

RUGOSCOPY – AN EMERGING TOOL IN FORENSIC ODONTOLOGY.*Dr. Suchita Daokar*¹

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Abstract

Forensic dentistry is the handling, examination and evaluation of dental evidence in criminal justice cases. Palatoscopy or rugoscopy is gaining importance in forensic dentistry due to many reasons, the most important being that the rugae are well protected in the oral cavity by the cheeks and arches. Rugae are found to be individualistic just like dermatoglyphics. The third most important factor being that they are easy to record. This article deals with the various classification, methods of recording and the clinical implication of rugoscopy in forensic dentistry.

Keywords: Rugoscopy, Palatoscopy, Forensic Dentistry, Forensic Odonotology.

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INTRODUCTION

Palatoscopy or palatal rugoscopy is the name given to the study of palatal rugae in order to establish a person's identity.¹ Palatal rugae is the defined as an anatomical fold or wrinkle usually made in the plural sense, the irregular fibrous connective tissue ridges located in the anterior third of the hard palate.² It is also known as "plica palatinae" or 'rugae palatine".

Development of palatal rugae:

Palatal rugae appears in the 3rd month of intra-uterine life and its development and growth is controlled by epithelial mesenchymal interactions.^{3,4} The pattern of orientation is formed by 12-14th week of intrauterine life from the hard connective tissue covering the palatal bone and their formation is under

genetic control and remain stable until the oral mucosa degenerates after death.^{5,6}

Anatomy of palatal rugae:

Palatal rugae are located on the anterior portion of the maxilla. Anatomically, in hard mucosal palate, one can identify an antero-posterior thin central groove, bordered, on each side, by a crest: the palatal rugae. Palatal rugae are irregular, assymmetric ridges of mucous membrane extending lateral from the incisive papilla and the anterior part of the median palatal raphe.^{7,8}

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Lund in 1924 observed that a connective tissue core is embedded deeply between the submucosal fatty tissue and the stratum reticulum of the palate.⁹ The number of rugae on each side of the palate varies between three and five. The palatine rugae do not extend posteriorly beyond the anterior half of the hard palate and never cross the midline. The anterior rugae are usually more prominent than the posterior rugae, 2/3rd of the rugae are curved, and the rest are angular.¹⁰

Historical background:

The earliest referent to rugae was in anatomy book by Winslow in 1732 and was first illustrated by Santorin in 1975.¹¹

The analysis of palatal rugoscopy for person's identification was first proposed by Allen in 1889.¹¹

Kuppler in 1897 was the first person to study palatal anatomy to identify racial anatomical features.¹²

Palatal rugoscopy was first proposed by a Spanish scientist named Trobo Hermosa in 1932.¹³

In 1937, Carrea designed a detailed study and found a way to classify palatal rugae.¹⁴

Da Silva proposed another classification in 1938.

In 1946, Martins dos Santos proposed a classification based on rugae location.¹⁵

In 1983, Brinon divided palatal rugae into two groups – fundamental and specific.¹⁵

Classification of palatal rugae:

1. Gorla's classification: He gave the first system of classification in 1911. He divided the rugae pattern into two ways: according to the number of rugae and according to the extent of rugal zone. In this system, compound rugae of two or more branches were counted as one. Gorla further categorised rugae into two types: simple or primitive or more developed.¹⁶

2. Lopez De Leon classification. (1924)¹³: The author proposed existence of a link between a person's personality and palatal rugae morphology. There are 4 known types of palatal rugae.

B – Bilious personality rugae

N- Nervous personality rugae.

S- Sanguinary personality rugae.

L-Lymphatic personality rugae. Letters B, N, S and L stand for the different personalities. The letters l and r stands for the left and right side of the palate and are followed by a number, which specifies the palatal rugae number on each side.

3. Da Silva classification (1938)¹³ In this classification, palatal rugae are divided into two groups. Simple and composed, resulting from two or more simple rugae. They are

named according to each rugae number. It is possible to classify each rugae individually.

Table No 1: Da Silva classification¹³

Classification	Rugae type
1	Line
2	Curve
3	Angle
1.	Circle
2.	Wavy
3.	Point

4. Lysell’s classification (1955)¹⁷

Rugae are measured in a straight line between the origin and termination and are grouped into three categories

- A. Primary: 5 mm or more.
- B. Secondary: 3 to 5 mm
- C. Fragmentary: 2 to 3 mm

Rugae smaller than 2 mm were not considered. The rugae on both sides of the palate are numbered separately from anterior to posterior and classified according to shape, position or origin in relation to the median palatal raphe. Three categories of unification are recognized in this system.

- Common origin diverging laterally
- Separate origins converging laterally
- Separate origins converging laterally but involving one primary and one secondary rugae.

4. Carrea (1955): He group four major variants of rugae according to direction, giving Roman numerals, and the shape denoted by letters.¹⁴

5. Basauri’s classification¹⁸: Consists of two type of rugae: simple and compound, which were further subdivided into ten subtypes that denote particular shape.

6. Lima classification (1968). Consists of four main types: punctate, straight, curved and composite.¹⁹

7. Tzatscheva and Jordanov (1970) Classified rugae according to their direction, branching, symmetry and radially.²⁰

8. Cormoy system classification. This system classifies palatal rugae according to their size⁽¹³⁾

- Principal rugae (over 5 mm)
- Accessory rugae (ranging from 3 to 4 mm)
- Fragmental rugae (With less than 3 mm length)

9. Thomaz and Kotze Classification of Palatal Rugae⁽²¹⁾

(1)According to this classification, palatal rugae were observed for

- a. Size
- b. Shape
- c. Direction
- d. Unification

(2)Based on size- the rugae were classified as

- a. Primary
- b. Secondary
- c. Fragmentary

(3)Based on shape- the rugae were classified as

- a. Curved
- b. Wavy
- c. Straight
- d. Circular

4. Based on direction

- A. Forward directed
- B. Backward directed

5. Based on Unification patten

(1)Converging

(2)Diverging.

10. Martin Dos Santos classification (1946)¹⁵

11. Based on the form and position of each palatal rugae, this classification indicates and characterizes the following

- One initial rugae, the most anterior one on the right side is represented by a capital letter.
- Several complementary rugae, the other right rugae are represented by numbers.
- One sub initial rugae, the most anterior one on the left side is represented by a Capital letter.

- Several sub complementary rugae, the other left rugae are represented by numbers.

The numbers and letters given to each rugae, relate to its form and can be seen in following table

Changes in the palatal rugae:

Once formed, the palatal rugae do not undergo any change except in length, due to normal growth, and remain in the same position throughout a person's life time.²² The design and structure of palatal rugae stay unchanged and are not altered by chemicals, heat, disease or trauma.²³ Usually form, layout and characteristics are not affected by the eruption of the teeth.

Functions of palatal rugae:

1. To facilitate food transportation through oral cavity.⁵
2. The presence of gustatory and tactile receptors on the rugae help them with the perception of taste, texture of food qualities and tongue position.⁵
3. Pronunciation of certain letters e.g. "S", "Sh" requires contact of the tongue to palatal rugae. Thus the rugae help in pronunciation.²⁴

Methods of palatal rugae examination:¹³

1. Intra-oral examination. This is the most commonly used technique.

- a. Advantages: Easy to perform, don't need any specific instruments and hence cost effective.
 - b. Disadvantages: No records exist with this method which makes future comparison difficult.
2. Photographs and impression of maxillary arch.
- a. Advantages: Can be stored for long duration and thus helpful for future reference. Easy to perform and cost effective.
3. Computer software programs.
- a. Digital photographs are superimposed on the computer assisted software available such as RUGFP-ID, Palatal Rugae comparison software (PRCS Version 2.0)
4. Calc rugoscopy or Overlay Print: Palatal rugae in maxillary cast can be used to perform comparative analysis.
5. Stereoscopy: Can be used to obtain the 3 D image of palatal rugae anatomy.

Clinical significance of palatal rugae:

Palatal rugae and ethnicity: Palatal rugae patterns are reported to be specific to racial groups. The difference in rugae pattern is attributed to the inter-racial genetic differences.²⁵ Santos and Caldas reported that in Portuguese population, straight type was the commonest rugae shape.²⁶

Abdellatiff et al found that curved and wavy type of palatal rugae were more common in Egyptian and Saudi population.²⁷

Caucasian, Australian, Nepalese and Indian population have predominantly wavy type of palatal rugae.^{28,29}

Shanmugam et al in their study reported a definite difference in palatal rugae pattern in southern and Northern Indians.³⁰

Hosmani et al²² compared rugoscopy between Indian and Tibetan populations and showed that Indian males possessed more primary palatal rugae on the left side when compared to females. Indian male also has more curved rugae compared to Tibetan male and Tibetan female has wavier rugae compared to Indian female.

Sex identification:

Rugoscopic studies conducted on Jordanians,²⁷ Rwandans,²⁸ Egyptians,²⁹ Saudi³⁰ and Indian³¹ Children showed no sexual dimorphism. Kapali et al and Saraf et al also did not find any significant difference in rugae patterns between Aboriginal males and females.^{30,31} Palatal rugae for individual identification: The anatomical position of the palatal rugae inside the oral cavity is surrounded by cheek, lips, tongue, teeth and a buccal pad of fat. This thus provide protection in case of trauma and/or fire. Rugae are thus protected and are preserved even after death, remaining accessible throughout life and death. Palatal rugae are

highly individualistic in nature. In a study by Viridi et al in a pediatric population revealed that palatal rugae patterns are unique and do not change over a period of time.³⁰

Sassouni stated that no two palates are alike in their configuration. Rugoscopy may be utilized as a necro identification technique.³¹

Conclusion:

Palatal rugae are highly individualistic in nature. Just like finger prints, no two individuals possess the same number or shape of palatal rugae. Palatal rugae are naturally protected by maxillary arch, cheek muscles and fat. They also bear the addition advantage of being easy to identify and record. Rugoscopy is the knowledge of palatal rugae and utilizing the knowledge for identification of an individual. The literature search gives promises for utilizing rugoscopy in forensic investigation.

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