

A Review on the Role of Tongue Prints and Lip Prints in Gender Determination: A Forensic Odontology Perspective

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Abstract

Forensic odontology has evolved beyond traditional dental evidence to incorporate innovative biometric identifiers such as lip and tongue prints. These unique and permanent patterns can reveal gender differences and assist in human identification. This review compiles scientific data on cheiloscopy and glossoscopy, emphasizing their classification systems, gender-specific variations, and forensic applications. Both parameters demonstrate high individual specificity, making them reliable and non-invasive tools in modern forensic investigation.

Keywords: Forensic Odontology, Cheiloscopy, Glossoscopy, Lip Prints, Tongue Prints, Gender Determination, Human Identification

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I. Introduction

Human identification forms the basis of forensic science and legal medicine. Conventional techniques such as fingerprints, DNA profiling, and dental records have long been used for identification, but these methods may sometimes be unavailable or compromised. In such circumstances, secondary identifiers like lip and tongue prints can play an important role.

Cheiloscopy (the study of lip prints) and glossoscopy (the study of tongue prints) are based on the principle that the grooves, fissures, and surface patterns of lips and tongue are unique and remain unchanged throughout life. Recent research has highlighted gender-related variations, thereby supporting their application in forensic gender determination.

II. Review of Literature

The concept of lip print identification was first noted by Fischer in 1902, while Suzuki and Tsuchihashi (1970) provided the first systematic classification. The idea of tongue prints as a biometric identifier was later proposed by Kaul et al. (2007). Since then, several studies have explored population-specific variations, gender dimorphism, and technical methods for recording these prints.

Both cheiloscopy and glossoscopy offer high reliability, low cost, and non-invasive data collection. They have been successfully employed in individual identification, gender estimation, and corroborating evidence in crime scenes.

III. Lip Prints (Cheiloscopy)

3.1 Anatomy and Principle:

The vermillion border of the lips exhibits grooves and furrows arranged in specific linear and branching patterns. These patterns, known as lip prints, are individualistic and remain stable over time.

3.2 Classification (Suzuki and Tsuchihashi, 1970):

- **Type I:** Clear vertical grooves running across the lip.
- **Type I':** Incomplete or partial-length vertical grooves.
- **Type II:** Branched grooves.
- **Type III:** Intersected grooves forming criss-cross lines.
- **Type IV:** Reticular or net-like grooves.
- **Type V:** Undetermined or irregular pattern.

3.3 Gender Variation:

Type I and I' patterns are more commonly found in females, whereas Types IV and V are predominantly seen in males. Hormonal and genetic factors likely contribute to these differences.

3.4 Forensic Utility:

Lip prints can be recovered from surfaces such as glass, paper, or skin using transparent tape or photographic methods. They can link a suspect to a crime scene even when DNA or fingerprints are absent.

IV. Tongue Prints (Glossoscopy)

4.1 Anatomy and Principle:

The dorsal surface of the tongue is composed of papillae, fissures, and grooves forming distinctive configurations. The shape and surface architecture of the tongue are highly individualistic and remain unchanged throughout life, making them valuable for biometric identification.

4.2 Classification (Kaul et al., 2007; modified by later researchers):

- **U-shaped:** Broad central depression forming a “U” contour.
- **V-shaped:** Prominent median sulcus creating a sharp “V” appearance.
- **Circular/Round:** Concentric or circular grooves forming a rounded outline.
- **Mixed:** Combination of more than one pattern on the dorsal surface.
- **Square:** Straight lateral borders forming a box-like shape.
- **Triangular:** Narrow anterior portion tapering to a pointed apex.
- **Rectangular:** Broad anterior region with nearly parallel sides.
- **Elliptical:** Oval outline, broader in the center and narrower at both ends.

4.3 Gender Variation:

Males frequently display U-shaped, square, and rectangular tongues, whereas females commonly exhibit V-shaped, triangular, and elliptical forms. Round and mixed patterns appear in both genders with nearly equal frequency.

4.4 Recording and Analysis: Impressions can be made using edible dyes or alginate materials, or recorded digitally using photographic and scanning devices. Artificial intelligence and 3-D imaging have recently improved pattern recognition accuracy in glossoscopy.

V. Comparative Analysis of Lip and Tongue Prints

Feature	Lip Prints (Cheiloscopy)	Tongue Prints (Glossoscopy)
Basis	Grooves and furrows on vermillion border	Dorsal surface ridges, papillae, and overall shape
Uniqueness	Permanent and Individual specific	Stable and unique for each person
Classification	Suzuki & Tsuchihashi (Types I–V)	Kaul et al. with later additions: U, V, Circular, Mixed, Square, Triangular, Rectangular, Elliptical
Gender Variation	Females: Type I/I'; Males: Type IV/V	Males: U, Square, Rectangular; Females: V, Triangular, Elliptical
Recording Medium	Lipstick or ink impression on tape/paper	Edible dye, alginate mold, or digital scanning
Durability	May vary with trauma or cosmetics	Remains stable due to muscular structure
Forensic Utility	Trace evidence at crime scenes	Live biometric and digital forensic identification

VI. Applications in Forensic Odontology

- **Gender Determination:** Clear sexual dimorphism in pattern distribution helps identify gender when skeletal or DNA evidence is unavailable.
- **Personal Identification:** Unique pattern combinations can individualize suspects or victims.
- **Integration with Other Biometrics:** When combined with dental and palatal data, lip and tongue prints improve accuracy.

- **Mass Disaster Victim Identification:** In cases of decomposition, preserved oral structures can provide supportive forensic evidence.

VII. Advantages and Limitations

7.1 Advantages:

- Non-invasive, cost-effective, and easy to record.
- Unique for every individual and resistant to change over time.
- Useful even in cases with partial remains.

7.2 Limitations:

- Print clarity may be affected by dryness, trauma, or coating on tongue.
- Difficulties in obtaining precise impressions in living subjects.
- Absence of a standardized global database for classification and comparison.

VIII. Conclusion

Lip and tongue prints are emerging tools in forensic odontology for gender and personal identification. Their anatomical uniqueness, stability, and ease of collection make them valuable supplementary evidence. With the introduction of digital and AI-based systems, their reliability and application scope in forensic investigations are expected to expand significantly.

IX. Future Scope

Future studies should focus on developing standardized international databases, employing high-resolution digital scanners for precise mapping, and conducting multicentric trials across diverse populations. Combining lip and tongue print analysis with genetic and dental profiling could revolutionize biometric identification in forensic science.

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