# To Determine Biometric Characteristics of Palatal Rugae Patterns in Human Identification and Its Correlation with Blood Group: An Institutional Study

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## Abstract

**Introduction:** Well protected palatal rugae patterning in the oral cavity has been suggested as useful complimentary information for forensic purposes. Also since the blood group remains same throughout the lifespan of an individual, can act as a biological record.

**Aim:** The aim of the presentation is to study the different palatal rugae patterns and to correlate and compare palatoscopy with blood group among patients visiting Indira Gandhi government dental college Jammu.

**Materials and methods:** A total of 100 patients with age group ranging between 14-45 years with known blood group were included in the study. Palatal rugae patterns on plastercasts, were obtained and examined for different biometric characteristics including number, shape, length and association with sex and the data was obtained.

**Results:** There was significant association found between palatal rugae, ABO blood groups and Rh factor (*chi square* statistic=18.205, P=0.034).

**Conclusion:** The study concluded that palatal rugae when correlated with suspect's specific blood group-Rh factor can be used to narrow down the suspect list and can also prove significant in identifying individuals in case of any disaster.

**Keywords:** ABO blood groups • Palatoscopy • Forensic tool • Personal identification • Palatal rugae

## Introduction

Human forensic identification relies on distinctive characteristics of individuals and systematic procedures to identify them. One of the applied disciplines is forensic odontology, predominantly by the comparison of ante-mortem and postmortem dental records to determine the identifying features and ideally the exact identity of the individual [1]. Transverse palatine folds or Palatal Rugae (PR), are asymmetrical and irregular elevations of the mucosa located in the anterior third of the palate, made from the lateral membrane of the incisive papilla, arranged in transverse direction from palatine raphe located in the midsagittal plane. These formations have been used in medicolegal identification processes because their individual morphological characteristics are stable over time [2]. When traffic accidents, acts of terrorism or mass disasters occur in which it is difficult to identify a person according to fingerprints or dental records, palatine rugae may be an alternative method of identification [3]. The palatine rugae are permanent and unique to each person and can establish identity through discrimination (*via* casts, tracings or digitized rugae patterns) [4,5]. The use of teeth in postmortem identification has gained prominence over the last half-century. Postmortem dental identification is, however, not possible in the edentulous and palatal rugae can be used as a supplement in such instances. Thus, palatal rugae appear to possess the features of an ideal forensic identification parameter uniqueness, postmortem resistance and stability. Hence, they can be used in postmortem identification provided an antemortem record exists. Most of the previous studies have focused on the use of palatal rugae for personal identification, with only few limited studies on sexual dimorphism in the biometric features of the palatal rugae. Yet another biological record that remains timeless throughout the lifetime of a person is the blood group. Determining the blood group of a person

as classified by Landsteiner, from the samples obtained at the site of crime, helps identify a person [6,7].

### Aims and objectives

To study the different palatal rugae patterns, to describe the different biometric characteristics of the palatal rugae, to determine the common patterns of palatal rugae in males and females in this group of population. And to correlate and compare palatoscopy with blood group among patients visiting Indira Gandhi government dental college Jammu.

## Materials and Methods

The present study was carried out in the department of oral diagnosis, medicine and radiology and department of orthodontia, Indira Gandhi government dental college Jammu after obtaining institutional ethical committee approval. Total of 100 patients including 49 of males and 51 of females with age group ranging between 14-45 years with known blood group were included in the study. The inclusion criteria were individuals who were free from any trauma or lesions on palate (Figure 1). The exclusion criteria were individuals with deformities of palate such as cleft palate, severe malocclusion, palatal asymmetries, any traumatic injury on palate, and patients who were allergic to alginate impression material. For palatal rugae alginate impressions of maxillary arch was prepared and poured by means of dental stone. A dental plaster base was then made. All plaster casts were obtained following informed verbal consent. The casts were free of voids and air bubbles and the rugae patterns were traced on these casts for better contrast using a sharp graphite pencil under sufficient light (Figure 2). The palatal rugae patterns were subsequently explored on these casts using magnifying lens. Palatal rugae patterns and number on plaster casts were obtained and examined for different biometric characteristics including number, shape, length and association with gender. The palatal rugae were classified by Kapali, et al. based on shape of palatal rugae (compound shapes were included in non-specific type pattern) [8]. Blood groups of subjects in the study were documented by using a valid report (Figure 3). The recorded data was compiled and entered in a spreadsheet (Microsoft excel) and then exported to data editor of SPSS Version 20.0. Statistical software SPSS (version 20.0) and Microsoft excel were used to carry out the statistical analysis of data. Continuous variables were expressed as Mean ± SD and categorical variables were summarized as percentages. *Chi-square* test was employed for establishing correlation of palatal rugae with various variables. Graphically the data was presented by bar and pie diagrams. A p-value of less than 0.05 was considered statistically significant. All p-values were two tailed.



**Figure 1.** Armamentarium used for the study purpose.



**Figure 2.** Palatal rugae patterns.



**Figure 3.** Blood group report.

## Results

The age distribution of the subjects is shown in Table 1 and Figure 4. Females (59%) slightly more in number than the males (41%) in the study. The observed numbers of palatal rugae according to gender and palatal side are shown in Tables 2 and 3, Figures 5 and 6 respectively. The mean number of rugae was slightly higher in females than in males on both sides of the palate. The mean number of rugae was also slightly higher on the left than on the right side of the palate in both females and males. Majority of the participants belonged to the blood group 'B' (38%) followed by A (36%), O (19%), and AB (7%). All participants were Rh positive (Table 4 and Figure 7).

The distribution of the numbers of rugae according to the print pattern is shown in Table 5 and Figure 8. Wavy type was most

predominant (63%) followed by nonspecific type (21%), curved (10%) and straight type (6%).

The distribution of palatal rugae in relation to gender is shown in Table 6 and Figure 9. Wavy type was more prevalent in males whereas rest was more prevalent in females.
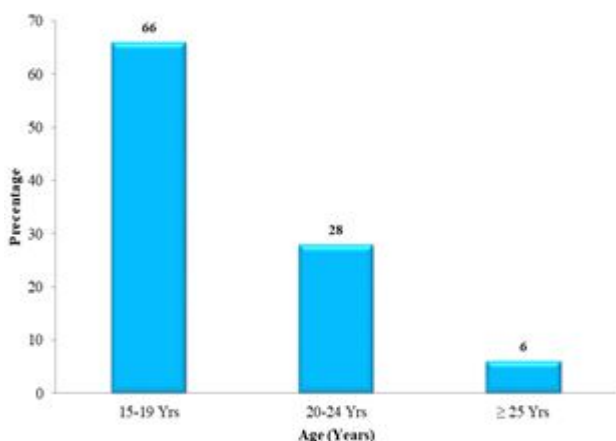
The distribution of palatal rugae in relation to side involved is shown in Table 7 and Figure 10. Wavy and non-specific types were more prevalent on left side whereas curved and straight types were more prevalent on right side.

The percentage distribution of the most prevalent palatal rugae print patterns within blood groups and Rh is shown in Table 8 and

Figure 11. In 'A' blood group, wavy type showed presentation with 69.4% followed by nonspecific type (19.4%) and straight type (11.1%). The incidence of wavy type in 'B' blood group showed occurrence (55.3%) followed by non-specific type (23.7%) and curved type (21.1%). 'O' blood group showed wavy type (52.6%) followed by non-specific type (26.3%) curved type (10.5%) and straight type (10.5%). 'AB' blood group showed only wavy type (100%). There was significant association found between palatal rugae, ABO blood groups and Rh factor as shown in Table 8 and Figure 11 (*chi square statistic=18.205, P=0.034*).

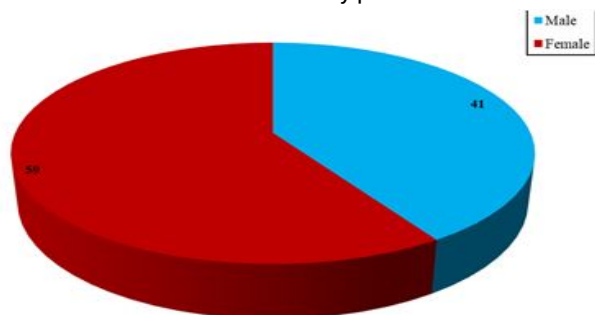| Age (Years) | Number | Percentage |
|---|---|---|
| 15-19 Yrs | 66 | 66% |
| 20-24 Yrs | 28 | 28% |
| 25 Yrs | 6 | 6% |
| Total | 100 | 100% |

**Table 1.** Age distribution of study patients



**Figure 4.** This graph showed age distribution of study patients.

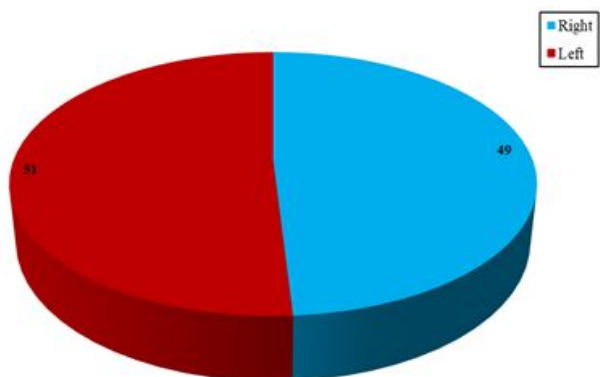| Gender | Number | Percentage |
|---|---|---|
| Male | 41 | 41% |
| Female | 59 | 59% |
| Total | 100 | 100% |

**Table 2.** Gender distribution of study patients.



**Figure 5.** This graph showed gender distribution of study patients.

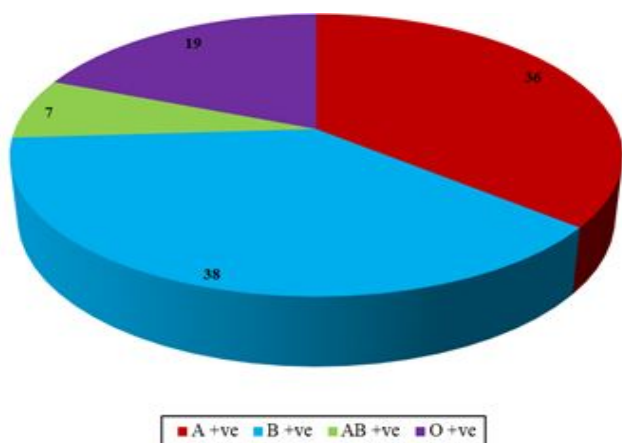| Side involved | Number | Percentage |
|---|---|---|
| Right | 49 | 49% |
| Left | 51 | 51% |
| Total | 100 | 100% |

**Table 3.** Distribution of most prevalent palatal rugae side involved.



**Figure 6.** This graph showed distribution of most prevalent palatal rugae side involved.

| Blood group | Number | Percentage |
|---|---|---|
| A +ve | 36 | 36% |
| B +ve | 38 | 38% |
| AB +ve | 7 | 7% |
| O +ve | 19 | 19% |
| Total | 100 | 100% |

**Table 4.** Blood group distribution of study patients.
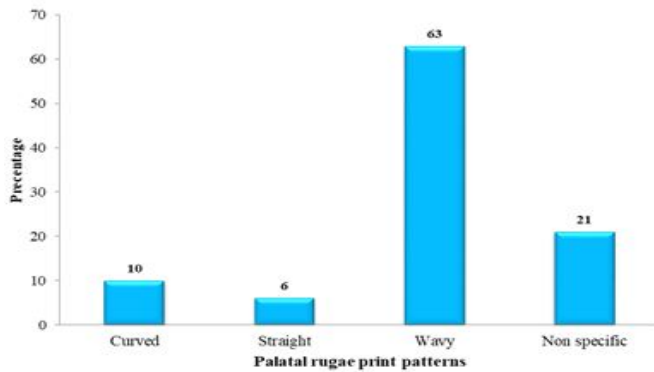


**Figure 7.** This graph showed blood group distribution of study patients.

| Palatal rugae print patterns | Number | Percentage |
|---|---|---|
| Wavy | 63 | 63% |
| Non specific | 21 | 21% |

| Curved | 10 | 10% |
| Straight | 6 | 6% |
| Total | 100 | 100% |

**Table 5.** Distribution of most prevalent palatal rugae print patterns.
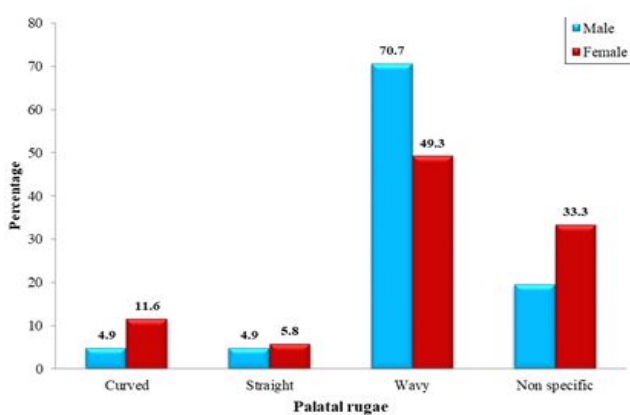


**Figure 8.** This graph showed distribution of most prevalent palatal rugae print patterns.

| Palatal rugae | Male | | Female | |
| --- | --- | --- | --- | --- |
| | No. | % age | No. | % age |
| Wavy | 29 | 70.7 | 34 | 49.3 |
| Non specific | 8 | 195 | 23 | 33.3 |
| Curved | 2 | 4.9 | 8 | 11.6 |
| Straight | 2 | 4.9 | 4 | 5.8 |
| Total | 41 | 100 | 69 | 100 |

*Chi-square*=2.701; P-value=0.436

**Table 6.** Most prevalent palatal rugae in relation to gender.



**Figure 9.** This graph showed most prevalent palatal rugae in relation to gender.

| Palatal rugae | Right | | Left | |
| --- | --- | --- | --- | --- |
| | No. | % age | No. | % age |
| Curved | 7 | 14.3 | 3 | 5.9 |
| Straight | 3 | 6.1 | 3 | 5.9 |

| | | | | |
|---|---|---|---|---|
| Vavy | 29 | 59.2 | 34 | 66.7 |
| Non specific | 10 | 20.4 | 11 | 21.6 |
| Total | 49 | 100 | 51 | 100 |

*Chi-square*=2.005; P-value=0.571

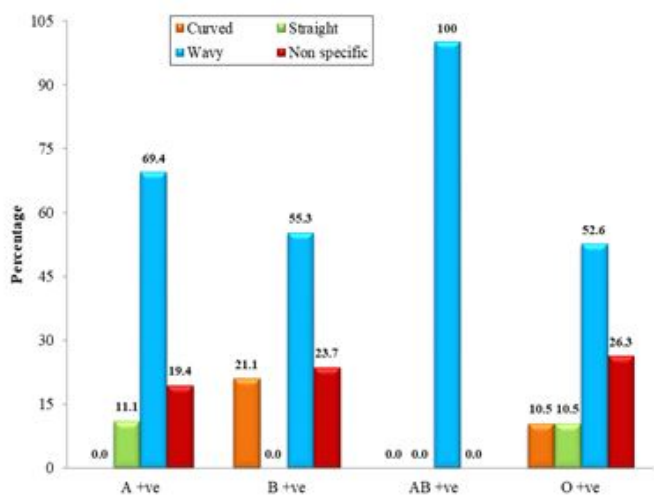**Table 7.** Most prevalent palatal rugae in relation to side involved.



**Figure 10.** This graph showed most prevalent palatal rugae in relation to blood group.

| Palatal rugae | A+ve | | B +ve | | AB +ve | | O +ve | |
|---|---|---|---|---|---|---|---|---|
| | No. | % age | No. | % age | No. | % age | No. | % age |
| Wavy | 25 | 69.4 | 21 | 55.3 | 7 | 100 | 10 | 52.6 |
| Non specific | 7 | 19.4 | 9 | 23.7 | 0 | 0 | 5 | 26.3 |
| Curved | 0 | 0 | 8 | 211 | 0 | 0 | 2 | 10.5 |
| Straight | 4 | 111 | 0 | 0 | 0 | 0 | 2 | 10.5 |
| Total | 36 | 100 | 38 | 100 | 7 | 100 | 19 | 100 |

*Chi-square*=18.205; p-value=0.034 (Statistically significant)

**Table 8.** Most prevalent palatal rugae in relation to blood group.



**Figure 11.** This graph showed most prevalent palatal rugae in relation to blood group.

## Discussion

The palatal rugae do not change during the life of the individual, are protected from trauma and high temperatures for its internal position in the oral cavity, surrounded and protected by lips, cheeks, tongue, teeth and bone. Once formed, only changed in its length, due to normal growth, these rugae stay in the same position throughout the life of a person. Even disease, trauma or chemical attack seems able to change the shape of the palatal rugae [9]. There are different ways to analyze the palatal rugae. Intraoral inspection is probably the most used and most easy and economical method. However, this can create difficulties if a future comparative review is required. A more detailed and accurate and the need to preserve evidence may justify the use of photographs or impressions [10]. While observing the shape of the rugae is a subjective process, it is relatively easy to record and does not require complex instrumentation. The palatoscopy is a technique that can be of great interest in human identification. In fact, contrary to the lips that are printed, it is possible to obtain antemortem data stable over time, such records that are in dental practice in its various forms (dental casts, intraoral photographs and dental prostheses). However, palatoscopy might not be as useful in investigations of crime scenes and in linking suspects

to crime scenes because such tests are not expected to find in such circumstances. It is important to note the existence of abnormal patterns and shapes on palatal rugae, these anomalies are considered as a reflection of alterations in the normal growth.

The epithelium of the primary palate and determination of the blood group are all genetically linked. Based on the above facts, one can correlate palatal rugae with blood group [11]. Hence, the present study was planned to take a step further wherein correlation as well as comparison of palatoscopy with blood groups were conducted among patients visiting Indira Gandhi government dental college Jammu.

The classification of palatal rugae was given by Thomas and Kotze for number, type, and unification, and Kapali, et al. classification was based on the shape [12]. Hunasgi, et al. conducted a study on palatal rugae in two different population and correlated with the sex of the individuals and his results inferred that wavy and curved patterns were predominant in Karnataka compared to Kerala population while straight was slightly more in Kerala population than Karnataka population [13]. Nayak, et al. and Saraf, et al. conducted similar studies but showed varying results wherein the curved pattern was more common in males than females [14,15]. Ramdas, et al. conducted a similar study on correlation and comparison of palatoscopy with blood groups among dental students from Western Maharashtra in which B+ being showed wavy type as most common pattern in the population followed by curved type and straight type. Since lot of variation existed in results using the shape of the palatal rugae in sex identification. The present study was done to correlate palatal rugae with blood group. The study results showed that the rugae patterns were specific for each blood group. To substantiate these results, similar studies should be conducted using blood group as the basic parameter.

## Conclusion

In the present study, all blood groups showed wavy type as most common pattern in the followed by nonspecific type, curved type and straight type. Complete absence of circular type of palatal reggae in the complete sample and thus nonspecific type included all the compound shapes present in the sample. All the patients were RH+. The rugae pattern can be an additional method of differentiation between the male and female in conjunction with the other methods such as visual, fingerprints, and dental characteristics in forensic sciences.

## Conflict of Interest

There is no conflict of interest.

## Funding

Self.

## Ethical Approval

Institutional ethical committee clearance with Ref No. 201 ECIGGDC22, was permitted on ethical grounds as per the DCI.

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