

Review on Rugae Pattern

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Abstract

The study of palate shape or rugae pattern is known as rugoscopy. Rugae are anatomical folds that are present on anterior third of palate of upper jaw behind the incisive papillae. These are transverse ridges located on palatal mucosa. These are used in forensic odontology for personal identification. They are unique and remain unchangeable throughout the life of a person from birth. The fat of buccal pad and tongue keep them (rugae pattern) protected from any kind of trauma. They vary in their size, shape, length and pattern from person to person and from left side to right side in same person and hence is used in personal identification.

Keywords: Rugae • Palate • Rugoscopy • Personal Identification

Introduction

Forensic science is the application of all-natural sciences to the court of law. The main objective of forensic science is to establish the individuality of a person i.e. personal identification. Fingerprints, handwriting, footprints, palmprints, iris pattern, anthropometric measurements, dental records, DNA analysis etc. are used for the identification of a person either living or dead. In case of mass disasters where a huge loss to life and property occur or in case of decomposed body where fingerprints, footprints, iris pattern etc. cannot be used for identification due to mutilation of the skin and organs or where the anti-mortem dental record doesn't match with post mortem record due to some dental treatment than the study of palatal rugae pattern is carried out for identification of a person. DNA analysis can also be performed but it is a very expensive technique.

Forensic odontology is the field of forensic science in which the skill, knowledge and experience of a dentist are used for personal identification. Rugae pattern are also used in forensic odontology for this purpose. The anatomical folds that are present on anterior third of palate of upper jaw behind the incisive papillae are known as rugae. These are transverse ridges located on palatal mucosa. They are also called as "Plica palatine," and their study is called as palatodontology or rugoscopy. Winslow described rugae pattern for the first time in 1753 and Allen suggested their use in personal identification in 1889. They are an aid in personal identification when all other parameters failed due to their post mortem resistance nature i.e. they do not get mutilated or altered easily. They are unique, stable, reliable and simple to examine. The fat of buccal pad and tongue keep them (rugae pattern) protected from any kind of trauma. They vary in their size, shape, length and pattern from person to person and from left side to right side in same person.

Classification of rugae pattern

Rugae pattern are classified for the first time by Glorio. He classified them as simple or primitive pattern and more developed. According to Trobo palatal rugae was classified into two groups:

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Simple rugae: Where rugae shapes were well defined and further sub-classified as A, B, C, D, E F.

Type A Point

Type B Line

Type C Curve

Type D Angle

Type E Sinuous

Type F Circle

Compound rugae: Where rugae were formed by union of two or more simple rugae and were classified as type X.

According to Lysell, Palatal rugae were classified as

- Primary rugae: 5mm or more
- Secondary rugae: 3 to 5mm
- Fragmentary rugae: 2 to 3 mm
- Rugae smaller than 2mm are disregarded

According to Kapali et al, classification is as follows

- Curved,
- Wavy,
- Straight and
- Circular

Carrea classification: Palatal rugae were divided into four different types

Type I Posterior-anterior directed rugae

Type II Rugae perpendicular to the raphe

Type III Anterior-posterior directed rugae

Type IV Rugae directed in several directions

Martins dos Santos classification: 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

Several other scientists also classified rugae such as Lysell, Lima, Correa, Trobo but the most widely used one classification is of Thomas and Kortze who classified them on the basis of their shape, size, length for their use in personal identification.

On the basis of shape: Straight – In this pattern type from the origin

point to the termination point there is a straight line only.

Curved – In this the rugae is present as a simple crescent shape with the gentle curve. If even the slight curve is there at the end of termination than it is considered as curved type.

Circular – The definite, continuous ring like structure is formed by rugae in this type and the diameter is measured from origin to termination point.

Wavy – In this rugae look like serpentine with a slightest curve either at termination or origin or both.

Unification – In this the two rugae are joined either from termination or from origin. It is further divided into two: -**Converging** – In unification when two rugae are originating from same region but converged immediately are said to be converging.

Diverging – In unification when two rugae are originating from same region but diverged immediately are said to be diverging.

On the basis of length, they are classified into three types: Primary – In this the rugae with length ranging from 5-10 mm are considered.

Secondary – In this the rugae with length ranging from 3-5 mm are considered.

Fragmentary – Rugae with less than 3mm of length are considered in this type.

Those entire rugae pattern which do not fall in the category of above described types are known as non-specific type.

Several studies have been done so far on rugoscopy. Oral [1] worked on Turkish orthodontic population with different sagittal skeletal malocclusion and observed that the most common rugae pattern are curve and wavy and there is no significant in number of rugae on left and right sides. They also found that droplet-shaped incisive papilla was the most common form of incisive papillae among different skeletal malocclusion groups and most of the rugae are arranged horizontally. Amol Bansal studied rugae pattern in terms of their size, shape, number of 1000 individuals and found that there is no significant difference in number of rugae pattern between males and females [2]. They observed that in both males and females the most common pattern type is curve followed by wavy and straight respectively and unifications and circular negligible but in males the percentage of wave pattern is more in comparison to females and in females the proportion of unification converging, non-specific and circular are more as compared to males. They also revealed that the size of rugae did not vary within two genders and that the number of palatal patterns decreases with increase in age. One of their tremendous finding was that the rugae patterns in twins or siblings are not identical neither between themselves nor with their parents and hence showed that there is no inheritance of rugae features from parents to off-spring. Their findings were found to be similar with the findings of Kapali, Fahami, Nayak, Vengas and Sharma. According to Pooja the average length of rugae are more in females as compared to males and straight pattern is more prominently observed in females. Nayak studied rugae pattern in population of Gujarat and Karnataka and observed that curvy and straight was the most predominant. In the study conducted by Savita. curved, wavy and straight pattern were found to be most common in population of Karnataka and Kerala. Prahalad Gadicheria [3], did their study on Bengaluru population and concluded that unification convergent type of rugae pattern are more common in females than males while unification divergent type of rugae pattern are more common in males than females.

Palatal rugae start to develop at the 3 months of intra uterine life and then appear distinguished in 32 mm human embryo near incisive papilla and finally become prominent in prenatal stage. After that they do not undergo any change except that they increase in dimension due to the growth of human body.

Analysis of Rugae Pattern

Various methods of palatal rugae analysis are available currently. Intra-oral examination is the most used technique as it is easy to perform

and is cost effective. The disadvantage is that no records exist with this method which makes future comparisons impossible. In order to obtain a detailed and exact analysis and also to overcome the problems concerning future comparisons, oral impressions and oral photographs are required. The use of dental casts is advantageous as they simplify analysis, reduce cost and can be easily done in any laboratory. Once the dental casts are made, the rugae outline are drawn confining to the shape of the individual rugae and the length is also measured. This is done as per the standard classification and according to the individual study design. The utilization of digital photography, personal computers and specific software's to edit and use digital images allow a significant improvement in recognition of the rugae pattern thereby allowing easy handling.

Another technique describes the superimposition of the photographs for comparison of palatal rugae. The results can be enhanced by the use of computer software such as Adobe Photoshop. Computer software programs such as RUGFP-ID match are available for palatal rugae analysis. Calcorrugoscopy, or the overlay print of palatal rugae can be used to perform comparative analysis. Other complex techniques like stereoscopy for obtaining a three-dimensional image of palatal rugae anatomy, stereo photogrammetry which allows for an accurate determination of the length and position of every single palatal rugae can also be used [4-6].

Discussion and Conclusion

Forensic odontology has achieved giant strides in recent times and the use of palatal rugae in postmortem identification has gained prominence over several decades. Many studies have been carried out on rugae patterns and it is an established fact that no two palates are alike in their configuration and once formed, they do not undergo any changes except in length due to normal growth, remaining in the same position throughout a person's entire life. Even diseases, chemical aggression or trauma do not seem to be able to change the palatal rugae form. 13 Rugoscopy finds application in the field of anthropology, comparative anatomy, genetics, forensic odontology, prosthodontics and orthodontics. Thus, palatal rugae appear to possess the features of an ideal forensic identification parameter, i.e. uniqueness, postmortem resistance and stability. Forensic dental identification including identification through palatal rugae depends largely on the availability of antemortem records. Antemortem records of palatal rugae patterns can be obtained in dental practice in various forms (dental casts intraoral photographs and dental prosthesis). In India, antemortem records are scant and if available are either incomplete or improper because no private dentist maintains a record. So, it is the responsibility of each dentist to maintain dental records of their patients for the noble social cause of identification in the event of any mass disaster. Palatal rugae may serve as an adjuvant to other techniques such as DNA analysis and fingerprinting in forensic investigations especially in human identification.

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