)	7 (7)	100 (100)
Chi square value: 7.527 p value: 0.006*			

($p< 0.05$ - Significant*, $p < 0.001$ - Highly significant**)

Table 3 shows comparison of lingual apex among males and females. There was a significant difference seen in lingual apex among males and females. 100% offemales presented with sharp lingual apex. In comparison, 86% males presented with sharp lingual apex and 14% of males presented with septate lingual apex. When these results were analysed statistically analysed using chi square test, significant results were obtained.

Forensic odontology is gaining great interest in today's world due to presence of innovative and efficient identification systems[3]. The purpose of introducing the use of tongue prints in forensic odontology is due to the uniqueness of the tongue[5]. In the present study, females presented with triangular shape of tongue and presence of shallow fissures more commonly than deep or absence of fissures. While males presented with rectangular shape of the tongue and presence of deep fissures more commonly than absence of fissures. As far as lingual apex was considered, females presented with sharp lingual apex while men presented with sharp as well as septate lingual apex. The current study shows diversification in various morphological aspects of tongue with respect to males and females.

On the contrary, there are also similar kinds of studies conducted. One of the studies includes shape and texture of the tongue as criteria, which showed results based on the age groups[5]. The other study includes criteria like shape of tongue and presence of fissures on the tongue. In this study, females presented with deep fissures while the males presented with shallow fissures[3]. Because of the uniqueness of the tongue, several studies have been undertaken to prove the use tongue prints in biometric authentication along with fingerprints and iris[5, 6].

Conclusion

The field of forensic odontology scrutinizes various dental evidence, and it confirms that individuals have some unique characteristics which can be used for evidence purpose[5, 7]. The dorsal surface of the tongue

holds prominent morphological features, thereby difficult to forge and can therefore be used in forensic odontology for sex determination[2, 5]. A photographic image of the lingual aspect along with the lingual impression, together can aid in forensic identification along with other proved methods[2]. Every dentist should therefore comprehend the forensic values and its connection with dental practice[3].

Financial support and sponsorship: Nil

Conflicts of Interest: There are no conflicts of interest.

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