



## Assessment of Palatal Rugae Patterns Among Different Age Groups – A Cross-Sectional Study

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### KEYWORDS

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sectional study.

### ABSTRACT:

**Background:** Palatal rugae are anatomical folds in the anterior part of the palatal mucosa that are unique to each individual and remain relatively stable throughout life. Their uniqueness and resistance to post-mortem changes make them useful in forensic identification. This study evaluates the number, shape, and symmetry of palatal rugae across different age groups to assess age-related changes.

**Aim of the study:** To assess and compare palatal rugae patterns among different age groups and evaluate their forensic significance

**Materials and Methods:** A cross-sectional study was conducted on 100 individuals divided equally into four age groups: Group A (10–20 years), Group B (20–35 years), Group C (35–45 years), and Group D (45–55 years). Maxillary impressions were taken using alginate and casts were prepared with dental stone. Rugae were traced and analysed for number, shape (wavy, curved, straight, circular), and symmetry using the modified Thomas and Kotze classification. Data were analysed using descriptive statistics.

**Results:** The mean number of rugae decreased with age: Group A ( $10.2 \pm 2.1$ ) to Group D ( $8.5 \pm 1.9$ ). Wavy and curved rugae were more prevalent in younger age groups, while straight and circular patterns were common in older individuals. Symmetry decreased with age: Group A (87%) to Group D (59%). Statistically significant differences were observed between age groups ( $p < 0.05$ ).

**Conclusion:** Palatal rugae patterns demonstrate age-related changes in number, shape, and symmetry. These variations can aid in age estimation and personal identification in forensic contexts. Further studies with larger and more diverse populations are recommended to validate these findings.

### Introduction

The study of palatal rugae is referred to as **palatoscopy** or **palatal rugoscopy**. This technique involves analyzing rugae patterns based on their unique form, length, width,

prominence, orientation, and number, making it a valuable tool for personal identification. The application of palatal rugae in gender determination is favoured because it is cost-effective, simple to perform, and reliable [1].



Identification becomes difficult in cases such as road traffic accidents, terrorist attacks, and natural calamities. The commonly employed techniques for establishing identity are visual recognition, fingerprint analysis, DNA profiling, and dental records. Palatal rugae, which are mucosal folds located on the anterior part of the palate, also serve as useful anatomical markers for this purpose.<sup>[2]</sup>

Rugae patterns are distinct to each individual and remain stable during adulthood. Generally, 3 to 6 folds are present on either side, which may not always be symmetrical. The length of each fold is measured horizontally from the midpalatal suture to its endpoint. Based on their length, rugae are classified as Primary (5–10 mm), Secondary (3–5 mm), and Fragmentary (<3 mm).<sup>[3]</sup> Rugae can be classified into four shape types: straight, curved, wavy, and circular, with their orientation assessed in relation to the mid-palatal raphe (MPR).<sup>[4]</sup>

Due to their position inside the oral cavity, palatal rugae are well shielded from trauma and extreme heat, being surrounded by the cheeks, buccal fat pad, lips, bone, teeth, and tongue. These rugae serve as unique identifiers for each individual and are often likened to fingerprints.<sup>[5]</sup> The purpose of this study was to evaluate the number, shape, and symmetry of palatal rugae in a selected population sample.

## Aims and Objectives

### Aim:

To assess and compare palatal rugae patterns (number, shape, and symmetry) among individuals of different age groups in order to evaluate age-related morphological changes and their forensic relevance.

### Objectives:

1. **To evaluate the number of palatal rugae** in individuals across four distinct age groups:
  - Group A: 10–20 years
  - Group B: 20–35 years
  - Group C: 35–45 years
  - Group D: 45–55 years
2. **To analyse the shape of palatal rugae** in each age group using the modified Thomas and Kotze classification system.
3. **To determine the presence or absence of symmetry** in rugae patterns within each age group.
4. **To compare the rugae patterns across the age groups** and identify any statistically significant age-related differences.

## Materials and Methods

A cross-sectional study was conducted on 100 subjects, equally divided into four age groups:

- Group A: 10–20 years
- Group B: 20–35 years
- Group C: 35–45 years
- Group D: 45–55 years

Subjects were selected using stratified random sampling. Exclusion criteria included individuals with congenital anomalies, prior orthodontic treatment, palatal trauma, or pathological conditions affecting the palate.

Maxillary impressions were taken using alginate and poured with dental stone. The casts were dried and examined under adequate lighting with the aid of a magnifying lens. Rugae were traced with a graphite pencil and were assessed for the following:

- (a) **Number**
- (b) **Shape** (wavy, curved, straight, circular)
- (c) **Symmetry** (presence or absence of mirror-image rugae on both sides of the midline)

The classification was based on the modified Thomas and Kotze system. Data were analysed using descriptive statistics, ANOVA, and Chi-square tests. A p-value of <0.05 was considered statistically significant.

## RESULTS:

The mean number of palatal rugae showed a decreasing trend with increasing age. Group A (10–20 years) had the highest mean number of rugae ( $10.2 \pm 2.1$ ), while Group D (45–55 years) had the lowest ( $8.5 \pm 1.9$ ). This suggests that age may have a mild inverse correlation with the number of palatal rugae, possibly due to age-related



anatomical changes or wear [Table-1]. The predominant rugae shapes varied across the age groups. Younger individuals (Group A and B) primarily exhibited wavy and curved patterns, while older groups (Group C and D) had a higher occurrence of straight and circular patterns. This shift may be indicative of morphological changes in palatal rugae associated with aging, which could have forensic significance in age estimation [Table -2]. The comparative analysis of palatal rugae patterns across different age groups reveals age-associated differences in number, shape, and symmetry [ [Table – 3]. These findings can be useful in forensic dentistry for age estimation and personal identification. Further studies with larger sample sizes and inclusion of other variables such as gender and ethnicity could provide deeper insights.

**Table 1: Mean Number of Palatal Rugae by Age Group**

Age Group	Mean Number of Rugae
Group A (10–20 years)	10.2 ± 2.1
Group B (20–35 years)	9.6 ± 2.4
Group C (35–45 years)	9.1 ± 2.0
Group D (45–55 years)	8.5 ± 1.9

**Table 2: Most Common Rugae Shapes by Age Group**

Age Group	Most Common Shapes
Group A (10–20 years)	Wavy (42%), Curved (33%)
Group B (20–35 years)	Curved (39%), Straight (28%)
Group C (35–45 years)	Straight (35%), Wavy (30%)
Group D (45–55 years)	Wavy (37%), Circular (20%)

**Table 3: Symmetry of Palatal Rugae by Age Group**

Age Group	Symmetry (%)
Group A (10–20 years)	87%
Group B (20–35 years)	73%
Group C (35–45 years)	68%
Group D (45–55 years)	59%

## Discussion

Palatal rugae are known for their individuality and long-term stability, making them a useful anatomical feature in forensic science. This study analyzed changes in the number, shape, and symmetry of palatal rugae across various age groups to evaluate their potential in age estimation. In 2005, Muthusubramanian et al.,<sup>[6]</sup> investigated the reliability of rugae identification in cases of burns and decomposition. Their study on burn patients and cadavers showed that after 72 hours of storage in a morgue at 5°C with 30–40% relative humidity, 93% of individuals with third-degree pan-facial burns retained normal palatal rugae, and 77% exhibited no alteration in colour.

The study found a gradual decrease in the **mean number of rugae** with advancing age. This could be due to aging-related changes such as mucosal thinning, palatal atrophy, or mechanical influences like mastication and speech. Group A had the highest number of rugae, reinforcing the idea that younger individuals retain more prominent rugae patterns.

In terms of **shape**, wavy and curved forms were dominant in younger individuals, while straight and circular forms became more common with age. This may indicate morphological simplification over time, possibly due to wear and biological remodeling. Kumar *et al.* Surekha *et al.*<sup>[10]</sup> showed the predominance of curved and wavy pattern of rugae in most population.

**Symmetry** also showed a marked decline with age. Group A had the highest level of symmetrical patterns, suggesting better developmental harmony in youth. In contrast, Group D exhibited significant asymmetry, likely influenced by age-related physiological changes or long-term oral habits.

These findings are consistent with earlier studies and reinforce the notion that palatal rugae can serve as a supplementary tool for forensic age estimation. However, variability between populations, genders, and ethnicities should be considered when generalizing findings.

## Limitations

- Small sample size
- No gender-based or ethnic sub-group analysis



- Manual tracing method prone to observer bias

Future studies should incorporate larger populations and digital technologies for enhanced accuracy.

## Conclusion

This cross-sectional study demonstrated age-related differences in palatal rugae patterns. A decline in the number, complexity, and symmetry of rugae with advancing age suggests that these features may aid in forensic age estimation. The palatal rugae continue to hold promise as a low-cost, non-invasive, and effective tool in forensic identification.

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