Tongue and its ties: Posterior tongue width in gender estimation – A forensic gratuity

ABSTRACT

Background and Objectives: Human identification is one of the challenging areas that man has been confronted with. The forensic odontologist deals with human identification based on unique features of the oral cavity. The human tongue is sheathed within the oral cavity, where it lies protected against the external atmosphere, just as the palatine folds. It can be easily showed for inspection but at the same time be protected from the external environment.

Aim and Objective: The objective of this study is to examine the uniqueness of tongue morphology and find out parameters to estimate gender of an individual using the same.

Methodology: A total of 30 subjects (15 girls and 15 boys) were taken for this study whose tongue were examined, photographed and alginate impression were taken to create a database of tongue morphology.

Result: The mean posterior width of the tongue was higher among the males in both cast as well as photographs.

Keywords: Forensic, gender, photographs, posterior width, tongue

INTRODUCTION

The recognition of human beings is one of the most demanding areas as well as difficult areas that we have been encountered with. The forensic odontologist mainly deals with the identification based on the recognition of unique features present in an individual’s oral structures. The tongue is very unique vital organ and its vitality is well inscribed in traditional Chinese medicine as “Tongue of life.”[1] The tongue is encased within the oral cavity, where it lies in isolation from and safeguarded against the exterior environment, just as the palatine folds do, unlike the other notorious elements employed in human identification.[2] It is the only organ that can be easily exposed for inspection, but at the same time well protected from environmental influences and therefore very difficult to manipulate or forge unlike other identification systems.[3]

The uniqueness of the tongue print is that no two tongues are the same, and studies have found that the tongue of identical twins also does not resemble each other.[4] The tongue provides both fixed and dynamic features for authentication. By means of its shape and texture, aspect, and color, this organ is helpful due to its exposed portion comprising information with visible differences from one individual to another and may be easily called and used as a “lingual impression.”[5] The individual lingual contour and dimension is unswerving, and the physiological texture is constant.

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The analysis of the lingual morphological aspects preserved using the alginate molding technique, the most reliable technique for duplicating the most minute details, represents a criterion with force of evidence upon uniqueness for each and every individual, with the help of which forensic dentistry identification provides information with predictive values as far as a person’s identity is concerned.[2]

The tongue also presents both geometric shape information and physiological texture information which are potentially useful in identity verification applications. Furthermore, the act of physically reaching or thrusting out is a convincing proof for the liveness.[6]

Objectives

- The objective of this study is to examine the uniqueness of tongue width and find out parameters to estimate gender of an individual using the same
- To compare the width of the tongue between positive and negative replica.

METHODOLOGY

The current study is a prospective cohort study. The protocol of this study was approved by the ethical committee of King George’s Medical University (858/Ethics/R. Cell-19) and informed consent from each participant was duly obtained. Thirty participants (15 girls and 15 boys) were taken for this study. The steps given below were followed:

- A reference point was taken starting from the tip of the tongue (V11) extending till the posterior third of the tongue (5 cm in total) with markings 1 cm apart. VX was a midpoint at posterior most marking. A line drawn from VX to V11 divided the tongue into two halves. The lateral most point on the posterior marking was be marked as VY, which defined the lateral most part (for the photograph) Figure 1.

- The reference point was taken starting from the tip of the tongue (W11) extending till the posterior third of the tongue (5 cm in total) with markings 1 cm apart. WX was a midpoint at posterior most marking. A line drawn from WX to W11 divided the tongue into two halves. The lateral most point on the posterior marking was marked as WY, which defined the later most part (for the cast) Figure 2.

- Step 1: The examination of the tongue was carried out after prior cleaning with sterile gauze piece, together with rinsing of oral cavity Figure 3
- Step 2: The tongue was photographed using Canon DSLR 500D Figure 3
- Step 3: Alginate impression was taken Figure 4
- Step 4: A cast was poured in the impression taken using dental stone Figure 5
- Step 5: Lines were drawn on the photographs as well as the cast to measure the width of the tongue. Reference points were predecided and were common for all Figure 6-7.
- Step 6: A database of tongue width was made.

RESULTS

The mean width of the tongue was higher among the males in both cast and photographs. The photographs did not show a significant result whereas there was a statistically significant difference seen among males and females when the cast measurements were done [Tables 1-2 and Graphs 1-2].

DISCUSSION

Identity fraud is a serious threat to society. Innovative and
efficient identification systems are an urgent need to combat this social issue.\[7\]

Forensic dentistry plays an important role in the identification of gender of an individual. Novel and efficient identification
tools are the need of the hour. Recently, tongue morphology and tongue print appeared to be a promising tool that aided in gender identification. Advantages of tongue prints over other biometric systems are that tongue prints vary with every individual and it can be obtained easily. Application of tongue biometric system in public use system such as banking system has been proved by Naaz et al. Stefanescu et al. validated the use of tongue prints in forensic identification and also proposed the use of alginate impression in obtaining lingual impression as an efficient technique.

To the best of our knowledge, the present study is a novel attempt and first of its kind. The methodology used in this study is easy and simple to adapt by any dentist on a daily basis. Creating the database of tongue morphology, we found out variability in the posterior width of the tongue in different gender. In the cast, the mean width of the tongue seen in males was $4.82 \pm 0.19$ and in females was $4.29 \pm 0.26$ (mean ± standard deviation [SD]). In the photograph, the mean width of the tongue seen in males was $2.90 \pm 0.69$ and in females was $2.82 \pm 0.33$ (mean ± SD). Our results revealed that males have more width as compared to females. Males have posterior tongue width of >4.5 cm, whereas female tongue width came out to be <4.5 cm. Furthermore, our study showed that positive replica, i.e., the cast of tongue, is more efficient than the negative replica, i.e., the photograph of tongue.

**CONCLUSION**

Tongue print being a unique record and one that cannot be forged is a better biometric authentication tool than others, and because it is personalized and constant, it can be used for forensic identification purposes too. Our study represents a preliminary analysis of tongue width with respect to gender which could be used as a new subjective identification tool. Further, a cross-sectional study with larger sample size is needed for validation of the same.

**Table 1: Comparison of the width of the tongue among the genders (cast)**

| Gender   | Width of the tongue, mean±SD | Z* | P   |
|----------|-----------------------------|----|-----|
| Males    | 4.82±0.19                   | -4.14 | 0.00* |
| Females  | 4.29±0.26                   |    | Significant |

*Mann–Whitney U-test, *Statistically significant, $P<0.05$. SD: Standard deviation

**Table 2: Comparison of the width of the tongue among the genders (photograph)**

| Gender   | Width of the tongue, mean±SD | Z* | P*  |
|----------|-----------------------------|----|-----|
| Males    | 2.90±0.69                   | -0.229 | 0.83 |
| Females  | 2.82±0.33                   |    | Not Significant |

*Mann–Whitney U-test, *Statistically significant, $P<0.05$. SD: Standard deviation

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**Conflicts of interest**

There are no conflicts of interest.

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