

# Usefulness of palatal rugae patterns in establishing identity: Preliminary results from Bengaluru city, India

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## Introduction

The federation Dentaire Internationale defines forensic odontology as that branch of dentistry which, in the interest of justice, deals with the proper handling and examination of dental evidence, and with the proper evaluation and presentation of dental findings.<sup>[1]</sup> Forensic odontological identification by their nature are multidisciplinary team efforts relying on positive identification as well as presumptive or exclusionary methodologies.<sup>[2]</sup> In forensic odontology dentists play a pivotal role in supporting legal and criminal issues.<sup>[3]</sup>

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## Abstract

**Introduction:** Palatal rugoscopy is the name given to the study of palatal rugae. Rugae pattern are widely considered to remain unchanged during an individual's lifetime. The rugae pattern has the potential to remain intact by virtue of their internal position in the head when most other anatomical structures are destroyed or burned. Moreover, rugae pattern are considered to be unique similar to fingerprints and are advocated in personal identification. **Objectives:** The purpose of the study is to establish, individual identity using palatal rugae patterns. **Materials and Methods:** The study group consisted of 100 study models all of whom were subjects above 14 years old. Martin dos Santos' classification was followed based on form and position to assess the individuality of rugae pattern. **Results:** Each individual had different rugae patterns including dizygous twins and the rugae patterns were not symmetrical, both in number and in its distribution. **Conclusion:** The preliminary study undertaken here shows no two palates are alike in terms of their rugae pattern. Palatal rugae possess unique characteristics as they are absolutely individualistic and therefore, can be used as a personal soft-tissue 'oral' print for identification in forensic cases.

**Key words:** Personal identity, palatal rugae, rugae pattern, rugoscopy, palatoscopy

Personal identification forms an integral part of forensic science, especially when they are dealing with crimes or with mutilated bodies that have undergone damage beyond recognition. Palatoscopy or palatal rugoscopy, is the name given to the study of palatal rugae in order to establish a person's identity.<sup>[4]</sup> According to English *et al.*<sup>[5]</sup> the use of palatal rugae was suggested as a method of identification first in 1889 by Allen. The palatal rugae, like fingerprints, do not change during the life of the individual, are protected from trauma and high temperatures owing to its internal position in the oral cavity, and protected by the lips, cheeks, tongue, teeth and bone, and prosthetic devices. Once formed, they only change in length, due to normal growth, staying in the same position throughout the life of a person.<sup>[6]</sup> Even disease, trauma or chemical attack do not seem to change the shape of palatal rugae.<sup>[6,7]</sup>

The most challenging situations in forensic odontostomatology are mass disasters, where the forensic dentist is usually confronted with charred human remains or heavily decomposed or fragmented bodies; the rugae

are in a position to resist trauma, high temperatures and decomposition.<sup>[8]</sup>

Studies have demonstrated that no two individual's rugae patterns are alike in their configuration [Figure 1] and that the characteristic rugae pattern of the palate does not change as a result of growth.<sup>[9-12]</sup> This demonstrated uniqueness led us to undertake a study to establish individual identity in an Indian population using palatal rugae pattern, since such studies have seldom been undertaken.

### Objectives of the study

1. To investigate the role of rugae pattern in personal identification.
2. To determine the uniqueness of palatal rugae pattern in an Indian population.
3. To identify any particular pattern of rugae among family members.
4. To determine if rugae pattern among twins is unique.

### Materials and Methods

This study was conducted at the Department of Oral Medicine and Radiology, M.R. Ambedkar Dental College and Hospital, Bengaluru. The study consisted of 100 healthy subjects aged 14 years and above who were randomly selected. The sample size comprised of 35 males and 35 females, 5 families (father, mother, child A and child B), 5 pairs of twins (dizygous twins).

Subjects with congenital anomalies/malformations, previous orthognathic surgery, allergic to impression material, bony and soft tissue protuberances, active lesions, deformity or scars and trauma of the palate were excluded.

Addition silicone was used as an impression material, as it has high tear strength and better accuracy. After obtaining informed consent from each subject impression of maxillary arch was made using an appropriate perforated metal tray, and the casts were poured in Type 3 dental stone. The palatal rugae patterns were highlighted using black graphite pencil on the cast and were analyzed following the classification of Santos (cited in Caldas *et al.*)<sup>[6]</sup> who presented a practical classification based on rugae location. 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-complimentary rugae*; the other left rugae are represented by numbers. The classified types of rugae patterns were recorded and results tabulated.
- The numbers and letters given to each rugae based on

its form is depicted in Table 1 (Modified from Caldas *et al.*).<sup>[6]</sup>

### Results

All the 100 working casts showed different rugae patterns. In this study, each individual had a different set of rugae pattern. However curve forms of rugae were more commonly seen [Figure 2].

On comparing both the sexes, curve (29.5%) and sinuous (22.5%) forms were found to be common in males and curve (33.2%) and line (24.04%) forms were more common in females [Figure 3]. The data in the study was not subjected to any statistical analysis per se. However, it was observed that total number of rugae in the sample showed slightly higher number of rugae in males compared to females.

Rugae pattern was not symmetrical either in number or its distribution when the right and left sides were compared.

The total number of rugae in the sample showed more number of rugae on the right side than on the left [Figure 4]. Rugae among twins (non-identical) also showed different and non-identical pattern [Table 2].

**Table 1: Matins dos santos' palatal rugae classification**

Rugae type	Anterior position	Other positions
Point	P	0
Line	L	1
Curve	C	2
Angle	A	3
Circle	O	4
Sinuous	S	5
Bifurcated	B	6
Trifurcated	T	7
Interrupt	I	8
Anomaly	An	9

**Table 2: Palatal rugae patterns among five pairs of dizygous twins**

Sl. no.	Right side	Left side
1 Pair		
a	C2552	B58
b	C52515	An159
2 Pair		
a	B996	B612
b	B1289	B1122
3 Pair		
a	C618	L289
b	B15	C25
4 Pair		
a	B12	A212
b	B2551	A1255
5 Pair		
a	B851	L553
b	C222	C88

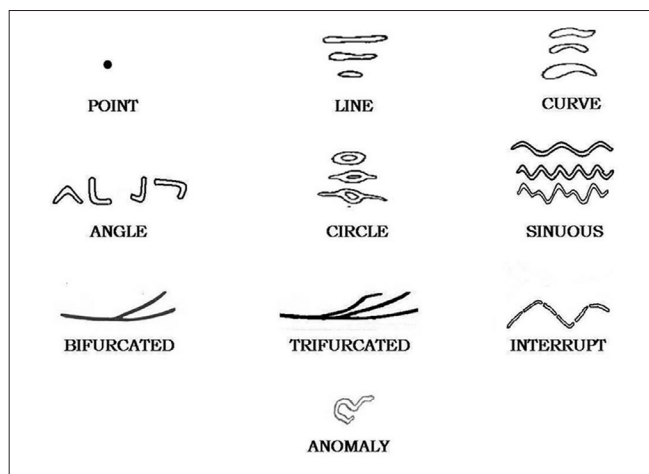


Figure 1: Different forms of palatal rugae

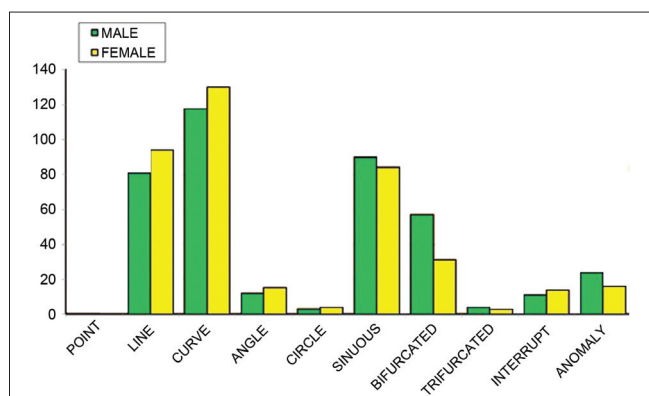


Figure 3: Distribution of forms of palatal rugae patterns among males and females

## Discussion

Palatoscopy or palatal rugoscopy, is the name given to the study of palatal rugae. From a forensic perspective, this is used primarily to establish a person’s identity. In the hard palate, anteroposteriorly a thin central groove is bordered on each side by a crest, the palatal raphae. From this crest, laterally three to seven smaller crests emerge on each side. These crests are called palatal rugae. Rugae develop as localized regions of epithelial proliferation and thickening.<sup>[4]</sup>

The orientation and forms of palatal rugae are governed by the core fibres running anteroposteriorly in concentric circles below each rugae. Fibroblasts and collagen fibres then accumulate in the connective tissue beneath the thickened epithelium and assume distinct orientation. The core within the palatal rugae of humans contains elements that are believed to contribute to the maintenance of its shape. The main structural element of a rugae contains glycosaminoglycans which by its hydrophilic nature causes the tissue to swell and contributes to the maintenance of the shape of a rugae throughout life.<sup>[4,8]</sup>

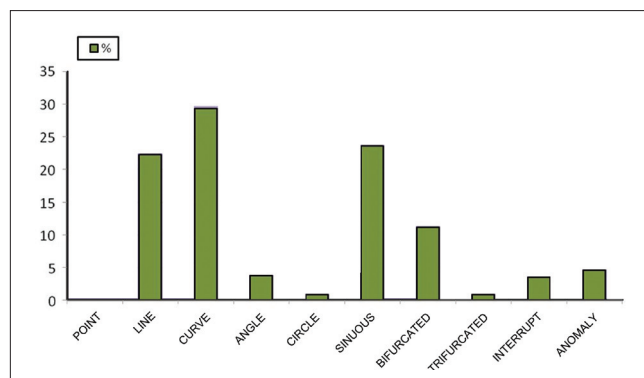


Figure 2: Distribution of forms of palatal rugae pattern

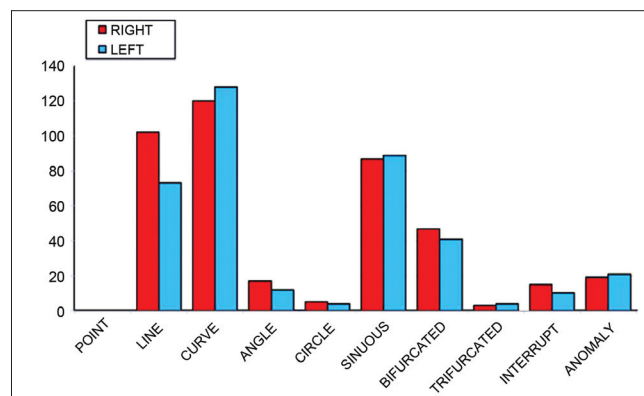


Figure 4: Distribution of forms of palatal rugae pattern right and left side

The anatomical position of the rugae in the mouth remains unchanged in its position throughout life, although there is no consensus on this issue. It is relatively stable and resists decomposition for a few days after death.<sup>[4]</sup>

The potential use of palatal rugae in forensic identification has advantages because of their low utilization cost, simplicity and reliability. It is sufficiently characteristic to discriminate between individuals because no two palatal rugae configurations are alike. This finding is in congruity with results obtained in the similar studies conducted before.<sup>[4,13-15]</sup>

The present study found that rugae pattern did not comprise of one form alone, but appeared as a mixture of varying forms. Curve forms were most commonly observed followed by line and sinuous forms. This is consistent with the results of Pretty<sup>[16]</sup> and Ohtani<sup>[17]</sup> et al. who observed different palatal rugae forms.

The palatal rugae pattern in all 100 subjects was distinct and unique. None of the patterns were identical and also no bilateral symmetry was observed in any individual. Therefore, uniqueness of palatal rugae pattern makes it a characteristic of an individual and thereby aids in personal

identification. This finding is in congruity with results obtained in the similar studies conducted before.<sup>[5,9,10]</sup>

We observed that curve form was most common which is consistent with the findings of the study by Nayak *et al.* in an Indian population. It can therefore be concluded that certain rugae shapes are specific to particular population and may also have utility in population differentiation.<sup>[4]</sup>

In this study, on comparing rugae pattern of males and females, curve and sinuous forms were found to be higher in males while the former and line forms were higher in females.

It was also noted that the total number of rugae in the sample showed that the number of rugae in males was slightly more than in females. The total number of rugae in the sample showed more rugae on the right side when compared to the left, suggesting intraoral environmental factors contributing to it.

The comparison of palatal rugae pattern among family members (father, mother, child A and child B) also showed different patterns. Although in one family few forms were similar, the rugae pattern was not identical suggesting that the role of heredity is uncertain in determining the orientation of rugae pattern, although we acknowledge that the limited number of families studied does not as yet allow us to make a comprehensive statement.

The palatal rugae pattern among the five pairs of twins (non identical) showed different patterns, although some similar (but unidentical) forms were observed on specific location in two pairs of twins.

This result is consistent with the study conducted by Ritter and Chae (cited in English *et al.*)<sup>[5]</sup> which strongly suggested the uniqueness of palatal rugae pattern and that the role of genetic influence was questionable in determining the rugae pattern in twins.

In light of these results, we strongly suggest that palatal rugae pattern can be used in forensic investigation for antemortem and post-mortem identification.

However, we recognize that further studies should be conducted on individuals of different races, family members and identical twins. Also, a standard and uniform procedure needs to be put forth for the collection, recording and computerized analysis of the palatal rugae.

## Conclusion

The use of palatal rugae in forensic identification is advantageous because of their low utilization cost, simplicity and reliability. Based on our study, it is sufficiently

characteristic to discriminate between individuals because no two palates are alike in their rugae configuration. Hence, palatal rugae can be one of the tools for personal identification in forensic odontological identification in the Indian context. In view of these findings, palatal rugae could be used as a personal print for identification.

## References

1. Acharya AB, Sivapathasundharam B. Forensic Odontology. In: Rajendran R, Sivapathasundharam B, Editors. Shafer's Textbook of Oral Pathology, 6th ed, Noida: Elsevier: 2009. p. 871-99.
2. Stimson P, Mertz CA. Scientific Methods of Identification. In Forensic Dentistry, 1st ed., Boca Raton, Florida: CRC Press LLC; 1997. p. 1-36.
3. Acharya AB. Teaching forensic odontology: An opinion on its content and format. Eur J Dent Educ 2006;10:137-41.
4. Nayak P, Acharya AB, Padmini AT, Kaveri H. Differences in the palatal rugae shape in two populations of India. Arch Oral Biol 2007;52:977-82.
5. English WR, Summitt JB, Oesterle LJ, Brannon RB, Morlang WM. "Individuality of Human Palatal Rugae". J Forensic Sci 1988;33:718-26.
6. Caldas IM, Magalhães T, Afonso A. Establishing identity using cheiloscopia and palatoscopia. Forensic Sci Int 2007;165:1-9.
7. Venegas VH, Valenzuela JS. Palatal rugae: Systemic analysis of its shape and dimensions for use in human dentition. Indian J Dent Res 2005;16:51-5.
8. Venegas VH, Valenzuela JS, López MC, Galdames IC. Palatal Rugae: Systematic analysis of its shape and dimensions for use in human identification. Int J Morphol 2009;27:819-25.
9. Muthsubramanian M, Limson KS, Julian R. Analysis of rugae in burn victims and cadavers to stimulate rugae identification in cases of incineration and decomposition. J Forensic Odontostomatol 2005;23:26-9.
10. Abou El-Fotouh MM, El-Sharkawy GZ. A study of palatal rugae pattern (rugoscopy) in an Egyptian population. J Egypt Dent Assoc 1998;44:3177-84.
11. Patil MS, Patil SB, Acharya AB. Palatine rugae and their significance in clinical dentistry. J Am Dent Assoc 2008;139:1471-8.
12. Limson KS, Julian R. Computerized recording of the palatal rugae pattern and an evolution of its application in forensic identification. J Forensic Odontostomatol 2004;22:1-4.
13. Kapali S, Tommsend G, Richards L, Parish T. Palatal rugae patterns in Australian Aborigines and Caucasians. Aust Dent J 1997;42:129-33.
14. Thomas CJ, Kotze TJ. The palatal ruga pattern in six Southern African human populations, Part I: A description of the populations and a method for its investigation. J Dent Assoc South Afr 1983;38:547-53.
15. Thomas CJ, Kotze TJ. The palatal ruga pattern in six Southern African human populations, Part II: Inter-racial differences. J Dent Assoc South Afr 1983;38:166-72.
16. Pretty IA. Forensic dentistry: 1. Identification of human remains. Dent Update 2007;34:621-2,624-6,629-30.
17. Ohtani M, Nishida N, Chiba T, Fukuda M, Miyamoto Y, Yoshioka N. Indication and limitations of using palatal rugae for personal identification in edentulous cases. Forensic Sci Int 2008;176:178-82.

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